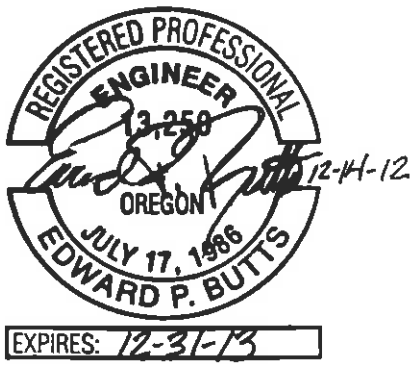
City of Keizer

Water Master Plan Update

December, 2012



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Water Master Plan Update
-2012-

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FIGURES

Glossary

A.G.S.	Above Ground Surface, measured in feet
ANSI	American National Standards Institute. A private, non-profit organization that oversees the development of voluntary consensus standards for products, systems, and services created within the United States. Often combined with ASTM as a dual standard.
Aquifer	A water bearing geological formation; in Oregon, viable aquifers usually consist of sand and/or gravel, basalt rock, and/or marine sediments (shale, sandstone, etc.)
ASTM	American Society for Testing and Materials. An international standards organization that develops and publishes voluntary consensus technical standards for 15 separate sections, including: iron and steel products, construction, and water and environmental technology equipment and processes used in the water supply field. Often combined with ANSI (ANSI/ASTM) to create a dual standard.
Average Day Demand (ADD)	The total amount of metered (delivered to customers) water in one full year divided by 365
Average Summer Demand (ASD)	The estimated average daily demand during 3 full summer months, typically July, August, and September.
Average Winter Demand	The estimated average daily demand during 3 full winter months, typically December, January, and February
AWWA	American Water Works Association: A water industry trade group that develops and publishes standards for equipment and chemicals used in the potable water supply industry.
B.G.S	Below Ground Surface, measured in feet
Cubic Feet (ft^3)	A measure of water volume, often used for water billing purposes. 1 cubic foot of water = 7.48 gallons
C.F.S or CFS	Cubic feet per second, a measurement of rate of fluid flow (1 CFS = 448 GPM)
DEQ	Oregon Department of Environmental Quality. Responsible state agency for wastewater collection, treatment, and discharge as well as for air quality and solid waste disposal
EPA	Environmental Protection Agency, Federal government agency responsible for calculating, establishing, and enforcing national (U.S.) drinking water quality standards
Feet of Head (feet) (ft.hd)	An engineering unit of pressure, usually used to equate a vertical column of water to gauge pressure. 1 foot of water = .433 pounds per square inch (psi) pressure
F.P.S. or FPS	Feet per second, usually used to indicate water velocity in a pipeline. 5 FPS is generally recognized as the recommended maximum pipeline velocity.
GPCD	Gallons Per Capita per Day (AKA: gallons per person per day)
GPD	Gallons Per Day
GPM	Gallons Per Minute, used as a common measurement unit of water flow rate
GR or G	GR=Ground water registrations before 1955 G=Certificate of registration for groundwater sources after 1955 (Oregon)
Groundwater	Naturally occurring water from a water bearing formation (aquifer) at depths $\geq$ 18' B.G.S.

Groundwater Act (Oregon)	In Oregon, a statute, adopted in 1955, that established water well contractor licensing, water well construction standards and well logs, and groundwater rights and permits.
HI	Hydraulic Institute: An independent organization that provides third-party testing and certification, as well as published standards, for pumping and hydraulic equipment in the United States.
HP, Horsepower	Horsepower-mechanical power necessary to perform work, typically used to calculate the work required to transfer a given volume of water against a given total dynamic head. 1000 GPM @ 100' TDH = 25 theoretical HP (THP). Actual or "Brake" HP (BHP) is usually 20-60% higher than theoretical value; i.e. 25 THP≈30-40 BHP.
Keizer, City of Keizer	City of Keizer; including all water customers supplied and billed by the city as well as city owned wells, pumps, storage, and distribution system.
Maximum Day Demand (MDD)	The maximum actual or projected daily water consumption in a given year. Source capacity and storage requirements are frequently based and sized on this demand.
MCL/MCLG/mcl	Maximum contaminant level-Max. allowed level of a given contaminant set by the EPA MCL goal =desired maximum level of a contaminant
Metered (or Sold) Water	The rate or volume of water delivered (and thus, metered) to customers through service connections and water meters. The difference between the "Production" and "Metered" volume of water is considered as unaccounted for or loss water and is not compensable.
MG/L or mg/L	Milligrams per liter; concentration of a mass of a chemical or contaminant per unit volume of water, roughly equal to 1 part per million (1 lb. per million lbs. = 1 mg/L)
MGD or mgd	Million gallons per day (1 MGD = 694.44 GPM or 1.55 CFS)
MSL	Mean Sea Level-elevation above or below normal sea level (usually expressed in feet)
NA or N/A	Not applicable, none available
ND or N/D	None detected or non-detectable level of an individual contaminant, chemical, element, or compound (mostly used in water quality tests)
NSF	National Sanitation Foundation; an organization that provides third-party testing and certification of water system components and chemicals. NSF standards 60 (components) and 61 (water treatment chemicals) are used in Oregon as the minimum levels of compliance, per OHA.
OHA or Health Authority	Oregon Health Authority, responsible state agency for the regulation of Public Water Systems in Oregon
Peak Hour Demand	The maximum instantaneous flow rate within a water system anticipated at any one time in a given year, usually expressed in gallons per minute (GPM). Often determines the source and pumping equipment, water storage, and/or distribution system sizing
Per Capita Demand (GPCD)	The rate of water consumed or used by a single person per day, expressed in gallons. Can be applied to average, maximum day, or peak hour demands
PSI (psi) (psig)	Pounds per square inch, a unit measurement of applied pressure. Note that 1 PSI = 2.31 Feet of water head; 100' of water head = 43.3 psi; 100 psi = 231 feet; Also, See Feet of Head
Production	Used to distinguish the total rate or volume of water delivered from the sources from the total rate or volume sold or delivered to customers. Used for average day, maximum day, and peak hour observations.

Pumping Water Level (PWL)	The stable distance from ground level downward to the lowest water level in a water well during sustained pumping conditions, usually measured in feet B.G.S.
Salem or City of Salem	City of Salem Public Works Department and all treatment, conveyance, and metering facilities owned or operated by the City of Salem.
Static Water Level (SWL)	The distance from ground level downward to the highest free standing water level in a water well that is not presently under pumping conditions, usually measured in feet B.G.S.
TDH or T.D.H.	Total Dynamic Head (in feet)-Sum of the vertical lift (lowest water surface to upper water surface or source to point of delivery) plus delivery pressure, and the sum of all pipe, valve, and minor friction losses.
Unit	Used to determine a total volume of water, often used for billing purposes (Typ. Value: 1 unit = 748 gallons)
USGS (U.S.G.S.)	United States Geological Survey
Well	An artificially created (usually vertical) opening or shaft constructed below ground level for the purpose of locating and extracting water, oil, or gas. A deep water well is usually defined as a well greater than 20'-30' in total depth.
WRD/OWRD	Oregon State Water Resources Department, State agency responsible for water well construction standards, water well contractor licensing, and water rights appropriations

Executive Summary

Executive Summary

General: This Water System Master Plan Update for the City of Keizer will outline and evaluate the current water system and the improvements necessary to accommodate the anticipated growth and correct current deficiencies. The time span of this study is 20 years, outlining the projected needs of the city's water system between Year 2012 to 2032, inclusive.

Scope of Study: A well prepared water system master plan will evaluate several factors. Among these are: inventory and status of the current water system, projected population growth, adequacy of existing sources and pumping facilities, status and adequacy of water rights, evaluation of pertinent water quality parameters, distribution system adequacy for varying water demands, water storage requirements, capital improvement requirements, funding options, and a recommended implementation schedule.

Existing System: The existing water system obtains all of its source water exclusively from fifteen individual deep groundwater wells with a sixteenth well (Lacey Court) scheduled for activation in Spring, 2013. All of the production wells derive water from unconsolidated (sand and gravel) type of aquifers and all wells drilled after 1980 are supplied from one or both of these aquifers: the Willamette Silts or the lower Troutdale Formation. The city's primary aquifer, the Troutdale aquifer, is a very productive water-bearing formation and wells capable of over 1000 GPM are often developed from this source. The other aquifer, the Willamette Silts, is more limited in production capability due to more cementation (clay binder) of the formation and wells are typically limited to 500-600 GPM in yield. The individual capacity of Keizer's fifteen well/pump system range from 300 GPM up to 2500 GPM. The Keizer water system is a "closed-loop" type of water system with a minor volume of available above ground water storage in which water is typically produced and delivered to customers on demand based on system pressure variations therefore, a closed loop water system is analogous to most electrical utility generating and supply systems in terms of delivery to customers. Due to the extensive nature of the aquifer, a large volume of available water is stored within and between the pores and openings of the geologic material (mostly sand and gravel) that comprise the aquifer rather than in elevated or ground level storage tanks common to most large water systems. This water is pumped from wells, via deepwell submersible or turbine pumps, to the distribution system and immediately delivered directly to water customers. The only treatment received by the water is the injection of Fluoride at all but three well sites for a dental health benefit and an Iron/Manganese sequesterant injected at selected sites. Both of these chemicals are currently introduced at the sites that are predominant in operation and have the highest levels of iron and manganese only. The total available above ground water storage in the Keizer water system is 2,800,000 gallons, comprised of three (3) steel water storage reservoirs: a 1,500,000 gallon ground level water storage reservoir, located at the Keizer Little League facility on Ridge Drive, a 750,000 gallon ground level "standpipe" water storage reservoir located at the Bair Park site, and a 550,000 gallon elevated storage water tank (EST) located within the southern region of Keizer Station. The Ridge Drive facility

includes a dedicated 600 GPM well for tank refill along with a 4,000 GPM booster pump station and the Bair Park Reservoir site includes a 1,500 GPM booster pump station as well as a dedicated 400 GPM well (Reitz) for refill of the reservoir. The Reitz well is the only well in the water system which receives direct filtration of any kind, performed for the removal of hydrogen sulfide gas, a known cause of taste and odor problems. Seven of the current sites are equipped with back-up engine driven or generator supplied pumps (7 individual units are equipped for auto-start/run operation-there are two (2) individual 1,000 GPM electrical powered pumping units at Ridge Drive) that are used to drive selected well or booster pumps in the event of a partial or city-wide electrical system failure or during extremely high water demands. The entire water system is controlled using a central computerized telemetry control system, located at the city shops, which continually monitors water system pressure from up to four (4) remote sites and, by using radio communication from the master site to any of the remote sites, activates or deactivates individual units to increase or decrease total flow and thereby maintain an average water system pressure between 60-70 psi. The Keizer water system is strategically divided into two (2) primary pressure zones for normal operation: the Northern Pressure Zone and Southern Pressure Zone (Figure 2-2). The Southern Pressure Zone includes the vast majority of water customers as well as wells/pumps and storage capacity and is situated between elevations 120' MSL to approximately 170' MSL. The Northern Pressure Zone includes all of the water customers located just north of the intersection of River and Wheatland Roads at elevations 170'-175' and higher. The Northern Pressure Zone includes the Delta (Well #8) and Meadows (Well #14) facilities as well as the Reitz Well (Well #16) and Bair Park Reservoir/booster pump station. The combined capacity of these three facilities is far more than what is required to provide even the maximum day or peak hour demand within the Northern Pressure Zone, therefore, provisions were designed and constructed to allow excess water supply to flow from the Northern Zone down to the Southern Zone. The two zones are physically interconnected at three (3) separate locations and water is allowed to easily pass between the two zones through any one of the three pressure reducing/bypass check valve stations which also normally function to provide the means of maintaining an approximate 20 psi pressure differential between the two zones. This configuration allows the water system to function and be considered as a single water system for planning and design purposes.

Population and Growth Projections: In 2012, the City of Keizer had an estimated (P.S.U.) population of 36,735. Due to presently confirmed and anticipated future development and growth, the City's population is projected to increase to 48,082 by the year 2032, an average 20 year growth rate of 1.35% per year. This level of growth represents a total percentage increase in population of 30.89% above 2012 levels, which is in accordance with the city's and most other independent projections of the future population. Although the annual population growth of the city is projected to average as high as 1.0%-1.5% over the 20 year study period, the current available and buildable land within the present urban growth boundary and city limits cannot absorb this degree of growth, therefore, it is assumed that a significant portion of future growth will be tied to an expansion of the existing urban growth boundary. Due to the uncertainties associated with this task, development or expansion of the source and/or

pumping, storage, and distribution systems outside of the current city limits have not been included or factored into this plan.

Water Requirements: The City's current average daily demand of water is approximately 3,500,000 (3.5 MGD) gallons per day, which equates to an approximate per person usage of 93 gallons per day and includes all water lost through system leakage. Although the average daily per person use of water has declined in recent years by approximately 25%, the current value of water consumption is nonetheless typical for a city of this size and water usage distribution. Current maximum day water demand, which usually occurs in July or August, is approximately 8,000,000 gallons, an increase of 2.25-2.35 times the average day consumption, which is also inline with established norms. System leakage and non-revenue water is currently averaging between 5%-8% per year. The majority of the distribution of water usage within the city is currently comprised of 98% for residential (all types) usage with the balance of water (2%) dedicated to commercial/industrial use. The currently available water sources (wells) can provide enough water for all current and projected daily uses but as the city continues to grow, additional storage and booster pumping capacity will be required to accommodate the increased fire flow and peak hour demands.

Future Water Requirements: By 2032, average daily water demand is projected to rise to 5,300,000 gallons per day (3,681 GPM over a 24 hour period) with maximum day demands as high as 12,000,000 gallons (8333 GPM over a 24 hour period). This value reflects limiting the volume of unaccounted for water (water lost to system leakage) to 5-8% of the total volume. As previously indicated, the safe capacity available from the existing wells in 2012 are adequate for all projected average and maximum day demands through the study period to 2032, assuming adequate maintenance is performed on each well and pump and there is no marked decrease of overall aquifer or well performance.

Source of Supply: The City currently derives all source water exclusively from groundwater sources. All of the wells presently derive groundwater from the Willamette Silts or the Troutdale aquifer, two productive and historically protected aquifers generally comprised of sand and gravel. All wells currently obtain water from below 80' in depth and most of the wells actually obtain water from between 120'-300' in depth. Although surface water rights from the Willamette River are locally available for municipal purposes, future planning has been exclusively performed using additional groundwater sources from the existing aquifers. This will avoid the high cost and complexity associated with the collection and treatment of surface water supplies. Future water supplies are projected to be evenly divided between optimizing and modifying the use of existing wells and adding one additional reservoir/pump station for peak and fire demands.

Water Quality Considerations: Since the City of Keizer uses groundwater supplies exclusively, recent modifications to the recently amended Safe Drinking Water Act that affect only surface water supplies are expected to have little or no impact to Keizer. The recently enacted EPA "Groundwater Rule," however, will have an impact as it is

intended to identify those water wells exposed to potential bacterial and/or viral contamination and require the level of treatment needed to lessen or eliminate the risk. Protection methods include various types of modification to the source and/or water system, including: implementation of disinfection processes, such as the use of chlorine, ultra-violet, or ozone, well reconstruction or replacement, or development of alternate water supplies. In the case of Keizer, significant improvements to the water system performed since 2001, including the replacement or abandonment of the most vulnerable wells, has greatly decreased the viral and bacterial exposure from the sources and thus increased the protection barrier afforded by the underlying clay layer and properly constructed wells. Most of this well rework has consisted of abandoning older, shallower wells and reconstructing new wells on the same site by sealing (using steel well casing and cement grout) into an impermeable clay layer which underlies most of the city at a depth between 60' to 100'. All of the wells drilled after 1980 now exclusively extract water from the aquifer below this depth. Due to the fact that the Keizer water system is served by an aquifer which underlies and is conveyed through a considerable amount of agricultural farmland, the possible presence of nitrates will always be of concern, however, recent improvements to identify and modify the most vulnerable wells by precluding the use of water from shallower sources and aquifers has greatly reduced the occurrence and risk from elevated nitrate levels. Next, the recent severe decline of the maximum contaminant level (MCL) for arsenic from .050 mg/L to .010 mg/L initially created a concern that some of the Keizer wells may or could be potentially impacted. To date, however, none of the city wells have demonstrated arsenic levels in water higher than 30% of the revised MCL (i.e. Delta well) with water from virtually all of the other city wells indicating no detection of arsenic at all. This contaminant will continue to be aggressively tracked and evaluated, however, as time passes and additional groundwater is drafted into the Keizer basin from upgradient locations. Finally, recent testing on the water from various Keizer production and monitoring wells have identified detectable concentrations of various volatile organic (carbon based) contaminants (VOCs). These include Tetrachloroethylene, Trichloroethylene, and Toluene. Although the levels of these contaminants have been consistently below the maximum contaminant level and it is believed they are presently still mostly confined to the upper and shallower aquifer, a pro-active approach to further identify and locate the extent of the contaminants is planned beginning with an engineering study to identify the extent of the contaminant plume. This on-going procedure is believed to be a critical and vital task to prevent the eventual movement (drafting) of the VOC's into the city used aquifer from continued pumping. This study will be the first step of a two-step approach to ascertain the levels, extent, and location of the plume of each VOC, ultimately resulting in installation of equipment for the extraction and removal of the contaminant before it moves into the lower production aquifer and production wells.

Water Storage: Due to the unique nature of adequate underground water storage within and under the Keizer city boundaries, the requirement for above ground water storage is not nearly as great in volume and/or necessity as typically required for similar municipal water systems. The protected nature and adequate storage of the aquifer, proven from over thirty years of continual and increased use, is believed to be sufficient

in volume and yearly recharge to accommodate all of the future twenty year projected daily needs. A deficiency does exist, however, in the water system's potential ability to meet the continuous or instantaneous high production demands such as seasonal (summer) peak hour demands or a large fire flow demand coincidental with typical summer water demands. The current available above-ground storage of 2,800,000 gallons consisting of the 1,500,000 gallons water storage, located at the Ridge Drive Little League Facility, 750,000 gallons at the Bair Park Facility, and 550,000 gallons available from the Elevated Storage Tank, combined with the current source production, is adequate for the current reserve and peak hour demands, however, additional storage will eventually be needed to accommodate the projected growth as well as stabilize water delivery in the extreme northern areas of the city as well as provide needed reserve and/or emergency storage to the entire water system. Planned improvements include the construction of a third reservoir/pump station (1.25 million gallons/2000 GPM) at a yet to be determined site, which, by Year 2032 will then total 4,050,000 gallons of above ground water storage. This volume is roughly equivalent to 76% of an average day of water consumption in Year 2032.

Hydraulic Analysis: Computer modeling indicates that the water distribution system can accommodate all of the current and future average, maximum day and peak hour water demands. Coincidental maximum day and fire flow demands can also be accommodated for the current and future study years through the existing distribution system. Fire or high flow demands for specific locations such as a large commercial or industrial development, however, are potentially limited due to possible pipeline and hydraulic limitations as a result of elevation or local restrictions. All proposed large scale developments must be individually evaluated to insure adequate capacity and pressure is available to the proposed site during all scenarios. Emphasis should be placed on continuing the city's pipeline replacement program for all remaining steel pipe to improve water delivery, prevent water main failures, lower the percentage of water loss, and lessen water quality complaints due to interior scaling of pipe walls. Continuing and eventually finishing the replacement of the remaining steel waterline throughout the city is important for several reasons: as time passes, the continued use of pressurized steel waterline, primarily installed during the 1950s-1960s, will increase the incidents of customer complaints from discolored water and/or taste and odor problems, will result in additional leakage and possible water main breaks due to corrosion and normal loss of integrity of the pipe material itself, and potentially cause more incidents of positive coliform bacteria tests. Since Keizer does not routinely provide chemical disinfection of its water supply (usually through chlorination), it is vital that the city take all possible steps to maintain the integrity and "tightness" of all components used to transfer and deliver water to customers, including the grid of transmission and distribution pipelines. New pipelines, consisting of cement lined ductile iron pipe, is recommended for exclusive use for all new and replacement pipe.

Capital Improvement Program (CIP): Most of the proposed capital improvements needed to accommodate the projected growth will need to be implemented between the Years 2020-2030, however, there are specific other improvements that must be performed in Phase I (2013-2015) to correct remaining deficiencies in the pumping

system, increase the reliable and emergency system capacity, and remove the potential risk due to VOC contaminants within the shallow aquifer underlying the city. This is due to the higher rate of population growth and possible city expansion expected during this period. Many of the proposed pipeline extensions or replacement projects outlined in the 1988 and 2001 Master Plan Updates have been either completed or included within this CIP. In order to accommodate the projected rate and schedule of growth, plus provide flexibility in the financial planning and budgeting arenas, the 2012 Master Plan Update CIP has been divided into four phases of implementation. Phase I ($2,378,400.00), slated to be performed between 2012-2015, includes the greatest number of improvements, although the total capital outlay is the second least in dollars. The work in Phase I includes a long planned intertie pipeline running parallel to the Salem Parkway between the Wiessner and Ridge Drive Pump Stations. This new pipeline will reinforce water delivery and improve pressures throughout the water system during high flow periods as well as provide an additional pathway for delivery of water from and between these two high capacity facilities (Ridge Drive Pump Station full capacity ≈ 4,000 GPM; Wiessner Pump Station full capacity ≈ 1,500 GPM). Also included in Phase I is an engineering/hydrogeological study and projected abatement plans for VOC contaminants currently present within the city's shallow, upper aquifer, installation of a "jockey" type booster pump and a standby generator at the Bair Park site to provide for lower flow demands and increased reliability of service within the Northern Pressure Zone, abandonment of the Lauderback well, the last city well of which the construction dates before 1980 plus the only remaining city well in use that is not felt to be sealed to an adequate depth, and a portion of the ongoing steel waterline replacement program. Phase II (2015-2020) continues the steel waterline replacement program plus installation of the second 2,600 gallon pressure tank at the Lacey Court Pump Station for an estimated cost of $1,248,000.00. Phase III (2020-2026) provides for the construction of a fourth city water storage reservoir (1.25 million gallons) and third booster pump station along with continuation of the steel pipeline replacement program at a cost of $3,834,000.00. Phase IV, slated for 2026-2032, represents the final planned portion of the steel waterline program at a projected cost of $2,424,000.00. The total cost for all four phases is $9,884,000.00 (2012 dollars).

Recommendations

1. Review, revise if necessary, and adopt this Master Plan.

2. Immediately begin Phase I improvements.

3. Develop a well monitoring and maintenance program based on an aggressive tracking of well flow rates, static water levels, and pumping water levels. The ultimate schedules and intervals of well rehabilitation should be based on an evaluation of the specific capacity (GPM divided by the drawdown) with well rehabilitation occurring at or before a drop of between twenty five (25%) to no more than thirty percent (30%) of the specific capacity is observed. Well rehabilitation, as with pump rebuilding, should be budgeted as a routine O&M (Operation and Maintenance) item.

4. Determine funding options for Phase I-IV improvements, develop a comprehensive rate study to determine needed revenue to fund improvements as well as on-going operation and maintenance costs.

5. Develop and implement an in-house effective Wellhead Protection Program, determine impact and implement required modifications to comply with the EPA Groundwater Rule.

6. Develop an inventory of the remaining steel pipe in the distribution system and implement a yearly budget to plan for the eventual total replacement of all steel pipe as outlined in Phase I-IV improvement programs. Replacement schedule should be based on budget constraints, availability of funds, and the condition of individual pipelines.

7. Develop and adopt an amended agreement with the City of Salem for water exchange criteria and procedures to execute an emergency water exchange in either direction. Enhance the current facilities between Salem to Keizer to provide a "fail safe" method of water transfer between the two cities.

8. Develop an Emergency Plan applicable to water system functions for storms, earthquakes, source contamination, extreme well failure, or waterline breaks

9. Continue the current excellent maintenance program. Budget for routine well and pump rebuilding, (for smaller units (≤1000 GPM) at 10 year maximum intervals, and for larger units at 15-20 year intervals as an on-going Operation and Maintenance expenditure. Perform yearly or bi-yearly pumping plant efficiency tests to track condition and performance for each pumping unit (conduct plant testing for smaller wells/pumping units at yearly intervals and every two years for larger units over 1000 GPM capacity). Determine actual rebuild intervals based on historical tracking of individual unit decline in performance or efficiency.

Chapter One

Introduction and Background

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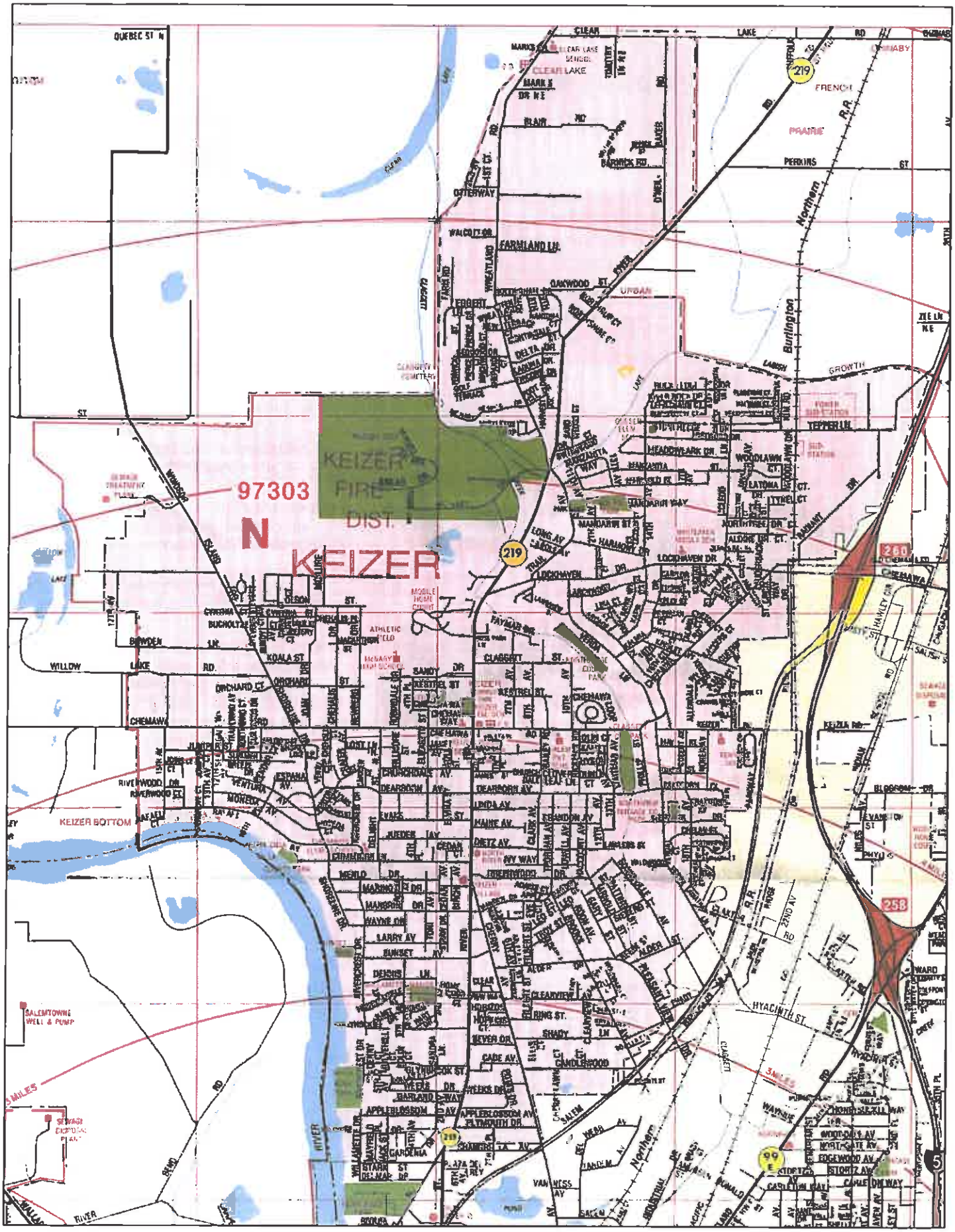
Introduction

Water is essential for the survival of all life on earth. Without it, crops and cities fail and entire civilizations have been known to collapse. A primary responsibility of most municipalities is the delivery of safe and adequate water supplies to its citizenry. As cities grow and expand, water supplies often become scarce, contaminated, and overburdened. A water system master plan assists the citizens and leaders in government by providing the necessary information needed towards making the often difficult decisions regarding preserving and enhancing current water supplies as well as predicting and planning for future needs. A properly prepared master plan must include accurate and reasonable predictions of population growth, current and future water use projections, regulatory and aesthetic water quality impacts, and other factors necessary to make informed and intelligent decisions. A master plan should not be considered as a political document, therefore, the authors should not be asked or required to be concerned or involved with any particular resistance or endorsement of growth or development within a given community. Alternatively, what it should be is an independent technical appraisal of the state of the current water system and currently needed improvements as well as a dynamic and flexible technical reference and planning document with reasonable and practical assumptions; a document that is also used as an informational resource and guide that is periodically reviewed and updated to address changes in the planning or growth of the community and water system. A well-prepared master plan will follow and enhance the vision and unique needs of the community it was developed to serve. With this goal in mind, this Master Plan Update is dedicated to the citizens of Keizer, Oregon.

Background

The City of Keizer is the second largest incorporated city in Marion County and the 14th largest city in Oregon. The city limits contain a 2012 population of 36,735 over a 7.36 square mile area. The city is located in the North-Central Willamette Valley, bordered to the south by the City of Salem, the State Capitol. The eastern boundary of the city limits abuts the westernmost city limits of Salem and the Interstate Five (I-5) freeway. The city is somewhat divided east-west by River Road Northeast and bordered to the north by agricultural farmland. The westernmost boundary of the city is the Willamette River and agricultural farmland (Figure 1-1). Keizer is generally regarded as primarily a residential community with a minor number of commercial and industrial facilities. Between 1990-2010, the State of Oregon as a whole, and the Willamette Valley, in particular, have absorbed an increase in population due to the influx of new residents. Marion County and Keizer have each been a beneficiary of this trend which is expected to continue at a slower pace over the next twenty years. The official elevation of the city is recorded at 135' (MSL).



City of Keizer
General City Map
Figure 1-1

City History (1)

Keizer's first settlers began to arrive in the Willamette Valley during the 1840's. By the mid-1850's, 18 families had laid claim to a total of 7,655 acres. Members of two families, the Keizurs and Pughs, had the largest total land holdings; 2,415 and 1,912 acres, respectively.

The community took the name of Thomas Dove Keizur, patriarch of the family which came to Oregon with the Applegate wagon train in the fall of 1843. From the time the Keizurs arrived in the United States, in the mid-18th century, they had used 15 different versions of their family name. Most of those settling in this area spelled it "Keizur."

The names of the original settlers were Keizur (three families), Pugh (four families), Zieber, Spong, Purdy, Smart, Ford, Claggett, Fisher, Force, Stephens, Penter, and Smith. In the Clear Lake area, holders of the donation land claims were George Lesley and Jeremiah Stevenson. Claims of Zieber and Smith included land in both communities. It was the Alvis Smith family who started Keizer's first and only cemetery. Originally known as the Smith graveyard, it is now called the Claggett Cemetery.

The first school was built on the Claggett farm, located at the intersection of Wheatland and River Roads. Hugh McNary, son-in-law of Charles Claggett, and the father of Judge John McNary and Senator Charles McNary, and eight other children, was an early teacher there, he also held church services in the school. When a new one-room school was built in 1878, on the 1± acres at Keizer corners donated by John and Sally Pugh, Nina, daughter of Hugh and Margaret Claggett McNary, was the first teacher.

One of the worst floods ever to hit the Willamette Valley was devastating to the farmers of the Keizer Bottom in 1861. Homes, barns, furnishings, farming implements, cattle and poultry were lost when waters traveled as far east as the Keizer School and also isolated the community from Salem to the south. Claggett Creek, then unnamed, flooded the lowlands now occupied by Claggett Park and closed the road to the east.

During the ensuing years, Keizer farmers built their homes on higher ground. The oldest home still standing is the John Pugh house, built in 1875 above Claggett Creek, of which high flood water would swell to the proportions of a river. In fact, it was the frequent flooding of the Willamette River that hampered development of the Keizer area. In 1917, more than 70 years after the first settlement, there were fewer than 70 families in the entire area, most were on higher elevations of Chemawa Road, near the Oregon Electric track and off what is now Verda Lane.

Developers generally steered away from the Keizer area, especially after the 1943 flood, which was one of major proportions and one which enabled a Coast Guard cutter to float all the way to the Rehfuss farm on Cherry Avenue through the draw where the Keizer Elks' clubhouse is now situated. There were additional major floods occurring in 1945, 1946, and 1948. However, the dams rapidly being constructed on the Willamette and its tributaries began to regulate the river to the extent that development began in earnest during the 1950's.

(1) This section derived from "A Brief History of Keizer" by Ann Lossner.

During this decade, the seeds were sown for a small town. City phones replaced the country line and a volunteer fire department was formed. River Road was realigned and paved. A doctor, dentist, optometrist, and a drug store soon moved to Keizer. The growing business community organized first as the Commercial Club and then as the Keizer Merchants. Lynn Martin expanded the budding Keizer News newspaper.

To facilitate further expansion of the Keizer School, the Grange Hall was moved from its location on River Road to Chemawa Road and the Keizer School became the largest grade school in Marion County. Then, Cummings School was built to relieve the expanding student population. The local merchants sponsored the popular Keizer Days parade and a Kids' Parade long after the demise of the Cherry Festival in Salem. There was every imaginable activity for youngsters; garden and service clubs for adults, and churches of practically every denomination.

By 1960, there were over 5,000 people residing in the Keizer community. Three schools were built to accommodate the existing and projected student enrollment. The Kennedy grade school was the first new school to open, constructed in 1964, followed by McNary High School in1965. McNary High School housed the Whitaker Junior High School until that school was built in 1968. McNary's football field was soon seeded and a cinder track completed. Then, after 16 flood-free years, the Willamette River went on a rampage in December 1964 and January 1965. Washers, dryers, TV sets, furniture, and parts of houses washed onto the track and the low lying areas of the school grounds--virtually a modern replay of the great flood of 1861. During the next decade, the population doubled to 11,405 with orchards and berry fields yielding space to new houses. Many Keizer residents currently treasure a full-grown fruit or nut tree in their yards, the fortunate beneficiaries of past years land use.

Another 7,000 people located in the Keizer area by 1980 and old-timers looked on sadly as familiar landmarks constantly disappeared. For example, the Cummings maple tree, whose trunk was six feet in diameter, was felled to permit construction of Shoreline Drive. It had once shaded the home of the pioneer John Keizer and his family.

As the need became apparent for city services, such as streetlights, water, or police protection, Keizer citizens consistently voted to finance them. Many times the City of Salem tried to annex the growing community adjacent to its city limits, however, the effort consistently failed. In 1964, a number of Keizer residents, chiefly V.E. Smithley, E.T. Riley and Robert Stutzman, tried to convince the people of Keizer that it would be cheaper and better to form their own city. This effort also failed.

To the north of Keizer, the heart of the Clear Lake community was the church, school, fire station, and country store, clustered at the intersection of Clear Lake and Wheatland Roads. It was a close-knit farming community with productive orchard; hop yard; and berry fields. Within a short time, however, developers soon built homes on Jays Drive and Barbara Way to the north, along the bluff above Mission Bottom and north and east of Claggett Creek.

When the Oregon Legislature made it possible for communities of 20,000 or more to incorporate during the 1980's, many Keizer citizens worked hard to get an incorporation measure on the ballot.

They believed that it was Keizer's last chance to retain its own identity. A number of Clear Lake's homeowners, faced with numerous drainage problems, joined in the effort and, in November, 1982, outvoted the dissenting local farmers. On November 2, 1982, Clear Lake residents joined the Keizer community and voted to become the new city of Keizer by a vote of 4440 to 3341. Current city government consists of a city council-manager form of government. The City Council consists of a Mayor and six Councilors. The Mayor's term runs two years and councilors serve four-year staggered terms. In 2010, there were 118.5 full time (or equivalent) city employees working in 11 departments. The city has 18 community and neighborhood parks including the well used Keizer Little League Park. In 1997, the Keizer Stadium, home of the Volcanoes, a minor league baseball team, opened. Today, the city is well known for the annual Miracle of Christmas lighting display and as the "Iris Capital of the World." Between 1990 to 2000, the city experienced rapid growth with a 1990 census population of 21,884 steadily growing to a Year 2000 population of 32,203 (2000 census), a 32% total rate of population growth, or 2.8% per year. Since the year 2000, however, the city's growth rate has declined to approximately 12.6%, an equivalent annual rate of .99%, just under 1% per year, culminating in an estimated (RE: P.S.U.- Center for Population Research) 2012 population of 36,735. In 2005-06, a commercial development in the eastern region of the city, known as "Keizer Station," was established. This regional shopping center and retail development was and is being built within the area formerly known and outlined as the "Chemawa Activity Center" (CAC) in the 2001 Water System Master Plan Update. (Refer to Chapter 3, Population and Land Use, Page 17).

Water System History

In 1957, a collection of private wells were consolidated to create the Keizer Water District. Prior to that date, homes in the area were served from individual wells. The original water system was funded with a $550,000 bond issue repaid at an interest rate of .048%. These funds were used to purchase existing wells serving two subdivisions and also constructed the original distribution system consisting of approximately 40 miles of mostly steel pipe in sizes starting at 4" up to 14". The wells that were combined to serve the District between 1957-1966 were the Potts well (now unused and long since abandoned),the Duncan Well (the existing well was abandoned and replaced several years ago and the site is now referred to as Willamette Manor), Carlhaven East and West wells, the Toni well, and the Shoreline (now referred to as Burnside) well. The Toni, Shoreline, and Duncan wells were originally used to provide water to the former Manbrin Gardens subdivision water system developed during the mid-late 1940's. The Water District served the Keizer area from these wells up to 1966. Most of the pipe installed and in service throughout the District up to 1966 was dipped and wrapped "O.D." (outside diameter) steel pipe. Since 1966, the pipe material of choice has been either cast or ductile iron, although steel pipe was still occasionally used until the 1970's. During 1966, the District completed an agreement to suspend use of their wells and purchase all water from the City of Salem through up to four one-way connections to Keizer's distribution system. These connections were located at Rivercrest and Sunset Ave (8"), Cherry Ave, between Alder and Manbrin Drive (12"), Wiessner Drive at the Salem Parkway (8") and Brooks Street and Candlewood Drive (8") (Figure 1-2 display the remaining intertie locations). During the period between 1966-1980, the District maintained its three wells in a stand-by condition and, due to an adequate water supply from Salem, were utilized very infrequently. During 1980, in response to a

CITY OF KEIZER / SALEM INTERTIE LOCATIONS
CONNECTION #1 = 12"
CONNECTION #2 = 8"

Figure 1-2

threatened severe increase in wholesale water rates from Salem, the District embarked on an ambitious program to reactivate their existing wells and develop additional wells. Funding for these improvements was accomplished through a 20 year $4,000,000 bond issue approved by local voters in March, 1980 by a 7 to 1 margin. The initial development of Keizer's water supply consisted of identification and exploration of available water sources. During hydrogeologic investigations, two potential sources were identified: shallow groundwater sources believed to be in gravel beds underlying and abutting the Willamette River and deeper groundwater resources from the Troutdale or Willamette silts aquifers located underground throughout the District. In an effort to determine the viability of utilizing shallow wells (Ranney collectors) near the Willamette River, the District drilled five test wells and one production well near the river. This concept was soon abandoned due to the lack of sufficient groundwater underlying the river bed and concerns related to water quality. Following this failed attempt, emphasis was immediately placed on pursuing deeper groundwater resources within the district boundaries. During 1980-1982, the District reactivated or redrilled two wells in the Brandon Road area (Carlhaven East and West wells), reactivated three wells (originally drilled circa 1940-1945) with new pumps in Manbrin Gardens (Burnside, Toni, and Willamette Manor), and began a new well development program. During 1981 the Keizer Water District purchased 12% of the City of Salem's total water supply at a cost of $365,000. By March, 1982, however, the District was serving 18,000 people through 5500 connections, was primarily self-reliant for water supply, and obtained additional water from Salem primarily during high-use periods.

The years of 1980 and 1981 saw the construction of the highest individual producing wells: Wiessner, Delta, McNary, and Chemawa. By late 1982 to mid-1983, these wells were equipped with pumping equipment and operable. The Cherry Avenue well was drilled and developed during late 1982. The Keizer Water District continued to supply water to the residents of the new City of Keizer from 1982 on as an independent entity. Also in 1982, the citizens of Keizer voted to add Fluoride to the water supply. Fluoride has been added to the water supply since that time with average Fluoride levels now averaging .60-.80 mg/L throughout the city. In May 1983, in response to a desire to encompass and unify water service to all areas within the new city, the Wilark Park Water District (a private water company) was purchased and the assets assumed by the Keizer Water District. The merging of these two districts added three additional operating wells (Lauderback, 13th Ave, and 17th Ave) to the Keizer Water District. By late 1983, the Keizer Water District was capable of supplying up to 16,000,000 gallons per day (over 11,000 GPM) from a total of 13 new and reconditioned wells. The first telemetry (or SCADA) system was installed in 1982-1983 for the control of all then operable wells. This improvement replaced the local control method utilizing pressure activated controls at each site previously in use up to this point and greatly improved the reliability and operating efficiency of the entire water system. The water system remained essentially unchanged (except for distribution system expansion and replacement) between 1984-1992. In July, 1985, the new City of Keizer absorbed the wells, pumps, and distribution system of the now defunct Keizer Water District. During that same month, the District's water system passed it's first major test since its inception. On 3 separate occasions, system peak demand reached 9,500 GPM with maximum day demands up to 7 mgd. In 1992, in response to additional growth, primarily occurring in the northern region of the city, a new 1300 GPM well and pump station was constructed adjacent to the new Meadows subdivision. In 1998-1999, a new

well, 1.5 million gallon reservoir, and booster pump station were constructed at the Keizer Little League facility on Ridge Drive. This reservoir and pump station, referred to as the Ridge Drive site, is used to primarily provide an emergency supply of water during power outages and/or provide additional water supply during extreme peak use periods, usually occurring during July and/or August. In 1994, the telemetry system was totally replaced and upgraded to a first generation of a "digital" computerized control system. This system, which totally replaced the original 1983 "analog" telemetry controls, provided a more accurate, reliable, and precise control system. The 2 intertie connections to the City of Salem (Figure 1-2), although not in active use, remain physically connected and operable on a manual basis. An emergency water inter-use agreement, executed in 1987 and amended in 2012, provides for the emergency exchange of water for either city. This emergency exchange agreement has been recently used three times; in 1996 and 1998, the City of Salem purchased water from Keizer for several days during the severe flood events that occurred during these years which caused a shutdown of Salem's Geren Island water treatment facility and in 2011, the City of Salem purchased water for several days in response to a severe draft of water during high summer usage. The City of Salem is currently (late, 2012) constructing an intertie booster pump station at the Cherry Avenue well/pump station site capable of transferring up to 5 million gallons per day (3500 GPM) from Keizer to Salem. A second intertie pump station is planned for the Wiessner site, however, the actual schedule for implementing this location has not been determined. In 1997, the city's water was judged as the "Best Tasting Groundwater in Oregon" by a statewide water utility association.

Since the last update of the city's water system master plan in 2000, the water system has continued to add new facilities to accommodate growth as well as replace antiquated or inadequate older facilities that were needed. These included the replacement of the Willamette Manor well in 2000, addition of the Reitz Well and Bair Park Reservoir/Pump Station in 2003-04, construction and activation of the Keizer Station well/pump station (2005-06) and elevated storage tank (EST) (2008), replacement of the Delta Well and addition of the City Hall Well in 2006, replacement of the Carlhaven East and West Wells in 2010, and finally, the replacement of Well #12 (17th Ave) in 2012. All of the above projects were CIP items outlined in the 2001 Master Plan Update. In addition to the above source enhancement projects, other projects to increase the reliability and operation of the water system were also undertaken. These additional improvements included isolation and pressure increasing within the northern pressure zone in 2001, expansion of the Wiessner well pump capacity and conversion to automatic operation of the back-up engine and expansion of the capacity to 1,400 GPM, and increasing the capacity of the McNary well to 1,400 GPM, both in 2002, expansion of the Chemawa well pump capacity to 2,500 GPM in 2004, and a total upgrade of the telemetry system to computer control using radio modem in 2006-07. Once again, all of the above improvements were listed within the 2001 Water System Master Plan Update CIP.

Topography

The City of Keizer is situated in a large floodplain landscape east of and along the Willamette River (Figure 1-3). The topography within most of the southern and central regions of the city is relatively flat with elevations ranging from 120-150 feet MSL up to

160-190 feet MSL in the northern regions of the city. The general trend of the topography is sloping from the east to west towards the Willamette River, and from north to south. Natural drainage topography exists within the city with several small streams and creeks draining to the Willamette River.

Soils and Geology

The soils of Keizer are classified in two general groups (Figure 1-4). The first group, found in the valley flood plains, are deep, often poorly drained, slightly acidic, silty clay loam. Typical of these are soils known as Wapato (Wc), Woodburn (Wu), and Amity (Am). Most of these soil groups are found in the eastern and northern regions of the city. Soils along river channels are well drained, very deep, silty clay loams, underlain with gravely subsoils and are variously known as Cloquato (Cm), Chehalis (Ch), and Newberg (Nw and Nu).

Climatic Conditions

The climate of Keizer resembles that of most Willamette Valley communities (Tables 1-1 and 1-2). The area has a temperate climate with definite seasonal changes consisting of moderately warm, dry summers and mild, wet winters. The annual average precipitation of 39.2 inches occurs during the fall/winter/spring seasons with very little rain occurring during the summer months. The average yearly temperature ranges between 51 and 54 degrees. Normal average January temperature is 46 degrees and the normal maximum August temperature is 82 degrees. The driest month is usually July. Prevailing winds are from the west and northwest during the summer months and from the south and southwest during winter storm periods. The data in Table 1-2 outlines the maximum temperatures during the years 1990-2012.

Authorization

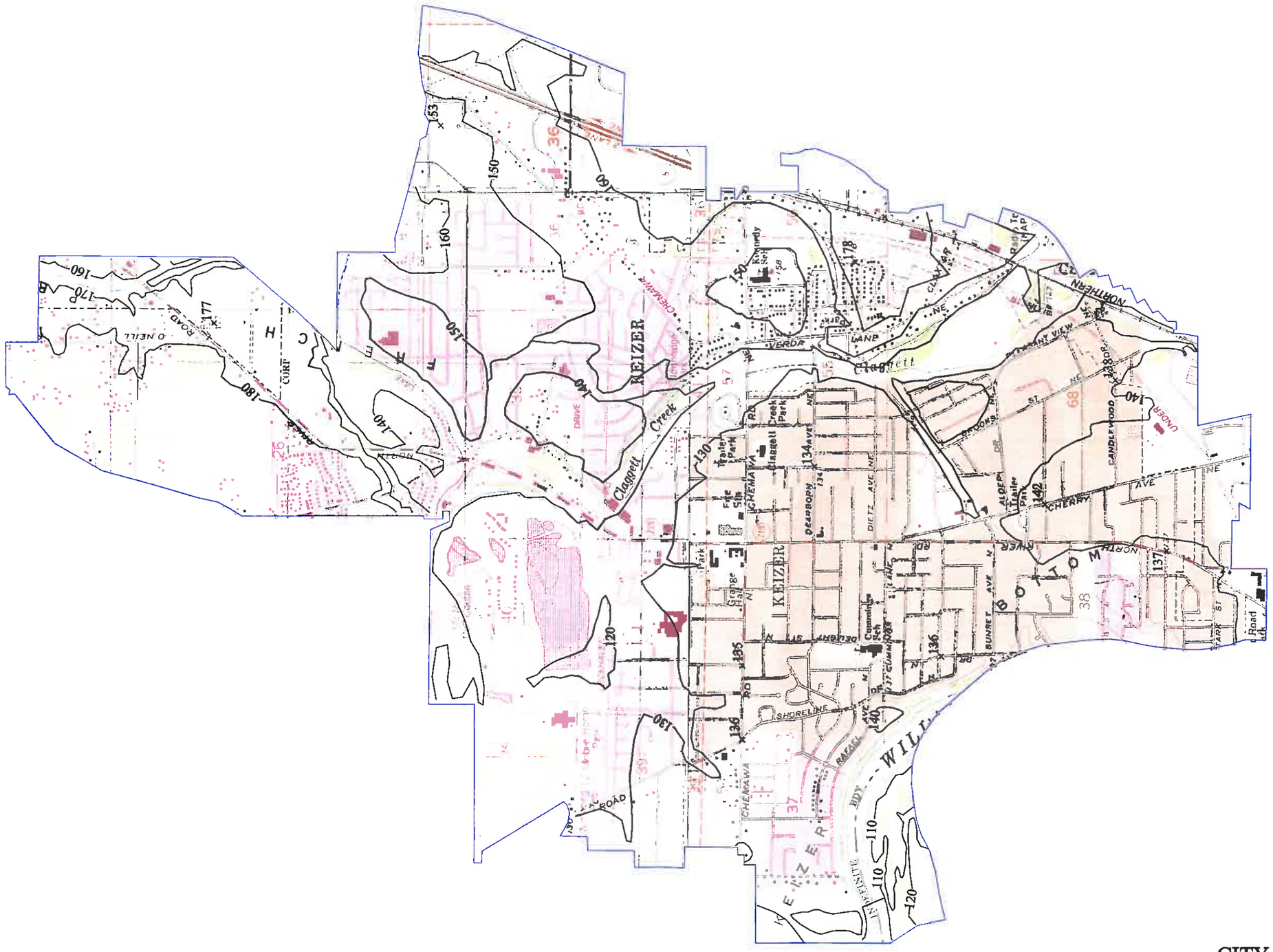
Preparation of this Master Plan update was authorized by the City of Keizer in July of 2012.

Scope of Study

The primary purpose of this master plan is to update and supplement all previous master plans (1980, JMM Engineers, 1988, HGE, Inc, and 2001, Stettler Company) using current population and water use data in addition to evaluation of allowable growth in specific areas. The scope of study and planning includes the following specific items:

1. Evaluate the existing water sources, distribution system, and storage facilities to determine adequacy and reliability.

2. Address appurtenant water quality and water rights issues affecting existing and potential new sources.



CITY OF KEIZER
TOPOGRAPHICAL ELEVATIONS

7A

FIGURE 1-3

3. Perform hydraulic analysis of the existing distribution system, using computer modeling, to determine if inadequacies exist, and if so, the degree of correction required.

4. Evaluate existing storage and booster pumping facilities for average day, maximum day, and peak hour adequacy and determine if additional storage and/or booster pumping capacity is needed to accommodate the present and future demands and for the adequacy of flow for fire protection.

5. Prepare cost estimates and determine potential sources of funding for necessary system improvements along with a proposed timetable for implementation.

6. When possible, specific details and recommendations from the 2001 Master Plan Update have been included within this report, however, several topics such as: growth projections, water use data, and specific improvements and implementation schedule have been revised for current (2012) conditions.

Time Span of Study

This master plan evaluates and estimates the needed improvements between the years 2012 and 2032, inclusive. Specific improvements may be delayed or advanced depending on actual city growth, economic factors, and City Council direction. Periodic review and updating of the master plan, generally occurring between an 8-12 year interval, may be necessary depending on specific factors such as actual rates of population growth and water quality regulatory changes. A citizen committee or task force is often assembled and utilized to facilitate oversight, input, and review of a master plan. This committee should be formed at least 4-6 months before actual modification of the master plan is begun to insure adequate time for review and gaining knowledge of the water system. Participation and input from citizens is important to the ultimate success of a master plan and will often produce a final document addressing local concerns and interests resulting in a plan with manageable and realistic goals which often results in a greater level of acceptance from the community and regulatory agencies. For the purpose of oversight and review, a committee has been appointed for this specific plan.

Table 1-1
Salem/Keizer Average Climate Data

Month	Average High (°F)	Average Low (°F)	Warmest on Record (°F)	Coldest on Record (°F)	Average Dew Point (°F)	Average Precipitation (inches)
January	46°	32°	68°	-10°	37°	5.9"
February	51°	34°	72°	-4°	37°	4.5"
March	55°	35°	80°	12°	39°	4.3"
April	60°	37°	93°	23°	41°	2.4"
May	67°	42°	100°	25°	46°	1.9"
June	74°	48°	105°	32°	50°	1.3"
July	81°	50°	108°	35°	53°	0.6"
August	82°	51°	108°	30°	53°	0.8"
September	76°	47°	104°	26°	50°	1.6"
October	64°	41°	93°	19°	46°	3.0"
November	52°	37°	72°	9°	41°	6.3"
December	46°	34°	72°	-12°	37°	6.8"
Avg. Yearly	65°	45°	-	-	44.2°	39.2"

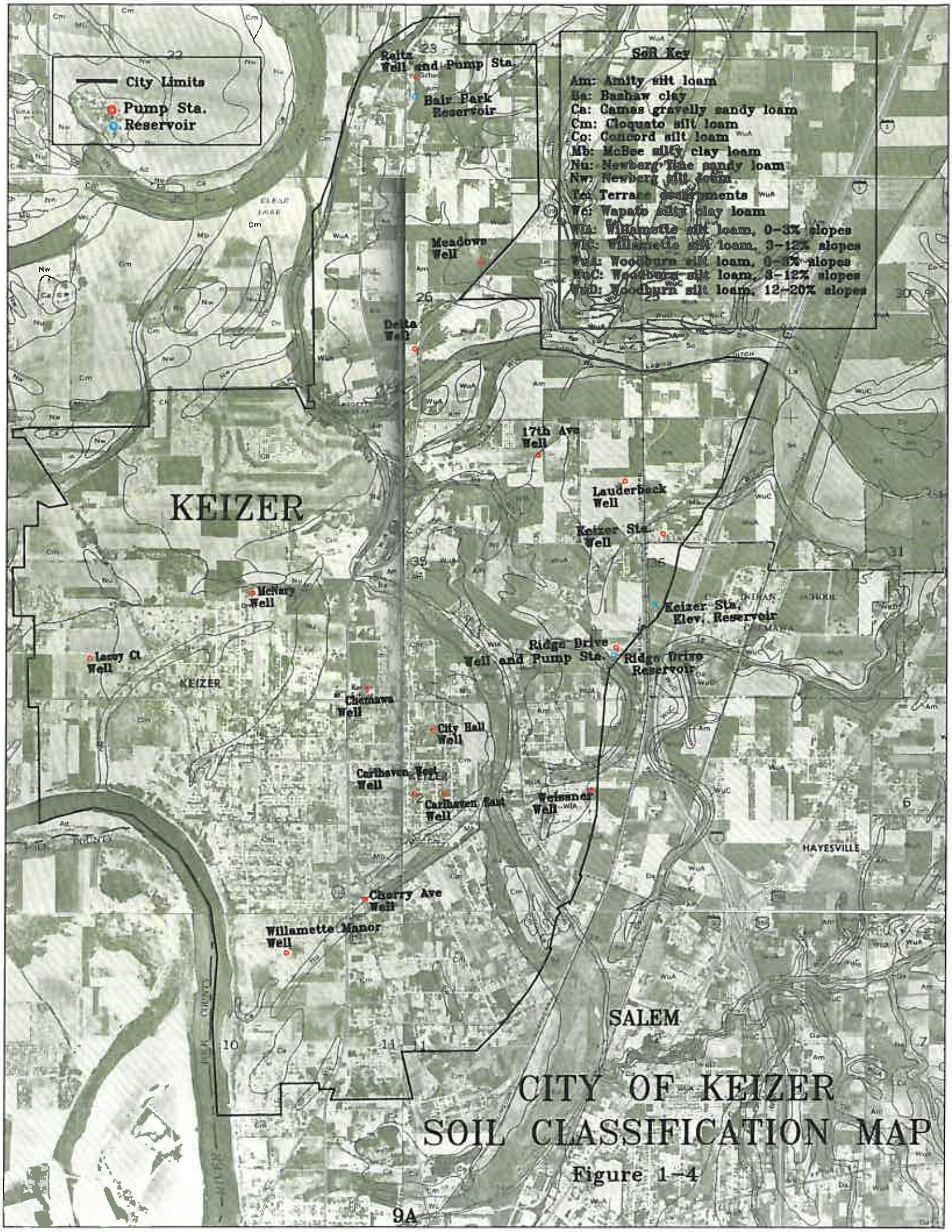
Average yearly temperature: 53.6°

Table 1-2
Maximum Daily Temperatures: 1990-2012

Year	Date	Temperature (°F)
1990	July 21	100 degrees
	August 10	98 degrees
	August 11	101 degrees*
1991	July 22	95 degrees
	July 23	98 degrees*
1992	July 30	100 degrees
	August 11	105 degrees*
	August 13	100 degrees
1993	August 2	97 degrees
	August 3	100 degrees*
	August 4	98 degrees
1994	July 19	100 degrees
	July 20	103 degrees*
	July 21	103 degrees*
1995	July 16	95 degrees
	July 17	101 degrees*
	July 18	92 degrees
1996	July 13	99 degrees*
	July 14	98 degrees
	August 10	99 degrees
1997	August 10	92 degrees
	August 12	96 degrees*
	August 14	94 degrees
1998	July 26	100 degrees
	July 27	101 degrees*
	July 28	99 degrees
1999	July 9	91 degrees
	September 12	95 degrees*
	September 13	94 degrees
2000	June 26	92 degrees
	June 27	99 degrees*
	June 28	94 degrees
2001	July 3	91 degrees
	August 9	96 degrees*
	August 12	94 degrees

*-Highest Temperature of the year

Year	Date	Temperature (°F)
2002	August 12	96 degrees
	August 13	104 degrees*
	August 14	96 degrees
2003	July 28	99 degrees
	July 29	101 degrees*
2004	July 22	99 degrees
	July 23	104 degrees*
	July 24	99 degrees
2005	July 26	96 degrees
	July 27	98 degrees*
	August 4	97 degrees
2006	July 23	104 degrees
	July 24	105 degrees*
	July 25	101 degrees
2007	July 10	103 degrees*
	July 11	103 degrees*
	August 2	95 degrees
2008	June 28	100 degrees
	June 29	101 degrees*
	August 17	98 degrees
2009	July 28	107 degrees*
	July 29	107 degrees*
	July 30	106 degrees
2010	July 25	96 degrees
	August 14	100 degrees
	August 15	101 degrees*
2011	August 20	96 degrees*
	August 21	96 degrees*
	September 10	95 degrees
2012	August 4	102 degrees
	August 5	103 degrees*
	August 16	97 degrees



CITY OF KEIZER
SOIL CLASSIFICATION MAP

Figure 1-4

Chapter Two

Existing System

Existing System

General: Specific details regarding the early water system are not known, however, general data is available as well as improvements performed after 1980.

Table 2-1
Chronology of Water System History

Year	Improvement
1943	Established earliest priority date for water rights from wells. Toni and Burnside Wells (1150 GPM) for Manbrin Gardens Inc.
1945	First application for water rights from Carlhaven East well filed (400 GPM)
1947	Application #GR24 filed for 390 GPM
1948	Application #GR2869 filed for 200 GPM from Potts Well
1953	Application # GR20 filed for 385 GPM from Burnside Well
1956	Application # GR139 filed for .56 CFS from Duncan (Willamette Manor) well
1957	Establishment of Keizer Water District
1958-1968	Construction of most of the original system
1966	Begin exclusive use of Salem supplied water
1973	Application #G6838 for 2 CFS (896 CFS) filed for Wilark Park Wells (13th Ave, 17th Ave, Lauderback)
1980	A) Rehabilitate and reactivate Carlhaven West well (Replace Carlhaven East) B) Develop Wiessner well (1500 GPM) C) Original Water System Master Plan (JMM Engineers)
1981	A) Reactivate Toni, Burnside, and Duncan wells B) Application #G9771 filed for 18.91 CFS for Delta, Cherry Ave, Chemawa, Carlhaven Wells
1982	A) Develop Cherry Ave well (500 GPM) B) Activate Wiessner well (1500 GPM) C) Design and install original telemetry control system (S&B Inc) D) Begin Fluoridation of water E) Keizer generally self-reliant for water supply
1983	A) Develop and activate Cherry Ave, Chemawa, McNary, and Delta wells B) Activate original telemetry control system C) Purchase 3 wells and distribution system from Wilark Park Water Co.
1985	Keizer Water District absorbed by the City of Keizer
1987-88	Master Plan Update (HGE, Inc)
1992	Drill and develop Meadows well (1300 GPM)
1994	Perform update to Telemetry System. Replace all current analog FSK equipment with digital based (Autocan Microcat) computer software (TSI, Inc).
1998/99	Drill new well, construct 1.5 million gallon reservoir and booster pump station at Ridge Drive site.
2000	A) Master Plan Update (Stettler Company)-Issued in 2001 B) Replace Willamette Manor well
2002	A) Expansion of Wiessner pump capacity to 1400-1500 GPM and conversion to automatic back-up engine operation B) Expansion of McNary well pump capacity to 1300-1400 GPM C) Application for Reitz Well water right permit filed
2003	A) Develop Reitz well (500 GPM)

2004	A) Construction and activate of Bair Park Reservoir/Booster Pump Station (.75 million gallon reservoir and 1500 GPM pump station) B) Expansion of Chemawa Pump capacity to 2500 GPM C) Abandon Toni and Burnside wells and remove from system
2005	A) Construction of Keizer Station well (750 GPM))-Water right permit filed B) Transfer (T-10592) of Burnside (GR-20) and Toni (GR-24) water right to City Hall Well
2006	A) Replacement of Delta Well to eliminate nitrates (700 GPM) B) Construction of City Hall well and pump station (800 GPM) C) Replacement of SCADA system to radio modem and computer based control (2006-07) (Taurus Power and Controls, Inc) D) Installation of 150KW standby genset at Ridge Drive facility
2008	A) Keizer Station Elevated storage tank (.55 million gallon reservoir)
2010	B) Replacement of Carlhaven East well (350 GPM) C) Replacement of Carlhaven West well (650 GPM)
2012	A) Replacement of Well #12 (17th Ave) (900 GPM) B) Abandon Well #13 (13th Ave well)
2013 (Projected)	A) Activation of Lacey Court Well (Projected: Spring) (+550 GPM)

Groundwater Sources

The City currently has access to sixteen individual groundwater well sites and five booster pumps at two reservoir sites. Groundwater sources are currently used exclusively in Keizer. See Table 2-3 for Well Data and Table 2-4 for Well Pump data. Figure 2-1 indicates the current water system schematic and Figure 2-2 indicates well locations.

Water Rights

The City of Keizer currently (2012) has approved and active permits or certificates for up to 16,441 GPM of exclusive groundwater sources with the Oregon Water Resources Department (Table 2-5). A redistribution and reallocation of water rights between existing and unused/abandoned wells is planned for Years 2013-15. The projected final reallocation of water rights is shown on Table 2-6 (Page 12D). The current water use area is shown in Figure 2-5.

Water Distribution System

The city's distribution system consists of primarily older wrapped steel pipe (approx. 87,000', 13% of the total length remains as of late, 2012) and newer ductile iron pipe with a minor amount of cast iron. Most of the original distribution system was installed during the period between 1957-1970. The city has embarked on a steel water line replacement program and plan to replace all remaining steel pipe within the study period. Between 1983-2012, water meters have risen from 5,200 to 10,326 (Table 2-2b). The city currently utilizes AWWA standard C-151 Pressure Class 350 ductile iron pipe as the standard pipe of choice. Refer to Figure 2-3 for the distribution system layout, Table 2-2a for the approximate lengths of various sizes within the system and Table 2-2b for the current number of service meters in the system.

Table 2-2a
Distribution System

Nominal Size (Inch)	Total Length (Feet)	Type(s)
4"	17,258'	Ductile Iron and Steel
6"	237,487'	Ductile Iron and Steel
8"	289,810'	Ductile Iron and Steel
10"	17,037'	Ductile Iron and Steel
12"	86,920'	Ductile Iron and Steel
14"-16"	15,020'	Ductile Iron

Total Length: 663,532'-Miles: 125.67

Table 2-2b
Water Meter Distribution (October, 2012)

Size	Number of Accounts	% of Total	Class
5/8"	8,118	78.6%	Residential
3/4"	1,641	15.9%	Residential
1"	288	2.8%	Residential-Commercial/Industrial
1-1/2"	153	1.5%	Residential-Commercial/Industrial
2"	95	.9%	Commercial/Industrial
3"	20	.2%	Commercial/Industrial
4"	7	.06%	Commercial/Industrial
6"	4	.04%	Commercial/Industrial
TOTAL	**10,326**	**100%**	**Approx. 97%-98.5% of all meters fall into Residential class**

The system has adequate isolation valving and good fire hydrant distribution throughout most of the system. Hydrants manufactured by Kennedy, Mueller, Waterous, or Clow are present within the system. New services are exclusively made from soft copper tubing installed from the main to service meter. Most of the distribution system is looped and intertied, where possible, to improve delivery and lessen water quality impacts to customers. The city routinely performs flushing of the distribution system during the spring season of each year.

Treatment Facilities

Due to the high quality of the raw water, the city does not routinely provide disinfection or filtration of any kind. Several wells, however, produce water with slightly elevated levels of iron and/or manganese. Iron and manganese, while not a health concern, often create aesthetic problems due to staining and taste and odor issues. A sequesterant (Calgon C-5) is introduced at selected sites to control iron and manganese. Fluoride (Sodium Fluoride) is injected proportional to flow at all active well sites except for the Chemawa, Wiessner, and McNary sites. Typical finished water fluoride levels average .70 mg/l, which is within the optimum level to provide a dental health benefit.

City of Keizer
Water System Well/Pump Data Sheets
Sheet #1--Well Data---November, 2012

Well/Site#	Description/Address	Site Elev.(MSL)	Well Diam.	Well Depth	Perforated or Screened	Perforation or Screen Interval/Slot Size	Seal Depth	S.W.L/O.B.Date	Well Test Capacity @P.W.L.	Yr.Drilled-Driller	Well ID #L/Well Log #—OHA Facility ID#
1	**Carlhaven West Well**	133ft.	10"	250'	10" tele. S.S. Screen	148'-160'-30 slot; 160'-170' & 190'-220'-100 slot	100'	31'-11"(2010)	750 GPM @ 128' PWL (10-2010)	2010-Westerberg	L-101905——MARI 63385
	950 Brandon NE					170'-190'-80 slot; 220'-240'-60 slot		32' (2011)	725 GPM @ 105' PWL (7-2012)		OHA Facility ID # EP-T—SRC-TA
2	**Willamette Manor Well**	139ft.	8"	191'	6" P.S. S.S. Screen	120'-140' & 175'-185'- 80 slot	95'	26'(5-30-00)	400 GPM @ 94' (6-09-00)	2000-Waldroop	L-38871——MARI 55036
	3868 5th. Ave.		6" below 113	Blank:113'-120'.		140'-145'-50 slot,145'-160'-100 slot		21' (2011)	300 GPM @ 99' PWL (7-2012)		OHA Facility ID # EP-K—SRC-KA
3	**Burnside (INACTIVE)**					**ABANDONED-2004**					Mari 57995 (abandonment)
	4335 Shoreline N										
4	**Keizer Station Well**	148ft.	12"	270'	8" P.S. S.S. Screen	150'-185'; 200'-234'; 239'-265'–All 60 Slot	150'	28.3'(2005)	750 GPM @ 128' PWL	2005-Boart Longyear	L-79776——MARI 59353
	2630 Jorie Road NE					Filter packed with 8 x 12 sand			775 GPM @ 151' PWL		OHA Facility ID# EP-Q—SRC-QA
5	**Cherry Ave. Well**	132ft.	12"	210'	12" & 10" S.S.Screen	12"Tele.-120'-140'-60 slot	80'	25'(1982)	410 GPM @ 74' (1999)	1982-Eola Well Drilling	L-32102——MARI 16771
	4110 Cherry Ave. NE				Tele. & P.S.	10"PS-170'-188'-30 slot,188'-205'-25 slot					OHA Facility ID# EP-E—SRC-EA
6	**Carlhaven East Well**	133ft.	12'	300'	12" tele. S.S. Screen	160'-252' w/ 60 slot & 252'-280' w/ 40 slot	96'	38'-11'(2010)	300 GPM @ 111' (10-2010)	2010-Westerberg	L-101904——MARI 63186
	1150 Brandon NE					Filter packed with 8/12 & 6/9 CSS sand-163'-280'			360 GPM @ 151' (7-2012)		OHA Facility ID# EP-U—SRC-UA
7	**Wiessner Well**	170ft.	18"	258'	16"-S.S. Screen	145'-185' & 205'-255'–All 100 Slot	30'	49' (3-3-00)	1350 GPM @ 99' * (1993)	1980-West Coast	L-32104——MARI 16734
	2005 Wiessner Ave.				"Hi-Cap"				1500 GPM @ 138' PWL (8-2009)		OHA Facility ID# EP-J—SRC-JA
8	**Delta Well**	181ft.	12"	328'	10" P.S. S.S. Screen	180'-195' w/ 150 slot, 210'-250' w/125 slot	150'	72.9'(2006)	1000 GPM @ 157 PWL	2006-Boart Longyear	L-82750——MARI 59708
	939 Delta NE					250'-270' w/ 90 slot, 280'-320' w/ 150 slot					OHA Facility ID# EP-R—SRC-RA
9	**McNary Well**	122ft.	16"	205'	16" P.S. S.S. Screen	119.5'-200'–All 150 Slot	96'	23'(1981)	1350 GPM @ 43'* (1993)	1981-Schneider	L-32106——MARI 5384
	610 Lockhaven NE				Double Xtra Strong-Hi Cap	Gravel Pack:0'-205'(1/2"-3/4")		31' (8-2009)	1300 GPM @ 60' PWL (8-2009)		OHA Facility ID# EP-H—SRC-HA
10	**Chemawa Well**	132ft.	16"	255'	16" P.S. S.S. Screen	120'-250'–All 150 Slot	85'	21'(1981)	2500 GPM @ 90' (1981)	1981-West Coast	L-32107——MARI 16779
	641 Chemawa					Gravel Pack:0'-255'(1/2"-)		36' (7-2012)	2100 GPM @ 77' PWL (2011)		OHA Facility ID# EP-D—SRC-DA
11	**Lauderback Well**	152ft.	10"	155'	Perforated w/ Mills Knife	Qty.= 250 perforations between 140'-150'	30'	24'(1973)	370 GPM @ 80' * (2000)	1973-Harlan Miller	L-32108——MARI 5200
	6180 Lauderback NE				Perfs: 1/2"x 2"				350 GPM @ 116' PWL (2012)		OHA Facility ID# EP-G—SRC-GA
12	**17th. Ave. Well**	155ft	10"	335'	10" S.S. telescope screen	152'-160'-185'-195'-295'-313' w/ 10 slot,	122'	31'(2012)	900 GPM @ 115' PWL	2012-Westerberg	L-106360——MARI 64141
	6288 17th. Ave. NE					160'-185'-195'-295' w/70 slot-313'-330' w/ 100 slot					OHA Facility ID# EP-V—SRC-VA
13	**13th. Ave. (INACTIVE)**	150ft.				**ABANDONED-2012**					
	6250 13th. Ave. NE										
14	**Meadows Well**	177ft.	12"	310'	10" PS S.S.Screen (3)	195'-230' & 275'-295' w/80 slot-230'-250' w/ 50 slot	52'	60'(1992)	1200 GPM @ 93' * (1992)	1992-Waldroop/Sippel	L-32109——MARI 17870
	7177 River Rd. NE										OHA Facility ID# EP-N—SRC-NA
15	**Ridge Drive Well**	158.5ft.	12"	260'	Perforated-3/8"x 2"	Perf- 144'-177'	127'	35'(1999)	830 GPM @ 143' * (1999)	1999-Waldroop	L-10949——MARI 54341
	5175 Ridge Dr. NE				10" P.S. Screen -125 slot	Screen- 190'-250'					OHA Facility ID# EP-O—SRC-OA
16	**Reitz Well**	180ft.	10"	410'	10" S.S. telescope screen	313'-410'	180'	80'(2006)	700 GPM @ 242' PWL (24 hr.)	2003-Beier/Waldroop	L-55502——MARI 57704
	1065 Bair Road NE									2012-Westerberg-Reh.	OHA Facility ID# EP-P—SRC-PA
17	**Elevated Reservoir**	Base Elev.: 177'									
	5700 Ulali Dr NE	Dome Elev.: 277'	High Water Surface Elev.: 270.40'								
18	**Lacey Court Well**	130' (approx)	12"	171'	10" S.S. P.S. Screen	128'-158' w/ 100 slot,	100'	27' (1989)	400 GPM @ 160' (Orig. Air Test)	1989-West Coast	MARI 5361
	5289 Lacey Ct NE					122'-158' & 158'-168'-10" Blank Casing		37' (2012)	600 GPM @ 122' PWL (Pump)-2012	2012-Westerberg-Reh.	OHA Facility ID# N/A
19	**City Hall Well**	135ft.	12"	290'	12" tele S.S. screen	170'-175' w/50 slot, 175-200 with 100 slot,	90'	29' 6"(2006)	950 GPM @ 161' PWL	2006-Boart Longyear	L-82935——MARI 60019
	Rickman Road NE					200'-240' w/35 slot ,265'-280' w/125 slot			833 GPM @ 152' PWL (36 hrs)		OHA Facility ID# EP-S—SRC-SA

LEGEND	
Tele.= Telescope Screen	S.W.L.= Static Water Level (in ft.)
S.S.=Stainless steel	P.W.L.= Pumping Water Level (in ft.)
P.S.= Pipe Size Screen	Reh. = Rehabililation
COS= Design or operating condition of pump	
* = Most Recent Test	

City of Keizer
Water System Well/Pump Data Sheets
Sheet #2--Well Data---November, 2012

Pump/Mtr Make/Type	Pump Model/Stgs./Imp. Dia/COS	HP	Pump Setting	Column/Shaft-Pipe/Wire Size	Utility-Voltage-Starting Method	Aux./Mode	Comments SYSTEM PRESSURE=	55-58psi-Low	65psi-Normal	70-72psi-High
Goulds Submersible Pump	7THC060-4 stg-4.875" Imp. Dia	60	133'	6" blk T&C pipe & #4/4 cu sub cable	PGE-480V-VFD 1	None	2010: New Well & Pump--Equipped with VFD &	750 GPM	725 GPM	700 GPM
Franklin Elec. mtr.	COS: 650 GPM @ 295' TDH				CARLHAVEN WEST-SITE NAME		Pitless Unit (Maass MB-10" x 8")			
Goulds Submersible Pump	7CLC03066C-3 stg.--5.125" Imp. Dia.	30	105'	4"blk. T&C pipe & #6/4 cu sub cable	Salem Elec.-480V-ALS 2	None	2000: New well and pump	360 GPM	325 GPM	300 GPM
Franklin Elec. Mtr.	COS: 350 GPM @ 265' TDH				WILLAMETTE MANOR		Well is equip. w/ pitless (Maass 10J4) + 2000g tank			
					Salem Elec. 3		RTU is Used for Willamette River Monitoring ONLY			
					BURNSIDE (INACTIVE)		Site has active no well or pump (as of 2004)			
Flowserve Submersible	8EHL-4 stg with 5.95" Imp. Dia.	60	137'	6" blk T&C pipe & #2/4 cu sub cable	PGE-480V-VFD 4	None	Well equipped with pitless adapter (Maass "MB")	700 GPM	675 GPM	650 GPM
Franklin Elec. Mtr.	COS: 700 GPM@ 270' TDH				KEIZER STATION		Site includes stormwater P.S.--3 Pumps: 1-Joc/2 H.S.			
Worthington VTP	10M41-8 stg.-7.33" Imp.SN VTP 57026	50	110'	6"x1 1/4" water-lube column/shaft	Salem Elec.-480V-ALS 5	N.G. Engine	1993: New pump/engine rebuild in 2011	525 GPM	500 GPM	480 GPM
U.S. Elec VHS mtr.	COS: 500 GPM @ 280' TDH		30' Tail Pipe		CHERRY	Auto Start/Run	Site has 5000 gal. Tank, Ford 300CI IL6 & Redi-Torq			
Goulds Submersible	6CHC040-7 stg-4.0625" Imp Dia.	40	168'	4" blk T&C Pipe & #4/4 sub cable	PGE-480V-ALS 6	None	2010: New Well & Pump--Maass 10J4 Pitless-4"	330 GPM	325 GPM	320 GPM
Franklin Elec. Mtr.	COS: 300 GPM @ 355' TDH				CARLHAVEN EAST					
Flowserve VTP	12ENL-7 stg.-8.83" Imp. Dia	125	190'	10"x1 1/2" water-lube column/shaft	PGE-480V-ALS 7	Diesel Engine	Caterpillar 3306 Engine-SN 66D41399	1450 GPM	1300 GPM	1250 GPM
U.S. Elec. VHS mtr.	COS: 1500 GPM @ 275' TDH			Pump SN 020CGC75415	WIESSNER	Auto Start/Run	Gearhead is Johnson Redi-Torq	(45 psi)	(55 psi)	(60 psi)
Goulds Submersible Pump	7THC-4 Stage--4.8125" Imp. Dia.	60	179'	6" blk. pipe & 180'-#1/0/4 cu cable	PGE-480V-VFD 8	None	2006: New well, 100 HP pump, Maass MB Pitless,	750 GPM	675 GPM	650 GPM
Hitachi 60 HP, 8" dia. Mtr	COS: 700 GPM @ 270' TDH				DELTA		2010: Pump Sized Down to 60 HP + Added 21' of pipe	(50 psi)	(60 psi)	(70 psi)
Goulds VTP	14RJLO-3 stg.-9.82" Imp. Dia.	100	102'	10"x1 1/2" water-lube column/shaft	PGE-480V-ALS 9	L.P.G. Engine	Manual Engine Drive & Johnson CH110 Gear	1450 GPM	1350 GPM	1250 GPM
U.S. Elec. VHS mtr.	COS: 1600 GPM @ 225' TDH			Pump SN 5737363-S	MCNARY	Manual	Engine: Ford 534CI-V8			
Goulds VTP	14RJHC-3 stg --9.75" Imp. Dia	150	110'	10"x1 1/2" water-lube column/shaft	PGE 10	Diesel Engine	Pump is Engine drive only-No elec. motor at site	2500 GPM	2300 GPM	2150 GPM
Caterpillar 3306 Engine	COS: 2250 GPM @ 250' TDH	(BHP)			CHEMAWA	Auto Start/Run	Caterpillar 3306 Engine-SN 66D34990			
Worthington VTP	8H38-13 stg.--5.30" Imp. Dia.	30	120'	6" x 1 1/4" water-lube column/shaft	PGE-240V-ALS 11	N.G. Engine	7000 gal. pressure tank on site-Ford 2.3 litre-6 cyl.	360 GPM	340 GPM	325 GPM
U.S. Elec. VHS mtr.	COS: 350 GPM @ 255' TDH			Pump SN VTP37067	LAUDERBACK	Manual				
Goulds Submersible Pump	8FDLC-5 stage--5.06" Imp. Dia.	100	142'	6" blk. T&C pipe & #00/4 cu sub cab	PGE-480V-VFD 12	None	1994: New 3000 gallon pressure tank & bldg. remodel	950 GPM	925 GPM	910 GPM
Franklin Elec. Mtr.	COS: 900 GPM @ 300' TDH			Pump SN M61127	17TH		2012: New Well & Pump-Maass MB Pitless Adapter			
					13TH (INACTIVE)					
Ingersoll/Dresser VTP	12H110-6 stg.--9.33" Imp. Dia.	125	150'	8"x 1 1/2" water-lube column/shaft	PGE-480V-ALS 14	Diesel Engine	Equipped with Redi-Torq	1300 GPM	1250 GPM	1200 GPM
U.S. Elec. VHS mtr.	COS: 1300 GPM @ 260' TDH			Pump SN 9401C0003	MEADOWS	Auto Start/Run	Caterpillar 3306 Engine-SN 85Z11875			
Goulds Submersible Pump	7THC030- 2 stg.--4.875" Imp. Dia.	30	168'	6" blk. T&C pipe & # 6/4 cu sub cabl	PGE-480V-ALS (Well) 15	Diesel Genset	Cat D150P1 150 kw genset-Runs all elec. pumps	600 GPM to Res	600 GPM to Res	600 GPM to Res
Franklin Elec. mtr.	COS: 625 GPM @ 150' TDH	Reservoir: 1.5 MG Dim: 101' D x 24' H			RIDGE DRIVE	Auto Start/Run	Well Pumps to Reservoir Only-via Maass MB Pitless	(See Booster Pump Specs for Sta. Output)		
Goulds Submersible Pump	8RJLC-4 stg.-5.1875" Imp. Dia.	50	273'	6" blk. T&C pipe & #2/4 cu sub cable	PGE-480V-VFD 16	None	Equipped with Maass MB Pitless	500 GPM to Res	500 GPM to Res	500 GPM to Res
Franklin Elec. mtr.	COS: 500 GPM @ 300' TDH	Reservoir: .75 MG Dim: 53' D x 47' H (Bair Park)			REITZ		Well Pumps to Reservoir Only-No Back-Up Equip.	(See Booster Pump Specs for Sta. Output)		
					17		Dimensions: 27' Spherical Diameter-37'6" Max. Head Range			
					ELEVATED RESERVOIR		Nominal Capacity: 550,000 U.S. Gallons-Designed for 4-6 Hour Max. Draft			
Goulds Submersible Pump	7TLC-5 stg.--4.75" Imp. Dia.	50	136'	6" blk. T&C pipe & #4/4 cu sub cable	18	None		575 GPM	525 GPM	500 GPM
Franklin Elec. mtr.	COS: 525 GPM @ 293' TDH				LACEY CT					
Flowserve VTP	10EHM-8 stg.--7.64" Imp. Dia	75	160'	8" x 1 1/2" waterlube column/shaft	PGE-480V-VFD 19	None	Equipped with VFD	850 GPM	800 GPM	750 GPM
U.S. Elec. VHS mtr.	COS: 725 GPM @ 320' TDH				CITY HALL					
							Total Source (Well) Capacity	**13,950 GPM**	**13,115 GPM**	**12,535 GPM**
								(20.10 MGD)	(18.90 MGD)	(18.06 MGD)
	Reitz (Bair Park Boosters)									
Peerless End-Suction	mdl. C740-750 GPM @ 120'	30	N/A	Vertically Mounted Pumps	PGE-480V-VFD. -REITZ BP #1 & 2	None	Combined Reitz (Bair Park) Elec. Boosters	1500 GPM	1200 GPM	1000 GPM
Centrifugal Pumps							(2 Identical booster pumps-No Back-Up Service @ site)			
	Ridge Drive Booster Pumps									
Ingersoll/Dresser VTP	12M90A-2 stg.--9.33" Imp. Dia.	40	5' (canned VTP)	8" x 1 1/4" water-lube column/shaft	PGE-480V-S.S.--RIDGE BP #1 & 2	Cat D150P1	Ridge #1 & 2 Booster Pumps-Auto Genset Back-Up	2300 GPM	2200 GPM	2000 GPM
U.S. Elec. VHS mtr.	COS: 1000 GPM @ 135' TDH			Pump SN 9805C71395 A & B		Auto Start/Run		(55 psi)	(60 psi)	(65 psi)
Ingersoll/Dresser VTP	15M185-2 stg.--10.85" Imp. Dia.	80HP	5' (canned VTP)	10" x 1 1/2" water-lube column/shaft	PGE-480V-N/A---RIDGE BP #3	Diesel Engine	Ridge #3 Engine Drive-via Johnson H110 geardrive	2300 GPM	2100 GPM	2000 GPM
Caterpillar 3304 Engine	COS: 2000 GPM @ 140' TDH	(Engine)		Pump SN 9905CGC72481	MOTOR STARTING METHOD KEY	Auto Start/Run	ELEVATED STORAGE TANK (EST)-Avg. Draft Rate	2,000 GPM	N/A	N/A
				T&C = Threaded & Coupled Pipe	S.S.=Soft Starter-(Electronic)	(Cat 3304)	Total System Capacity (w/oWells #15 &16)	20,950 GPM	17,515 GPM	16,435 GPM
VTP=Vertical Turbine Pump				blk.= Black Steel Pipe	VFD= Variable Freq. Drive		Auto Start/Run Capacity (with EST Contribution)	12,375 GPM	9,650 GPM	9,080 GPM
					ALS = Across (the) Line Start		Projected Peak Hour Demand-Pop.=36K	15,000 GPM	15,000 GPM	15,000 GPM

CITY OF KEIZER
CURRENT WATER RIGHTS-2012

POD-ID	FACILITY	TRANSFER	CERT #	PERMIT	APPLN.	L/S	PRIORITY	TWP	RGE	SEC	Q/Q	USE	RATE	U	FLOW (GPM)	P/A/S	SOURCE	TRIBUTARY TO
32045	Meadows Well	—	0	G-11899	G-12793	L	2/28/1992	6S	3W	26	SENE	MU	3.1200	CFS	1,398	P	A Well	Claggett Creek
—	City Hall	T-10592	0	GR-20	GR-24	L	1/23/1947	7S	3W	2	NWNW	MU	775.0000	GPM	775	P	City Hall Well	Willamette River
12757	Burnside	—	0	GR-2868	GR-3065	L	12/31/1943	7S	3W	3	SWSE	MU	700.0000	GPM	700	P	Well 1	Willamette River
12759	Potts	—	0	GR-2869	GR-3066	L	12/31/1948	7S	3W	11	NESW	MU	200.0000	GPM	200	P	Well 2	Willamette River
11627	Carlhaven West	—	0	GR-2871	GR-3068	L	12/31/1945	7S	3W	2	NWSE	MU	200.0000	GPM	200	P	Well 3	Claggett Creek
11626	Carlhaven East	—	0	GR-2870	GR-3067	L	12/31/1945	7S	3W	2	NESW	MU	200.0000	GPM	200	P	A Well	Claggett Creek
12755	Toni	—	0	GR-2872	GR-3069	L	12/31/1943	7S	3W	2	SWSW	MU	450.0000	GPM	450	P	Well 5	Claggett Creek
12756	Carlhaven West	—	0	GR-3160	GR-3412	L	12/31/1954	7S	3W	2	SWSW	MU	150.0000	GPM	150	P	A Well	Claggett Creek
11628	Willamette Manor	—	31611	G-139	G-222	L	1/30/1956	7S	3W	10	NENE	MU	0.5600	CFS	251	P	O.H. Duncan Well	Willamette River
11630	13th Ave	—	50519	G-6836	G-6189	L	6/27/1973	6S	3W	35	NWNE	MU	2.0000	CFS	—	P	Well 1	Claggett Creek
20924	17th Ave	—	50519	G-6838	G-6189	L	6/27/1973	6S	3W	35	NENE	MU	2.0000	CFS	896	A	Well 2	Claggett Creek
20925	Lauderback	—	50519	G-6838	G-6189	L	6/27/1973	6S	3W	36	NENW	MU	2.0000	CFS	—	A	Well 3	Claggett Creek
11622	Delta Well	T-10591	86617	G-9771	G-10446	L	7/13/1981	6S	3W	26	NESW	MU	3.3300	CFS	1,492	P	Delta Well	Willamette River
11623	McNary Well	T-10591	86617	G-9771	G-10446	L	7/13/1981	6S	3W	34	NESE	MU	3.2200	CFS	1,443	P	McNary Well	Willamette River
11624	Wiessner Well	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	1	SWNW	MU	3.0200	CFS	1,353	P	Weissner Well	Willamette River
11625	Chemawa Well	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	2	NENW	MU	4.0900	CFS	1,832	P	Chemawa Well	Willamette River
11626	Carlhaven West	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	2	NESW	MU	0.7800	CFS	349	P	Carlhaven West Well	Willamette River
11627	Carlhaven East	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	2	NWSE	MU	2.4300	CFS	1,089	P	Carlhaven East Well	Willamette River
11628	Willamette Manor	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	10	NENE	MU	0.7100	CFS	318	P	Willamette Manor Well	Willamette River
11629	Cherry Ave	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	11	NENW	MU	1.3300	CFS	596	P	Cherry Ave Well	Willamette River
49305	Ridge Drive	—	0	G-13784	G-14916	L	1/29/1999	6S	3W	36	SESW	MU	2.2300	CFS	1,000	P	A Well	Claggett Creek
—	Reitz Well	—	NA	G-15369	G-15729	L	3/27/2002	6S	3W	23	SWSE	MU	2.2300	CFS	1,000	P	A Well	Clearlake
—	Keizer Station	—	NA	G-16094	G-16433	L	4/8/2005	6S	3W	36	SENW	MU	1.0300	CFS	461	P	A Well	Labish Creek
—	Keizer Station	—	NA	G-16164	G-16588	L	12/28/2005	6S	3W	36	SENW	MU	0.642	CFS	288	P	A Well	Labish Creek

Total: 16,441 GPM

12C

City of Keizer
Current Water
Rights-2012
Table 2-5

CITY OF KEIZER
PROPOSED FUTURE WATER RIGHT DISTRIBUTION

POD-ID	FACILITY	TRANSFER	CERT #	PERMIT	APPLN.	L/S	PRIORITY	TWP	RGE	SEC	Q/Q	USE	RATE	U	FLOW (GPM)	P/A/S	SOURCE	TRIBUTARY TO
32045	Meadows Well	—	0	G-11899	G-12793	L	2/26/1992	6S	3W	26	SENE	MU	3.1200	CFS	1,398	P	A Well	Claggett Creek
—	City Hall	T-10592	0	GR-20	GR-24	L	1/23/1947	7S	3W	2	NWNW	MU	775.0000	GPM	775	P	City Hall Well	Willamette River
—	Lacey Ct	Pending	0	GR-2868	GR-3065	L	12/31/1943	6S	3W	34	SWSW	MU	700.0000	GPM	700	P	A Well	Willamette River
11625	Chemawa Well	Pending	0	GR-2869	GR-3066	L	12/31/1948	7S	3W	2	NENW	MU	200.0000	GPM	200	P	A Well	Willamette River
11625	Chemawa Well	Pending	0	GR-2871	GR-3068	L	12/31/1945	7S	3W	2	NWSE	MU	200.0000	GPM	200	P	A Well	Claggett Creek
11625	Chemawa Well	Pending	0	GR-2870	GR-3067	L	12/31/1945	7S	3W	2	NESW	MU	200.0000	GPM	200	P	A Well	Claggett Creek
12755	Toni	—	0	GR-2872	GR-3069	L	12/31/1943	7S	3W	2	SWSW	MU	450.0000	GPM	450	P	Well 5	Claggett Creek
12756	Carlhaven West	—	0	GR-3160	GR-3412	L	12/31/1954	7S	3W	2	SWSW	MU	150.0000	GPM	150	P	A Well	Claggett Creek
11624	Wiessner Well	Pending	31611	G-139	G-222	L	1/30/1956	7S	3W	1	SWNW	MU	0.5600	CFS	251	P	A Well	Willamette River
20924	17th Ave	—	50519	G-6838	G-6189	L	6/27/1973	6S	3W	35	NENE	MU	2.0000	CFS	896	A	Well 2	Claggett Creek
11622	Delta Well	T-10591	86617	G-9771	G-10446	L	7/13/1981	6S	3W	26	NESW	MU	3.3300	CFS	1,492	P	Delta Well	Willamette River
11623	McNary Well	T-10591	86617	G-9771	G-10446	L	7/13/1981	6S	3W	34	NESE	MU	3.2200	CFS	1,443	P	McNary Well	Willamette River
11624	Wiessner Well	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	1	SWNW	MU	3.0200	CFS	1,353	P	Weissner Well	Willamette River
11625	Chemawa Well	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	2	NENW	MU	4.0900	CFS	1,832	P	Chemawa Well	Willamette River
11626	Carlhaven West	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	2	NESW	MU	0.7800	CFS	699	P	Carlhaven West Well	Willamette River
11627	Carlhaven East	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	2	NWSE	MU	2.4300	CFS	739	P	Carlhaven East Well	Willamette River
11628	Willamette Manor	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	10	NENE	MU	0.7100	CFS	318	P	Willamette Manor Well	Willamette River
11629	Cherry Ave	T-10591	86617	G-9771	G-10446	L	7/13/1981	7S	3W	11	NENW	MU	1.3300	CFS	596	P	Cherry Ave Well	Willamette River
49305	Ridge Drive	—	0	G-13784	G-14916	L	1/29/1999	6S	3W	36	SESW	MU	2.2300	CFS	1,000	P	A Well	Claggett Creek
—	Reitz Well	—	NA	G-15369	G-15729	L	3/27/2002	6S	3W	23	SWSE	MU	2.2300	CFS	1,000	P	A Well	Clearlake
—	Keizer Station	—	NA	G-16094	G-16433	L	4/8/2005	6S	3W	36	SENW	MU	1.0300	CFS	461	P	A Well	Labish Creek
—	Keizer Station	—	NA	G-16164	G-16588	L	12/28/2005	6S	3W	36	SENW	MU	0.642	CFS	288	P	A Well	Labish Creek

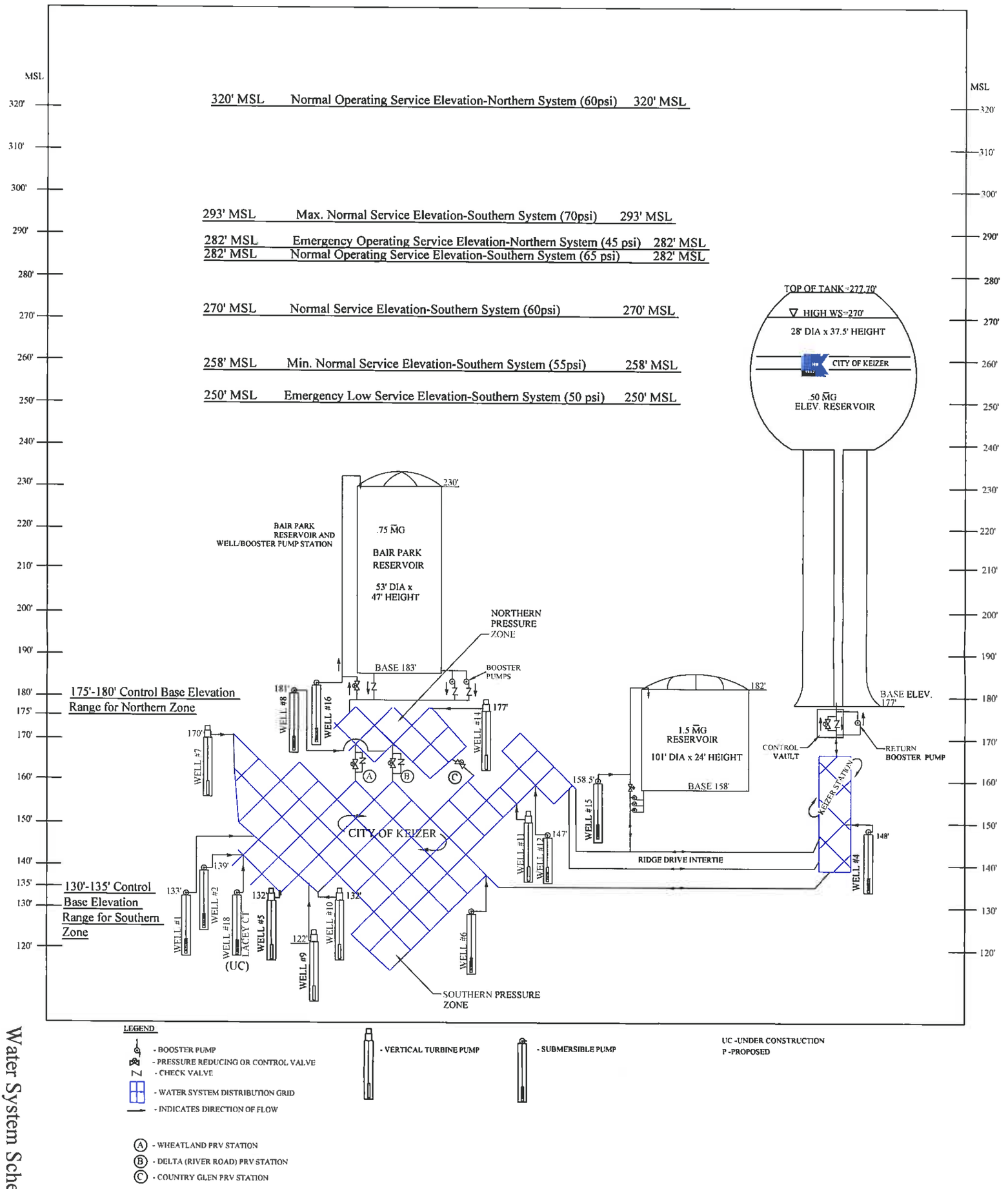
Total: 16,441 GPM

CITY OF KEIZER
FINAL WATER RIGHTS DISTRIBUTION

Well	Flow (in GPM)
Carlhaven West	949
Willamette Manor	318
Keizer Station	749
Cherry Ave	596
Carlhaven East	639
Wiessner Well	1,604
Delta Well	1,492
McNary Well	1,443
Chemawa Well	2,432
17th Ave Well	896
Meadows Well	1,398
Ridge Drive Well	1,000
Reitz Well	1,000
Lacey Ct Well	700
City Hall Well	775
Possible Future Well (Toni)	450
Total	**16,441**

12D

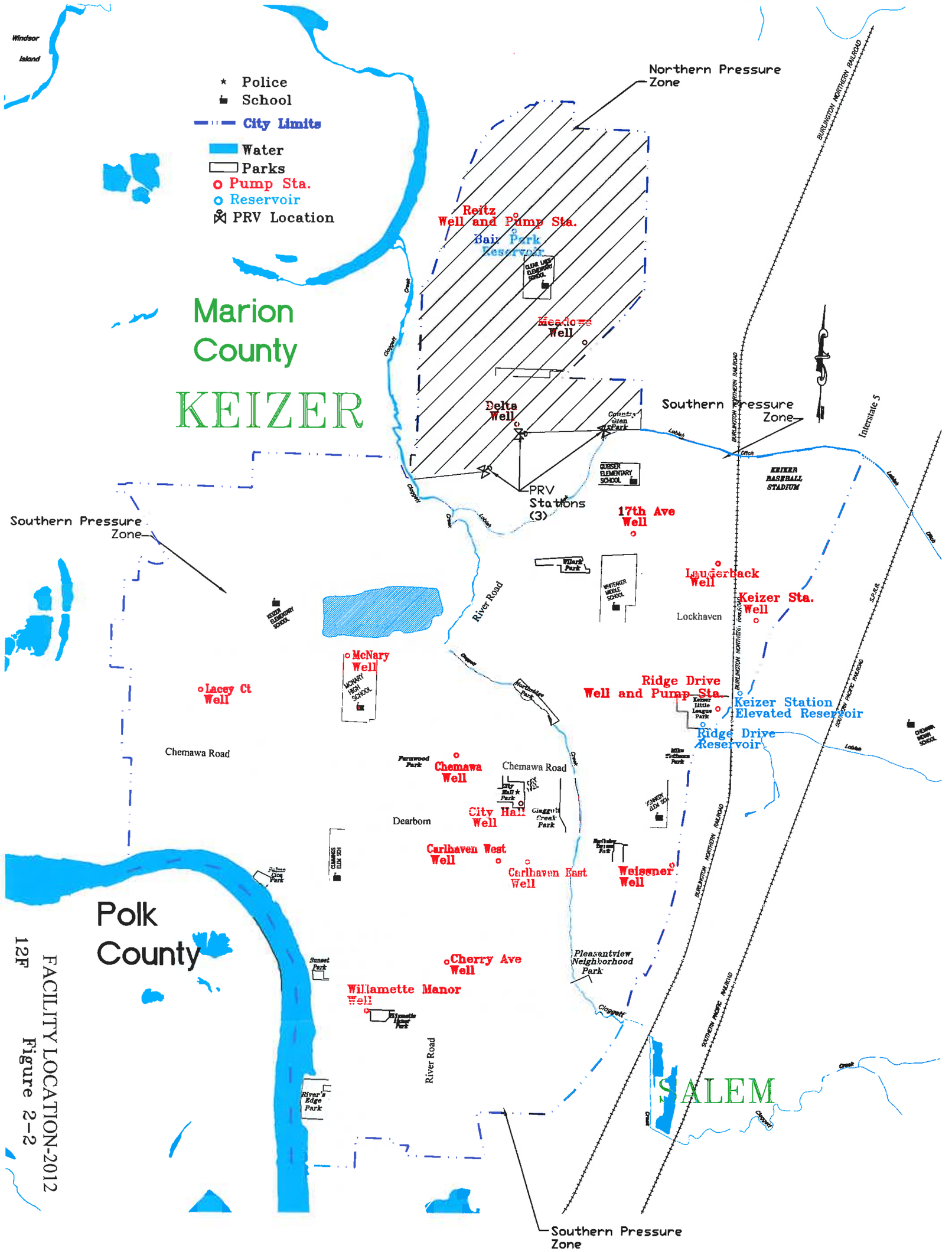
City of Keizer
Proposed
Future Water
Right
Distribution
Table 2-6



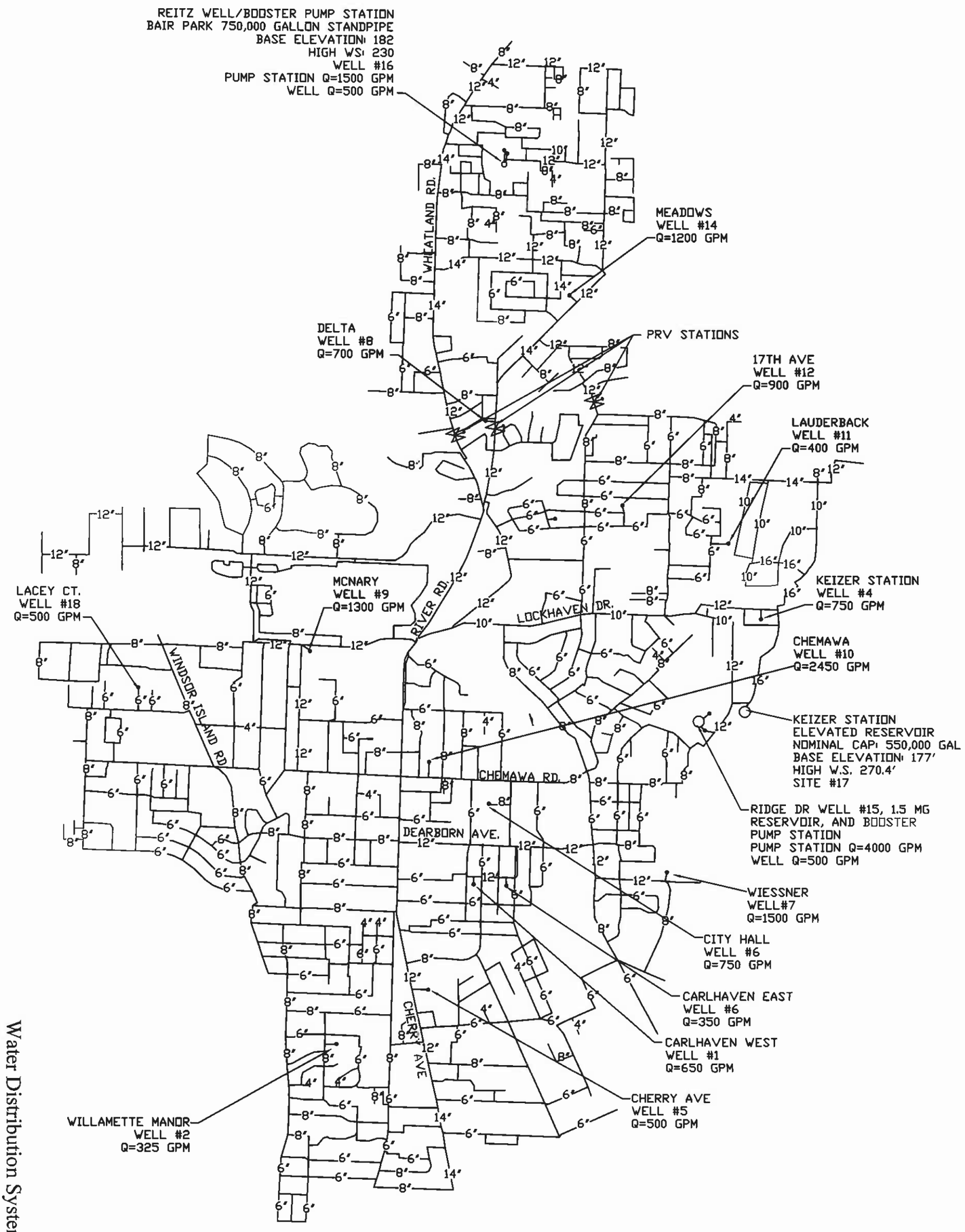
Water System Schematic-2012

Figure 2-1

12E



FACILITY LOCATION-2012
12F
Figure 2-2



Water Distribution System-2012
Figure 2-3

As of December, 2012, the following sites receive water treatment as indicated below:

Table 2-7
Treatment Systems

State ID	Facility Name	Treatment Process	Treatment Objective
WTP-E	TP for Cherry Ave	Fluoridation	Other
WTP-E	TP for Cherry Ave	Sequestration	Manganese Control
WTP-G	TP for Lauderback	Fluoridation	Other
WTP-G	TP for Lauderback	Sequestration	Manganese Control
WTP-K	TP for Willamette Manor	Fluoridation	Other
WTP-K	TP for Willamette Manor	Sequestration	Manganese Control
WTP-N	TP for Meadows	Sequestration	Manganese Control
WTP-O	TP for Ridge Drive	Fluoridation	Other
WTP-O	TP for Ridge Drive	Sequestration	Manganese Control
WTP-P	TP for Reitz	Fluoridation	Other
WTP-P	TP for Reitz	Hypochlorination, Pre	Taste/Odor Control
WTP-P	TP for Reitz	Filtration, Pressure Sand	Taste/Odor Control
WTP-Q	TP for Keizer Station	Fluoridation	Other
WTP-R	TP for Delta	Fluoridation	Other
WTP-S	TP for City Hall	Fluoridation	Other
WTP-T	TP for Carlhaven West	Fluoridation	Other
WTP-U	TP for Carlhaven East	Fluoridation	Other
WTP-V	TP for 17th Ave	Fluoridation	Other
WTP-W	TP for Lacey Court	Fluoridation (Pending)	Other

Booster Pump Systems.

Currently, the city operates two booster pump stations, the first is located at the 1.5 million gallon Ridge Drive reservoir site. This pump station is primarily designed and used for peak-hour and/or high fire flow demands. The pump station is equipped with three individual short-coupled vertical turbine pumps: 2 are electrically driven with 40 HP motors and one is engine drive (Caterpillar diesel) only. A 150KW automatic start/run standby generator was installed at this site in 2006 to provide emergency power to both electrically driven booster pumps and the well pump. Total pump station capacity from all 3 units is between 3500-4200 GPM, depending on system pressure. The second booster pump station is located at the 750,000 gallon Bair Park Reservoir within the northern pressure zone. This facility utilizes two (2) 30 HP end-suction centrifugal pumps, each designed for 750 GPM. Each motor is equipped with a variable frequency drive (VFD) to vary motor speed, control flow, and regulate system pressure. There is no emergency or stand-by power currently available at this site. The total design flow rate of this facility is 1500 GPM.

Control System

The city currently operates all wells automatically and on an "as needed" and "as selected" basis. The current control system, installed in 2006 by Taurus Power and Controls, utilizes digital based computer controlled technology. This system replaced the original digitally based control system (Autocon) installed in 1994. The current control system utilizes a proprietary software control system for water system control (Wonderware) and includes a "live" back-up computer should failure occur to the primary unit. The system is designed to increase total system capacity sensed by declining water pressure, through up to 25 pre-programmed incremental flow "steps". System operators select the number and location for up to 25 wells or booster pumps in each program step and then insert this data into the

computer via an electronic "matrix" of simulated switches. Each incremental program step results in increased or decreased total water system flow capacity. Rapid declines in system pressure are accommodated by an accelerated activation of pumps by "stepping up" the program sequence faster than normal. Conversely, the control system steps back pumping units to accommodate decreased system flow requirements. All wells are equipped with back-up and overriding pressure controls to allow "local" activation of pumps during a control system failure or vary rapid pressure declines. This back-up system is referred to as "local control."

Storage Facilities

The city operates two ground-level reservoirs, located at the Ridge Drive and Bair Park sites. In addition, one (1) elevated water storage reservoir exists in the eastern most region of the water system and is primarily designed for emergency water supply and fire protection within Keizer Station.

Table 2-8
Existing Storage Facilities

Water Storage Reservoir Location and Year Constructed	Nominal Diameter and Height Type	Rated Water Storage (in Gallons)	Material of Construction	Reservoir Floor Elevation (Ft-MSL)	Maximum Water Surface Elevation (Ft-MSL)	Maximum Water Depth (Ft)
Ridge Drive, 1999 (Site #15) (5175 Ridge Dr NE)	101' Dia x 24' Hgt Ground level	1,500,000	Steel (glass lined, bolted)	158.5'	182.33'	23'
Bair Park. 2005 (Site # 16) (1066 Bair Park NE)	53' Dia x 47' Hgt Ground level	750,000	Steel (glass lined, bolted)	183'	230'	46'
Elevated Storage Tank (EST) Keizer Station, 2007 (Site #17) (5700 Ulali Dr NE)	27' Dia x 37'-6" Working Head Range Elevated Hydrosphere	550,000	Welded steel	177' (base)	270'	37'-6"

Either ground level reservoir can be filled by either the dedicated on-site well (500-600 GPM) or back-fed (up to 1000 GPM) from the distribution system. Typically, day to day use requires refill of the reservoir through use of the on-site wells only. The elevated reservoir, primarily referred to as the Elevated Storage Tank or EST, is back-fed and refilled using system pressure, primarily from the Ridge Drive facility. A recirculation system is used to maintain potability and freshness of water (Figure 2-4) within the elevated reservoir.

Although not significant in volume, the water system also includes hydropneumatic storage vessels at several sites:

Table 2-8A
Hydropneumatic Pressure Tanks

Site Name and Number	Pressure Vessel Size	Air Volume Control
Willamette Manor (#2)	2000 gallon	Yes
Lacey Ct	2600 gallon	Yes
Cherry Ave (#5)	5000 gallon	Yes
Lauderback (#11)	7000 gallon	Yes
17th Ave (#12)	3000 gallon	Yes

Total Hydropneumatic storage: 19,600 gallons

The pressure tanks provide a minor amount of surge protection and pressure buffering within the distribution system and are important for the day to day operation.

Service Levels

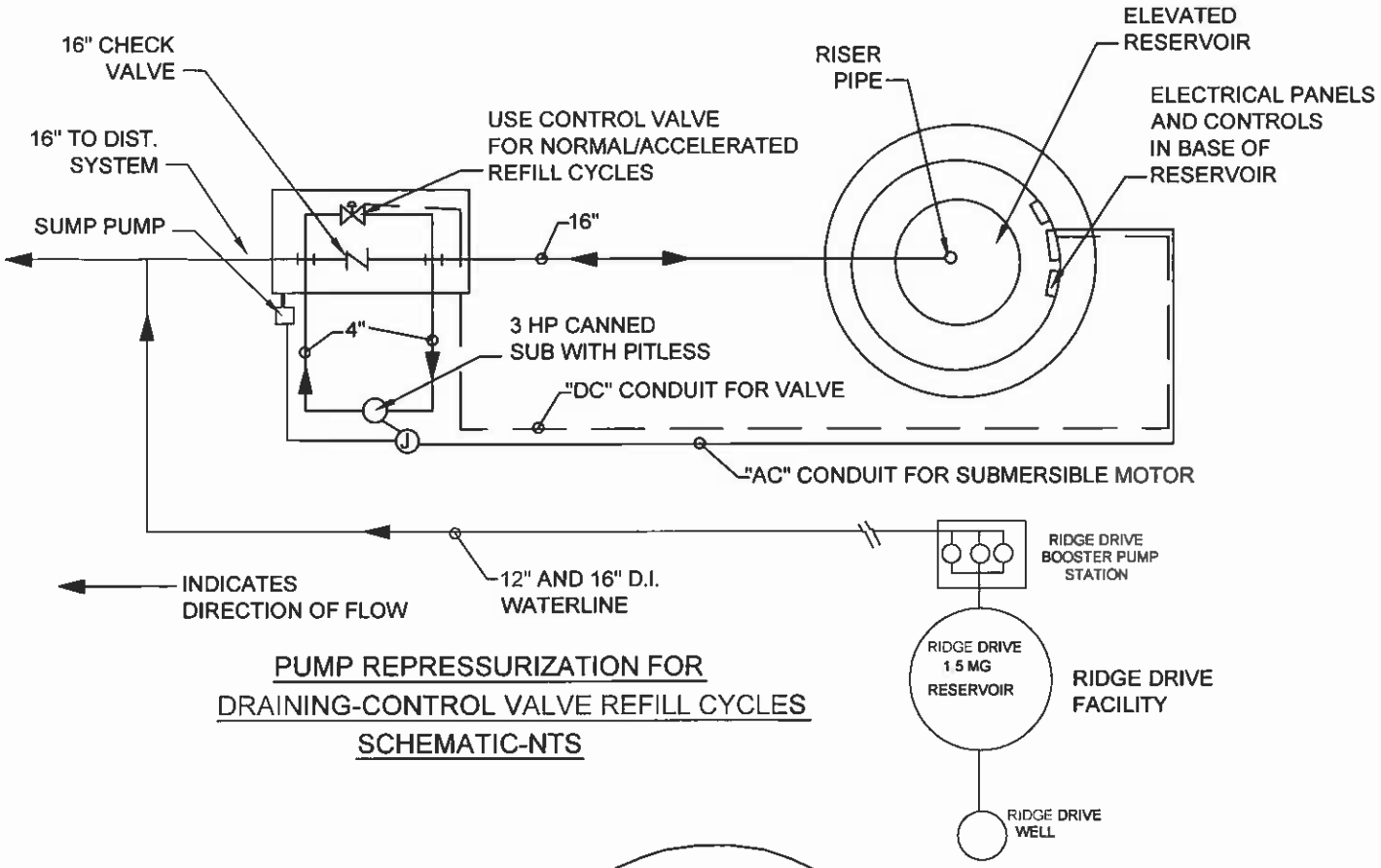
The city currently provides water to two separate service levels throughout the city, referred to as the "Northern" and "Southern" zones. The elevations within the southern pressure zone of the city range from 120' MSL up to 175' MSL which results in normal delivery pressures to customers ranging from 55-70 psi. The city, in 2002, isolated the northern area of the city to create a second service level. The Delta, Meadows, and Bair Park sites now operate in the North Pressure zone where typical service pressures average 55-65 psi. The zones are intertied through the use of three (3) pressure reducing/check valve (bypass) control vault stations. Each bypass vault is designed to provide up to 2000 GPM to flow in either direction and to or from either pressure zone. The three control vaults are located at the Delta Pump Station (River Road), Wheatland Road, and at the intersection of Horizon Ridge and Jakewood Avenues. The River Road and Horizon Ridge/Jakewood PRV stations are equipped with 8" and 3" control valve/bypass assemblies while the Wheatland PRV station is a combination of 6" and 3" pressure reducing valves, capable of reverse flow through the valve, eliminating the need for check valves.

Engineering Factors

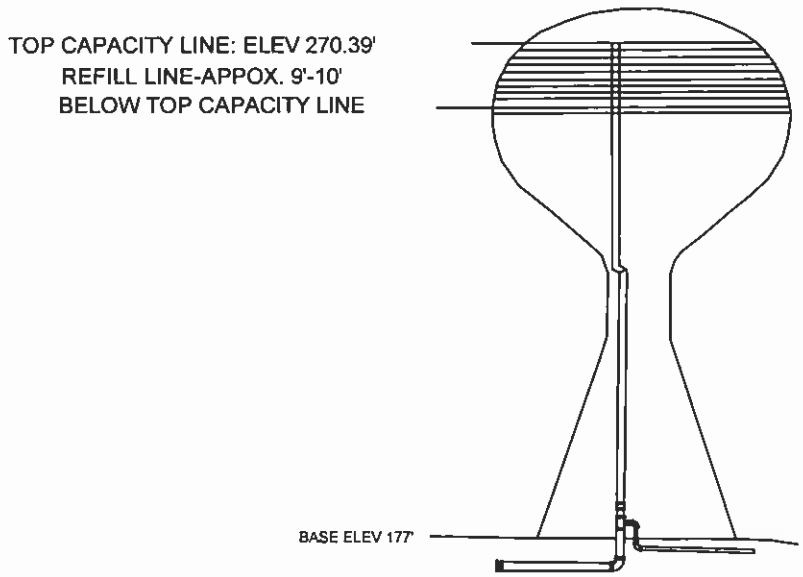
For engineering purposes, both pressure zones of the Keizer water system functions as a "closed loop" type of municipal water system with no defined hydraulic gradeline. The pumping system typically operates between Elevation 260' MSL to Elevation 295' MSL in the Southern Pressure Zone and Elevation 260' MSL to Elevation 295' MSL in the Northern Pressure Zone. The pressure zones are interconnected at three separate locations which allow water to flow between the zones, depending on pressure differentials. Generally, the Northern Zone operates at a 15-20 psig higher pressure due to the isolation of the zones through use of pressure reducing/check valve stations.

Regulatory Classifications

The City of Keizer is classified by the Oregon State Health Authority (OHA) as a "Public Water System," specifically a "Community Water System," which is defined as a system that provides water to 15 or more service connections or 25 or more year round residents. The city's water system currently serves a population between 15,001 and 50,000 for the purpose of determining water quality monitoring and certified operator requirements. The Oregon Health Authority identification number is PWS ID# 4100744. The city water system, by Health Authority rules, must be operated by a certified operator. The current level of certification required is WD (Water Distribution) 3 and WT (Water Treatment) I. According to information obtained from the OHA data base, the City of Keizer, as of November of 2012, employs a total of 13 certified operators, with 4 certified at WD3, 3 certified at WD2, and 6 at WD1. There are four operators currently certified for the WT1 (Water Treatment 1) level. Bill Lawyer is presently the DRC operator (in direct responsible charge) for both WD3 and WT1 levels for the city.



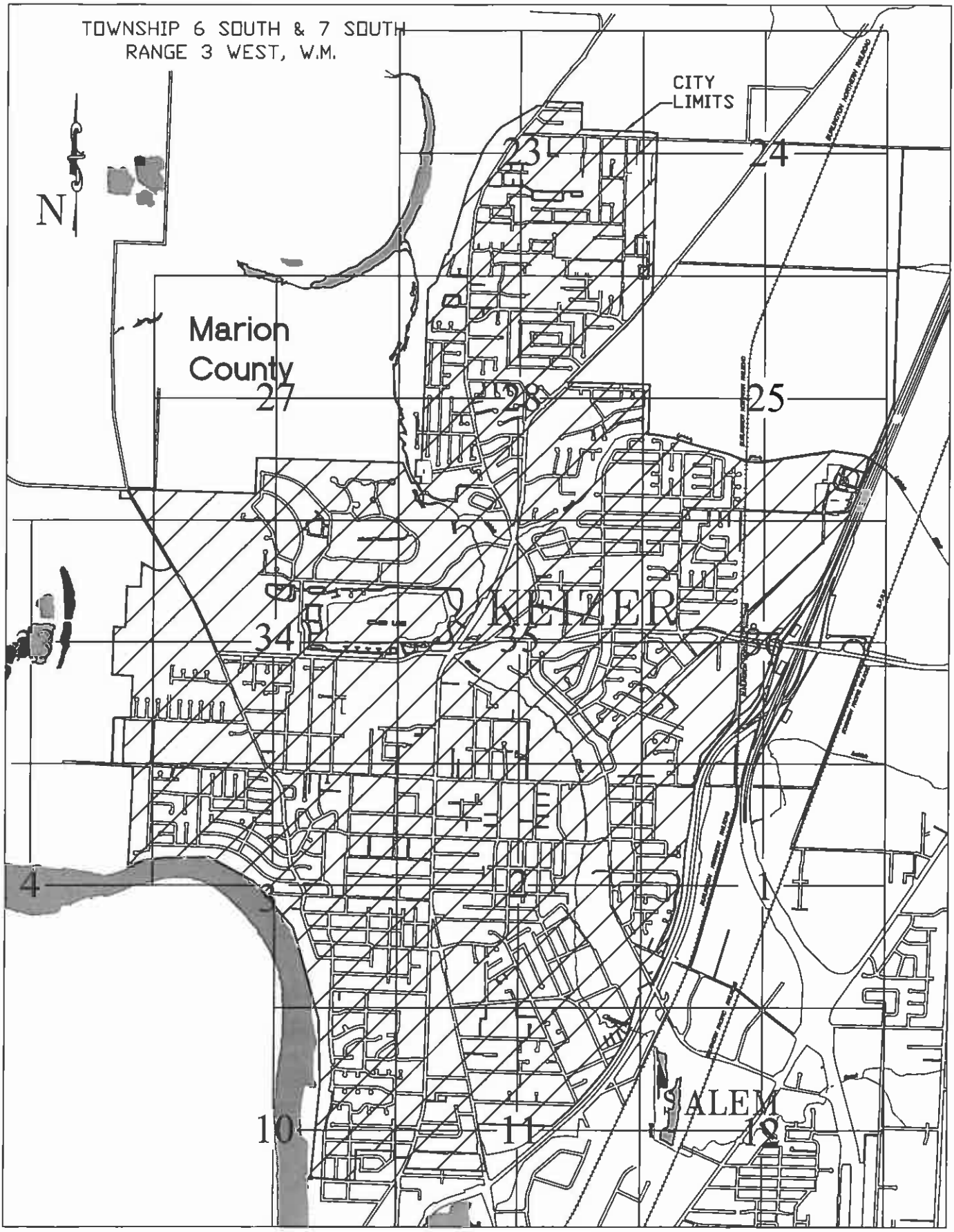
PUMP REPRESSURIZATION FOR DRAINING-CONTROL VALVE REFILL CYCLES SCHEMATIC-NTS



RESERVOIR DETAILS

ELEVATED RESERVOIR RECIRCULATION SYSTEM

FIGURE 2-4



WATER USE AREA-

CITY OF KEIZER-WATER USE AREA
FIGURE 2-5

Table 2-9
Pumping Equipment Flow Ranges and Control Mode

Site #	Name	Design Flow Range	Flow Regulation Method
1	Carlhaven West	300-700 GPM	VFD
2	Willamette Manor	300-350 GPM	None
4	Keizer Station	300-700 GPM	VFD
5	Cherry	300-600 GPM	Control Valve
6	Carlhaven East	300-350 GPM	None
7	Wiessner	1,100-1,400 GPM	None
8	Delta	300-700 GPM	VFD
9	McNary	1,100-1,400 GPM	Control Valve
10	Chemawa	1,500-2,500 GPM	Control Valve
11	Lauderback	300-350 GPM	None
12	17th Ave	300-950 GPM	VFD
14	Meadows	1,000-1,300 GPM	Control Valve
15	Ridge	600 GPM	To Reservoir
16	Reitz	400 GPM	To Reservoir
18	Lacey Ct	300-550 GPM	VFD
19	City Hall	300-800 GPM	VFD
Ridge BP #1	N/A	1,000 GPM	None
Ridge BP #2	N/A	1,000 GPM	None
Ridge BP #3	N/A	2,000 GPM	None
Bair Park BP #1	N/A	200-800 GPM	VFD
Bair Park BP #2	N/A	200-800 GPM	VFD

Chapter Three

Population and Land Use

Population and Land Use

Population Increase Projection

As indicated in Table 3-1, the population in Marion County, during the years 1990-2000, increased greater than the overall state average, however, the period between 2000-2010 exhibited a virtually identical growth rate for the state and county. Several independent sources were consulted during preparation of this study to obtain a realistic and objective estimate of population growth over the next 20 years. These sources include: United States Census Report, Mid-Willamette Council of Governments, Marion County Planning Department, Portland State University Center for Population Research and Census, and the State Office of Economic Analysis. All of these sources project an increase of population within Marion County and Keizer (when applicable) over the next 20 years. This is due to the influx of new residents as well as an expected shift of urban population.

Table 3-1
1990/2000/2010 U.S. Census

	Marion County	Oregon State Average
1990 Population	228,483	2,842,321
2000 Population	284,838	3,421,399
% of Change, 1990-2000	24.7% (2.23%/Year)	20.4% (1.87%/Year)
2010 Population (Census)	315,335	3,831,074
% of Change, 2000-2010	10.7% (1.0%/Year)	11.97% (1.13%/Year)

Table 3-2
2012 Revised Population Projections:
1999-2035 Marion County (1)

Year	Marion County	% Increase
1999 (Actual)	275,250	20.46% (from 1990)
2000 (Actual)	284,834	3.48%
2010 (Actual)	315,335	10.7% (1.02%/year)
2015 (Forecast)	344,443	9.23% (1.78%/year)
2020 (Forecast)	367,018	6.15% (1.27%/year)
2025 (Forecast)	388,898	5.96% (1.16%/year)
2030 (Forecast)	410,022	5.43% (1.06%/year)
2035 (Forecast)	429,824	4.83% (.947%/year)

The period between 2010-2030 represents a net county projected population growth of 30% (94,687 or 1.32% per year). In the case of Keizer, this rate of growth is felt to be slightly high due to the lack of adequate undeveloped land within the existing city limits and urban growth boundary needed for this level of additional development combined with the unusually high percentage of growth already seen between 1990-2000. A recent population update for Keizer between 2000-2010 indicated a net growth of 4,275 residents, an increase of 13.2 % or 1.25% per year, however, even this growth rate cannot be sustained without a modification to the existing urban growth boundary due to the previously indicated shortage of undeveloped land.

(1) Source: PSU Center for Population Research-State Office of Economic Analysis

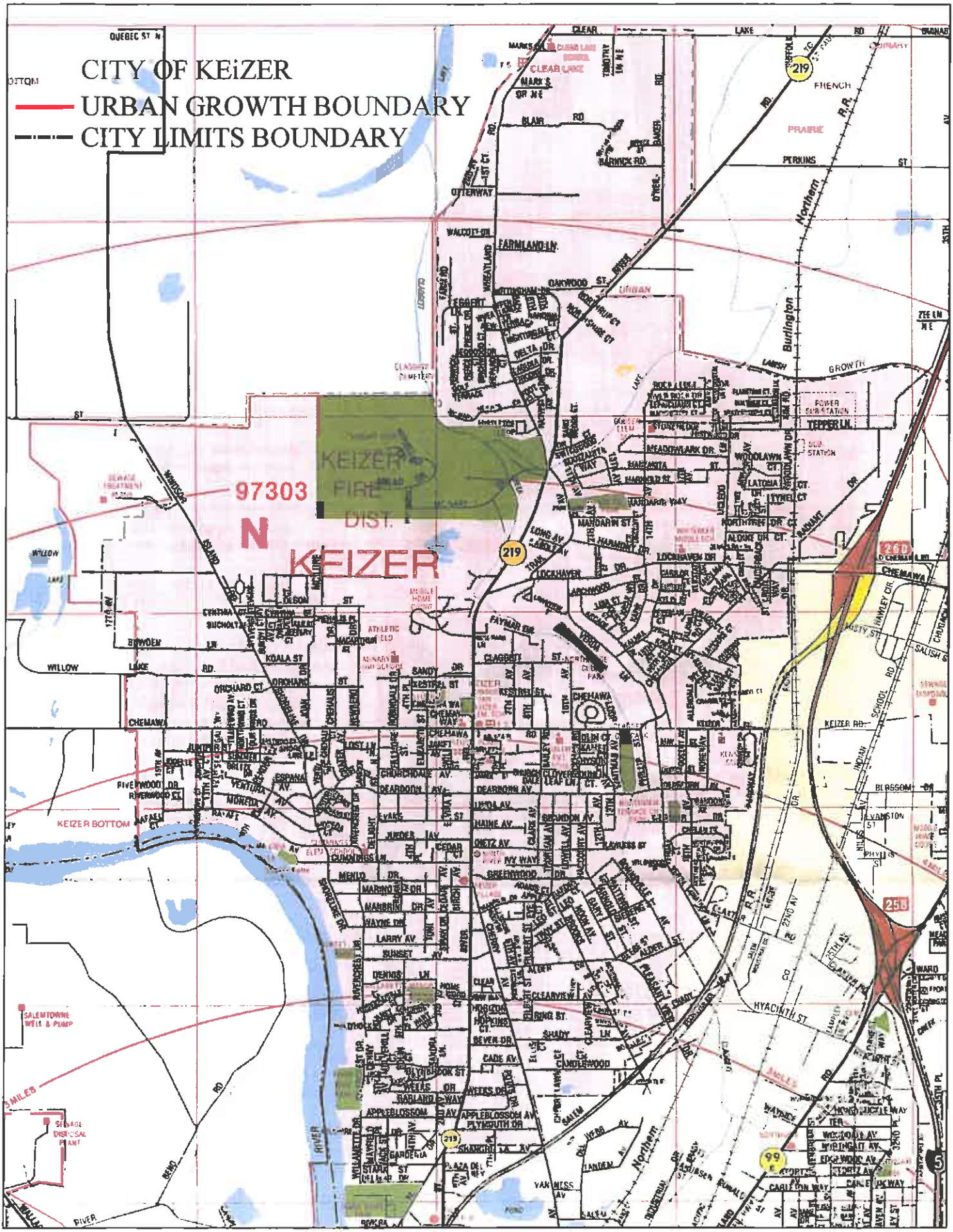

CITY OF KEIZER
URBAN GROWTH BOUNDARY
CITY LIMITS BOUNDARY
97303
KEIZER FIRE DIST.
N KEIZER
KEIZER BOTTOM

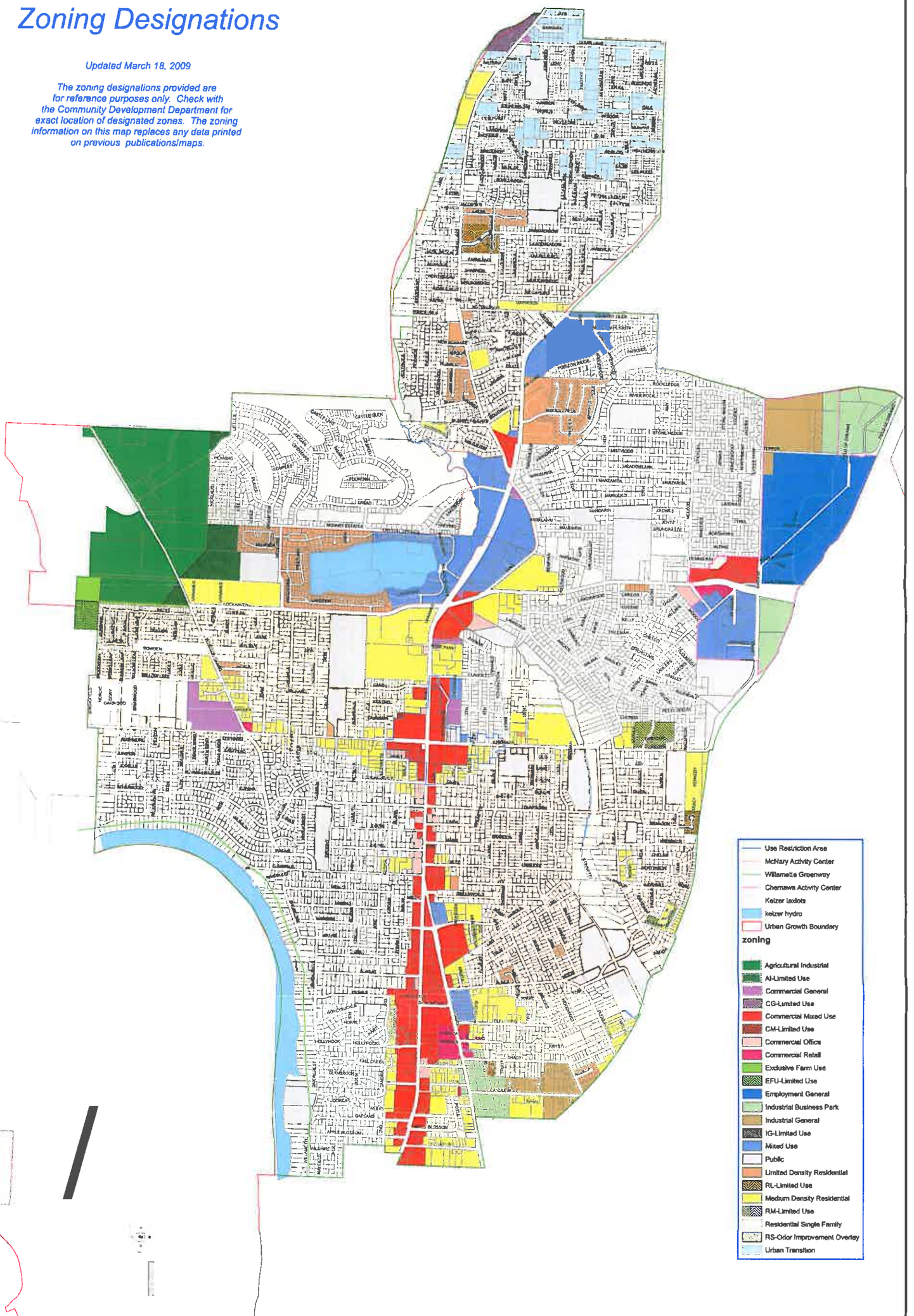
Figure 3-1

City of Keizer

Zoning Designations

Updated March 18, 2009

The zoning designations provided are for reference purposes only. Check with the Community Development Department for exact location of designated zones. The zoning information on this map replaces any data printed on previous publications/maps.



16B FIGURE 3-2

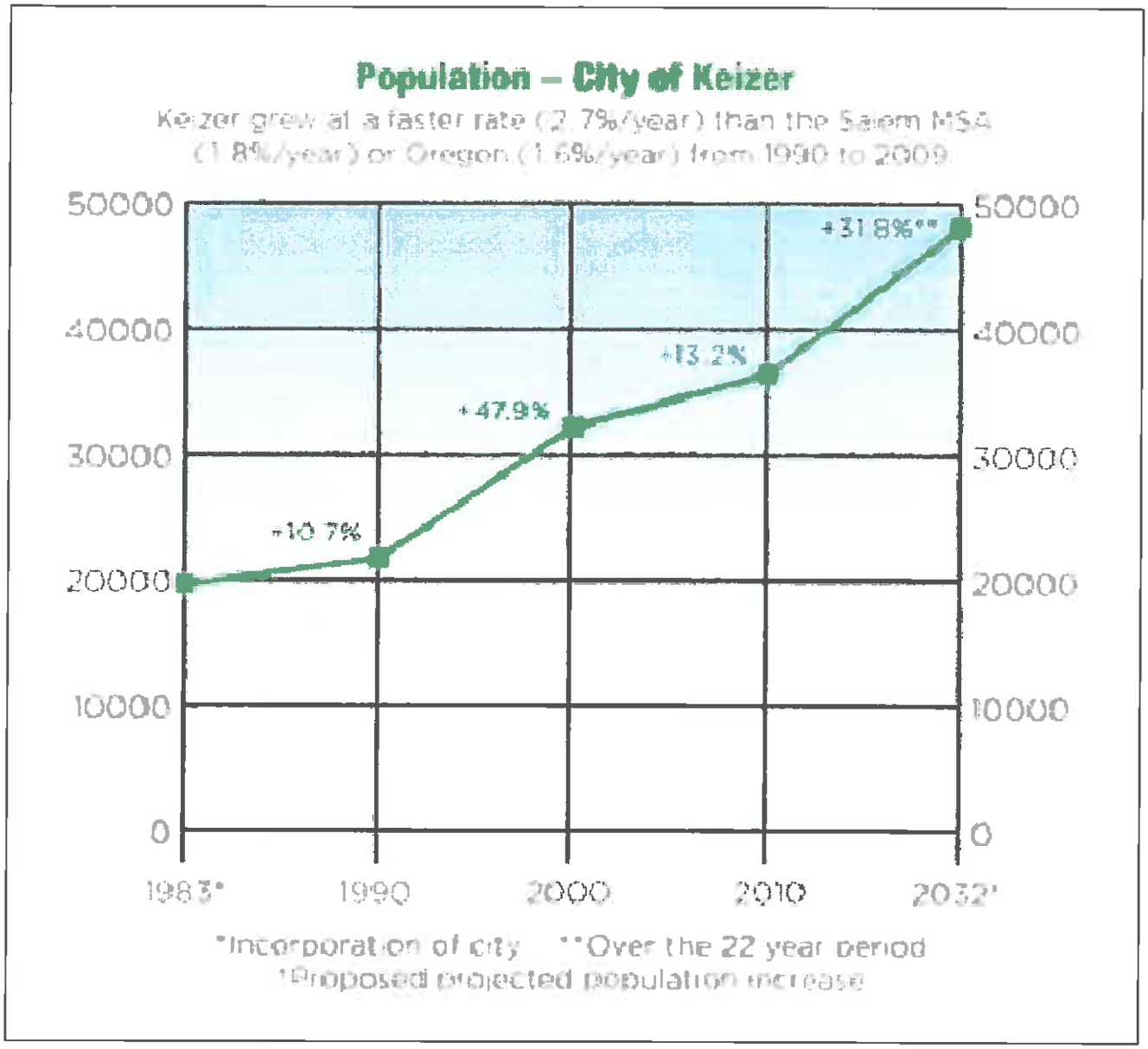

Population – City of Keizer
Keizer grew at a faster rate (2.7%/year) than the Salem MSA
(1.8%/year) or Oregon (1.6%/year) from 1990 to 2009.
50000
40000
30000
20000
10000
0
+10.7%
+47.9%
+13.2%
+31.8%**
1983*
1990
2000
2010
2032'
*Incorporation of city
**Over the 22 year period
'Proposed projected population increase

Figure 3-3

Population Increase Projection-Statewide and Marion County

Between 1980 and 2000, the population of Oregon increased from 2.64 million to 3.42 million, an increase of 29.5%. Based on current projections, the population growth rate of Oregon is expected to continue to grow faster than the United States as a whole over the next thirty years. Several forces will affect the future demographics of Oregon's population:

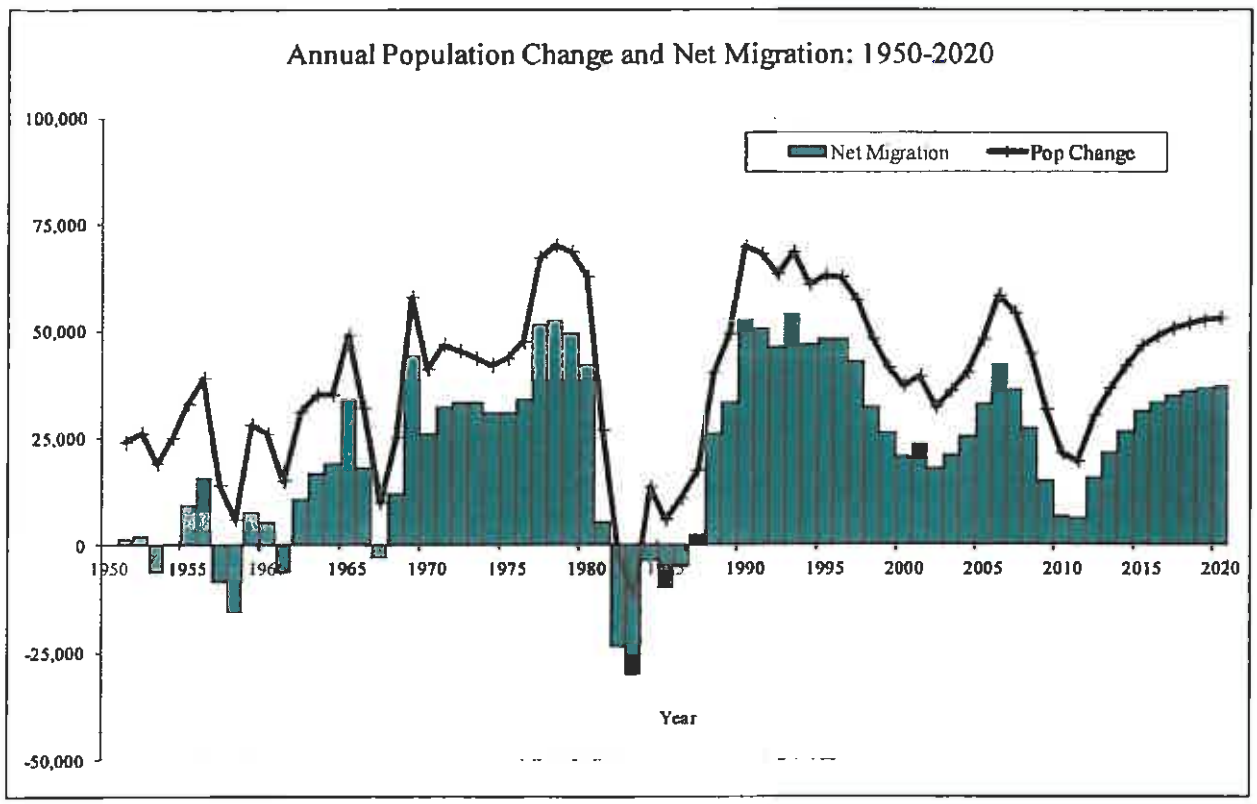
(1) During the next 5-10 years, rapid growth is expected for age groups: 18-24 years old,45-64 year olds, and those over 75.

(2) After Year 2010, the population of retirement eligible individuals will rise rapidly due to retirement of the "baby-boomer' generation.

(3) Migration of residents from other states is expected to continue at a rapid pace.

(4) Slower or flattened growth is expected for those of school age population (5-17 year olds), 25-44 year olds, and 65-74 year old individuals over the next 5-10 years.

Table 3-3
Annual State of Oregon Population Change



Projected Growth for Keizer: 2012-2032

In the 2001 Water System Master Plan Update, the projected rise in population between 2000-2010 was estimated at 4,511 residents. This figure is very close to the actual increase in population of 4,275 individuals during this same period. This estimate was originally

obtained from a regional Transportation Plan (1997) which formed the basis of the 20 year population projection in the 2001 Master Plan Update. This source estimated the population growth within the city would total 7,357 residents between Years 1997 to 2010, very close to the actual increase in population (8,138) during this time span. Since the population projections in the 2001 report closely approximated the actual growth and the system improvements that were made over this 12 year period were based on this population growth, it is believed that the 2001 Capitol Improvement Plan was appropriate in both scope and implementation schedule.

To analyze the specific population projection for Keizer in the Year 2032, several sources were consulted. These included information received from the Keizer and Marion County Planning Departments, Portland State University Center for Population Research, Mid-Willamette Valley Council of Governments, the original Keizer Water District Water System Master Plan (1980-JMM Consulting Engineers), 1988 Water Master Plan Update (HGE Inc), and 2001 Water System Master Plan Update (Stettler Company). The population in study Base Year 2012 is estimated at 36,735 which was obtained from the Portland State University Center for Population Research. It is apparent from the projected growth between 2012 to the end of the study period in 2032, that the existing city limits and urban growth boundary cannot accommodate a 23.7% increase in population, therefore, it is assumed that an expansion of the urban growth boundary will occur as the aggressive phase of population growth starts around 2015-2020. For the purposes of this study, therefore, the following population projections will be used:

Table 3-4
City of Keizer
Past and Projected Population Growth

Year	Population	% Increase/Year
1990	21,884 (US Census) (1)	---
1996	27,450 (estimate)	----
1997	28,340 (estimate)	3.8%
1998	29,235 (estimate)	3.2%
1999	30,260 (estimate)	3.5%
2000	32,203 (2000 Census) (1)	6.4%
2005	34,735 (Estimate)	1.52%
2010	36,478 (1)	.98%
2012	36,735 (2)	.52%
2015	37,416	.50%
2020	40,280	1.48%
2025	43,350	1.48%
2030	46,655	1.48%
2032	48,082	1.51%

(1) 1990, 2000 and 2010 populations are based on data received from US Census
(2) P.S.U. estimate

Table 3-3 indicates most of the city's growth is expected between Years 2020-2032, therefore, most of the water system improvements will also be needed during this same period.

Future Service and Study Area

The City currently operates within established geographical and political boundaries that

comprise the City limits and the Urban Growth Boundary (UGB) (Figure 3-1) The City is bounded on the east by the City of Salem and Interstate 5, and the UGB to the north and south, and the Willamette River to the west. Most of the land presently available for future development is in the northern section of the City with a smaller percentage available in other regions of the city.

Land Use

General: Land use within the City of Keizer is defined in six basic categories: Residential, public, farm, parks, religious, commercial, and industrial. These land uses are further categorized as follows:

Residential
Single Family Residential
Farm use, single-Family Residential
Multi-Family Residential
Duplexes
Vacant Residential
Mobile Homes

Public
Public Service (parks, golf courses, and other public facilities)
Public Buildings and Use
Vacant Public Land, RIW, Easement

Commercial
Commercial-General
Commercial-Mixed
Commercial-Office

Industrial
Industrial Land
Vacant Industrial Land

Farm Use
Farm, Forested
General Farm Use, Primarily Crop

Religious
Religious organizations

In addition, the city has defined three sub-categories of residential land use to be used for all future growth.

Table 3-5
Land Use Classifications for Future Growth

Code	Definition	Min. Lot Size	Development Density
LDR	Low density residential	.10 acre	5 units per acre
MDR	Medium density residential	.16 acre	9 units per acre
MHDR	Medium-High density residential	.16 acre	17 units per acre

Existing Land Uses and Growth Potential

Existing Land Use

The existing land use for the City of Keizer is shown in Figure 3-2. Currently, there are 4,713 acres of land within the city limits.

Keizer Station

The Keizer Station development consists of the development of approximately 237 acres of presently developed and undeveloped land in the northeastern region of the City of Keizer. Originally, the possible development of this area was suggested in the Keizer Comprehensive Plan of 1987, which established two activity centers within the city—the McNary Activity Center and the Chemawa Activity Center. In 1993, the City Council and Planning Commission focused attention on the Chemawa area and adopted an interim plan, which established a policy framework to guide land use decisions, lifted the requirement that no development could occur until a plan was adopted (under the new plan, development proposals were to be processed as Conditional Uses and were to be shown to conform to the Plan's policies in order to be approved), and called for additional planning to address specific land use, transportation, and financing issues. In 1994, a grant administered by the Department of Land Conservation and Development (LCDC) and Oregon Department of Transportation (ODOT) provided funds for preparation of a study to evaluate the land use and transportation needs and potential for the entire Chemawa Road/Interstate 5 interchange area. The conclusions reached in this study replaced the entire 1993 version of the Chemawa Activity Center Plan and updated the Comprehensive Plan for the City of Keizer in a new Plan issued in 1995. The new 1995 Chemawa Activity Center Plan served as a guide for private and public investment potential of the lands on the west side of the Chemawa/I-5 Interchange and recognized that the land was valuable due to its sensitive location as the "gateway" to the City of Keizer. In 1997, the Chemawa Activity Center Plan received yet another revision, which provided for the future development of a mixed-use area, incorporating housing, retail, office, service commercial, public and industrial uses. One of the most prominent features of this version of the Plan was the creation of an industrial business park in what was now being referred to as "Area A", although demand for industrial uses at this site, and in Keizer generally, has proven to be minimal.

After several attempts to develop the Chemawa Activity Center, the Keizer Mayor, City Council, and Urban Renewal Board appointed the "Chemawa Activity Center Task Force" to evaluate the plan. The Task Force concluded that the land use designations in the 1997 Plan were too restrictive and recommended changes to the City Council. Several issues, such as: the appropriate amount of commercially zoned property in Area A, landscaping requirements, the requirement that no single development exceed 50,000 square feet, and protection of neighboring residential property from traffic impacts, were addressed, among others. Soon after, the City of Keizer and the Urban Renewal Agency entered into a "non-exclusive" predevelopment agreement with Northwest National LLC to conduct "certain predevelopment tasks" prior to further agreement of the parties relating to full development of the property. On May 14, 2001, a team from Northwest National LLC presented the Keizer Station Master Plan Concept to the City Council during a work session. This plan

was subsequently approved by the Keizer City Council on May 21, 2001 through a resolution which initiated the process to consider amendments to the Chemawa Activity Center Plan. As of September 21, 2001, the Chemawa Activity Center Plan has been fully replaced with a new plan that addresses local zoning and comprehensive land use issues that is now called the Keizer Station Plan.

The Keizer Station Plan essentially created five distinct regions, called "areas", each with different types of uses and size. Area A, referred to as the Village Center, consists of 100 acres of retail and mixed-use commercial development. Area B, known as Retail Center, consists of 11 acres of commercial and 1 acre of residential development. Area C, Keizer Station Center, is a 36 acre parcel, intended to be zoned as mixed use, consisting of approximately 1 restaurant, 7 retail outlets, 1 office space, 1 medical center, 2 still undefined uses, and 56 apartment units. Area C is planned to encompass just under 280,000 square feet of development. Area D, Commerce Center, is zoned as 15 acres of industrial business park. Finally, although not currently included in the formal plan, Area E, known as the Entertainment and Sports Center, is located on 71 acres of land zoned as industrial business park (41 acres) and general industrial use (30 acres). For water system planning purposes, Area E is planned to initially consist of a multi-screen indoor theater and a basketball/sports complex.

The actual distribution of the originally planned individual development in each area is summarized below:

Table 3-6
Keizer Station
Development Areas, Uses, and Zoning

Area #	Name	Use	Area (ft2)	Occupancy Group	Stories
A	Anchor A	Retail	20,304	M	1
A	Shops "C"	Retail	5,200	M	1
A	Anchor 1	Home Improvement	65,703	M	1
A	Majors 7, 8, and 9	Apparel	88,407	M	1
A	Anchor 3	Apparel	123,735	M	1
A	Major 1	Office/Craft	20,390	M	1
A	Major 2	Home Accessory	36,520	M	1
A	Major 3	Electronics	42,976	M	1
A	Major 4	Apparel	30,004	M	1
A	Major 5	Retail	30,387	M	1
A	Major 6	Retail	21,432	M	1
A	Retail 1	Retail	7,217	M	1
A	Retail 2	Retail	6,310	M	1
A	Retail 3	Retail	10,478	M	1
A	Retail 4	Retail (2 buildings)	8,638	M	1
A	Shop A	Retail	6,309	M	1
A	Shop B	Retail	3,793	M	1
A	Shop C	Retail	5,200	M	1
A	Pad A	Bank	4,000	A3	1
A	Pad B	Bank	2,940	A3	1
A	Pad C	Restaurant	4,206	A3	1
A	Pad D	Restaurant	4,040	A3	1

A	Pad E	Retail/Restaurant	5,094	S3	1
A	Pad F	Retail	2,994	B	1
A	Pad G	Restaurant	3,169	S3	1
A	Pad H	Restaurant	2,448	A3	1
A	Pad I	Restaurant	2,227	A3	1
A	Restaurant 1	Restaurant	6,564	A3	1
A	Restaurant 2	Restaurant	5,643	A3	1
A	Restaurant 3	Restaurant	6,524	A3	1
A	Restaurant 4	Restaurant	4,351	A3	1
A	Restaurant 5	Restaurant	5,400	A3	1
A	Office Building	Commercial Office	100,000	B	4
A	Hotel	Hotel	42,000	R1	3
B	Retail	Various Retail	479,105 (Total)	M	1
B	Residential	Mixed Use Residential	43,555	NA	1-2
C	Res/Comms	Mixed Use	36 acres (Total)	NA	1-2
D	Building 1	Office	14,800	B	1
D	Building 2	Office	6,500	B	1
D	Building 3	Office	7,900	B	1
D	Building 4	Office	9,400	B	1
D	Building 5	Office	18,600	B	1
D	Building 6	Office	8,475	B	1
D	Building 7	Office	10,600	B	1
D	Tenant 1	Office	13,000	B	1
D	Tenant 2	Office	5,000 (Approx)	B	1
D	Tenant 3	Office	5,000 (Approx)	B	1
D	Tenant 4	Office	12,000 (Approx)	B	1
E	Theater	Theater	40,000	NA	1-2
E	Sports Complex	Multi-Sports	30,000	NA	1-2

Although full scale development of all areas will require a considerable volume of water to accommodate the average, maximum, and peak demands of Keizer Station, future expansion of Keizer Station will be greatly constrained by several factors. Most of the impediments to expansion will occur due to geographic limitations and the current presence of interfering borders or easements. Expansion to the east will be limited by the existence of Interstate 5 and ODOT easements, the west is hampered by existing residential development and railroad tracks and the accompanying right-of-way, the north, beyond the boundaries of Area E, is limited by existing BPA and PGE powerlines and substations and the Volcano Stadium, and finally, any growth to the south is precluded by the existence of Interstate 5, Ridge Drive, Keizer Little League Field, and existing residential development. All of these impediments to possible expansion of Keizer Station, when grouped together, allow for much easier master planning of a water system than normal. Although many of the currently planned individual structures may be delayed or even cancelled, the demand imposed on a water system by the largest developments drive the size and fire flow of the entire system. Elimination or postponement of up to 25% of the entire development will have little impact on the planning of the water system as the key element of needed storage and capacity is determined by the fire flow requirements of the largest structure within the development. Information received from design engineers and the local fire authority, Keizer Fire District, has revealed that the largest single water demand within the entire development is the 4000 GPM fire flow requirement at Anchor 1 in Area A, Lowe's

Home Improvement Store. This value, in turn, guides and determines the vast majority of the fire flow planning for the entire development.

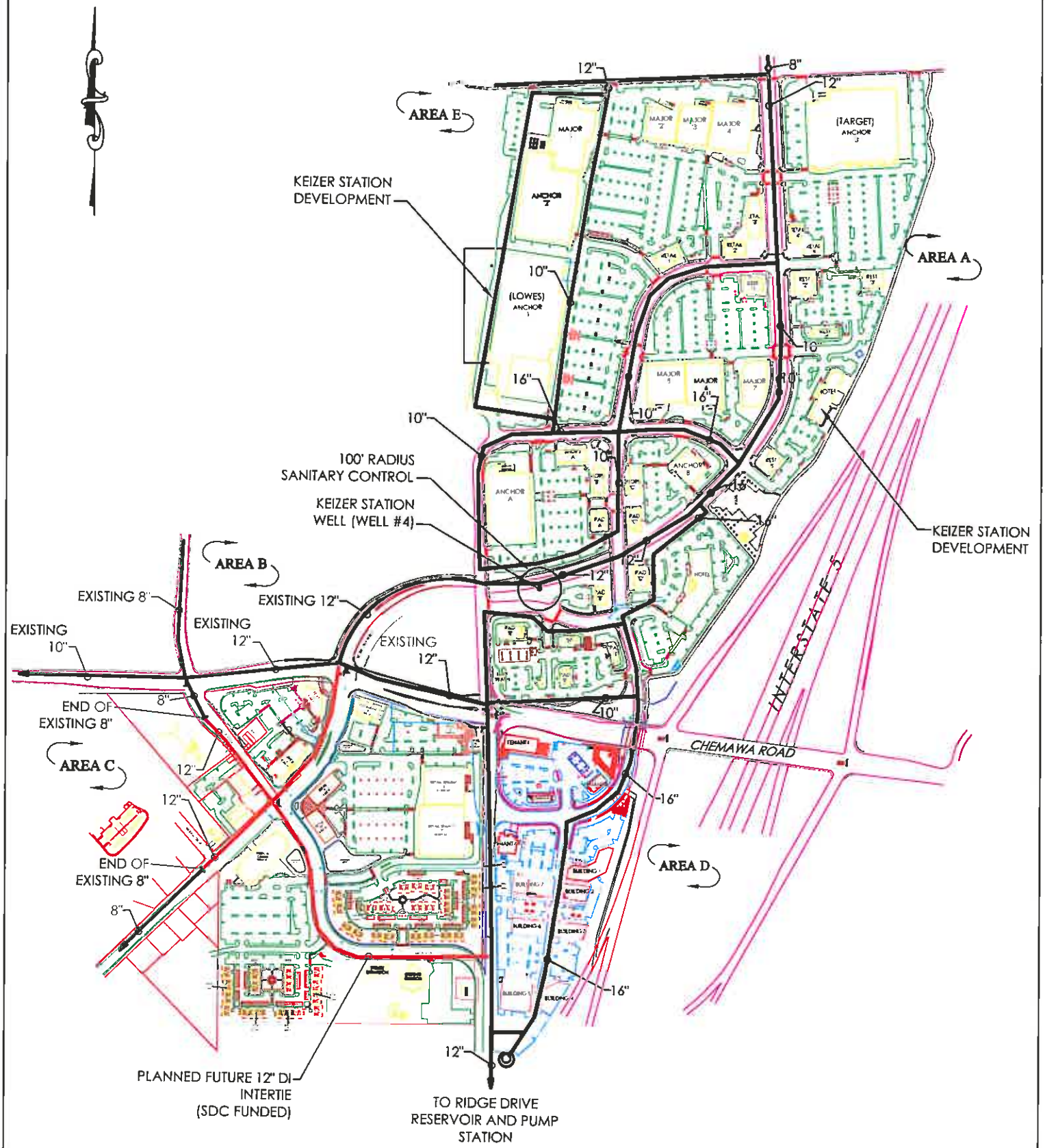
In 2004, a separate water system master plan was developed for Keizer Station by 4B Engineering and Consulting of Keizer. This document served as the planning model for the entire development and addressed all of the water supply requirements, even at build-out. The author of the plan determined a new water well was required to supply the separate day to day water needs of the development as well as an elevated storage tank (EST) to provide the majority of the 4000 GPM fire flow for Lowes. The fire flow is met through a combination of the elevated storage tank along with water from the city.

Water Supply: The majority of the water supply to Keizer Station will most likely originate from the Keizer Station well and/or the Ridge Drive reservoir/pump station. The close proximity of these sites to Keizer Station translates to available instantaneous capacities up to 2000 GPM, with minor pressure losses from either the Keizer water system or the EST. Although the Keizer Station water system grid is interconnected to the City of Keizer's parent water system, the development is generally served from the 750 GPM "Keizer Station" well, located within the region. In addition, emergency and fire protection water is provided from the elevated storage tank (EST) in the southern area of Keizer Station or directly from the City of Keizer.

Water Quality: Due to the anticipated water quality present in the local wells, consideration of elevated iron (.2-.5 mg/L), manganese (.10-.30 mg/L), and calcium hardness (100-150 mg/L) levels must be given. This is particularly important to industrial facilities that manufacture electronic components.

Water Transmission: The area is currently served from 12" and 16" waterlines on the northern and southern boundaries and within the development (Figure 3-4). Pipeline looping within the development is performed to optimize water delivery and provide redundancy.

Future Expansion (Areas B, C, and D): At the date of this study (December, 2012), Areas B, C, and D of Keizer Station remain underdeveloped, however, construction is currently underway within Area B. The available capacity from the existing 8" and 12" waterlines surrounding the Area B development will provide adequate pressure and delivery volume for virtually any intended use. The planned development of Area C is shown on Figure 3-4 with the planned waterline routes and sizes. The configuration, routes, sizes and interconnections of the waterlines through Area C are required to provide a looped waterline configuration within Keizer Station as well as a path to optimize the delivery of water from the Ridge Drive Reservoir and Pump Station and the EST to the Keizer water system. Future water service throughout Area D was originally planned in the 2006 Keizer Station Water Master Plan and consists of delivery from either the existing 16" waterline that passes through Area D or the parallel 12" waterline on Ridge Drive.



KEIZER STATION PLAN
FIGURE 3-4
NTS

Chapter Four

Water Requirements

Water Requirements

Historical records of pumping (production) records were evaluated between the five years of 2008-2012 as well as the historical records for the seven year period between 1993-1999 to determine water system demands.

Table 4-1
Total Production: 2008-2012

Month/Year	Total Well Production (in Gallons)	
January, 2008	86,283,296	
February, 2008	72,369,748	
March, 2008	76,467,292	
April, 2008	89,371,788	Estimated Population: 36,150 Average Day: 3,693,725 GPD Average Day per Capita: 102 GPCD Maximum Day: 8,600,000 GPD Maximum Day per Capita: 238 GPCD
May, 2008	113,770,800	
June, 2008	146,203,332	
July, 2008	208,976,988	
August, 2008	181,737,072	
September, 2008	140,748,168	
October, 2008	79,106,236	
November, 2008	73,862,008	
December, 2008	80,236,464	
TOTALS	**1,349,133,192**	
January, 2009	77,707,476	
February, 2009	66,788,920	
March, 2009	75,557,724	
April, 2009	91,557,444	Estimated Population: 36,220 Average Day: 3,581,260 GPD Average Day per Capita: 99 GPCD Maximum Day: 8,250,000 GPD Maximum Day per Capita: 228 GPCD
May, 2009	116,200,304	
June, 2009	140,102,644	
July, 2009	201,704,184	
August, 2009	176,786,060	
September, 2009	126,917,648	
October, 2009	84,273,420	
November, 2009	72,084,760	
December, 2009	77,479,336	
TOTALS	**1,307,159,920**	
January, 2010	76,403,712	
February, 2010	68,128,588	
March, 2010	80,145,208	
April, 2010	93,381,816	Estimated Population: 36,570 Average Day: 3,459,877 GPD Average Day per Capita: 95 GPCD Maximum Day: 8,340,000 GPD Maximum Day per Capita: 228 GPCD
May, 2010	90,809,444	
June, 2010	104,010,896	
July, 2010	193,055,808	
August, 2010	194,325,164	
September, 2010	124,115,640	
October, 2010	86,559,308	
November, 2010	76,490,480	
December, 2010	75,429,068	
TOTALS	**1,262,855,132**	

January, 2011	75,158,292	Estimated Population: 36,715 Average Day: 3,333,826 GPD Average Day per Capita: 91 GPCD Maximum Day: 7,730,000 GPD Maximum Day per Capita: 210 GPCD
February, 2011	68,107,644	
March, 2011	77,715,704	
April, 2011	91,101,164	
May, 2011	86,203,260	
June, 2011	108,452,520	
July, 2011	163,782,080	
August, 2011	186,853,392	
September, 2011	133,086,404	
October, 2011	80,313,508	
November, 2011	71,968,072	
December, 2011	74,104,360	
TOTALS	**1,216,846,400**	
January, 2012	75,358,008	Estimated Population: 36,735 (P.S.U. Estimate) Average Day: 3,424,481 GPD Average Day per Capita: 93 GPCD Maximum Day: 8,035,000 GPD Maximum Day per Capita: 218.7 GPCD
February, 2012	68,739,704	
March, 2012	72,179,008	
April, 2012	84,060,240	
May, 2012	105,372,256	
June, 2012	105,812,828	
July, 2012	167,118,908	
August, 2012	185,990,200	
September, 2012	153,182,920	
October-December 2012	232,977,755	
EXTRAPOLATED TOTAL	**1,250,791,827**	

Table 4-1A
Water Requirement/Monthly Water Production and Metered Sales (in Gallons)
2008-2012

Month/Year	Total Well Production	Total Metered Sales	Unaccounted Water (Percent)
January, 2008	86,283,296	79,007,500	
February, 2008	72,369,748	66,383,504	
March, 2008	76,467,292	81,775,100	
April, 2008	89,371,788	75,081,996	
May, 2008	113,770,800	72,984,604	
June, 2008	146,203,332	84,484,356	(100,000 units deducted for presumed error from June, 2008)
July, 2008	208,976,988	157,000,712	
August, 2008	181,737,072	172,643,636	
September, 2008	140,748,168	225,504,048	
October, 2008	79,106,236	115,702,884	
November, 2008	73,862,008	101,975,588	
December, 2008	80,236,464	61,562,644	
TOTALS	**1,349,133,192**	**1,294,106,572**	**4.08%**
January, 2009	77,707,476	74,595,796	
February, 2009	66,788,920	67,963,280	
March, 2009	75,557,724	70,324,716	
April, 2009	91,557,444	69,043,392	
May, 2009	116,200,304	79,485,472	
June, 2009	140,102,644	76,316,196	
July, 2009	201,704,184	141,076,540	
August, 2009	176,786,060	132,274,824	

September, 2009	126,917,648	221,684,760	
October, 2009	84,273,420	133,729,684	
November, 2009	72,084,760	92,849,988	
December, 2009	77,479,336	63,229,188	
TOTALS	**1,307,159,920**	**1,222,573,836**	**6.47%**
January, 2010	76,403,712	76,179,312	
February, 2010	68,128,588	66,974,424	
March, 2010	80,145,208	61,626,972	
April, 2010	93,381,816	66,409,684	
May, 2010	90,809,444	79,673,220	
June, 2010	104,010,896	68,642,464	
July, 2010	193,055,808	93,837,348	
August, 2010	194,325,164	138,472,752	
September, 2010	124,115,640	230,690,680	
October, 2010	86,559,308	111,249,292	
November, 2010	76,490,480	85,690,880	
December, 2010	75,429,068	67,291,576	
TOTALS	**1,262,855,132**	**1,146,738,604**	**9.20%**
January, 2011	75,158,292	72,814,060	
February, 2011	68,107,644	57,174,128	
March, 2011	77,715,704	66,545,072	
April, 2011	91,101,164	63,536,616	
May, 2011	86,203,260	73,905,392	
June, 2011	108,452,520	64,311,544	
July, 2011	163,782,080	118,141,364	
August, 2011	186,853,392	119,085,340	
September, 2011	133,086,404	190,655,476	
October, 2011	80,313,508	129,341,168	
November, 2011	71,968,072	103,979,480	
December, 2011	74,104,360	64,540,432	
TOTALS	**1,216,846,400**	**1,124,030,072**	**7.63%**
January, 2012	75,358,008	81,263,468	
February, 2012	68,739,704	60,683,744	
March, 2012	72,179,008	67,191,344	
April, 2012	84,060,240	62,017,428	
May, 2012	105,372,256	72,903,072	
June, 2012	105,812,828	72,543,284	
July, 2012	167,118,908	113,409,516	
August, 2012	185,990,200	129,034,488	
September, 2012	153,182,920	213,304,168	
TOTALS	**1,017,814,072**	**872,350,512**	**14.3%**
Extrapolated Full Year 2012	**1,250,791,827**	**1,155,136,213**	**7.65%**

The data contained within Table 4-1 reflects the raw production from the sources and is indicative of the total output of water into the system. The data within Table 4-1A reflect the total production data as well as metered (sold) water consumption. This data permits determination of current unaccounted for (lost) water. As reflected in Table 4-1 A, typical values of unaccounted for water range from 4.07% up to 9.2%. The value represented in 2012 reflects the actual percentage of unaccounted for water believed to be currently present in Keizer (7.6%). All of the displayed values are acceptable for a water system of this size and is within the generally accepted range of 2%-10%.

Table 4-2
2008-2012 Water System Statistics

Parameter	7 Year Average (1993-1999)	2008	2009	2010	2011	2012	Average of 2008-2012
Population	28,433	36,150	36,220	36,570	36,715	36,735	36,478
Average Daily Demand (Production Sources)	3,484,747 GPD (2,420 GPM)	3,693,725 GPD (2,565 GPM)	3,581,260 GPD (2,487 GPM)	3,459,877 GPD (2,403 GPM)	3,333,826 GPD (2,315 GPM)	3,424,481 GPD (2,378 GPM)	3,498,634 GPD (2,430 GPM)
Average Daily Demand (Metered Sold Water)	3,349,769 GPD (3 year average)	3,543,071 GPD	3,349,517 GPD	3,141,750 GPD	3,079,534 GPD	3,162,591 GPD	3,255,293 GPD
Average Yearly Unaccounted Water (Percent)	4.25% (3 year average)	4.07%	6.47%	9.2%	7.63%	7.65%	7%
Maximum Month	July-August	July	July	August	August	August	July-August
Average Day during Maximum Month (GPD)	5,968,770 GPD	6,741,193 GPD	6,506,587 GPD	6,268,554 GPD	6,027,529 GPD	5,999,684 GPD	6,308,709 GPD
Maximum Day (GPD)	7,851,046 GPD	8,600,000 GPD	8,250,000 GPD	8,340,000 GPD	7,730,000 GPD	8,035,000 GPD	8,191,000 GPD
Maximum Day/Average Day (GPD)	2.25	2.32	2.30	2.41	2.31	2.35	2.33
Average Summer Day (July-September)	5,234,679 GPD	5,776,763 GPD	5,493,564 GPD	5,559,746 GPD	5,257,846 GPD	5,503,174 GPD	5,518,219 GPD
Maximum Day/Average Summer Day	1.50	1.49	1.50	1.50	1.47	1.46	1.48
Average Summer Day/Average Day	1.50	1.56	1.53	1.60	1.57	1.60	1.57
Minimum Month	February	February	February	February	February	February	February
Average Winter Day (December-February)	2,463,814 GPD	2,651,701 GPD	2,497,032 GPD	2,466,796 GPD	2,429,944 GPD	2,424,467 GPD	2,493,988 GPD
Average Winter Day/Average Day	.707	.72	.70	.71	.73	.71	.71
Average Per Capita Day	123 GPCD	102 GPCD	99 GPCD	95 GPCD	91 GPCD	93 GPCD	96
Per Capita Usage: Average Day During Summer Months	184 GPCD	160 GPCD	152 GPCD	152 GPCD	143 GPCD	149 GPCD	151
Maximum Per Capita Day (GPCD)	276 GPCD	238	228	228	210	219	225
Peak Hour (GPCD)	541 GPCD	536	479	479	473	491	492
Peak Hour/Max. Day	1.96	2.25	2.10	2.10	2.25	2.25	2.19
Peak Hour/Average Day	4.40	5.25	4.83	5.04	5.20	5.28	5.12
Peak Hour (GPM)	10,682 GPM	13,456 GPM	12,050 GPM	12,165 GPM	12,060 GPM	12,568 GPM	12,460 GPM

Note: Maximum day and peak hour figures for Year 2008-2012 are estimates based on historical averages of previous 10 years.

The City of Keizer generally reads service meters around the middle of each month and reads 50% of the meters per month (bi-monthly billing cycles), which accounts for the variance of monthly readings between metered consumption and source production. Typically, these variances average out over the course of a full year.

Typical Water System Demand Patterns

Generally, most potable water supply systems deliver water to consumers at varying rates throughout any given day (Figure 4-1). Three distinct terms are typically used to quantify the water system demand at any specific time or period. An "average daily demand" is used to express the amount of water either produced or consumed during any given day of the year. This value is determined by dividing the total yearly volume of water produced by 365 days/year. A "Maximum Day Demand" is used to equate the maximum amount of water either produced or consumed during any single day. Most often, maximum day demands occur during the months of July or August, however, they can occur as early as May or as late as October.

This type of water demand often occurs during the days with the highest yearly temperatures. A maximum day demand can also occur, however, during a day with large or several fires, during pipeline flushing, or during a prolonged dry spell. A "Peak Hour Demand" is used to express the highest instantaneous water demand occurring during any hour of any day. Although the term implies that this demand occurs over one hour, it can last as long as four hours or as little as 10 minutes.

Table 4-3
Master Plan Comparative Values (GPCD)

Study	Average Day	Maximum Day	Peak Hour	Maximum Day/ Average Day	Peak Hour/ Maximum Day
1980 JMM Master Plan	130 GPCD	390 GPCD	630 GPCD	3.0	1.62
1988 HGE Update	135 GPCD	405 GPCD	770 GPCD	3.0	1.9
2000 Stettler Update (Actual Values)	125 GPCD	267 GPCD	514 GPCD	2.14	1.92
2012 4B Update (Actual Values)	96 GPCD	225 GPCD	492 GPCD	2.34	2.18
Average	122 GPCD	322 GPCD	602 GPCD	2.64	1.87
Typical Design Values	75-150 GPCD	200-400 GPCD	400-1000 GPCD	1.5-3.5	1.3-3.0
2012 Planning Values	110 GPCD	250 GPCD	500 GPCD	2.27	2.0

Although the actual usage values are between 15-30% lower than the 2000 planning values, the 2012 assumed planning values of 250 GPCD (maximum day) and 500 GPCD (peak hour) will be used to provide more realistic and accurate estimates while maintaining an adequate margin of safety.

Commercial/Industrial Water Use

Since the Keizer community consists of mostly residential (98%-99% of total water connections) homes, commercial and industrial water facilities are not significant to the existing overall water system demands. An analysis indicates that the majority of the current commercial water demands consist of mostly light/medium commercial

2012 Pumping Records (In US Gallons)

Well	January	February	March	April	May	June	July	August	September	October	November	December	Total	Percent
Carlhaven West	0	513,128	10,098,748	4,050,420	1,005,312	2,075,700	16,112,668	17,805,392	17,094,792	No data	No data	No data	68,756,160.00	6.76%
Willamette Manor	9,492,120	8,305,792	9,867,616	8,671,564	9,306,616	7,579,484	6,515,828	3,897,080	6,933,212	No data	No data	No data	70,569,312.00	6.93%
Keizer Station	3,803,580	5,005,616	7,157,612	10,608,884	13,799,852	11,669,548	13,564,980	13,623,324	10,898,360	No data	No data	No data	90,131,756.00	8.86%
Cherry Ave	1,745,832	2,635,952	1,503,480	8,186,860	10,823,560	10,268,544	22,236,544	22,630,740	14,470,060	No data	No data	No data	94,501,572.00	9.29%
Carlhaven East	9,465,192	9,217,604	10,553,532	10,510,148	10,878,912	8,593,024	9,880,332	11,993,432	8,345,436	No data	No data	No data	89,437,612.00	8.79%
Wiessner	0	0	42,636	30,668	967,164	0	1,211,760	361,284	471,988	No data	No data	No data	3,085,500.00	0.30%
Delta	14,885,948	13,356,288	15,359,432	13,995,828	15,147,000	10,420,388	11,034,496	14,600,212	14,038,464	No data	No data	No data	122,838,056.00	12.07%
McNary	77,044	23,188	0	3,624,060	2,873,068	584,936	24,042,216	22,875,336	7,414,924	No data	No data	No data	61,514,772.00	6.05%
Chemawa	0	0	-748	0	61,336	0	0	0	0	No data	No data	No data	60,588.00	0.01%
Lauderback	12,503,568	11,211,024	12,791,548	13,011,460	14,877,720	13,731,036	14,252,392	15,115,584	16,970,624	No data	No data	No data	124,464,956.00	12.23%
17th Ave	0	0	0	0	0	0	0	23,240,360	27,022,996	No data	No data	No data	50,263,356.00	4.94%
13th Ave	0	0	0	-7,138,164	0	0	0	0	0	No data	No data	No data	-7,138,164.00	-0.70%
Meadows	11,968	940,236	29,172	6,417,840	6,957,896	22,603,064	20,148,128	7,212,964	3,686,144	No data	No data	No data	68,007,412.00	6.68%
Ridge Drive	3,501,388	1,652,332	3,178,252	2,271,676	3,312,892	1,848,308	7,950,492	7,396,224	4,161,872	No data	No data	No data	35,273,436.00	3.47%
Reitz	3,687,640	1,872,992	1,597,728	372,504	0	1,276,088	9,017,140	18,190,612	16,168,020	No data	No data	No data	52,182,724.00	5.13%
City Hall	15,959,328	14,005,552	0	9,446,492	15,360,928	15,162,708	11,151,932	7,047,656	5,506,028	No data	No data	No data	93,640,624.00	9.20%
Total	75,133,608	68,739,704	72,179,008	84,060,240	105,372,256	105,812,828	167,118,908	185,990,200	153,182,920	No data	No data	No data	1,017,589,672.00	100.00%

TABLE 4–4

PRODUCTION BY WELL

2010 Pumping Records (In US Gallons)

Well	January	February	March	April	May	June	July	August	September	October	November	December	Total	Percent
Carlhaven West	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00%
Willamette Manor	9,400,116	8,721,680	10,033,672	11,803,440	11,645,612	8,931,120	9,899,780	4,723,620	6,889,080	987,360	3,269,508	7,570,508	93,875,496.00	7.43%
Kelzer Station	12,704,032	11,366,608	9,387,400	10,504,912	9,204,140	10,963,436	12,168,464	12,983,036	10,127,172	2,828,936	1,399,508	1,574,540	105,212,184.00	8.33%
Cherry Ave	4,488	323,136	1,038,972	1,705,440	1,826,616	6,139,584	22,235,796	23,249,336	9,312,600	340,340	19,448	147,356	66,343,112.00	5.25%
Carlhaven East	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00%
Wiessner	-6,732	-748	-2,992	164,560	920,788	0	12,733,952	8,714,200	590,920	25,432	0	-748	23,138,632.00	1.83%
Delta	8,619,204	12,685,332	8,053,716	4,494,732	14,651,824	8,856,320	13,483,448	16,847,952	16,638,512	16,366,988	13,889,612	15,037,792	149,625,432.00	11.85%
McNary	-71,808	-10,472	290,224	2,799,016	830,280	5,443,944	33,434,852	42,802,056	10,014,224	0	0	8,228	95,540,544.00	7.56%
Chemawa	0	0	748	0	0	0	866,184	1,296,284	0	-748	0	-748	2,161,720.00	0.17%
Lauderback	5,316,784	7,681,960	10,147,368	9,587,864	7,453,820	10,424,876	15,155,976	15,973,540	14,701,940	11,265,628	10,492,196	8,885,492	127,087,444.00	10.06%
17th Ave	4,570,280	2,071,960	4,977,192	9,171,976	12,727,220	11,766,788	7,785,184	8,434,448	12,979,296	14,378,804	12,472,152	12,649,428	113,984,728.00	9.02%
13th Ave	306,680	0	267,784	771,936	819,060	3,961,408	7,149,384	5,339,224	8,707,468	8,973,756	3,555,244	982,872	40,834,816.00	3.23%
Meadows	14,212	77,792	777,920	6,390,164	166,056	4,075,852	10,565,500	7,942,264	2,101,132	5,236	8,228	175,032	32,299,388.00	2.56%
Ridge Drive	2,892,516	2,517,768	5,354,932	4,426,664	6,620,548	6,913,764	14,446,872	15,687,804	5,957,124	4,239,664	4,038,452	3,947,944	77,044,052.00	6.10%
Reitz	10,964,932	6,418,588	9,156,268	13,071,300	4,217,224	7,725,344	16,716,304	14,980,944	7,295,244	4,342,888	5,520,240	3,392,180	103,801,456.00	8.22%
City Hall	21,689,008	16,274,984	20,662,004	18,489,812	19,726,256	18,808,460	16,414,112	15,350,456	19,100,928	22,805,024	21,825,892	21,059,192	232,206,128.00	18.38%
Total	76,403,712	68,128,588	80,145,208	93,381,816	90,809,444	104,010,896	193,055,808	194,325,164	124,415,640	86,559,308	76,490,480	75,429,068	1,263,155,132.00	100.00%

27B

2011 Pumping Records (In US Gallons)

Well	January	February	March	April	May	June	July	August	September	October	November	December	Total	Percent
Carlhaven West	0	0	0	0	0	0	691,152	14,205,268	16,323,604	17,985,660	15,967,556	15,221,052	80,394,292.00	6.54%
Willamette Manor	10,051,624	9,072,492	8,943,836	11,938,828	11,836,352	12,103,388	7,435,120	4,225,452	4,930,816	1,418,208	581,944	7,110,488	89,648,548.00	7.30%
Kelzer Station	7,690,188	15,379,628	12,011,384	7,542,832	9,732,976	15,183,652	16,590,640	14,102,792	12,199,132	4,605,436	3,025,660	4,372,808	122,437,128.00	9.97%
Cherry Ave	1,237,940	2,580,600	3,602,368	3,137,112	6,156,788	9,556,448	21,143,716	20,522,876	14,556,080	62,832	17,952	1,751,816	84,326,528.00	6.86%
Carlhaven East	0	0	0	0	0	388,960	2,778,072	13,908,312	-3,497,648	10,238,624	7,177,808	9,456,964	40,451,092.00	3.29%
Wiessner	0	0	-2,992	361,284	0	-748	3,538,788	3,021,172	695,640	0	0	0	7,613,144.00	0.62%
Delta	14,680,248	10,524,360	12,954,612	7,189,028	107,712	9,023,124	13,441,560	15,853,112	15,809,728	15,400,572	4,398,240	14,431,912	133,814,208.00	10.89%
McNary	26,180	0	292,468	3,050,344	894,608	6,364,732	25,601,048	24,894,936	8,391,064	0	-740	0	69,514,640.00	5.66%
Chemawa	-748	0	-748	3,050,344	-1,496	0	0	0	41,140	0	0	0	3,088,492.00	0.25%
Lauderback	8,201,072	8,922,892	10,299,212	304,436	12,422,036	11,353,892	11,204,292	14,872,484	14,951,772	12,258,224	10,338,856	12,020,360	127,149,528.00	10.35%
17th Ave	13,507,384	11,664,312	13,090,748	12,249,248	7,184,540	5,624,212	14,262,864	14,885,948	15,411,044	14,196,292	12,372,668	2,937,396	137,386,656.00	11.18%
13th Ave	1,353,880	15,340,732	3,834,248	11,667,304	1,667,292	0	2,992	2,097,392	0	0	0	0	35,963,840.00	2.93%
Meadows	5,236	-2,244	547,536	1,297,032	219,912	641,036	7,367,052	6,150,056	3,846,216	106,216	496,672	-2,992	20,671,728.00	1.68%
Ridge Drive	3,449,776	4,079,592	5,390,088	2,950,112	3,235,848	3,337,576	5,921,916	8,440,432	6,721,528	2,887,280	2,650,164	2,979,284	52,043,596.00	4.24%
Reitz	2,481,116	2,209,592	1,598,476	9,517,552	15,279,396	13,855,204	14,522,420	16,471,708	12,074,964	1,154,164	11,967,252	1,668,040	102,799,884.00	8.37%
City Hall	12,474,396	0	5,154,468	16,956,412	17,467,296	21,021,044	19,280,448	13,201,452	10,631,324	0	2,974,048	2,157,232	121,318,120.00	9.87%
Total	75,158,292	79,771,956	77,715,704	91,211,868	86,203,260	108,452,520	163,782,080	186,853,392	133,086,404	80,313,508	71,968,080	74,104,360	1,228,621,424.00	100.00%

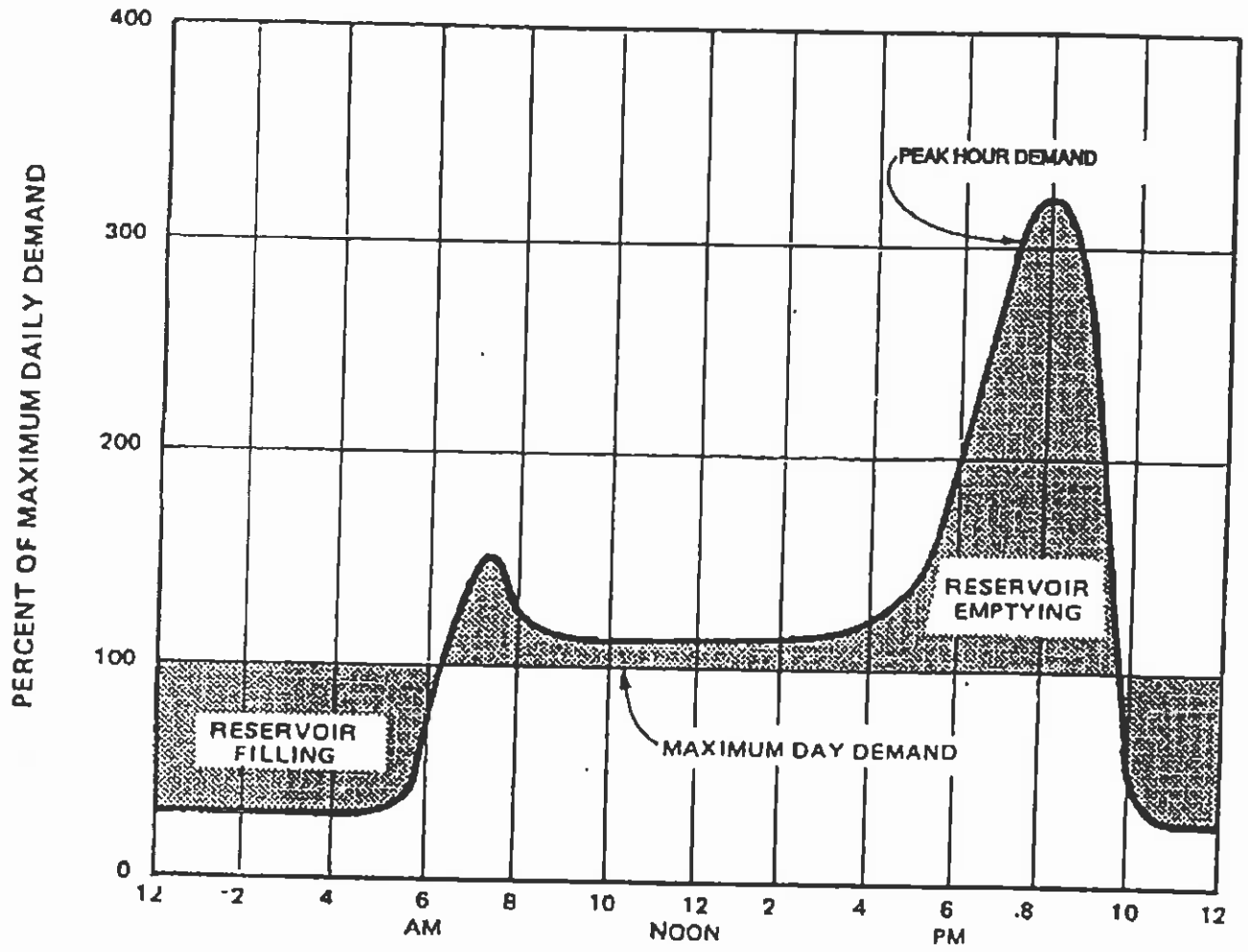
2008 Pumping Records (in US Gallons)

Well	January	February	March	April	May	June	July	August	September	October	November	December	Total	Percent
Carlhaven West	6,450,752	1,496	1,288,056	6,176,984	12,253,736	11,025,520	10,370,272	10,738,288	9,086,704	10,617,860	9,033,596	2,990,504	90,033,768	6.26%
Willamette Manor	8,849,588	7,118,716	11,235,708	10,758,484	12,285,152	11,992,684	11,992,684	12,102,640	12,213,344	6,227,100	1,420,452	9,614,792	115,811,344	8.05%
Kelzer Station	19,581,144	15,402,816	17,703,664	17,703,664	20,738,300	11,992,684	16,224,120	14,720,640	11,192,324	10,706,124	8,270,636	7,293,748	171,529,864	11.92%
Cherry Ave	5,143,248	10,663,488	13,201,452	13,201,452	10,608,884	18,310,292	18,310,292	12,490,104	7,410,436	3,385,448	8,546,648	1,976,216	123,247,960	8.57%
Carlhaven East	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00%
Wiessner	0	1,496	0	1,038,972	3,739,252	16,686,384	16,686,384	7,834,552	1,424,940	0	0	0	47,411,980	3.30%
Delta	29,958,896	17,767,244	14,809,704	16,129,872	9,445,744	10,234,884	10,234,884	15,682,568	26,055,832	22,828,960	20,040,416	20,764,480	213,953,484	14.87%
McNary	154,088	1,296,284	1,949,288	1,902,912	10,834,032	25,814,228	25,814,228	13,958,428	4,841,056	175,032	1,510,960	899,844	89,150,380	6.20%
Chemawa	7,480	0	0	748	22,440	955,944	955,944	348,568	0	748	-2,244	0	2,289,628	0.16%
Lauderback	4,074,356	5,791,016	3,856,688	2,075,700	8,171,152	10,566,996	10,566,996	7,863,724	4,725,116	132,396	2,282,896	7,073,088	67,180,124	4.67%
17th Ave	748	0	0	645,524	7,445,592	9,164,496	9,164,496	9,559,440	8,277,368	4,692,952	8,713,452	11,350,900	69,114,968	4.80%
13th Ave	135,388	2,817,716	7,173,320	4,784,208	9,926,708	15,565,880	15,565,880	13,930,752	11,755,568	8,852,580	10,945,484	10,277,520	111,731,004	7.77%
Meadows	6,788,100	8,524,956	0	1,724,140	31,038,260	45,761,144	45,761,144	34,577,048	19,466,700	2,538,712	0	8,976	196,189,180	13.64%
Ridge Drive	1,286,560	1,401,004	1,670,284	6,409,612	7,008,760	9,023,124	9,023,124	10,020,956	5,737,908	3,965,896	977,636	1,378,564	57,903,428	4.03%
Reitz	3,852,948	1,583,516	3,879,128	6,819,516	3,913,536	8,306,540	8,306,540	11,525,184	439,824	4,982,428	1,300,024	3,756,456	58,665,640	4.08%
City Hall	0	0	0	0	0	0	0	6,384,180	14,162,632	0	822,052	2,851,376	24,220,240	1.68%
Total	0	72,369,748	76,767,292	89,371,788	147,431,548	205,400,800	208,976,988	181,737,072	136,789,752	79,106,236	73,862,008	80,236,464	1,438,432,992	100.00%

27C

2009 Pumping Records (in US Gallons)

Well	January	February	March	April	May	June	July	August	September	October	November	December	Total	Percent
Carlhaven West	9,280,436	10,451,056	12,392,116	13,026,420	13,616,592	7,420,908	2,876,060	11,638,132	11,543,884	2,775,828	0	0	95,021,432.00	7.27%
Willamette Manor	9,138,316	9,020,880	10,537,076	11,520,696	11,736,868	12,576,124	12,217,832	11,837,100	11,475,816	10,855,724	9,092,688	9,851,160	129,860,280.00	9.93%
Kelzer Station	4,920,344	12,109,372	17,963,220	17,439,620	12,546,204	7,046,160	12,865,600	16,261,520	10,978,396	2,582,844	10,053,868	11,251,416	136,018,564.00	10.40%
Cherry Ave	10,063,592	3,895,584	806,344	3,175,260	7,604,168	8,626,684	19,895,304	14,325,696	5,794,008	80,036	2,992	49,368	74,319,036.00	5.68%
Carlhaven East	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00%
Wiessner	-11,220	0	0	371,756	1,077,120	1,042,712	13,675,684	11,189,332	4,427,412	67,320	-2,244	0	31,837,872.00	2.43%
Delta	19,420,324	14,102,044	14,027,244	18,710,472	23,113,200	17,256,864	18,216,044	20,723,340	19,512,328	19,043,332	9,385,904	10,040,404	203,551,500.00	15.56%
McNary	210,936	52,360	0	1,890,944	3,731,024	7,461,300	25,909,224	5,181,396	0	-3,740	-748	23,188	44,455,884.00	3.40%
Chemawa	-748	0	0	-748	35,156	0	358,292	0	0	0	0	0	391,952.00	0.03%
Lauderback	2,741,420	0	8,884,744	363,528	4,019,752	15,024,328	15,225,540	15,582,336	15,211,328	11,714,428	2,559,656	6,663,932	97,990,992.00	7.49%
17th Ave	4,229,192	6,416,344	5,280,132	9,252,760	8,991,708	8,892,972	9,627,508	11,086,108	9,614,792	6,295,168	5,931,640	7,108,992	92,727,316.00	7.09%
13th Ave	2,793,032	1,484,032	1,632,884	5,908,452	3,790,864	4,062,388	5,137,264	2,589,576	1,259,632	2,028,576	1,304,512	117,436	32,108,648.00	2.46%
Meadows	0	3,740	0	3,143,844	7,640,072	17,498,712	31,849,092	26,608,604	8,515,232	41,140	94,996	20,944	95,416,376.00	7.30%
Ridge Drive	3,584,416	3,095,224	2,327,776	3,554,496	3,700,356	3,532,804	4,348,872	5,299,580	3,556,740	3,404,896	2,943,380	2,519,264	41,867,804.00	3.20%
Reitz	2,609,024	1,549,108	1,706,188	3,199,944	6,161,276	6,518,072	6,469,452	3,971,132	6,119,388	2,689,060	8,846,596	7,595,940	57,435,180.00	4.39%
City Hall	8,728,412	4,609,176	0	0	8,435,944	23,144,616	23,032,416	20,492,208	18,908,692	23,379,488	21,871,520	22,237,292	174,839,764.00	13.37%
Total	77,707,476	66,788,920	75,557,724	91,557,444	116,200,304	140,104,644	201,704,184	176,786,060	126,917,648	84,954,100	72,084,760	77,479,336	1,307,842,600.00	100.00%



Typical Demand Pattern During Day of Maximum Use

Figure 4-1

establishments along River Road and in Keizer Station. Most of the water consuming commercial establishments consists of restaurants, car washes, and grocery stores. Since virtually all of the commercial demands are fairly consistent in daily demands and occur in close proximity to River Road or within Keizer Station, both areas served by a large water main and adequate looping, individual consideration of commercial water demands within this study is not required. Review of water consumption records indicate current commercial water demands can be included within per capita usages. Further examination of the city reveals a minor amount of industrial customers and none with a substantial impact on the water system. Future commercial and industrial growth will be assumed to coincide with the expected population growth and will be factored using the per capita figures.

Based on design criteria previously stated, the following values will be used for planning purposes:

Table 4-5
Projected Water Demands: 2012-2032

	2012	2015	2020 (1)	2025 (1)	2032 (1)
Design Population	36,735 (Estimate)	37,416	40,280	43,350	48,082
Average Daily Demand (3)	4,040,850 GPD (2,806 GPM)	4,115,760 GPD (2,858 GPM)	4,430,800 GPD (3,077 GPM)	4,768,500 GPD (3,311 GPM)	5,289,020 GPD (3,673 GPM)
Average Winter Demand	2,828,600 GPD (1,964 GPM)	2,881,032 GPD (2,000 GPM)	3,101,560 GPD (2,154 GPM)	3,337,950 GPD (2,318 GPM)	3,702,314 GPD (2,571 GPM)
Average Summer Demand	6,061,275 GPD (4,209 GPM)	6,173,640 GPD (4,287 GPM)	6,646,200 GPD (4,615 GPM)	7,152,750 GPD (4,967 GPM)	7,933,530 GPD (5,509 GPM)
Maximum Daily Demand (2)	9,183,750 GPD (6,378 GPM)	9,354,000 GPD (6,496 GPM)	10,070,000 GPD (6,993 GPM)	10,837,500 GPD (7,526 GPM)	12,020,500 GPD (8,348 GPM)
Peak Hour (4)	12,756 GPM	12,992 GPM	13,986 GPM	15,052 GPM	16,696 GPM

(1) Years 2020-2032 reflect increased daily demand to accommodate the higher rate of projected city growth during this time span
(2) Maximum Daily Demand is based on 250 gallons per capita/day
(3) Average Daily Demand is based on 110 gallons per capita/day
(4) Peak Hour Demand is assumed to be 2 x Maximum *Day* Demands

Required Source Capacity

Future required capacity is dependent on several factors. Among these are: duration of consecutive maximum days, source redundancy and reliability, system pressure, type of water use, and available storage. In the case of Keizer, historical records accumulated over 30 years indicate few incidents of consecutive or long term maximum day demands. Typically, the maximum daily water demands in any given year are incurred for a maximum of 3-4 consecutive days followed by a period of more typical and lower volume summer demands. Source reliability over the years has generally been excellent with few prolonged power or equipment failures. The city's current total source capacity and active storage of 2,800,000 gallons is adequate to accommodate the current maximum day demands with only 50% of all available units operable, however, a failure or loss of any of the larger (≥ 1,000 GPM) wells or pumps will expose the water system to a potentially hazardous condition under both current and future peak demands. Future planning, therefore, must consider the reliability of the existing electrical power supply used by most of the wells, aging of the existing water system components, and the fact that only wells and two reservoir/booster pump stations are available for all needed demands. For example, a prolonged failure or severe contamination of any large well, even under current conditions, could result in a potentially catastrophic event. To lessen this potential, new sources should

be adequately spaced and sized so that contamination or failure of any one source will have little or no impact on the others. Another area of concern is related to the current use of only 6-7 high capacity wells to provide most of the water system's total needed capacity. To help alleviate this concern, future minimum design capacities will be based on the total and simultaneous loss of two of the largest well/booster pumps in the system.

Fire Flow

The City of Keizer is located within the Keizer and Marion County #1 Fire District for fire protection and is served from the main station located on Chemawa Road. Table 4-6 indicates needed and available fire flows for various locations within the city. These flows are based on normal fire flow requirements for specific structure or development classifications and are based on testing performed by the Insurance Services Office (ISO) in May, 1997.

The City currently has a Class 3 Fire Protection Rating as established by the Insurance Services Office (ISO). The Fire Protection Rating was downgraded due to issues outside of water supply. In fact, during the October, 2006 ISO evaluation, the city received a score of 39.28 points out of a possible 40 points allowed for the water supply (98.2%). This score is up from the previous evaluation score of 36.57 awarded in 1997.

In October, 2006, ISO tested the water supply at the intersection of River Road N and Dietz Ave. The flow was tested at a flow rate of 3,500 GPM @ 20 psi and passed. During an evaluation of the system, the highest projected instantaneous fire flow demand would most likely occur within the downtown core area along River Road or at McNary High School. As seen in Table 4-6, the past fire hydrant flow testing performed by ISO in May, 1997, indicated a maximum deliverable flow rate of 4,600 GPM @ 20 psi residual pressure at River Road and Dietz Avenue. The minimum required flow in this area is 3,500-4,500 GPM. Due to the exposure of a potentially large fire at the McNary High School campus, this area of the city, along with Keizer Station, are currently regarded as the most serious fire flow requirements in the city. Available capacity at the high school was determined to be 3900 GPM, which is 600 GPM less than the desirable flow of 4500 GPM, however, computer modeling indicates that more than 6000 GPM should be available to the McNary campus, therefore, it is suspected that the ISO testing did not provide adequate time for the pressure in the water system to stabilize.

Table 4-6
Required Fire Flow

Test No.	Test Dist.	Test Location	Service	Flow (GPM)			Pressure (in PSI)		Flow (At 20 PSI)	
				Individual	Hydrants	Total	Static	Resid.	Needed	Avail.
1	Comm	River Rd. and Chemawa Rd.	Main	1010	950	1960	78	62	4000 3500	3900
2	Comm	River and Dietz	Main	950	860	1810	76	66	4500 3500	4600
3	Comm	Sandy and McNary High School	Main	690	630	1320	80	72	4500 1000	3900
4	Comm	Trail and	Main	980	1025	2005	72	60	7000	4400

		Harmony							750	
5	Comm	Cummings and Delight St	Main	810	870	1680	78	68	2500	4300
6	Comm	Keizer and Noren	Main	710	790	1500	78	58	4000 750	2700
7	Comm	River Rd and Apple Blossom	Main	890	840	1730	78	62	2500	3500
8	Comm	McClure and Sonata	Main	1010	980	1990	80	64	1000	4100
9	Comm	14th and Stonehenge	Main	580	710	1290	68	56	3500	2700
10	Comm	Lockhaven and Kalmia	Main	650	690	1340	78	64	7000 1000	2900
11	Comm	Park Meadow and Meadow Glen	Main	710	750	1460	50	38	3500	2400

In order to verify the available fire flow capacity within Keizer Station, hydrant flow tests were performed by Keizer Public Works personnel in March of 2006. These tests indicated that between 7,000-10,000 GPM of flow was simultaneously available through multiple hydrants. Tests conducted at the fire station on Chemawa Road in August of 2007 verified an available flow rate of over 3,600 GPM at this site. In order to fully understand the operational dynamics of the Keizer Water System, accurate readings of static pressures followed by a sustained time period of adequate duration to allow the starting, activation, and full engagement of pumping units, before reading the residual pressures, must be provided. It is highly recommended that a confirmation series of fire flow tests, using the above protocol, be employed at each ISO tested site.

For the purpose of this study, determination of the required fire flow is based on the standard ISO equation:

$$(1)\ Q(GPM) = 1020\sqrt{P}\,(1 - 0.01\sqrt{P})$$

Where P = Population in Thousands

Q (in 2012) = 5,808 GPM

Q (in 2032) = 6,582 GPM

Required 2032 Total Volume: 6,582 GPM X 60 mins/hr X4 hrs = 1,580,000 gallons.

For planning purposes, a Year 2032 fire flow of 6,667 GPM will be assumed over a 4 hour duration = 1,600,000 gallons.

Maximum Water System Capacities

The data previously complied is used to determine the maximum capacity that the Keizer water system must produce for various scenarios. Due to the limited above-ground water storage volume, the city's water system must be capable of handling all anticipated water demands by utilizing the combined capacities of available sources and/or booster pumping from storage reservoirs. To provide adequate redundancy and a reasonable factor of safety, each demand condition includes the assumption that the two largest wells or booster pumps are disabled or otherwise not available for service. Depending on the actual scenario, this factor may include wells, well pumps, booster pumps, storage reservoir, or a combination of two or more of each. Since it has already been determined that the existing water system can easily accommodate the average day demand throughout the entire span

of the study period, this requirement will not be included in the planning guide. The three specific demand requirements that do require consideration, however, are listed separately below for each incremental year.

Maximum day demands are assumed to be the system demands that must be met by sources only. This is due to the potential of this type of demand occurring over several consecutive days.

Table 4-7A
Maximum Day Requirements (2)

	2012	2015	2020	2025	2032
Total Required Maximum Day Capacity (Sources)	6,378 GPM	6,500 GPM	7,000 GPM	7,530 GPM	8,350 GPM
(+) Reserve Source Capacity (1)	4,000 GPM	4,000 GPM	4,000 GPM	4,000 GPM	4,000 GPM
Total Required Source Capacity (Required for Maximum Day Demands)	10,378 GPM	10,500 GPM	11,000 GPM	11,530 GPM	12,350 GPM
Total Safe Well Flow (2012)	12,500 GPM	12,500 GPM	12,500 GPM	12,500 GPM	12,500 GPM
Surplus (+)/Deficit (-)	+2,122 GPM	+2,000 GPM	+1,500 GPM	+970 GPM	+150 GPM

(1) Derived from the combined capacity from the loss of the two largest wells (Chemawa and Wiessner)
(2) Many of the individual flow values have been rounded down or up for simplification

Peak hour demands are those demands that generally occur over periods of 2-3 consecutive hours, typically during maximum demand days. These demands are supplied by using a combination of both sources and reservoir storage/booster pumps.

Table 4-7B
Peak Hour Requirements (4)

	2012	2015	2020	2025	2032
Total Required Peak Hour Capacity (Sources and Booster Pumps)	12,750 GPM	13,000 GPM	14,000 GPM	15,100 GPM	16,700 GPM
(+) Reserve System Capacity (1)	5,000 GPM	5,000 GPM	5,000 GPM	5,000 GPM	5,000 GPM
Total Required Source Capacity (Sources and Booster Pumps)	17,750 GPM	18,000 GPM	19,000 GPM	20,100 GPM	21,700 GPM
Total Safe Flow (2012) (Combined from all sources)	20,950 GPM	20,600 GPM (3)	20,600 GPM (3)	22,600 GPM (2) (3)	22,600 GPM (2) (3)
Surplus (+)/Deficit (-)	+3,200 GPM	+2,600 GPM	+1,600 GPM	+2,500 GPM	+900 GPM

(1) Derived from the combined capacity from the loss of the two largest wells or booster pumps
(2) Following the addition of a new 1.25 million gallon reservoir and 2000 GPM booster pump station
(3) Following the abandonment of Well #11 (Lauderback)
(4) Many of the individual flow values have been rounded down or up for simplification

The third scenario assumes a large fire demand coincidental with a maximum water demand day.

Table 4-7C
Maximum Day and Fire Flow Demands (4)

	2012	2015	2020	2025	2032
Total Required Maximum Day Capacity	6,400 GPM	6,500 GPM	7,000 GPM	7,530 GPM	8,350 GPM
Fire Flow Demand	5,808 GPM	5,860 GPM	6,100 GPM	6,300 GPM	6,667 GPM
Total Required Capacity	12,208 GPM	12,360 GPM	13,100 GPM	13,830 GPM	15,017 GPM
(+) Reserve System Capacity (1)	5,000 GPM	5,000 GPM	5,000 GPM	5,000 GPM	5,000 GPM
Total Required System Capacity	17,208 GPM	17,360 GPM	18,100 GPM	18,836 GPM	20,017 GPM
Total Safe Flow (2012) (Combined from all sources)	20,950 GPM	20,600 GPM (3)	20,600 GPM (3)	22,600 GPM (2) (3)	22,600 GPM (2) (3)
Surplus (+)/Deficit (-)	+3,742 GPM	+3,240 GPM	+2,540 GPM	+3,764 GPM	+2,583 GPM

(1) Derived from the combined capacity from the loss of the two largest wells or booster pumps
(2) Following the addition of a new 1.25 million gallon reservoir and 2000 GPM booster pump station
(3) Following the abandonment of Well #11 (Lauderback)
(4) Many of the individual flow values have been rounded down or up for simplification

From these analyses, it is apparent that the values in Table 4-7B or 4-7C require the highest capacity for any scenario. These are the values that be used for future source, storage, and booster pump planning purposes.

Chapter Five

Future Water Sources

Future Water Sources

Based on the data in Tables 4-7, the determination of future water sources for the City of Keizer must consider two distinct flow conditions; 1) Maximum Day demands (source capacity considerations) and 2) Peak hour or maximum day with coincidental fire flow (source capacity and available storage and booster pumping equipment). Each of these scenarios deserve individual evaluation and discussion:

Maximum Day Demands

Presently, the city's sources are capable of a combined safe yield of 13,115 GPM at 65 psi operating pressure; and 13,950 GPM at 55 psi operating pressure. Based on the data in Table 4-7A, it is apparent that the source enhancement recommendations outlined in the 2001 Water System Master Plan Update were successful and the water system can safely accommodate the current (2012) and future (2032) maximum day demands, therefore, additional source capacity will not be needed for future demands. Beyond the obvious volume of reserve pumping capacity that is currently available from the sources, a genuine concern regarding the potential for "overpumping" of a single or group of wells as well as "overdrafting" of the aquifer itself exists. Although substantial effort was performed within the period between 2000-2012 to insure that new or replacement wells were adequately sealed into an impermeable clay layer, sustained or high volume pumping of a single well could nonetheless introduce or drafting unwanted contaminants into a production well. In order to reduce this potential staggered operation and avoiding simultaneous operation of adjacent wells is highly recommended. This action must be performed by system operators when planning and executing the control matrix for the active wells/pump stations. The only consideration required for a full evaluation of the current sources (wells), is the planned elimination of Well #11 (Lauderback). This well is now the oldest well in the water system (drilled in 1973), has an inferior sanitary seal depth (30'), is limited in effective capacity, is relatively difficult to access for service, and is perforated, rather than screened, creating an inefficient hydraulic structure.

The elimination of the Lauderback well, rather than selecting the alternatives of either replacing or "mothballing" the well is appropriate and desirable for several reasons. Replacing the well with a new well on the same site would be far more expensive for the relative projected maximum yield gained (500-600 GPM at most) than other comparable wells recently drilled due to the inaccessibility of the site, lack of adequate power and pipeline capacity needed at the site for increased yield, and the potential impact on the recently reconstructed 17th Avenue Well (Well #12), now a reliable 900 GPM source. Placing the well in an "inactive, but useable" state would maintain the risk of potentially utilizing a well with an inadequate seal, possible nitrate exposure, and an unreliable well and pump at the end of their effective and economic lives. Additionally, current water rights regulations do not allow suspending the use of a permitted water well for more than five (5) years without permanently abandoning the well. This rule would necessitate periodic use of the well in order to continue the legal access to the water, thus greatly increasing the risk of eventually introducing contaminated water into the water system. Finally, the total aggregate volume of water currently permitted from the three original Wilark Park Wells (13th Ave, 17th Ave, and Lauderback) is 2.0 CFS (896 GPM). Given the successful results from the newly constructed 17th Avenue replacement well (800-900 GPM) and the

abandonment of the 13th Ave well (Well #13), it is believed that the singular use of the new 17th Avenue well within the Wilark Park area represents the best use of the existing water right as well as providing water with the highest overall water quality to the Keizer water system without the risk of interference from neighboring wells. The loss of this well to the aggregate source capacity will total less than 3% (325-350 GPM) of the total system production and will therefore not be detrimental to the water system.

Peak Hour or Simultaneous Maximum Day and Fire Flow Demands

Due to the unique nature of the Keizer water system, high water demands, such as peak hour or maximum day with a coincidental large fire, must be accommodated from a combination of sources (wells) along with the above ground water storage and booster pumping. Although these demands are typically much shorter in duration than the maximum day demands, the increase in required capacity is usually significant and often instantaneous in nature. The Keizer water system, until 1998-1999, historically supplied water during all high demand events using source supplies only. In 1999, a new 1.5 million gallon reservoir and pump station was constructed on Ridge Drive to assist in providing water for primarily peak hour demands. In addition a new well, along with a second (750,000 gallon) water storage reservoir and 1,500 GPM booster pump station was constructed at Bair Park in 2004-05 to help provide peak demands, primarily in the northern zone. The logic for the continued and expanded use of this concept is based on several reasons:

1. Use of storage/booster pumping allows optimum site selection and the use of pumps with higher flow rates (>2000 GPM) than can be safely realized from individual wells in most areas of Keizer. This type of facility typically has a lower or equal cost per delivered gallon than comparable well/pump facilities.
2. Use of storage/booster pumping assists in preventing over-pumping and stressing of the primary aquifers. This concept also lessens the risk of contaminant draw to a well due to the lower pumping rate and resulting area of influence.
3. The Willamette silts and Troutdale aquifers, as all aquifers, have a finite capacity and high capacity withdrawal increases the likelihood of well to well interference, increased pumping lifts, and higher operating costs. Additionally, sand pumping is less likely when pumping wells at lower capacity.
4. Generally speaking, reliability is higher and maintenance costs are lower with booster pumping than equivalent high capacity wells.
5. Incorporation of emergency stand-by equipment is generally lower in cost and higher in reliability.
6. Above-ground reservoirs provide a small measure of gravity storage, when properly located, which will provide limited water to the system during power or equipment failures for a short time allowing time needed to engage back-up equipment.

As previously outlined, the water system, through a combination of wells and storage/booster pumps, must be capable of handling any anticipated water demand. From the data in Tables 4-7B and 4-7C, the highest anticipated water demand will occur during peak hour or should a large or numerous fires develop during a maximum day event.

Although it is theoretically possible for a large fire to begin during peak-hour conditions, the likelihood of this coincidence is very low and unlikely to occur at a large scale. In addition, peak hour demands are typically short in duration, usually 3-4 hours or less in length, and the actual highest demands generally occur in less than one hour.

Although the risk of a substantial fire developing during the highest peak-hour demand is low, it is felt that some measure of reserve capacity must be available should an event such as this occur. In the case of Keizer, this compensation is especially important due to the lack of an adequate volume of elevated or gravity water storage. Review of Tables 4-7B and 4-7C indicate a greater difference of 1,683 GPM between the expected peak hour demands in Year 2032 and maximum day demand with highest projected fire flow, therefore, the requirements of peak hour demand will govern over the maximum day demand with coincidental fire. Table 5-1 is used for determining future source and booster pumping requirements based on the demand values outlined in Table 4-7:

Table 5-1
Required Total System Capacity

	2012	2015	2020	2025	2032
2012 Total Available System Capacity (1) (Table 2-4) (w/ EST contribution)	20,950 GPM	20,600 GPM (2)	20,600 GPM(2)	22,600 GPM (2) (3)	22,600 GPM (2) (3)
Highest Required system capacity (Peak Hour) (Table 4-7B)	17,750 GPM	18,000 GPM	19,000 GPM	20,100 GPM	21,700 GPM
Deficit (-), Surplus (+)	+3,200 GPM	+2,600 GPM	+1,600 GPM	+2,500 GPM	+900 GPM

(1) Capacities shown at 55 psi delivery pressure, lowest allowable design pressure
(2) After deduction for expected loss of flow from Lauderback well
(3) After addition of new 1.25 million gallon reservoir and 2000 GPM pump station

Emergency Water Supply

The City of Keizer water system is quite unique for a city with a population of over 30,000 in that all water has historically been delivered to customers on-demand directly from wells. Since 1980, the city has successfully relied solely on electrically or engine driven well pumps for all water demands. Generally, a water system of this size depends on some degree of gravity (elevated) water storage to supply uninterrupted water service to all customers, regardless of the status of electrical service. The addition of the 550,000 gallon (.55 million gallon) Elevated Storage Tank (EST) in 2008 at Keizer Station, although primarily designed for fire protection within Keizer Station, nonetheless, offers a direct benefit to the entire Keizer Water system. This volume of storage, although a minor amount compared to the average day demand, can provide up to 3000 GPM of instantaneous flow into the water system, giving the standby pumping equipment and generators the needed time to start and engage, thus, preventing a serious loss of water system pressure within the distribution system. Although Keizer's water system has provided excellent and uninterrupted water supply since its 1980 inception, the current size, concern over future electrical utilities generation, transmission, and distribution capacity and reliability, and complexity and size of the city's water system necessitates additional consideration of potential emergencies.

There are various reasons the city's water system has been extremely reliable over the years. Among these are:

1. The city is served by two separate electrical utilities (Salem Electric and Portland General Electric) which individually supply electrical service as follows:

Pump Station	Electrical Service Provider
Carlhaven West and East	PGE
Willamette Manor	Salem Electric
Cherry Ave	Salem Electric
Wiessner	PGE
Delta	PGE
McNary	PGE
Chemawa	Engine Drive only
Lauderback	PGE
17th Ave	PGE
Meadows	PGE
Ridge Drive	PGE
City Hall	PGE
Lacey Ct	PGE
Reitz/Bair Park	PGE

2. The water system is controlled by a computer based controller with active back-up. Local over-ride control is available at all pump stations in the event of control failure.
3. The city performs an excellent program of maintenance.
4. The water system utilizes reliable and durable mechanical and electrical components.
5. There has been sufficient redundancy and flow distribution between the existing sites
6. Water demands have been mostly residential in nature which are usually predictable and consistent

In the future, as growth continues and additional burden is placed on the existing electrical systems, the likelihood of a severe or partial outage of electrical service increases. As evidenced by recent events, the likelihood of future brownouts or blackouts in Oregon will increase as existing electrical facilities are stressed due to growth, age, and increased electrical loads. This factor, combined with the aging of the water system components and a projected rise in population, suggests recommendation of two specific enhanced emergency provisions. The city is recommended to undertake the following minimum steps:

A) Install an emergency, automatic-start, standby generator at the Reitz Well/Bair Park Reservoir-Pump Station. This unit should be sized large enough to be capable of starting and operating the 50 HP well pump plus the three (3) booster pumps planned at this site. A preliminary analysis indicates a 180 KW will be adequate for this purpose. Adequate space exists within the existing storage room to accommodate a generator installation, which will save costs. A standby generator at this site will provide a totally independent system, including operation of the well pump to refill the reservoir and the filtration system, in addition to the three booster pumps at the site, insuring the Northern Pressure Zone will maintain the design pressures intended when the two zones were segregated. It will also provide a primary backup over the Meadows well, currently the only facility in the Northern Pressure Zone with automatic startup capability, but with generally undesirable aesthetic

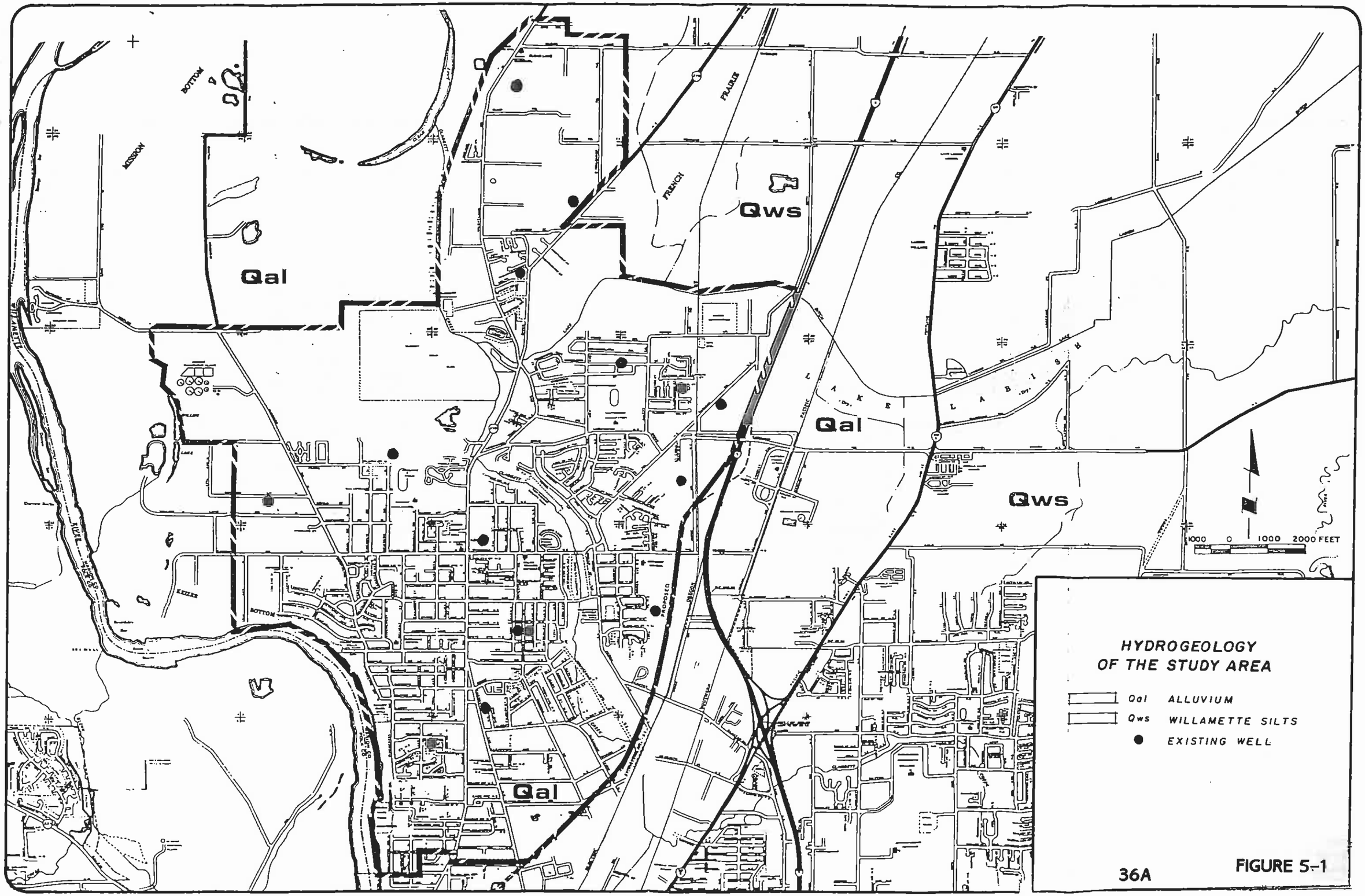


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FIGURE 5-1

water quality. Installation of this standby unit at an existing well/reservoir/pump station site will also allow deferment of a third reservoir/pump station until 2023-25.

B) Construct a third ground-level water storage reservoir and booster pump station to support the two existing facilities. This third reservoir and pump station will not only be capable of supplying the deficit of peak demand water projected by Year 2025, but will provide the needed redundancy in storage/high production facilities. Currently, any prolonged service or maintenance of either of the two existing storage reservoirs/pump stations will create a serious loss of emergency/supplemental capacity, necessitating a total reliance on the sources for peak demands or large fires. Construction of a third reservoir/pump station will provide continued service at the present level even if 1 of the 2 other sites is offline. This third site will also provide an additional automatic start/run pumping unit, increasing the available emergency water supply to the projected higher population within the city at the time of implementation.

C) Negotiate a modification of the emergency agreement with the City of Salem to allow installation of an automatic entry pressure reducing valve at the Cherry Avenue site. This valve would provide a "fail safe" function by automatically transferring water between Salem to Keizer under extreme events only, insuring the Keizer system pressure does not fall to dangerous levels.

The following sites are currently equipped with automatic engine-drive pumping equipment:

Table 5-2
Automatic Engine Drive Pumps (@55 psi)

Backup Type	Site #	Facility Name	Type of Equipment	Rated Capacity
Well	5	Cherry Ave	Engine back up to electrical	550 GPM
Well	7	Wiessner	Engine back up to electrical	1,400 GPM
Well	10	Chemawa	Engine drive only	2,500 GPM
Well	14	Meadows	Engine back up to electrical	1,400 GPM
Booster Pump	15	Ridge Drive	Engine drive only	2,300 GPM
Booster Pump	15	Ridge Drive	Standby generator for electrical pumps	2,200 GPM
				Total: 10,450 GPM
Future				
Booster Pump	TBD	TBD	Engine back up to electrical	2,000 GPM
				Total: 12,450 GPM

Table 5-3
Manual Engine Drive Units

Backup Type	Site #	Facility Name	Type of Equipment	Rated Capacity
Well	9	McNary	Manual engine backup to electrical	1300 GPM
Well	11	Lauderback	Manual engine backup to electrical	350 GPM (1)
				Total: 1,650 GPM

(1) Will be removed from service between 2012-2015

Total Booster Pump Capacity: 6,500 GPM
Total Well Capacity: 7,500 GPM

The present available capacity of automatic backup equipment is over 4000 GPM more than the current maximum day demand of 6,400 GPM and 2,100 GPM more than the Year 2032 maximum day demand, even without any contribution from the EST. This positive difference of emergency/standby pumping capacity indicates the current system has adequate facilities and redundancy for present conditions and that the loss of the Lauderback facility plus the addition of the third reservoir/pump station will still provide the needed capacity for future growth.

Water Right Implications

To satisfy the proposed groundwater development schedule, the City will not need to modify, obtain or secure additional water rights beyond those currently in place. The city currently holds valid permits for 36.63 CFS (16,441 GPM) for the current combined sources. All of these permits are for year round use. These permitted flows are far in excess of the required capacity and only the permits necessary for the Lacey Court well will need to be procured or transferred. Additionally, other water permits are planned to be modified or transferred to provide a better distribution between current sources.

Surface Water Development

According to information obtained from the Water Resources Department and the Willamette Basin Plan (Nov. 1994), surface water for municipal use is available from the Willamette River at Salem/Keizer. At this time, Keizer has no current or pending surface water rights applications, permits, or certificates. The amount of water available via water rights allocation from the Willamette River is far in excess of the projected water demands for Keizer through the study period. The cost associated with treatment, storage, and transmission of this source to the city, however, is felt to be economically excessive. Given the high cost of development and treatment of surface water, public resistance, the possible risk of contaminants due to local agricultural practices and upstream wastewater discharges, and the availability of adequate groundwater; development or use of any surface water source is not recommended at this time.

Groundwater

Geographically, the City of Keizer lies in the most southerly end of the French Prairie, a large, flat plain lying north of Salem, extending nearly to Canby in Clackamas County. Boundaries of the French Prairie are, in general; the Willamette River on the west and north, the Pudding and Little Pudding Rivers on the east, and the northern Salem city limits to the south. With the exception of the extreme northeast corner, which lies in Clackamas County, the French Prairie is situated entirely in Marion County.

Geologists generally describe the French Prairie as part of a broad northeastward-trending synclinal trough that is partly filled with nonmarine sedimentary deposits. These sedimentary deposits consist mainly of fine-grained lake-deposited materials that grade into courser grained river-deposited materials toward the south and east boundaries.

The surface geology of the French Prairie, lying in the vicinity of the City of Keizer, is shown in Figure 5-1, and manifests itself in two distinct well-defined geological units, namely (1) alluvium, and (2) Willamette silt. The approximate boundary between these two units is Claggett Creek, with the alluvium lying to the west and the Willamette Silt to the east. Claggett Creek flows northerly at the base of a bluff 30 feet or more in height, which forms an apparent physical boundary between the two surface geological units.

The alluvium (Qal), in terms of geological time, is very recent river deposited sand and gravels situated beneath the Willamette River flood plain. Alluvium sands and gravels are generally less than 50 feet deep. Peaty soils and some sands and gravels underlie Lake Labish. Willamette Silts (Qws) consist of tan to reddish-brown silts of uniform texture containing some thin lenses of clay and fine sand. The silts grade into predominantly fine sand near the base of the formation, and range in depth from 50 to 100 feet deep in the area of the City of Keizer.

Underlying, the two surface geological units is the Troutdale formation consisting of alternating layers of clay, silt, sand, and gravel, with gravel predominant beneath the southeastern part of the area. The Troutdale formation is approximately 250 feet deep. The geologic formations which underlie the Troutdale formation are generally quite deep and for the most part have low permeability; i.e., the capacity of a soil material to transmit water Only a few wells through the French Prairie have been drilled into the formations underlying the Troutdale formation. Therefore, for the purposes of this report, only the surface formations, i.e. alluvium and Willamette silts, and the underlying Troutdale formation will be considered as playing a significant role in the development of groundwater supplies.

Groundwater availability and its development as a source of water supply in terms of quantity and to a certain extent quality, will vary with the geological formations.

The alluvium sands and gravels of shallow depth underlying the Willamette River flood plain are generally very permeable and yield water readily to wells. Static groundwater levels in the alluvial area generally ranges from 20 to 30 feet below ground level, depending on surface topography, season of the year, and amount of rainfall. The groundwater level is maintained by the hydraulic gradient of water moving from the valley floor toward the Willamette River.

During flood stage, the hydraulic gradient may even reverse briefly and flow from the river. Withdrawal of water from existing wells has not lowered the static groundwater level in the area to any appreciable degree, although because of their shallow depth, wells in the alluvium appear to be more susceptible to variation in yield because of seasonal variation in the groundwater table. Also, shallow wells, less than 100 feet deep, are more susceptible to contamination from surface sources of pollution.

Willamette Silt has a relatively low permeability and, in general, yields water too slowly to sustain large drafts of long duration especially in the upper reaches of the formation. The lower part of the formation, consisting of fine to medium sands, probably will yield moderate quantities of water to carefully constructed wells utilizing appropriately designed and fabricated well screens.

yield wells in the area tap one or more sand, gravel or sand and gravel beds in the formation. The most permeable materials of the Troutdale formation underlie the southern part of the French Prairie, where they are predominantly coarse grained and fairly well sorted. Wells tapping the Troutdale formation have withdrawal rates ranging from several hundred to several thousand gallons per minute (gpm) with relatively small drawdowns.

In considering the continued use and further development of groundwater as the primary source of water supply, of major concern is not only adequate quantity and volume, but also satisfactory quality. Although groundwater varies somewhat in its chemical makeup from well to well, groundwater quality in the Keizer area is typically acceptable for potable uses.

Well Interference Potential

Given the fairly close proximity between the City's wells, the possibility of well interference between existing wells certainly exists. Fortunately, many of the larger wells are not frequently used at high capacities, but if prolonged or sustained high capacity pumping of the wells occurred, the very real potential exists for interference and/or excessive drawdown. If this occurred for an extended period of time, several of the smaller wells, and possibly larger wells, would most likely incur a drop in production of up to 10% - 50%. The high variable in drop of production would be related to the time of year of use (summer greater than winter), available water stored in the aquifer from recent recharge, depth and construction method of the affected well, and the proximity, rate, and duration of pumping from other nearby high capacity wells.

Recognizing this potential, future operational plans call for utilizing the stored water from the Ridge Drive, Bair Park, and future reservoirs for both minor and major peak-hour demands as much as possible. Utilizing the largest wells, Chemawa, McNary, and Wiessner for short-term, supplementary supply is recommended for optimal water system operation and aquifer efficiency. In addition, static water levels and pumping levels should be closely monitored in all wells at regular intervals. Significant changes in static or pumping water levels, decreased flows, and sand pumping are all possible indicators of well interference or well/aquifer plugging. Well performance should be monitored and determined for each well yearly using parameters such as: specific capacity, drawdown, drawdown rate, and recovery time. Periodic maintenance and rehabilitation of all wells is recommended based on specific data obtained through regular monitoring.

Chapter Six

Water Quality

Water Quality

Water quality issues will continue to significantly impact both surface and groundwater sources over the next 10 years. Strict new regulations and monitoring requirements are either presently in effect or due to be enacted during the next 2-5 years. Many of these new regulations apply to both surface and groundwater sources while some only apply to one type of source. A complete and detailed background and discussion of the Safe Drinking Water Act and its provisions can be found on the OHA/EPA websites. The water quality discussion in this update will be limited to the current and projected contaminant issues expected to impact the City of Keizer. As the City of Keizer currently utilizes only groundwater sources, the impact of proposed groundwater regulations will primarily be discussed.

Background

In 1974, the U.S. Congress passed the Safe Drinking Water Act (SDWA) with the purpose of establishing a uniform set of regulations and water quality standards. These regulations and standards applied to all "Public Water Systems" throughout the United States with the Environmental Protection Agency (EPA) providing the primary role in setting the standards. The intent of the SDWA was for individual states to assume "primacy" and provide implementation and enforcement of these standards. Oregon was one of the last states to accept primacy for the SDWA, assuming this role in 1986. The 1986 SDWA amendments were passed by Congress at the same time Oregon assumed primacy. These amendments at that time provided the most stringent regulations and standards in the history of the United States with all public water systems impacted in some form. Under those amendments, the number of individual contaminants regulated totaled 111 by 1995 with 25 new contaminants regulated every three years into the future. In addition, new regulations were enacted which provided for mandatory filtration of surface water, disinfection requirements, and lead and copper testing. The current monitoring requirements are outlined in Table 6-1. The City of Keizer by virtue of its population and number of services is classified as a "Community Water System" serving greater than 10,001 people but less than 100,000.

The SDWA, in 1996, underwent considerable changes that effected virtually every public water system in the country. The 1996 amendments, as opposed to previous SDWA laws, were prepared with assistance and input from the regulated community. This law was passed by Congress and signed into law by President Clinton on August 6, 1996 as Public Law 104-182. As expected, the SDWA revision included some relaxation in some areas and increased enforcement in other areas. A summary of the current SDWA is as follows:

Current Status of Oregon Drinking Water Quality Standards

Drinking water contaminants are defined as any substance present in drinking water that could have an adverse impact on human health if present in sufficient concentrations. Although water systems are required to routinely monitor water quality, the simple presence of a single or several contaminants does not necessarily mean that the water presents a health risk. There are currently 88 different regulated contaminants established by the United States Environmental Protection Agency (EPA). They are typically grouped into five categories:

1) Microbial Contaminants-8

   This group includes contaminants such as viruses, bacteria, and parasites; which usually result from sewage or septic system activity, agricultural and livestock operations, and/or wildlife. Turbidity is also included in this group.

2) Disinfectants and Disinfectant By-Products-7

   Chemicals used in water disinfection and the by-products that are formed as the result from the reaction between the chemicals and natural substances in the water.

3) Inorganic Chemicals-16

   This group includes such chemicals as metals and salts, which can be naturally occurring or can result from stormwater runoff, industrial or domestic wastewater discharge, and other types of industrial and commercial activity.

4) Organic Checmicals-53

   This group includes the volatile (VOC) and synthetic (SOC) organic contaminants, such as pesticides and herbicides, that originate from a variety of sources, such as agricultural, urban stormwater runoff, industrial, commercial, and even residential uses. Frequently, the organic chemicals detected in groundwater come from industrial processes and/or petroleum production, distribution, or storage. This class of contaminants often has a high affinity of "sticking" to water molecules in transit to groundwater settings and then traveling many miles down gradient to a pumping well, where they are ultimately detected. Due to that characteristic, many organic contaminants "age" and form into "daughter" products when ultimately discovered. Facilities such as gasoline stations, dry cleaning, and agricultural operations are often the originating source of organic contaminants.

5) Radiological Contaminants-4

   This category includes naturally occurring radioactive contaminants, or those that form from oil and gas production or mining operations. This class includes Radon, a radioactive gas that is often present in older, hard rock groundwater formations, such as granite.

Health Division Classification

The City of Keizer water system is regulated by the State of Oregon Health Authority Drinking Water Section (OHA-DHS) and the EPA. The identification number for the water system is PWS ID: 4100744 (41 refers to the State: Oregon). Refer to Figure 6-1 for OHA sample schedule.

Table 6-1
Community Water Systems Routine Chemical Monitoring (1)

Chemicals	Ground Water	Last Test	Next Test Due
Inorganics	Every 3 or 9 Years (4)	Varies	Varies
Arsenic	Every 3 or 9 Years	Varies	Varies
Nitrate	Annually (2)	Varies	Varies
Nitrite	Every 3 or 9 Years	Varies	Varies
Asbestos AC Pipe	Every 9 Years (3)	Varies	Varies
Source Asbestos	One	Varies	Varies
Organics (SOC & VOC)	Every 3 Years	Varies	Varies
Total Trihalomethanes	Every 3 Years	Varies	Varies
Lead and Copper	Every 3 Years	Varies	Varies

(1) This table describes the routine monitoring currently required for the City of Keizer waivers, reductions, wellhead protection programs, or detections will affect the sampling requirements. You will find details on number, location, and timing of samples in the OHA rule book.
(2) Nitrate: testing for systems can be reduced to annually after 4 consecutive quarters of sampling below 5 mg/L and a reduction is requested in writing. Some wells require quarterly monitoring of Nitrates.
(3) Asbestos: routine monitoring is one sample every nine years. Monitoring will go to one sample every 3 years if the system exceeds Lead or Cooper action levels.
(4) Reflects a Modified Schedule based on a Monitoring Reduction from 3 to 9 years.

Fluoride

The City of Keizer adds Sodium Fluoride at each well except for the McNary, Wiessner, and Chemawa wells due to their sporadic and infrequent operation. Original fluoride injection was started in 1983.

Aesthetic Concerns

Given the characteristics of Keizer's source water, aesthetic (taste, odor, and staining) problems are currently the greatest area of water quality concern. The city's finished water from the combined wells do not contain appreciable levels of iron, manganese, or hardness, which are the primary causes of staining. Customers in close proximity to wells with higher levels of iron or manganese, however, may experience staining. Long detention periods in pipelines or reservoirs can also cause isolated incidences of taste and odor complaints that can usually be remedied by line flushing or tank drain/refill cycles. Continuous or frequent operation of the Meadows and McNary wells do result in higher iron and manganese levels due to the background water quality of these wells. To lessen the effect of iron and manganese, several wells are equipped with chemical feed equipment used to inject sequesterants. Sequesterents are used to bind or "tie up" iron and manganese in elemental form in water supplies, preventing or lessening combining with oxygen (air), resulting in oxidation and precipitation and then leading to staining impacts to customers. The use of this chemical is very common and often successful under proper application. In this case, this chemical should be applied as a sequesterant rather than as a corrosion inhibitor.

Volatile Organic Contaminants

During the decade between 2000-2010, low levels of several water contaminants, classified within as Volatile Organic Contaminants (VOC's), were identified in various Keizer wells, notably Willamette Manor, Carlhaven West, and the former Toni and Burnside wells. These

contaminants were Chloroform, Isopropylbenzene, Tetrachloroethene, and Trichloroethene. All of these contaminants, when present, were in levels below the applicable maximum contaminant level (MCL), however, repeated testing indicated a gradual rise in the levels, primarily for Tetrachloroethene and/or Trichloroethene.

Although the original source(s) have not been positively identified, to date, the suspected sources are a former dry cleaning establishment on Cherry and Manbrin Avenues and an unknown origin located to the south of Keizer. The most recent tests, performed as an element of the EPA assessment of local groundwater contamination in the Summer of 2012, indicates a widespread and significant plume of VOC contamination exists in the shallow groundwater aquifer underlying much of the city, notably within the Manbrin Gardens/River Road area. Since these contaminants are known to be present and in rising concentrations, a program to identify and install equipment for removal (air stripping) is planned for the first phase of the Capital Improvement Plan.

Groundwater Specific Issues

In addition to the previously outlined observations and recommendations regarding VOC, SOC, bacteria, and other water quality concerns, new regulations have impacted the use and treatment of groundwater. The recently adopted Groundwater Disinfection Rule has had a significant impact on Keizer since many of the sources were previously deemed as potentially vulnerable to viral contamination. In February 2001, the Burnside, Toni, Delta, and the 3 Wilark wells were classified as "potentially vulnerable" as outlined in correspondence from the Oregon Health Division. The source water assessment included these specific wells considered to be potentially sensitive to viral contamination, necessitating replacement or enhanced water quality monitoring. Individual sensitivity determinations and general recommendations were evaluated and included within the 2001 master plan update capital improvement program, to be implemented during the first 1- 2 phases of improvements. During the period between 2000 through 2012, all of the wells, with the exception of the Lauderback well, deemed to be "sensitive" by the Oregon Health Division (now Authority) were either fully abandoned and removed from service or replaced with a new well with a deeper sanitary seal. The planned abandonment of the Lauderback well will remove the last well of concern. Continued monitoring and control of nearby fertilizer and pesticide application within each well recharge area should be performed by the city for each well. Additionally, the city has implemented a quarterly nitrate sampling program for the wells with elevated (>5 mg/L) levels of Nitrates by State mandate.

Viral and/or bacterial pathogens, often found in fecal contamination from animal and human feces, can readily reach groundwater and, in turn, drinking water supplies, through shallow or even deep wells via a route of inadequate or defective well depth or sanitary seals, broken or corroded well casings, wellhead flooding, failed septic systems, and/or wells constructed too close to a septic drainfield, in addition to other means. Waterborne diseases, caused from viral or bacterial pathogens, usually results in gastrointestinal symptoms, such as diarrhea and/or vomiting, that usually does not require medical attention for healthy adults, but can be very serious, or even fatal, to high-risk groups of the population, such as young children, the elderly, and people with compromised immune systems. Although the available data does not indicate that any more than a small percentage of wells or aquifers actually have the presence of fecal contamination, the

severity of the possible health impacts, and the number of affected water consumers potentially exposed to the pathogens, indicated that some type of regulatory response was needed. The GWR applies to more than 150,000 public water systems serving more than 100 million consumers in the United States and is also applicable to water systems where ground water supplies are mixed with surface water supplies in which the ground water system is not treated to the same level as the surface water supply. The rule was originally proposed by the EPA on May 10, 2000, signed into law on October 11, 2006, published in the Federal Register on November 8, 2006, and took effect on January 8, 2007.

The Science of the GWR

A basic understanding of the Ground Water Rule requires some discussion of the science and logic behind the reasons for the rule. As previously indicated above, the GWR has been promulgated to provide for an increased level of protection against viral and bacterial pathogens in public water systems that use ground water. Specifically, the EPA is concerned with ground water systems that are exposed or susceptible to fecal contamination because these systems are at a far greater risk of passing harmful pathogens into a water supply. Several viral pathogens are known to exist in ground water aquifers, such as Hepatitis A and E, Coxsackie viruses, Echovirus, and Noroviruses, while bacterial pathogens found in ground water include the well-known strain of Escherichia coli (E. coli), in addition to other lesser-known bacterial pathogens such as Salmonella and Shigella. Due to the known relationship between the possible coincidental presence of fecal contamination and pathogenic viruses and bacteria in a water supply, and the fact that presumptive and rapid laboratory tests for viruses are not readily available, the EPA has established the presence of fecal contamination in a ground water supply as the prime indicator for the possible presence of pathogenic viruses or bacteria. In addition, fecal contamination is presumed to be present when one or more specific fecal indicators in the water are present. The three fecal indicators that have been selected for use in the Ground Water Rule are: E. coli, enterococci, and coliphage. Each of these indicators can be easily detected via various analytical methods commonly available through approved testing labs. Although fecal indicators, by themselves, are not typically harmful when ingested, their presence in ground water is a presumptive indication that fecal contamination is also present, which, in turn, provides a strong indication that viral and/or bacterial pathogens, or at the very least, a pathway for these pathogens, may also be present into the ground water supply. This, in a nutshell, forms the basis of the science of the Ground Water Rule.

In order to identify ground water systems at risk to fecal contamination, the EPA has established a "risk-targeted" approach to identify these systems. The risk targeted approach relies on and evaluates four major components:

1) Periodic Sanitary Surveys of ground water systems that require the evaluation of eight critical elements: 1. source, 2. treatment, 3. distribution system, 4. finished water storage, 5. pumps, pump facilities, and controls, 6. monitoring, reporting, and data collection, 7. system management and operation, and 8. operator compliance with state requirements. States have until December 31, 2012 to complete the initial sanitary survey cycle for community water systems and until December 31, 2014 for all non-community water systems and systems that already meet the performance

criteria. The sanitary surveys will be used to identify water systems with significant deficiencies or systems that already have source water problems;

2) Source water monitoring that is triggered when a water system identifies a confirmed positive coliform sample during its routine Total Coliform Rule monitoring as well as state optional assessment monitoring at high risk systems;

3) Corrective action is required when a water system is identified to have a significant deficiency or source water contamination, and;

4) Compliance monitoring to ensure that an adequate level of treatment is provided to reliably treat drinking water in order to achieve at least 99.99% (4-log) inactivation or removal of viruses.

The projected average cost to implement the GWR is less than $5.00 per year for 90% of the U.S. households served by public ground water systems. Over $3.6 billion dollars has been earmarked to ensure that drinking water systems comply with the Safe Drinking Water Act. Much of these funds are already available for low-interest loans to qualified water systems. The city is taking a proactive approach.

Inorganic Contaminants

Inorganic contaminants, commonly referred to as "Primary" contaminants, include 15 regulated metals and minerals such as Arsenic, Barium, Cadmium, etc. Inorganics can be either naturally-occurring or present due to agricultural or industrial uses. Inorganic contaminants most often originate from the source of water supply, but can also be present due to water contact with pipeline and storage tank materials. For most inorganic contaminants, health concerns are related to long-term or lifetime exposures with the exception of Arsenic, Nitrates and Nitrites. These final two contaminants can seriously affect infants in short-term exposures by interfering with the transfer of oxygen from the lungs to the bloodstream.

Arsenic

Arsenic is a regulated inorganic contaminant that has recently been under increased scrutiny by the EPA. The current maximum contaminant level of .010 mg/L is easily met by Keizer's source water. The Arsenic Rule was implemented in 2001 which lowered the MCL or MCLG from .050 mg/L to .010 mg/L. This is expected to create a severe hardship on many utilities. Currently, all of the city's tests for Arsenic show levels less than .005 mg/L. Increased or more precise monitoring may be required in the future, however, as of the date of this plan, this potential is not known.

Nitrates

A separate discussion regarding Nitrates is warranted due to the past history of elevated levels of this contaminant, particularly from the Delta, 17th, and 13th Ave wells. As previously indicated, Nitrates in drinking water can cause elevated Nitrogen levels in blood, especially in infants and young children occasionally resulting in "blue baby" syndrome.

Before the well was relocated and redrilled, the Nitrate level present from the Delta well averaged the highest level of any well since the well's activation in 1983. On several occasions, the test results were barely under the maximum contaminant level of 10 mg/L. The tests performed on water from the 13th Avenue and 17th Avenue wells on the same date showed Nitrate levels of 4.6 mg/l and 5.2 mg/l, respectively. During episodes of elevated Nitrate levels, the city blends water from the remaining wells to lower Nitrate levels to customers. This is an acceptable method of short term Nitrate control when properly executed, however, customers close to the respective wells high in Nitrate will undoubtedly receive higher levels of Nitrates than other consumers. The increase in Nitrate levels observed during winter and spring months raised a concern in regard to sustained higher capacity pumping from this well. In order to correct this situation, reconstruction of the Delta well was proposed in the 2001 Water System Master Plan Update CIP. Upon initiating the process, however, it was determined that reconstruction of the existing well was cost-prohibitive. A new replacement well was constructed on the same site in 2006 and the existing well abandoned. The new well was sealed through the previously used upper aquifer and the levels of nitrates from water delivered from the new well are well below the MCL. Currently, the level of nitrates from all sources average below 5.0 mg/L (50% of the MCL), with most results displaying less than 2.0 mg/L.

Trihalomethanes (Disinfection-By Products)

Common disinfection treatment used to kill micro-organisms in drinking water, such as chlorine, can react with naturally occurring organic and inorganic material in water to form disinfection by-products. These disinfection by-products are suspected carcinogens over a lifetime of exposure. Total trihalomethane (TTHM) testing is required for cities with population greater than 10,000. Currently, the City of Keizer does not add disinfection products to the water, therefore, the potential for TTHM formation is low.

Coliform Bacteria

The Total Coliform Rule affected all public water systems in Oregon beginning in 1991. Coliform bacteria is the primary measure of the microbial quality of drinking water. Coliform is a group of generally harmless bacteria that are naturally present in the environment and are used as an indicator that other, potentially harmful, bacteria may be present. All Oregon water suppliers, within the projected population ranges of Keizer, are required to test for coliform bacteria according to the following monitoring guidelines:

Table 6-2
Coliform Monitoring Frequency

Population	Samples per Month
25,0001-33,000	30
33,001-41,000	40

Currently, the City of Keizer by virtue of a population of 36,735 must test for coliform bacteria forty times per month. As the City grows in population over *40*,000, increased monitoring will be required in the future. Information obtained from the Oregon Health Authority indicates consistently negative coliform bacteria tests since 1990. The City, however, has experienced occasional positive Total Coliform samples, which was believed

to be due to biofilm growth in the pipeline or sampling errors. Subsequent repeat testing indicated negative coliform results.

Consumer Confidence Reports

The City of Keizer was required to initially issue consumer confidence reports (CCR) to all water consumers by October 19,1999 and by July 1st each year thereafter, for subsequent calendar years. The 2011 CCR is included for reference within this report. The CCR is basically an annual report card which informs water customers whether or not their water system meets federal guidelines.

In the case of Keizer, specific information regarding source quality, susceptibility, and additional water quality data must be *evaluated* and incorporated into the CCR. The water supplier must mail or otherwise deliver a water bill and must make a good faith effort to deliver to non-bill paying consumers. Water systems that serve fewer than 10,000 but not less than 500 persons must publish the CCR in at least one local newspaper. The following information must be included in the CCR:

1. The source(s) of drinking water(springs, wells, rivers, etc.)

2. A brief summary of the susceptibility to contamination of the source water based upon the source water assessments as they are completed by the states *over* the next 3 years.

3. Instructions on obtaining a copy of the water system's source water assessments.

4. A table showing the highest *level* of any contaminant detected in their drinking water plus EPA's health based standard (maximum contaminant *level)* for that contaminant for comparison and the probable source of the contaminant.

5. The water system's compliance with other drinking-water-related rules including monitoring.

6. An educational statement for vulnerable populations. Individuals who have suppressed immune systems caused by chemotherapy, organ transplants, AIDS, etc. fall into this category.

7. Educational information on nitrate, arsenic, or lead where the contaminants are detected above 50 percent of EPA's maximum contaminant levels.

8. The phone numbers for additional sources of information available from the water system's staff or EPA's Safe Drinking Water Hotline (800) 426-4791 .

9. The rule specifies how the data is to be presented, with specific instructions for reporting and explaining results for turbidity, lead and copper, total and fecal coliform, cryptosporidium, radon, arsenic, nitrate, and any other contaminants.

Complete information regarding preparation and distribution of the CCR is available from the Oregon Health Authority.

Lead and Copper Rule

The primary purpose of this rule is to address possible lead and copper contamination from materials commonly found in customer services. The rule was promulgated by the EPA on June 7, 1991 and the City has performed 11 rounds of testing to date. The rule established "Action" levels of .015 mg/l for lead and 1.3 mg/l for copper. None of the sources has naturally occurring lead or copper. Since the City's distribution system does not contain any known lead, copper would be the most expected element to occur. The first round of lead and Copper testing was performed in 1992. The 90th percentile Copper level observed in this first round was .374 mg/l, well below the action level of 1.3 mg/l. The city is now on a three year testing cycle with the most recent testing, performed in July of 2011, indicated no detectable lead and a .271 mg/L level for copper.

Radiological (Gross Alpha)

The current federal rule for radiological sampling (Radionuclides) requires 1 sample every 6 or 9 years, depending on the well. All past tests that have been performed have indicated low levels or the presence of any Radionuclides. Radioactivity is uncommon from shallow ground water sources and is generally found in deep groundwater sources that are subject to a much longer and greater natural radioactivity exposure such as basalt or granite.

Secondary Contaminants

Secondary contaminants are not regulated contaminants but do include water quality parameters that can affect aesthetic conditions and taste and odor concerns. Because aesthetic water quality conditions are often the most apparent to customers, a discussion of their impact is included.

Table 6-3
Secondary Contaminants

Parameter	Suggested Limit	15 Well Average Values
pH	6.5-8.5	7.48
Alkalinity	None	135
Calcium	None	27.5
Chloride	<250 mg/L	8.4
Hardness	<250 mg/L	141
Iron	.3 mg/L	<.1
Manganese	.05 mg/L	.09
Sodium	10 mg/L	18
Sulfate	250 mg/L	5.6
Total Solids	500	182
Zinc	5	<.01

The only secondary water quality constituents that cause concern at this time are the iron and manganese levels present in several wells. As outlined in other chapters of this report, these levels are typical for most wells in this vicinity.

PWS #: 00744 KEIZER, CITY OF Routine Sampling Schedules For Chemicals

Facility ID	Name	Status	Test Group	Samples Required	Sampling Interval	Start	End	Notes*
DIST-A	Distribution System	A	LEAD & COPPER	30	3 Years	01/01/2002	Open	Sample Between June 1st and Sept 30th
EP-D	EP FOR CHEMAWA	A	ARSENIC	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
EP-D	EP FOR CHEMAWA	A	IOC	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-D	EP FOR CHEMAWA	A	NITRATE	1	Yearly	01/01/2002	Open	Sample in the 1st Quarter
EP-D	EP FOR CHEMAWA	A	NITRITE	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-D	EP FOR CHEMAWA	A	RAD - GROSS ALPHA	1	6 Years	01/01/2008	Open	
EP-D	EP FOR CHEMAWA	A	RAD - RADIUM 226/228	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-D	EP FOR CHEMAWA	A	RAD - URANIUM	1	6 Years	01/01/2008	Open	
EP-D	EP FOR CHEMAWA	A	SOC	2	3 Years	01/01/2002	Open	2 Consec. QT Samples
EP-D	EP FOR CHEMAWA	A	VOLATILE ORGANICS	1	3 Years	01/01/2002	Open	
EP-E	EP FOR CHERRY AVENUE	A	ARSENIC	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
EP-E	EP FOR CHERRY AVENUE	A	IOC	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-E	EP FOR CHERRY AVENUE	A	NITRATE	1	Yearly	01/01/2002	Open	Sample in the 1st Quarter
EP-E	EP FOR CHERRY AVENUE	A	NITRITE	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-E	EP FOR CHERRY AVENUE	A	RAD - GROSS ALPHA	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-E	EP FOR CHERRY AVENUE	A	RAD - RADIUM 226/228	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-E	EP FOR CHERRY AVENUE	A	RAD - URANIUM	1	6 Years	01/01/2008	Open	
EP-E	EP FOR CHERRY AVENUE	A	SOC	2	3 Years	01/01/2002	Open	2 Consec. QT Samples
EP-E	EP FOR CHERRY AVENUE	A	VOLATILE ORGANICS	1	3 Years	01/01/2002	Open	
EP-G	EP FOR LAUDERBACK	A	ARSENIC	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
EP-G	EP FOR LAUDERBACK	A	IOC	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-G	EP FOR LAUDERBACK	A	NITRATE	1	Yearly	01/01/2002	Open	Sample in the 1st Quarter
EP-G	EP FOR LAUDERBACK	A	NITRITE	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-G	EP FOR LAUDERBACK	A	RAD - GROSS ALPHA	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-G	EP FOR LAUDERBACK	A	RAD - RADIUM 226/228	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-G	EP FOR LAUDERBACK	A	RAD - URANIUM	1	6 Years	01/01/2008	Open	
EP-G	EP FOR LAUDERBACK	A	SOC	2	3 Years	01/01/2002	Open	2 Consec. QT Samples
EP-G	EP FOR LAUDERBACK	A	VOLATILE ORGANICS	1	3 Years	01/01/2002	Open	
EP-H	EP FOR McNARY	A	ARSENIC	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
								Schedule Reflects Monitoring Reduction

FIGURE 6-1

EP-H	EP FOR McNARY	A	IOC	1	9 Years	01/01/2002	Open	Granted
EP-H	EP FOR McNARY	A	NITRATE	1	Yearly	01/01/2002	Open	Sample in the 1st Quarter
EP-H	EP FOR McNARY	A	NITRITE	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-H	EP FOR McNARY	A	RAD - GROSS ALPHA	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-H	EP FOR McNARY	A	RAD - RADIUM 226/228	1	6 Years	01/01/2008	Open	
EP-H	EP FOR McNARY	A	RAD - URANIUM	1	6 Years	01/01/2008	Open	
EP-H	EP FOR McNARY	A	SOC	2	3 Years	01/01/2002	Open	2 Consec. QT Samples
EP-H	EP FOR McNARY	A	VOLATILE ORGANICS	1	3 Years	01/01/2002	Open	
EP-J	EP FOR WIESSNER	A	ARSENIC	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
EP-J	EP FOR WIESSNER	A	IOC	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-J	EP FOR WIESSNER	A	NITRATE	1	Yearly	01/01/2002	Open	Sample in the 1st Quarter
EP-J	EP FOR WIESSNER	A	NITRITE	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-J	EP FOR WIESSNER	A	RAD - GROSS ALPHA	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-J	EP FOR WIESSNER	A	RAD - RADIUM 226/228	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-J	EP FOR WIESSNER	A	RAD - URANIUM	1	6 Years	01/01/2008	Open	
EP-J	EP FOR WIESSNER	A	SOC	2	3 Years	01/01/2002	Open	2 Consec. QT Samples
EP-J	EP FOR WIESSNER	A	VOLATILE ORGANICS	1	3 Years	01/01/2002	Open	
EP-K	EP FOR WILLAMETTE MANOR	A	ARSENIC	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
EP-K	EP FOR WILLAMETTE MANOR	A	IOC	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-K	EP FOR WILLAMETTE MANOR	A	NITRATE	1	Yearly	01/01/2002	Open	Sample in the 1st Quarter
EP-K	EP FOR WILLAMETTE MANOR	A	NITRITE	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-K	EP FOR WILLAMETTE MANOR	A	RAD - GROSS ALPHA	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-K	EP FOR WILLAMETTE MANOR	A	RAD - RADIUM 226/228	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-K	EP FOR WILLAMETTE MANOR	A	RAD - URANIUM	1	6 Years	01/01/2008	Open	
EP-K	EP FOR WILLAMETTE MANOR	A	SOC	2	3 Years	01/01/2002	Open	2 Consec. QT Samples
EP-K	EP FOR WILLAMETTE MANOR	A	TETRACHLOROETHYLENE	1	Yearly	01/01/2010	Open	Sample in the 1st Quarter
EP-K	EP FOR WILLAMETTE MANOR	A	TRICHLOROETHYLENE	1	Yearly	01/01/2010	Open	Sample in the 1st Quarter.
EP-K	EP FOR WILLAMETTE MANOR	A	VOLATILE ORGANICS	1	3 Years	01/01/2002	Open	
EP-N	EP FOR MEADOWS	A	ARSENIC	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
EP-N	EP FOR MEADOWS	A	IOC	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-N	EP FOR MEADOWS	A	NITRATE	1	Yearly	01/01/2002	Open	Sample in the 1st Quarter
EP-N	EP FOR MEADOWS	A	NITRITE	1	9 Years	01/01/2002	Open	Schedule Reflects Monitoring Reduction Granted
EP-N	EP FOR MEADOWS	A	RAD - GROSS ALPHA	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-N	EP FOR MEADOWS	A	RAD - RADIUM 226/228	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-N	EP FOR MEADOWS	A	RAD - URANIUM	1	6 Years	01/01/2008	Open	
EP-N	EP FOR MEADOWS	A	SOC	2	3 Years	01/01/2002	Open	2 Consec. QT Samples

EP-N	EP FOR MEADOWS	A	VOLATILE ORGANICS	1	3 Years	01/01/2002	Open	
EP-O	EP FOR RIDGE DRIVE	A	ARSENIC	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
EP-O	EP FOR RIDGE DRIVE	A	IOC	1	3 Years	01/01/2005	Open	
EP-O	EP FOR RIDGE DRIVE	A	NITRATE	1	Yearly	01/01/2004	Open	Sample in the 1st Quarter
EP-O	EP FOR RIDGE DRIVE	A	NITRITE	1	3 Years	01/01/2005	Open	
EP-O	EP FOR RIDGE DRIVE	A	RAD - GROSS ALPHA	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-O	EP FOR RIDGE DRIVE	A	RAD - RADIUM 226/228	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-O	EP FOR RIDGE DRIVE	A	RAD - URANIUM	1	6 Years	01/01/2008	Open	
EP-O	EP FOR RIDGE DRIVE	A	SOC	2	3 Years	01/01/2005	Open	2 Consec. QT Samples
EP-O	EP FOR RIDGE DRIVE	A	VOLATILE ORGANICS	1	3 Years	01/01/2005	Open	
EP-P	EP FOR REITZ	A	ARSENIC	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
EP-P	EP FOR REITZ	A	IOC	1	3 Years	01/01/2005	Open	
EP-P	EP FOR REITZ	A	NITRATE	1	Yearly	01/01/2006	Open	
EP-P	EP FOR REITZ	A	NITRITE	1	3 Years	01/01/2005	Open	
EP-P	EP FOR REITZ	A	RAD - GROSS ALPHA	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-P	EP FOR REITZ	A	RAD - RADIUM 226/228	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-P	EP FOR REITZ	A	RAD - URANIUM	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-P	EP FOR REITZ	A	SOC	2	3 Years	01/01/2005	Open	2 Consec. QT Samples
EP-P	EP FOR REITZ	A	VOLATILE ORGANICS	1	3 Years	01/01/2005	Open	
EP-Q	EP FOR KEIZER STATION	A	ARSENIC	1	3 Years	01/01/2008	Open	
EP-Q	EP FOR KEIZER STATION	A	IOC	1	3 Years	01/01/2008	Open	
EP-Q	EP FOR KEIZER STATION	A	NITRATE	1	Yearly	01/01/2007	Open	
EP-Q	EP FOR KEIZER STATION	A	NITRITE	1	3 Years	01/01/2008	Open	
EP-Q	EP FOR KEIZER STATION	A	RAD - GROSS ALPHA	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-Q	EP FOR KEIZER STATION	A	RAD - RADIUM 226/228	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-Q	EP FOR KEIZER STATION	A	RAD - URANIUM	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-Q	EP FOR KEIZER STATION	A	SOC	2	3 Years	01/01/2005	Open	2 Consec. QT Samples
EP-Q	EP FOR KEIZER STATION	A	VOLATILE ORGANICS	1	3 Years	01/01/2005	Open	
EP-R	EP FOR DELTA	A	ARSENIC	1	3 Years	01/01/2008	Open	
EP-R	EP FOR DELTA	A	IOC	1	3 Years	01/01/2008	Open	
EP-R	EP FOR DELTA	A	NITRATE	1	Yearly	01/01/2007	Open	
EP-R	EP FOR DELTA	A	NITRITE	1	3 Years	01/01/2008	Open	
EP-R	EP FOR DELTA	A	RAD - GROSS ALPHA	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-R	EP FOR DELTA	A	RAD - RADIUM 226/228	1	6 Years	01/01/2008	Open	
EP-R	EP FOR DELTA	A	RAD - URANIUM	1	9 Years	01/01/2008	Open	Schedule Reflects Monitoring Reduction Granted
EP-R	EP FOR DELTA	A	SOC	2	3 Years	01/01/2005	Open	2 Consec. QT Samples
EP-R	EP FOR DELTA	A	VOLATILE ORGANICS	1	3 Years	01/01/2005	Open	
EP-S	EP FOR CITY HALL	A	ARSENIC	1	3 Years	01/01/2008	Open	
EP-S	EP FOR CITY HALL	A	IOC	1	3 Years	01/01/2008	Open	
EP-S	EP FOR CITY HALL	A	NITRATE	1	Yearly	01/01/2008	Open	
EP-S	EP FOR CITY HALL	A	NITRITE	1	3 Years	01/01/2008	Open	

EP-S	EP FOR CITY HALL	A	RAD - GROSS ALPHA	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
EP-S	EP FOR CITY HALL	A	RAD - RADIUM 226/228	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
EP-S	EP FOR CITY HALL	A	RAD - URANIUM	1	9 Years	01/01/2011	Open	Schedule Reflects Monitoring Reduction Granted
EP-S	EP FOR CITY HALL	A	SOC	2	3 Years	01/01/2008	Open	2 Consec. QT Samples
EP-S	EP FOR CITY HALL	A	VOLATILE ORGANICS	1	3 Years	01/01/2008	Open	
EP-T	EP FOR CARLHAVEN WEST	A	ARSENIC	1	3 Years	01/01/2011	Open	
EP-T	EP FOR CARLHAVEN WEST	A	IOC	1	3 Years	01/01/2011	Open	
EP-T	EP FOR CARLHAVEN WEST	A	NITRATE	1	Yearly	01/01/2011	Open	
EP-T	EP FOR CARLHAVEN WEST	A	NITRITE	1	3 Years	01/01/2011	Open	
EP-T	EP FOR CARLHAVEN WEST	A	RAD - GROSS ALPHA	1	6 Years	01/01/2014	Open	
EP-T	EP FOR CARLHAVEN WEST	A	RAD - RADIUM 226/228	1	6 Years	01/01/2014	Open	
EP-T	EP FOR CARLHAVEN WEST	A	RAD - URANIUM	1	9 Years	01/01/2014	Open	Schedule Reflects Monitoring Reduction Granted
EP-T	EP FOR CARLHAVEN WEST	A	SOC	1	Yearly	01/01/2011	Open	
EP-T	EP FOR CARLHAVEN WEST	A	VOLATILE ORGANICS	1	Yearly	01/01/2011	Open	
EP-U	EP FOR CARLHAVEN EAST	A	ARSENIC	1	3 Years	01/01/2011	Open	
EP-U	EP FOR CARLHAVEN EAST	A	IOC	1	3 Years	01/01/2011	Open	
EP-U	EP FOR CARLHAVEN EAST	A	NITRATE	1	Yearly	01/01/2011	Open	
EP-U	EP FOR CARLHAVEN EAST	A	NITRITE	1	3 Years	01/01/2011	Open	
EP-U	EP FOR CARLHAVEN EAST	A	RAD - GROSS ALPHA	1	6 Years	01/01/2014	Open	
EP-U	EP FOR CARLHAVEN EAST	A	RAD - RADIUM 226/228	1	6 Years	01/01/2014	Open	
EP-U	EP FOR CARLHAVEN EAST	A	RAD - URANIUM	1	9 Years	01/01/2014	Open	Schedule Reflects Monitoring Reduction Granted
EP-U	EP FOR CARLHAVEN EAST	A	SOC	1	Yearly	01/01/2011	Open	
EP-U	EP FOR CARLHAVEN EAST	A	VOLATILE ORGANICS	1	Yearly	01/01/2011	Open	
EP-V	EP FOR 17TH AVENUE	A	ARSENIC	1	3 Years	01/01/2011	Open	
EP-V	EP FOR 17TH AVENUE	A	IOC	1	3 Years	01/01/2011	Open	
EP-V	EP FOR 17TH AVENUE	A	NITRATE	1	Yearly	01/01/2012	Open	
EP-V	EP FOR 17TH AVENUE	A	NITRITE	1	3 Years	01/01/2011	Open	
EP-V	EP FOR 17TH AVENUE	A	RAD - GROSS ALPHA	1	Quarterly	10/01/2012	Open	
EP-V	EP FOR 17TH AVENUE	A	RAD - RADIUM 226/228	1	Quarterly	10/01/2012	Open	
EP-V	EP FOR 17TH AVENUE	A	RAD - URANIUM	1	Quarterly	10/01/2012	Open	
EP-V	EP FOR 17TH AVENUE	A	SOC	1	Yearly	01/01/2012	Open	
EP-V	EP FOR 17TH AVENUE	A	VOLATILE ORGANICS	1	Yearly	01/01/2012	Open	

Chemical Sampling Schedule Status OR4100744 -- KEIZER, CITY OF

Sample Point ID	Analyte Group or Analyte		Sampling Interval	Monitoring Period Start	Monitoring Period End	Days Until End	Samples Required	Samples Received	Last Sample Date
DIST-A Distribution System	LEAD & COPPER	notes	3 Years				30	done	07/21/2011
					Seasonal sampling period:		06/01 thru 09/30		
EP-D EP FOR CHEMAWA	ARSENIC	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	05/15/2008
EP-D EP FOR CHEMAWA	IOC	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	07/18/2002
EP-D EP FOR CHEMAWA	NITRATE	notes	Yearly	01/01/2012 -	12/31/2012	48	1	done	01/18/2012
EP-D EP FOR CHEMAWA	NITRITE	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	07/18/2002
EP-D EP FOR CHEMAWA	RAD - GROSS ALPHA		6 Years	01/01/2008 -	12/31/2013	413	1	Incomplete	
EP-D EP FOR CHEMAWA	RAD - RADIUM 226/228	notes	9 Years	01/01/2008 -	12/31/2016	1509	1	Incomplete	07/22/2003
EP-D EP FOR CHEMAWA	RAD - URANIUM		6 Years	01/01/2008 -	12/31/2013	413	1	Incomplete	07/22/2003
EP-D EP FOR CHEMAWA	SOC	notes	3 Years	01/01/2011 -	12/31/2013	413	2	Incomplete	11/17/2008
EP-D EP FOR CHEMAWA	VOLATILE ORGANICS		3 Years	01/01/2011 -	12/31/2013	413	1	done	07/28/2011
EP-E EP FOR CHERRY AVENUE	ARSENIC	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	05/15/2008
EP-E EP FOR CHERRY AVENUE	IOC	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	07/18/2002
EP-E EP FOR CHERRY AVENUE	NITRATE	notes	Yearly	01/01/2012 -	12/31/2012	48	1	done	01/18/2012
EP-E EP FOR CHERRY AVENUE	NITRITE	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	07/18/2002
EP-E EP FOR CHERRY AVENUE	RAD - GROSS ALPHA	notes	9 Years	01/01/2008 -	12/31/2016	1509	1	Incomplete	
EP-E EP FOR CHERRY AVENUE	RAD - RADIUM 226/228	notes	9 Years	01/01/2008 -	12/31/2016	1509	1	Incomplete	07/22/2003
EP-E EP FOR CHERRY AVENUE	RAD - URANIUM		6 Years	01/01/2008 -	12/31/2013	413	1	Incomplete	07/22/2003
EP-E EP FOR CHERRY AVENUE	SOC	notes	3 Years	01/01/2011 -	12/31/2013	413	2	Incomplete	11/17/2008
EP-E EP FOR CHERRY AVENUE	VOLATILE ORGANICS		3 Years	01/01/2011 -	12/31/2013	413	1	done	07/28/2011
EP-G EP FOR LAUDERBACK	ARSENIC	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	05/15/2008
EP-G EP FOR LAUDERBACK	IOC	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	07/18/2002
EP-G EP FOR LAUDERBACK	NITRATE	notes	Yearly	01/01/2012 -	12/31/2012	48	1	done	01/18/2012
EP-G EP FOR LAUDERBACK	NITRITE	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	07/18/2002
EP-G EP FOR LAUDERBACK	RAD - GROSS ALPHA	notes	9 Years	01/01/2008 -	12/31/2016	1509	1	Incomplete	
EP-G EP FOR LAUDERBACK	RAD - RADIUM 226/228	notes	9 Years	01/01/2008 -	12/31/2016	1509	1	Incomplete	07/22/2003
EP-G EP FOR LAUDERBACK	RAD - URANIUM		6 Years	01/01/2008 -	12/31/2013	413	1	Incomplete	07/22/2003
EP-G EP FOR LAUDERBACK	SOC	notes	3 Years	01/01/2011 -	12/31/2013	413	2	Incomplete	11/17/2008
EP-G EP FOR LAUDERBACK	VOLATILE ORGANICS		3 Years	01/01/2011 -	12/31/2013	413	1	done	07/28/2011
EP-H EP FOR McNARY	ARSENIC	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	05/15/2008
EP-H EP FOR McNARY	IOC	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	07/18/2002
EP-H EP FOR McNARY	NITRATE	notes	Yearly	01/01/2012 -	12/31/2012	48	1	done	01/18/2012
EP-H EP FOR McNARY	NITRITE	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	07/18/2002
EP-H EP FOR McNARY	RAD - GROSS ALPHA	notes	9 Years	01/01/2008 -	12/31/2016	1509	1	Incomplete	
EP-H EP FOR McNARY	RAD - RADIUM 226/228		6 Years	01/01/2008 -	12/31/2013	413	1	Incomplete	07/22/2003
EP-H EP FOR McNARY	RAD - URANIUM		6 Years	01/01/2008 -	12/31/2013	413	1	Incomplete	07/22/2003
EP-H EP FOR McNARY	SOC	notes	3 Years	01/01/2011 -	12/31/2013	413	2	Incomplete	11/17/2008
EP-H EP FOR McNARY	VOLATILE ORGANICS		3 Years	01/01/2011 -	12/31/2013	413	1	done	07/28/2011
EP-J EP FOR WIESSNER	ARSENIC	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	06/10/2008
EP-J EP FOR WIESSNER	IOC	notes	9 Years	01/01/2011 -	12/31/2019	2604	1	Incomplete	07/18/2002
EP-J EP FOR WIESSNER	NITRATE	notes	Yearly	01/01/2012 -	12/31/2012	48	1	done	01/18/2012

EP-J	EP FOR WIESSNER	NITRITE	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	07/18/2002
EP-J	EP FOR WIESSNER	RAD - GROSS ALPHA	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	
EP-J	EP FOR WIESSNER	RAD - RADIUM 226/228	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	07/22/2003
EP-J	EP FOR WIESSNER	RAD - URANIUM		6 Years	01/01/2008 - 12/31/2013	413	1	Incomplete	07/22/2003
EP-J	EP FOR WIESSNER	SOC	notes	3 Years	01/01/2011 - 12/31/2013	413	2	Incomplete	11/17/2008
EP-J	EP FOR WIESSNER	VOLATILE ORGANICS		3 Years	01/01/2011 - 12/31/2013	413	1	done	07/28/2011
EP-K	EP FOR WILLAMETTE MANOR	TRICHLOROETHYLENE	notes	Yearly	01/01/2012 - 12/31/2012	48	1	done	10/10/2012
EP-K	EP FOR WILLAMETTE MANOR	TETRACHLOROETHYLENE	notes	Yearly	01/01/2012 - 12/31/2012	48	1	done	10/10/2012
EP-K	EP FOR WILLAMETTE MANOR	ARSENIC	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	05/15/2008
EP-K	EP FOR WILLAMETTE MANOR	IOC	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	07/18/2002
EP-K	EP FOR WILLAMETTE MANOR	NITRATE	notes	Yearly	01/01/2012 - 12/31/2012	48	1	done	01/18/2012
EP-K	EP FOR WILLAMETTE MANOR	NITRITE	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	07/18/2002
EP-K	EP FOR WILLAMETTE MANOR	RAD - GROSS ALPHA	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	
EP-K	EP FOR WILLAMETTE MANOR	RAD - RADIUM 226/228	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	07/22/2003
EP-K	EP FOR WILLAMETTE MANOR	RAD - URANIUM		6 Years	01/01/2008 - 12/31/2013	413	1	Incomplete	07/22/2003
EP-K	EP FOR WILLAMETTE MANOR	SOC	notes	3 Years	01/01/2011 - 12/31/2013	413	2	Incomplete	12/09/2008
EP-K	EP FOR WILLAMETTE MANOR	VOLATILE ORGANICS		3 Years	01/01/2011 - 12/31/2013	413	1	done	10/10/2012
EP-N	EP FOR MEADOWS	ARSENIC	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	05/15/2008
EP-N	EP FOR MEADOWS	IOC	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	07/18/2002
EP-N	EP FOR MEADOWS	NITRATE	notes	Yearly	01/01/2012 - 12/31/2012	48	1	done	01/18/2012
EP-N	EP FOR MEADOWS	NITRITE	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	07/18/2002
EP-N	EP FOR MEADOWS	RAD - GROSS ALPHA	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	
EP-N	EP FOR MEADOWS	RAD - RADIUM 226/228	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	07/22/2003
EP-N	EP FOR MEADOWS	RAD - URANIUM		6 Years	01/01/2008 - 12/31/2013	413	1	Incomplete	07/22/2003
EP-N	EP FOR MEADOWS	SOC	notes	3 Years	01/01/2011 - 12/31/2013	413	2	Incomplete	11/17/2008
EP-N	EP FOR MEADOWS	VOLATILE ORGANICS		3 Years	01/01/2011 - 12/31/2013	413	1	done	07/28/2011
EP-O	EP FOR RIDGE DRIVE	ARSENIC	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	11/04/2010
EP-O	EP FOR RIDGE DRIVE	IOC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/04/2010
EP-O	EP FOR RIDGE DRIVE	NITRATE	notes	Yearly	01/01/2012 - 12/31/2012	48	1	done	01/18/2012
EP-O	EP FOR RIDGE DRIVE	NITRITE		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/04/2010
EP-O	EP FOR RIDGE DRIVE	RAD - GROSS ALPHA	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	
EP-O	EP FOR RIDGE DRIVE	RAD - RADIUM 226/228	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	07/22/2003
EP-O	EP FOR RIDGE DRIVE	RAD - URANIUM		6 Years	01/01/2008 - 12/31/2013	413	1	Incomplete	07/22/2003
EP-O	EP FOR RIDGE DRIVE	SOC	notes	3 Years	01/01/2011 - 12/31/2013	413	2	Incomplete	11/17/2008
EP-O	EP FOR RIDGE DRIVE	VOLATILE ORGANICS		3 Years	01/01/2011 - 12/31/2013	413	1	done	07/28/2011
EP-P	EP FOR REITZ	ARSENIC	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	11/04/2010
EP-P	EP FOR REITZ	IOC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/04/2010
EP-P	EP FOR REITZ	NITRATE		Yearly	01/01/2012 - 12/31/2012	48	1	done	01/18/2012
EP-P	EP FOR REITZ	NITRITE		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/04/2010
EP-P	EP FOR REITZ	RAD - GROSS ALPHA	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	11/29/2007
EP-P	EP FOR REITZ	RAD - RADIUM 226/228	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	11/29/2007
EP-P	EP FOR REITZ	RAD - URANIUM	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	11/29/2007
EP-P	EP FOR REITZ	SOC	notes	3 Years	01/01/2011 - 12/31/2013	413	2	Incomplete	11/17/2008
EP-P	EP FOR REITZ	VOLATILE ORGANICS		3 Years	01/01/2011 - 12/31/2013	413	1	done	07/28/2011
EP-Q	EP FOR KEIZER STATION	ARSENIC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/04/2010
EP-Q	EP FOR KEIZER STATION	IOC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/04/2010
EP-Q	EP FOR KEIZER STATION	NITRATE		Yearly	01/01/2012 - 12/31/2012	48	1	done	01/18/2012
EP-Q	EP FOR KEIZER STATION	NITRITE		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/04/2010

EP-Q	EP FOR KEIZER STATION	RAD - GROSS ALPHA	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	11/29/2007
EP-Q	EP FOR KEIZER STATION	RAD - RADIUM 226/228	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	11/29/2007
EP-Q	EP FOR KEIZER STATION	RAD - URANIUM	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	11/29/2007
EP-Q	EP FOR KEIZER STATION	SOC	notes	3 Years	01/01/2011 - 12/31/2013	413	2	Incomplete	11/17/2008
EP-Q	EP FOR KEIZER STATION	VOLATILE ORGANICS		3 Years	01/01/2011 - 12/31/2013	413	1	done	07/28/2011
EP-R	EP FOR DELTA	ARSENIC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/08/2010
EP-R	EP FOR DELTA	IOC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/08/2010
EP-R	EP FOR DELTA	NITRATE		Yearly	01/01/2012 - 12/31/2012	48	1	done	01/18/2012
EP-R	EP FOR DELTA	NITRITE		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/08/2010
EP-R	EP FOR DELTA	RAD - GROSS ALPHA	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	11/29/2007
EP-R	EP FOR DELTA	RAD - RADIUM 226/228		6 Years	01/01/2008 - 12/31/2013	413	1	Incomplete	11/29/2007
EP-R	EP FOR DELTA	RAD - URANIUM	notes	9 Years	01/01/2008 - 12/31/2016	1509	1	Incomplete	11/29/2007
EP-R	EP FOR DELTA	SOC	notes	3 Years	01/01/2011 - 12/31/2013	413	2	Incomplete	11/17/2008
EP-R	EP FOR DELTA	VOLATILE ORGANICS		3 Years	01/01/2011 - 12/31/2013	413	1	done	07/28/2011
EP-S	EP FOR CITY HALL	ARSENIC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/04/2010
EP-S	EP FOR CITY HALL	IOC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/04/2010
EP-S	EP FOR CITY HALL	NITRATE		Yearly	01/01/2012 - 12/31/2012	48	1	done	01/18/2012
EP-S	EP FOR CITY HALL	NITRITE		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	11/04/2010
EP-S	EP FOR CITY HALL	RAD - GROSS ALPHA	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	11/04/2010
EP-S	EP FOR CITY HALL	RAD - RADIUM 226/228	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	11/04/2010
EP-S	EP FOR CITY HALL	RAD - URANIUM	notes	9 Years	01/01/2011 - 12/31/2019	2604	1	Incomplete	11/04/2010
EP-S	EP FOR CITY HALL	SOC	notes	3 Years	01/01/2011 - 12/31/2013	413	2	Incomplete	12/09/2008
EP-S	EP FOR CITY HALL	VOLATILE ORGANICS		3 Years	01/01/2011 - 12/31/2013	413	1	done	07/28/2011
EP-T	EP FOR CARLHAVEN WEST	ARSENIC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	10/13/2010
EP-T	EP FOR CARLHAVEN WEST	IOC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	10/13/2010
EP-T	EP FOR CARLHAVEN WEST	NITRATE		Yearly	01/01/2012 - 12/31/2012	48	1	done	02/29/2012
EP-T	EP FOR CARLHAVEN WEST	NITRITE		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	10/13/2010
EP-T	EP FOR CARLHAVEN WEST	SOC		Yearly	01/01/2012 - 12/31/2012	48	1	done	07/30/2012
EP-T	EP FOR CARLHAVEN WEST	VOLATILE ORGANICS		Yearly	01/01/2012 - 12/31/2012	48	1	done	07/05/2012
EP-U	EP FOR CARLHAVEN EAST	ARSENIC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	08/03/2010
EP-U	EP FOR CARLHAVEN EAST	IOC		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	08/03/2010
EP-U	EP FOR CARLHAVEN EAST	NITRATE		Yearly	01/01/2012 - 12/31/2012	48	1	done	01/18/2012
EP-U	EP FOR CARLHAVEN EAST	NITRITE		3 Years	01/01/2011 - 12/31/2013	413	1	Incomplete	08/03/2010
EP-U	EP FOR CARLHAVEN EAST	SOC		Yearly	01/01/2012 - 12/31/2012	48	1	done	07/30/2012
EP-U	EP FOR CARLHAVEN EAST	VOLATILE ORGANICS		Yearly	01/01/2012 - 12/31/2012	48	1	done	07/05/2012
EP-V	EP FOR 17TH AVENUE	ARSENIC		3 Years	01/01/2011 - 12/31/2013	413	1	done	03/08/2012
EP-V	EP FOR 17TH AVENUE	IOC		3 Years	01/01/2011 - 12/31/2013	413	1	done	03/08/2012
EP-V	EP FOR 17TH AVENUE	NITRATE		Yearly	01/01/2012 - 12/31/2012	48	1	done	03/08/2012
EP-V	EP FOR 17TH AVENUE	NITRITE		3 Years	01/01/2011 - 12/31/2013	413	1	done	03/08/2012
EP-V	EP FOR 17TH AVENUE	RAD - GROSS ALPHA		Quarterly	10/01/2012 - 12/31/2012	48	1	Incomplete	03/08/2012
EP-V	EP FOR 17TH AVENUE	RAD - RADIUM 226/228		Quarterly	10/01/2012 - 12/31/2012	48	1	Incomplete	03/08/2012
EP-V	EP FOR 17TH AVENUE	RAD - URANIUM		Quarterly	10/01/2012 - 12/31/2012	48	1	Incomplete	03/08/2012
EP-V	EP FOR 17TH AVENUE	SOC		Yearly	01/01/2012 - 12/31/2012	48	1	done	03/08/2012
EP-V	EP FOR 17TH AVENUE	VOLATILE ORGANICS		Yearly	01/01/2012 - 12/31/2012	48	1	done	03/08/2012

Nitrate Samples - PWS ID: 00744 — KEIZER, CITY OF

Sample ID	Sample Date	Receive Date	Analyte Name	Source Name	Source ID	Results	MCL	UOM
20120308016-I	03/08/2012	08/21/2012	NITRATE	EP FOR 17TH AVENUE	EP-V	ND	10.0000	MG/L
20120308016-I	03/08/2012		NITRATE-NITRITE	EP FOR 17TH AVENUE	EP-V	ND	10.0000	MG/L
203010603-I	02/29/2012	04/05/2012	NITRATE	EP FOR CARLHAVEN WEST	EP-T	ND	10.0000	MG/L
201190304-I	01/18/2012	02/06/2012	NITRATE	EP FOR CHEMAWA	EP-D	0.1800000	10.0000	MG/L
201190309-I	01/18/2012	02/06/2012	NITRATE	EP FOR CHERRY AVENUE	EP-E	ND	10.0000	MG/L
201190315-I	01/18/2012	02/06/2012	NITRATE	EP FOR LAUDERBACK	EP-G	0.1200000	10.0000	MG/L
201190311-I	01/18/2012	02/06/2012	NITRATE	EP FOR McNARY	EP-H	ND	10.0000	MG/L
201190303-I	01/18/2012	02/06/2012	NITRATE	EP FOR WIESSNER	EP-J	1.8500000	10.0000	MG/L
201190310-I	01/18/2012	02/06/2012	NITRATE	EP FOR WILLAMETTE MANOR	EP-K	ND	10.0000	MG/L
201190313-I	01/18/2012	02/06/2012	NITRATE	EP FOR MEADOWS	EP-N	ND	10.0000	MG/L
201190302-I	01/18/2012	02/06/2012	NITRATE	EP FOR RIDGE DRIVE	EP-O	0.7600000	10.0000	MG/L
201190312-I	01/18/2012	02/06/2012	NITRATE	EP FOR REITZ	EP-P	ND	10.0000	MG/L
201190301-I	01/18/2012	02/06/2012	NITRATE	EP FOR KEIZER STATION	EP-Q	ND	10.0000	MG/L
201190314-I	01/18/2012	02/06/2012	NITRATE	EP FOR DELTA	EP-R	0.9400000	10.0000	MG/L
201190305-I	01/18/2012	02/06/2012	NITRATE	EP FOR CITY HALL	EP-S	ND	10.0000	MG/L
201190306-I	01/18/2012	02/06/2012	NITRATE	EP FOR CARLHAVEN EAST	EP-U	0.1100000	10.0000	MG/L
109010401	08/31/2011	12/23/2011	NITRATE	EP FOR CITY HALL	EP-S	ND	10.0000	MG/L
109010401-I	08/31/2011	12/23/2011	NITRATE	EP FOR CITY HALL	EP-S	ND	10.0000	MG/L
109010402-I	08/31/2011	12/23/2011	NITRATE	EP FOR CARLHAVEN WEST	EP-T	ND	10.0000	MG/L
109010403-I	08/31/2011	12/23/2011	NITRATE	EP FOR CARLHAVEN EAST	EP-U	0.1000000	10.0000	MG/L
101260413-I	01/25/2011	02/11/2011	NITRATE	EP FOR CHEMAWA	EP-D	ND	10.0000	MG/L
101260401-I	01/25/2011	02/11/2011	NITRATE	EP FOR CHERRY AVENUE	EP-E	0.1000000	10.0000	MG/L
101260409-I	01/25/2011	02/11/2011	NITRATE	EP FOR LAUDERBACK	EP-G	0.1600000	10.0000	MG/L
101260403-I	01/25/2011	02/11/2011	NITRATE	EP FOR McNARY	EP-H	ND	10.0000	MG/L
101260412-I	01/25/2011	02/11/2011	NITRATE	EP FOR WIESSNER	EP-J	1.9800000	10.0000	MG/L
101260402-I	01/25/2011	02/11/2011	NITRATE	EP FOR WILLAMETTE MANOR	EP-K	ND	10.0000	MG/L
101260407-I	01/25/2011	02/11/2011	NITRATE	EP FOR 13TH AVENUE	EP-L	5.7600000	10.0000	MG/L
101260408-I	01/25/2011	02/11/2011	NITRATE	EP FOR 17TH AVENUE	EP-M	6.3000000	10.0000	MG/L
101260405-I	01/25/2011	02/11/2011	NITRATE	EP FOR MEADOWS	EP-N	ND	10.0000	MG/L
101260411-I	01/25/2011	02/11/2011	NITRATE	EP FOR RIDGE DRIVE	EP-O	0.5100000	10.0000	MG/L
101260404-I	01/25/2011	02/11/2011	NITRATE	EP FOR REITZ	EP-P	ND	10.0000	MG/L
101260410-I	01/25/2011	02/11/2011	NITRATE	EP FOR KEIZER STATION	EP-Q	ND	10.0000	MG/L
101260406-I	01/25/2011	02/11/2011	NITRATE	EP FOR DELTA	EP-R	2.6000000	10.0000	MG/L
011090603-I	11/08/2010	01/05/2011	NITRATE	EP FOR DELTA	EP-R	2.3500000	10.0000	MG/L
011090603-I	11/08/2010		NITRATE-NITRITE	EP FOR DELTA	EP-R	2.3500000	10.0000	MG/L
011050701-I	11/04/2010	01/05/2011	NITRATE	EP FOR RIDGE DRIVE	EP-O	0.6800000	10.0000	MG/L
011050701-I	11/04/2010		NITRATE-NITRITE	EP FOR RIDGE DRIVE	EP-O	0.6800000	10.0000	MG/L
011050703-I	11/04/2010	01/05/2011	NITRATE	EP FOR REITZ	EP-P	ND	10.0000	MG/L
011050703-I	11/04/2010		NITRATE-NITRITE	EP FOR REITZ	EP-P	ND	10.0000	MG/L

011050702-I	11/04/2010	01/05/2011	NITRATE	EP FOR KEIZER STATION	EP-Q	ND	10.0000	MG/L
011050702-I	11/04/2010		NITRATE-NITRITE	EP FOR KEIZER STATION	EP-Q	ND	10.0000	MG/L
011050704-I	11/04/2010	01/05/2011	NITRATE	EP FOR CITY HALL	EP-S	ND	10.0000	MG/L
011050704-I	11/04/2010		NITRATE-NITRITE	EP FOR CITY HALL	EP-S	ND	10.0000	MG/L
20101013048-I	10/13/2010	06/09/2011	NITRATE	EP FOR CARLHAVEN WEST	EP-T	ND	10.0000	MG/L
20101013048-I	10/13/2010		NITRATE-NITRITE	EP FOR CARLHAVEN WEST	EP-T	ND	10.0000	MG/L
20100803052-I	08/03/2010	06/09/2011	NITRATE	EP FOR CARLHAVEN EAST	EP-U	ND	10.0000	MG/L
20100803052-I	08/03/2010		NITRATE-NITRITE	EP FOR CARLHAVEN EAST	EP-U	ND	10.0000	MG/L
001081013-I	01/07/2010	02/05/2010	NITRATE	EP FOR CHEMAWA	EP-D	0.1700000	10.0000	MG/L
001081001-I	01/07/2010	02/05/2010	NITRATE	EP FOR CHERRY AVENUE	EP-E	ND	10.0000	MG/L
001081009-I	01/07/2010	02/05/2010	NITRATE	EP FOR LAUDERBACK	EP-G	0.2400000	10.0000	MG/L
001081003-I	01/07/2010	02/05/2010	NITRATE	EP FOR McNARY	EP-H	ND	10.0000	MG/L
001081012-I	01/07/2010	02/05/2010	NITRATE	EP FOR WIESSNER	EP-J	1.8500000	10.0000	MG/L
001081002-I	01/07/2010	02/05/2010	NITRATE	EP FOR WILLAMETTE MANOR	EP-K	ND	10.0000	MG/L
001081007-I	01/07/2010	02/05/2010	NITRATE	EP FOR 13TH AVENUE	EP-L	5.2000000	10.0000	MG/L
001081008-I	01/07/2010	02/05/2010	NITRATE	EP FOR 17TH AVENUE	EP-M	5.8200000	10.0000	MG/L
001081005-I	01/07/2010	02/05/2010	NITRATE	EP FOR MEADOWS	EP-N	ND	10.0000	MG/L
001081011-I	01/07/2010	02/05/2010	NITRATE	EP FOR RIDGE DRIVE	EP-O	0.8000000	10.0000	MG/L
001081004-I	01/07/2010	02/05/2010	NITRATE	EP FOR REITZ	EP-P	ND	10.0000	MG/L
001081010-I	01/07/2010	02/05/2010	NITRATE	EP FOR KEIZER STATION	EP-Q	ND	10.0000	MG/L
001081006-I	01/07/2010	02/05/2010	NITRATE	EP FOR DELTA	EP-R	1.2900000	10.0000	MG/L
001081014-I	01/07/2010	02/05/2010	NITRATE	EP FOR CITY HALL	EP-S	ND	10.0000	MG/L
907221302-I	07/21/2009	08/13/2009	NITRATE	EP FOR 13TH AVENUE	EP-L	5.3300000	10.0000	MG/L
907221301-I	07/21/2009	08/13/2009	NITRATE	EP FOR 17TH AVENUE	EP-M	5.6000000	10.0000	MG/L
904290206-I	04/28/2009	06/08/2009	NITRATE	EP FOR 13TH AVENUE	EP-L	5.1700000	10.0000	MG/L
904290207-I	04/28/2009	06/08/2009	NITRATE	EP FOR 17TH AVENUE	EP-M	5.1600000	10.0000	MG/L
901141401-I	01/13/2009	02/06/2009	NITRATE	INACTIVE EP FOR CARLHAVEN WEST	EP-C	1.2600000	10.0000	MG/L
901141414-I	01/13/2009	02/06/2009	NITRATE	EP FOR CHEMAWA	EP-D	ND	10.0000	MG/L
901141402-I	01/13/2009	02/06/2009	NITRATE	EP FOR CHERRY AVENUE	EP-E	ND	10.0000	MG/L
901141410-I	01/13/2009	02/06/2009	NITRATE	EP FOR LAUDERBACK	EP-G	0.9400000	10.0000	MG/L
901141404-I	01/13/2009	02/06/2009	NITRATE	EP FOR McNARY	EP-H	ND	10.0000	MG/L
901141413-I	01/13/2009	02/06/2009	NITRATE	EP FOR WIESSNER	EP-J	1.9800000	10.0000	MG/L
901141403-I	01/13/2009	02/06/2009	NITRATE	EP FOR WILLAMETTE MANOR	EP-K	ND	10.0000	MG/L
901141408-I	01/13/2009	02/06/2009	NITRATE	EP FOR 13TH AVENUE	EP-L	5.5000000	10.0000	MG/L
901141409-I	01/13/2009	02/06/2009	NITRATE	EP FOR 17TH AVENUE	EP-M	6.2000000	10.0000	MG/L
901141406-I	01/13/2009	02/06/2009	NITRATE	EP FOR MEADOWS	EP-N	ND	10.0000	MG/L
901141412-I	01/13/2009	02/06/2009	NITRATE	EP FOR RIDGE DRIVE	EP-O	1.0100000	10.0000	MG/L
901141405-I	01/13/2009	02/06/2009	NITRATE	EP FOR REITZ	EP-P	ND	10.0000	MG/L
901141411-I	01/13/2009	02/06/2009	NITRATE	EP FOR KEIZER STATION	EP-Q	ND	10.0000	MG/L
901141407-I	01/13/2009	02/06/2009	NITRATE	EP FOR DELTA	EP-R	0.7900000	10.0000	MG/L
901141415-I	01/13/2009	02/06/2009	NITRATE	EP FOR CITY HALL	EP-S	ND	10.0000	MG/L

811260306-I	11/25/2008	12/18/2008	NITRATE	EP FOR 13TH AVENUE	EP-L	5.4500000	10.0000	MG/L
811260307-I	11/25/2008	12/18/2008	NITRATE	EP FOR 17TH AVENUE	EP-M	5.4900000	10.0000	MG/L
808290106-I	08/28/2008	09/23/2008	NITRATE	EP FOR 13TH AVENUE	EP-L	5.1300000	10.0000	MG/L
808290107-I	08/28/2008	09/23/2008	NITRATE	EP FOR 17TH AVENUE	EP-M	5.7700000	10.0000	MG/L

Arsenic Samples - PWS ID: 00744 --- KEIZER, CITY OF

Sample ID	Sample Date	Receive Date	Source Name	Source ID	Results	MCL	UOM
20120308016-I	03/08/12	08/21/12	EP FOR 17TH AVENUE	EP-V	0.0021000	0.010	MG/L
011090603-I	11/08/10	01/05/11	EP FOR DELTA	EP-R	0.0032000	0.010	MG/L
011050701-I	11/04/10	01/05/11	EP FOR RIDGE DRIVE	EP-O	ND	0.010	MG/L
011050703-I	11/04/10	01/05/11	EP FOR REITZ	EP-P	ND	0.010	MG/L
011050702-I	11/04/10	01/05/11	EP FOR KEIZER STATION	EP-Q	ND	0.010	MG/L
011050704-I	11/04/10	01/05/11	EP FOR CITY HALL	EP-S	ND	0.010	MG/L
20101013048-I	10/13/10	06/09/11	EP FOR CARLHAVEN WEST	EP-T	ND	0.010	MG/L
20100803052-I	08/03/10	06/09/11	EP FOR CARLHAVEN EAST	EP-U	ND	0.010	MG/L
806110607-A	06/10/08	07/09/08	EP FOR WIESSNER	EP-J	ND	0.010	MG/L
805160801-A	05/15/08	06/04/08	INACTIVE EP FOR CARLHAVEN WEST	EP-C	ND	0.010	MG/L
805160812-A	05/15/08	06/04/08	EP FOR CHEMAWA	EP-D	ND	0.010	MG/L
805160802-A	05/15/08	06/04/08	EP FOR CHERRY AVENUE	EP-E	ND	0.010	MG/L
805160809-A	05/15/08	06/04/08	EP FOR LAUDERBACK	EP-G	ND	0.010	MG/L
805160804-A	05/15/08	06/04/08	EP FOR McNARY	EP-H	ND	0.010	MG/L
805160803-A	05/15/08	06/04/08	EP FOR WILLAMETTE MANOR	EP-K	ND	0.010	MG/L
805160807-A	05/15/08	06/04/08	EP FOR 13TH AVENUE	EP-L	ND	0.010	MG/L
805160808-A	05/15/08	06/04/08	EP FOR 17TH AVENUE	EP-M	ND	0.010	MG/L
805160805-A	05/15/08	06/04/08	EP FOR MEADOWS	EP-N	ND	0.010	MG/L
805160810-A	05/15/08	06/04/08	EP FOR RIDGE DRIVE	EP-O	ND	0.010	MG/L
805160813-A	05/15/08	06/04/08	EP FOR REITZ	EP-P	ND	0.010	MG/L
805160811-A	05/15/08	06/04/08	EP FOR KEIZER STATION	EP-Q	ND	0.010	MG/L
805160806-A	05/15/08	06/04/08	EP FOR DELTA	EP-R	ND	0.010	MG/L
20060608007-I	06/08/06	07/13/08	INACTIVE EP FOR CARLHAVEN EAST	EP-B	ND	0.010	MG/L
20060425009-I	04/25/06	05/31/06	EP FOR DELTA	EP-R	ND	0.010	MG/L
50413-3	04/12/05	05/11/05	INACTIVE EP FOR CARLHAVEN EAST	EP-B	ND	0.050	MG/L
50413-4	04/12/05	05/11/05	INACTIVE EP FOR CARLHAVEN WEST	EP-C	ND	0.050	MG/L
50413-14	04/12/05	05/11/05	EP FOR CHEMAWA	EP-D	ND	0.050	MG/L

ANNUAL DRINKING WATER QUALITY REPORT

2011

KEIZER SINCE 1982

City of Keizer

This Report is in conformance with the Safe Drinking Water Act requirement that water utilities provide water quality information to their customers each year. The City of Keizer is committed to protecting the high quality of your water supply through careful monitoring and testing.

City of Keizer drinking water meets or exceeds all state and federal standards set for quality and safety.

In 1997 the Oregon Association of Water Utilities voted the City of Keizer to have the Best Tasting Ground Water in the State of Oregon.

What's Inside:

WATER SOURCE

The 1996 Amendments to the Safe Drinking Water Act require that all states conduct Source Water Assessments for public water systems within their boundaries. The assessments consist of (1) identification of the Drinking Water Protection Area, i.e., the area at the surface that is directly above that part of the aquifer that supplies groundwater to our well(s), (2) identification of potential sources of pollution within Drinking Water Protection Area, and (3) determining the susceptibility or relative risk to the well water from those sources.

The purpose of this assessment is to provide water systems with the information they need to develop a strategy to protect their drinking water resource if they choose. The respective Drinking Water Programs of the Oregon Health Authority and Environmental Quality have completed the assessment for our system. A copy of the report (Source Water Assessment Report) is on file and available for viewing at Keizer City Hall.

The source of the City of Keizer's water is the Troutdale Aquifer. (An aquifer is an underground geologic formation that can store water.) Keizer's aquifer is located beneath the entire city. 15 deep wells draw from this aquifer and distribute the water to your home through 105 miles of piping.

Average winter use is 1.5-3 mgd and average summer use is 6.5-8 mgd. Your water is clean and contaminant free. However, the following language is required in this report by the EPA:

Required Additional Health Information

To ensure that tap water is safe to drink, the Environmental Protection Agency (EPA) prescribes limits on the amount of certain contaminants in water provided by public water systems. Food and Drug Administration (FDA) regulations establish limits for contaminants in bottled water.

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline **(1-800-426-4791)**.

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:

A. Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife.
B. Inorganic contaminants, such as salts and metals, which can be naturally occurring or result from urban storm runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.

C. Pesticides and herbicides, which may come from a variety of sources such as agriculture, storm water runoff, and residential uses.

D. Organic chemical contaminants, including synthetic and volatile organics, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban storm water runoff, and septic systems.
E. Radioactive contaminants, which can be naturally occurring or be the result of oil and gas production and mining activities. In order to ensure that tap water is safe to drink, EPA prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. FDA regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

Some people may be more vulnerable to contaminants in bottled water than is the general population. Immune-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium are available from the Safe Drinking Water Hotline **(1-800-426-4791)**.

Information on Lead

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. The City of Keizer is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in you water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline, 800-426-4791 or at http://www.epa.gov/safewater/lead.

INFORMATION ABOUT COLIFORM SAMPLING

Total Coliform bacteria are commonly found in the environment (e.g. soil, vegetation, and in the air) and are generally harmless. Usually, Coliform tests are used as an indicator showing there may be a problem with the system's treatment or distribution system (pipes) or that other, potentially-harmful, bacteria may be present. If only total Coliform bacteria are detected in drinking water the source is probably environmental and a non-health hazard. Whenever we detect Coliform bacteria in any sample, we do follow-up testing to see if other bacteria of greater concern, such as fecal Coliform or E. coli, are present. In the history of all Keizer's positive samples ever encountered, no fecal or E-coli or other harmful bacteria have ever been detected, and after flushing mainlines, all repeat tests have been negative for Total Coliform.

How can Coliform Bacteria get into drinking water?
Coliform bacteria do not occur naturally in Oregon aquifers. (Fractured or creviced bedrock aquifers that are close to the surface are the exception.) Bacteria washed into the ground by rainfall or snowmelt are usually filtered out as water seeps through the soil, so properly constructed water wells (City of Keizer's wells) do not typically harbor Coliform bacteria. However, Coliform bacteria may persist within bio-film formed by naturally occurring ground water microorganisms. The bio-film may cling to the well screen, casing, column, drop pipe, pump, and distribution piping. Disturbances during pumping or well maintenance can cause the bio-film to dislodge, releasing the Coliform bacteria. Sometimes Keizer runs different wells that may cause water to flow in different directions that may stir up the distribution lines.

CALL BEFORE YOU DIG

If you plan on doing any type of digging at your home this year please call for utility locates at least 48 hours prior to starting your project. Utility companies will come and mark your property for free, giving you locations of their underground utilities. This can not only save you money and time, but could also save your life. The number for the Oregon Utility Notification Center is 1-800-332-2344 or 811.

KEIZER WELL FACTS

Fluoride is added to your water at a rate of .70 parts per million which is the recommended level set by the American Dental Association and the Oregon Health Authority. An Iron/Manganese sequesterant is also added to the water to reduce staining. Hardness of the water is 140 parts per million or approximately 8 grains per gallon.

The water system is controlled by a computerized telemetry system which continually monitors the water pressure and activates or deactivates individual wells to maintain a system water pressure of 60-68 pounds per square inch. Keizer has three water storage facilities equaling 2.75 million gallons of storage. The City was voted "best tasting ground water in the State" by the Oregon Association of Water Utilities in 1997.

WATER QUALITY TESTING RESULTS

INORGANIC CONTAMINANTS							
Substance	Date Tested	Unit	MCLG	MCL	Detected Level	Source	Violation
*1 Nitrate	2011	ppm	10	10	6.3	see pg. 5	No
*2 Fluoride	2011	ppm	4	4	1.1	see pg. 5	No
*3 Lead	2011	ppm	0.015	AL=0.015	0	see pg. 5	No
*4 Copper	2011	ppm	1.35	AL=1.35	0.27	see pg. 5	No
*5 Total Coliform	2011	No Units	0	presence of coliform bacteria	0.01%	see pg. 5	Yes/Cleared

ORGANIC CONTAMINANTS							
Substance	Date	Unit	MCL	Well	Detected	Source	Violation
*6 Trichloroethylene	Jan-11	ppm	0.005	Willamette	0.0008	A man made chemical widely used as a cleaning agent in the dry cleaning industry and as a metal degreaser in the manufacturing industry.	No
	Feb-11	ppm	0.005	Willamette	0.0008		No
	Mar-11	ppm	0.005	Willamette	0.0008		No
	Apr-11	ppm	0.005	Willamette	0.0007		No
	Jun-11	ppm	0.005	Willamette	0.0008		No
	Jul-11	ppm	0.005	Willamette	0.0006		No
	Aug-11	ppm	0.005	Willamette	0.0014		No
	Sep-11	ppm	0.005	Willamette	0.0012		No
	Oct-11	ppm	0.005	Willamette	0.0007		No
	Nov-11	ppm	0.005	Willamette	0.0012		No
*7 Tetrachloroethylene	Jan-11	ppm	0.005	Willamette	0.0008	Manufatured chemical compound that is widely used for the dry cleaning of fabrics and for metal degreasing.	No
	Feb-11	ppm	0.005	Willamette	0.0008		No
	Mar-11	ppm	0.005	Willamette	0.0008		No
	Apr-11	ppm	0.005	Willamette	0.0008		No
	Jun-11	ppm	0.005	Willamette	0.0007		No
	Jul-11	ppm	0.005	Willamette	0.0006		No

This chart provides representative analytical results of water samples, collected from Keizer's system. Please note the following definitions:

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

Action Level (AL): The concentration of a contaminant which, if exceeded, triggers a treatment or other requirement that a water system must follow.

Method Reporting Limit (MRL): Also known as the detection limit. The minimum limit at which a contaminant can be detected using a particular lab testing method.

Parts per million (ppm): One part per million is the equivalent of 1/2 of a dissolved aspirin tablet in a full bathtub of water (approx. 50 gallons).

Parts per billion (ppb): One part per billion is the equivalent of 1/2 of a dissolved aspirin in 1,000 bathtubs of water (approx. 50,000 gallons).

WATER QUALITY TESTING SOURCE

1* Of the 16 wells that served Keizer in 2011, 6 had detects ranging from 0.10 to 2.60. Keizer had 2 wells above the MRL of 5.0. They were 5.76 (13th Ave.)and 6.30 (17th Ave.). The MCL is 10.0. These two wells were abandonded in March 2012. Nitrate in drinking water at levels above 10 ppm is a health risk for infants of less than six months of age. High nitrate levels in drinking water can cause blue baby syndrome. Nitrate levels may rise quickly for short periods of time because of rainfall or agricultural activity. If you are caring for an infant, you should ask for advice from your health care provider.

*2 During 2011 the EPA changed the recommended dose of fluoride from 1.0ppm to .70ppm. Keizer uses Sodium Fluoride.

*3,4 Monitoring for levels of lead and copper leached from household plumbing by corrosive water supplies. Systems that exceed "action levels" must install corrosion control treatment systems. No samples tested exceeded the action levels.

*5 In 2011 a total of 550 bacteria samples were collected from the distribution system and 6 tested positive for Total Coliform. The Oregon Health Authority, Drinking Water Section, requires that repeat samples be taken immediately from the original site that tested positive as well as taps adjacent to that site. On January 31, 2011, we had 1 sample come back positive. Repeat samples had 2 positive tests that put us in violation for the month and required us to notify customers. More explanation and information on Coliform sampling can be found on page 3.

*6,7 Testing for Volitile Organic Compounds (VOC's) are required by the State every 3 years. However, because of detections in 2002, the City has been voluntarily monitoring and reporting VOC's to the State on a monthly basis. All detects have been far below the MCL. The level at which a lab can detect Tetrachloroethylene and Trichloroethylene is 0.0005.

WATER CONSERVATION TIPS

The following are some ways that you can conserve water and save money, too.

- Check every faucet and toilet for leaks. Even a slow drip wastes a lot of water each day.
- Take short showers and shallow baths.
- Turn off the water while you are brushing your teeth or scraping the dishes or washing your hands.
- Don't use the toilet to flush away tissues, gum wrappers or any other small scraps. It is not a trash can.
- Be careful to water the lawn, not the sidewalk or street.
- Do not use a hose to clean off the driveway. A broom is better.
- Keep a jug of drinking water in the refrigerator, then you won't have to run water to cool it.
- Use the washing machine and dishwasher only for full loads.
- Landscape your yard with drought-resistant trees and plants.
- Install water-saving shower heads or flow restrictors.
- Take preventative measures to keep your pipes from freezing and breaking.

Questions?

Contact Your Professional Water Staff at **503-390-8280**

PUBLIC PARTICIPATION OPPORTUNITY

The City of Keizer Public Works Department invites all interested citizens to join them at:

- City Council Meetings, held on the first and third Monday of each month, 7:00pm at Keizer City Hall, 930 Chemawa Rd. NE
- Keizer Public Works Day at Keizer Rapids Park will be in August 2012. Check website (www.keizer.org) this summer for details.

Questions concerning this document?
Contact: Pat Taylor
Water Quality & Source Supervisor
City of Keizer, P.O. Box 21000
Keizer, OR 97307-1000
503-856-3560

The City of Keizer Source Water Assessment is available for viewing at City Hall located at:
930 Chemawa Rd. NE
Keizer, OR 97303

FREQUENTLY ASKED QUESTIONS WITH ANSWERS

Q-What is that yellow, black, or blue staining I get in my dishwasher, toilet, sinks, and laundry?

A-Keizer gets its' water from deep wells. Well water has natural minerals which can cause staining. The yellow or orange color stain is mostly caused by iron whereas the blue or black stains are caused by manganese. These minerals are common in ground water.

Q-How do I get rid of these stains?

A-In the dishwasher, we suggest running a cycle with a citrus base package of drink mix or some tablet form detergent. Sometimes a second cycle is necessary but this should clear up the problem. In laundry, we suggest you minimize or eliminate the use of bleach. Bleach actually draws out the iron and suspends it in the water, making the staining worse. There are products on the market that are made for hard water stains.

Q-My water has this odor that smells like rotten eggs, or sulfur. What causes the smell and is it safe to drink?

A- We have found that the majority of our odor complaints are due to various supply tubes that are located under sinks, behind toilets, and behind refrigerators. This line is typically clear and braided, opaque, or has stainless webbing. These supply pipes are being used in most new homes and remodels today. The minerals in our water seem to react with these types of tubes. When water sits for a period of time unused in these pipes, a sulfuric odor may present itself. After running water a short time, the odor goes away. Replacing the braided type hose with copper or chrome piping usually solves most odor problems. If you have replaced the supply tubing and still have a problem, you may need to replace an anode in your hot water heater. It is also recommended that you flush your hot water heater annually. The water is still safe to drink even if there is an odor.

Q-Why is my water bill so high?

A-Keep in mind that your bill is for two months usage. Also, you will notice that the majority of your bill (2/3) is for sewer. A unit of water is 748 gallons. For that unit you pay only $1.18!

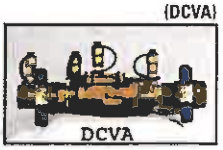
Q-Is our water safe?

A-First and most importantly, YES our water is safe to drink and use. There are trace amounts of some compounds found detected sporadically in one Keizer well. Because of improving technology, water laboratories are able to detect lower levels of compounds today than they could just a few years ago. Compounds found in Keizer's water samples are just above the detectable limit, but far below the Maximum Contaminant Level (MCL). According to the Rules and Regulations set forth by the Oregon Health Authority (OHA), any well below the MCL may continue to operate on a daily basis. There has been no increase in the levels of these compounds since first detected in August of 2002.

Q-I got this letter in the mail that says something about having my backflow device tested and I have no idea what that is. I just moved into my house and no one told me about this, what is it and why do I have to test it every year?
A-The backflow device is to prevent contamination of our drinking water. The State mandates that they are tested once a year as does our City ordinance. Typically they are installed for a sprinkler system. The device protects both the City water system and your domestic line as well. (See next question)

Q-Is there anything I need to know when installing or retrofitting my irrigation system?
A-Yes. You must provide some sort of backflow protection on your sprinkler system.
The three most common preventors are a double check valve assembly (DCVA), a pressure vacuum breaker assembly (PVBA), and an atmospheric vacuum breaker (AVB). The DCVA and PVBA must be tested by a state certified backflow tester within 30 days of installation and annually thereafter with a copy of the report mailed to the City. The AVB is a non-testable device that must be freeze protected. You need to take out a permit with Marion County to install your sprinkler system. You may pick up a permit along with installation procedures at City Hall in the Community Development Department or at the Marion County office.

(DCVA)



(PVBA)

(AVB)

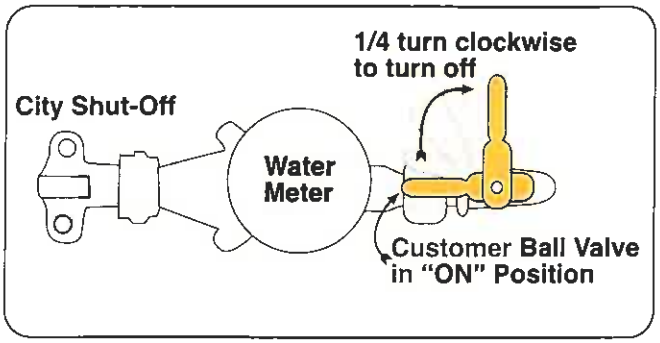
Q-I have a well and I want to hook up to City water but I still want to use my well for irrigation, do I have to abandon my well? What are my options?
A-The answer is no, you do not need to abandon your well. When you hook up to City water you must separate the well completely from your home drinking water line. You also must install a reduced principal pressure backflow assembly (RP) on your new water line going to the house. Make sure to read about thermal expansion when installing any device on service line (see below). There are installation instructions available at City Hall.

(RPBA)

Q-What is thermal expansion?
A-Water heaters are installed with a temperature and pressure (T/P) valve, which is designed to relieve excessive water temperature or pressure. Also aiding in the control of excessive heat and pressure is a condition known as thermal expansion, which allows extremely hot water to backflow into water main lines, mixing with the cold water and dissipating the heat. However, when a backflow prevention assembly is installed on a household water service line, the water cannot go back out into the water system. This leaves the T/P valve as the only release route for the overheated water.

If a water heater thermostat becomes defective, allowing the water temperature to increase to more than 212 degrees F., and the T/P valve fails, your domestic water can become "superheated". Superheated water can cause water heaters to explode or can allow scalding steam to be released from faucets upon use. We recommend that you inspect your T/P valve periodically. Also, a licensed plumber can inspect, repair or replace your T/P valve to ensure your safety. Thermal expansion chambers and pressure-relief toilet ball cock assemblies can provide additional protection.

Q-How do I shut off my water if I need to?
A-If you have an updated meter you should have a handle on your side of the meter. A quarter turn of this handle clockwise will shut off your water. (See illustration)

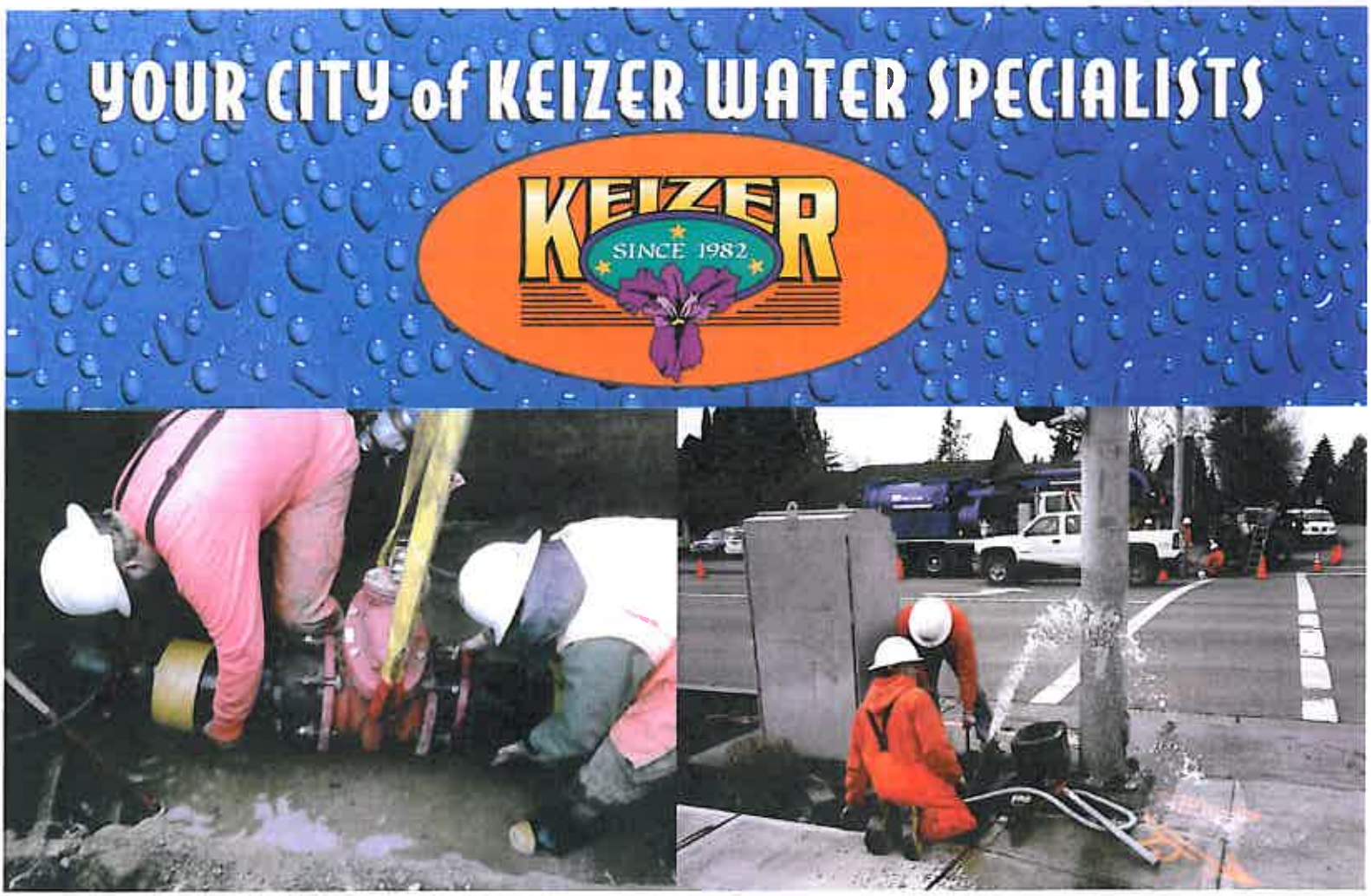


If you have any other questions call City Hall at **503-390-8280** or try our website: **www.keizer.org**

City of Keizer
P.O. Box 21000
Keizer, OR 97307-1000

This document contains important information regarding your water quality.

Este informe contiene informacion importante acerca de su agua potable. Haga que alguien lo traduzca para usted, o hable con alguien que lo entienda.



STORMWATER NOTES

The City of Keizer's Stormwater program was established in 2007 when the City was issued their National Pollutant Discharge Elimination System (NPDES) permit. The permit is administered by the Department of Environmental Quality (DEQ) and allows the City to discharge stormwater to local waterways. The City must follow a suite of management practices such as providing public education and outreach, cleaning the stormwater system, and developing ordinances that prohibit certain activities that will impact water quality. The NPDES permit has a 5 year term and Keizer has just completed its first permit term. The City remains in compliance with the conditions of the NPDES permit. With the expiration of the first permit on February 28, 2012, Keizer applied for a new permit. City staff will be working with DEQ to reach an agreement on new management practices for the next 5 year permit term. If you would like to review the City's evaluation of the first permit term and the proposed Revised Stormwater Management Plan, go to the City website at http://www2.keizer.org/ Choose the City Departments link, then Public Works, then Stormwater Operations.

Claggett Creek Watershed Council

Are you looking for an opportunity to make a difference in the community, network with your neighbors, and get a little exercise? Consider joining the Claggett Creek Watershed Council. The watershed council is a regional group of volunteers from Keizer, Salem, and Marion County. The volunteers of the Claggett Creek Watershed Council have been involved in the installation and maintenance of the restoration site at Ben Miller Family Park in Keizer, restoration work along Claggett Creek adjacent to the Claggett Creek Middle School, tree planting at Claggett Creek Park, restoration work along Labish Ditch at Country Glen Park, and much more. Currently the group is focused on recruiting new members that have an interest in assisting with similar projects and helping the group to develop a master plan for restoration projects in the Claggett Creek Watershed.

The mission of the Claggett Creek Watershed Council is to involve the local community in the stewardship of its watershed and attendant natural resources. This involvement is aimed at the development and implementation of a sustainable plan for enhancing and restoring watershed health while recognizing the need to balance a variety of environmental, social, and economic interests.
To learn more about this energetic group of volunteers call 503-383-1265 or visit the website at http://www.claggettcreekwatershedcouncil.org/

What's in the Pipe?

The City of Keizer has nearly 70 miles of publicly owned stormwater pipe within the community. Some of that pipe is solid and discharges stormwater to local waterways, and some is perforated and discharges stormwater into the soil. In order to abate problems such as clogged

pipes, and identify needed repairs, a camera is put into the pipe to record 'what's in the pipe'. The City of Keizer began TVing underground injection control (UICs) devices in 2010. As a result of that work, the City has identified several high priority repairs that will need to be addressed in the upcoming months. The Public Works Department expects to have the UIC inspection work completed in the upcoming year.

Starting in 2012/2013 the Public Works Department will be using the TV process listed above to inspect solid pipe. The multiple separate storm sewer system (MS4) makes up about 93% of the City's stormwater system. The goal for this project will be to inspect approximately 10% of the MS4 per year. Stormwater Division staff will look to complete this work for the entire system, about 65 miles, over a 10 year period.

In preparation for the work ahead, Stormwater Division staff has compiled an inventory of the stormwater system that allows for a better understanding of the infrastructure and more efficiency when planning projects, responding to emergencies, and conducting repairs. Managing the inventory for 70 miles of pipe, and the associated structures, is a daunting task at best, but well worth the effort.

New Keizer Rapids Park Boating Facility

Construction of a new boat ramp at Keizer Rapids Park along the Willamette River will be completed by the end of September 2012. The new facility will include a single lane concrete boat ramp, a boarding float, an access road, and a parking lot with a vault restroom. This new addition to the Keizer Rapids suite of amenities is being designed with the environment and water quality in mind!

In order to move forward with this project the City of Keizer was required to obtain permits from the Department of State Lands and the United States Army Corps of Engineers. Mitigation work will take place within and around the conservation easement that includes removal of invasive plant species and bank stabilization projects.

In addition, the stormwater generated from the parking lot will be managed and treated at an adjacent vegetated swale. This feature will be designed to capture stormwater and automotive pollutants commonly found in parking lots such as oil, fuel, and heavy metals. The interaction of soil, plants, and the beneficial microbes that concentrate on plant roots will allow stormwater to settle out and infiltrate the soil. More plants result in higher-quality treatment, so you can expect to see features that are heavily planted and look natural rather than manicured. Creative management of stormwater in this manner provides for the addition of recreational facilities to sensitive areas without environmental degradation.

Chapter Seven

Water Storage Requirements

Water Storage Requirements

Background

Water storage is provided for several reasons:

1. To equalize supply and demand for daily flow variations, maximum day, and peak hour requirements.
2. To provide emergency reserve supply during pipeline breaks, mechanical failures, and power outages.
3. To provide water for fire protection.

As previously outlined, in Chapter Four; the estimated future average day, maximum day, and peak hour demands for the four (4) selected intervals within the 20 year study period are as follows:

Year	Population	Average Day (GPD) (1)	Maximum Day (GPD) (1)	Peak Hour (GPM) (1)
2012	36,735	4,040,850	9,183,750	12,750
2020	40,280	4,430,800	10,070,000	14,000
2025	43,350	4,768,500	10,837,500	15,100
2032	48,082	5,289,020	12,020,500	16,700

(1) For water storage planning purposes, values reflect current non-revenue and unaccounted for water loss of 10%.
(2) Guide 10 Determination or Required Fire Flow-American Insurance Association and Insurance Services Office.

In the determination of the total required storage volume, several factors must be evaluated. Among these are: Operational storage (daily fluctuations), fire protection storage, reserve emergency storage, and source reliability.

Operational Storage

Operational or equalizing storage provides reserve water during variations in system demands that occur within one given day of normal operation. This reserve storage is used to allow the sources to pump at a reasonably continuous rate. Given the fact that Keizer's water system consists of mostly predictable residential and light commercial demands and depends on closed-loop pumping rather than immediate access to active water storage for peak demands, a factor of 20% of the average day demand will be used for operational storage. This value equates to slightly over 800,000 gallons at Year 2012 condition, equivalent to a 240 minute (4 hour) reservoir withdrawal rate of 3,333 GPM. When divided between the two existing reservoir/booster pump stations, the individual withdrawal rate is 1,333 GPM, 89% of the full capacity of the Bair Park facility and 100% capacity (2,000 GPM) of the electrically operated booster pumps at the Ridge Drive facility. The Year 2032 value of operational storage (1,322,255 gallons) is roughly equal to 240 minute (4 hours) of full production from the two existing and future booster pump stations (electrically operated units) or 5,500 GPM x 240 minutes = 1,320,000 gallons. (i.e. Ridge Drive Pump Station @ 2,000 GPM, future pump station @ 2,000 GPM, and Bair Park @ 1,500 GPM). Since most "peak-hour" events typically last less than two hours in duration, the selected percentage value of operational storage is felt to be adequate and commensurate with the projected need during each study interval.

Fire Protection Storage

As previously stated in this report under "Fire Flow," the quantity of water required for effective fire fighting varies according to population and type of development. Since the Keizer system currently consists of two interconnected pressure zones, both of which are designed to allow water to pass easily in either direction through any of one or all three (3) separate PRV stations upon demand, the needed fire reserve will be calculated for the total city population. Fire flow used for this study, therefore, will be 5,808 GPM for current (2012) conditions and 6,667 GPM for Year 2032[2]. This flow is typical for the Year 2032 projected population of 48,000 and is also felt to be adequate to accommodate any large fire within the downtown area, Keizer Station, or at McNary High School. For Year 2012 and 2032 scenarios, storage requirements will also be based on four (4) hours of fire flow duration. The current required fire storage, therefore, for 2012 is 5,808 GPM X 240 minutes = 1,393,920 gallons while the required fire storage for Year 2032 is: 6,667 GPM x 240 minutes (4 hours) = 1,600,000 gallons.

Reserve Emergency Storage

This requirement, particularly for a water system such as Keizer, is dependent on several factors. Among these are: source reliability (including a separate analysis for each well and pumping facility), power reliability, storage volume, pipeline integrity, types of demand(s), and available automatic and manually engagable standby facilities. See Table 7-1 for the most common types of expected emergencies along with the corresponding duration of outage:

Table 7-1
Typical Water System Emergencies (in order of likelihood)

Emergency Type	Maximum Expected Duration of Repair (Days)	Affected Well(s)/Site(s)
1. Power outage (localized)	1/2-2	Any one/Up to 4-5
2. Pumping Equipment Failure	5-30	Typically only one per incident
3. Water main break	1/4-2	Varies as to location of break
4. Regional Power Outage (Major)	1-5	Several to All
5. Water System contamination (back flow, cross-connection, etc)	2-4	None
6. Aquifer or Well Contamination	Indefinite	One to Potentially All Wells

The most common emergencies expected to disrupt the normal water system operation are numbers 1,2,3 and 4. The maximum expected duration of any of these emergencies is approximately 30 days. Each type of emergency applies to Keizer uniquely and will be discussed separately.

Each of the well pump/booster pump sites are individually served with electrical power from either Portland General Electric or Salem Electric. Historically, most power outages have been isolated to individual wells located within affected neighborhoods. The distribution of wells throughout the city, along with the number of automatically operated standby equipment, will generally preclude a total loss of pumping capacity due to a loss of electrical power, except for major regional outages affecting both serving utilities. Existing

sources are located within two miles of each other and all source flow is transmitted through a small grid of common pipelines to the customers. The fourteen (following the abandonment of Lauderback well and addition of Lacey Court well) wells that pump directly into the distribution system each contribute varying flows to the system and the greatest impact to the system would involve the loss of one or more of the largest wells (i.e. Wiessner, Delta, 17th Ave, Chemawa, McNary, Meadows). Although unlikely, the partial or total loss of one or more of the largest units is feasible enough to warrant redundancy and emergency back-up facilities. From the beginning, historical planning and redundant design concepts have been based on the assumption that the total system pumping capacity could potentially be curtailed due to the simultaneous and sustained loss of one or two of the largest wells or booster pumps in the water system and that both sites could potentially be unavailable or out of service for an indefinite period of time. While this scenario provides for adequate unit reliability, it does not address a massive citywide or grid loss of electrical power. Adequate redundancy of pumping capacity is currently available and all new facilities have been designed to further enhance unit redundancy. Redundancy and an adequate number of reserve pumps/wells alone are not adequate, however, to provide sufficient protection against a system wide sudden loss of power or a catastrophic water hydrant or main break. To protect against these potential events, an elevated reservoir at Keizer Station, capable of delivering water by gravity to the entire water system, was constructed in 2006/07. This reservoir was placed high enough within the city to provide a minimum of 20 psi to all points within the system at peak hour flow conditions for up to 30 minutes. This period provides adequate time to activate and begin water delivery from the emergency back-up sources.

Power reliability is and will remain a current and ongoing concern due to the fact that almost all of the wells are served by one of two primary power source utilities (Salem Electric and PGE). A sustained outage, in the absence of standby facilities, could result in a severe depletion of system pumping capacity before power restoration. Although the concern and risk of electrical power loss is genuine, based on a full analysis of the factors related to the reliability and integrity of the local AC power grid, combined with the historical record of utility power service reliability and outage frequency/duration, the relative risk is believed to be very low for several reasons. Even though both utilities are served from Bonneville Power facilities, as well as utility owned facilities, the utilities are served by different feeders from different directions. Power failure to anyone or group of wells or pump stations, therefore, will not necessarily result in a widespread power failure to any other sites. In addition, the availability of automated standby engines or generators will allow instantaneous emergency operation of several of the pump stations or wells. The telemetry control at the City shops will notify system operators immediately upon a power failure at any site which will significantly lessen the response time needed to activate the manual standby engines. A long power outage, therefore, will not prevent operation of all of the wells as there are currently automated standby facilities at several existing sites and additional are planned at the proposed Bair Park and future reservoir/pump station sites.

For planning purposes, an ultimate reserve emergency storage equivalent to sixty (60) minutes of each peak hour demand starting with Year 2012 and ending with Year 2032 peak hour demand will be used. This storage must be available to the entire water system in the event of a massive citywide power failure or significant water main break occurring at any location within the water system. Water will flow, under gravity conditions, at or above 20 psi throughout the system from the 550,000 gallon Elevated Storage Tank (EST),

located at Keizer Station, while automatic starting stand-by equipment activates and is brought on-line. At conditions of low pressure (≤20 psi), water will be automatically delivered from the water distribution grid preventing a dangerous loss of water pressure within the system. Even though only the highest portion of Bair Park standpipe is available for gravity storage, for the purposes of this study, the entire reservoir volume is assumed to be available (through booster pumping) to the water system. This reserve combined with the operational storage also provides a measure of water storage (without compromising fire protection) through each year of the study period. The Cities of Keizer and Salem currently have in place emergency water connections between their respective water systems. Both cities are encouraged to explore added potential uses of these connections and endeavor to modify the current inter-exchange agreement and facilities towards the mutual benefit of both cities. Understandably, this type of arrangement can also impact Keizer's water storage and wells, however, if properly negotiated and operated, this emergency connection can give the city the time it needs to implement backup power or repair facilities. Alternately, this existing facility could also be used to provide water to Salem during the same extreme emergency. Conceivably, proper implementation of this inter-use facility can have economic and reliability benefits for both cities.

Table 7-2
Storage Requirements
Years 2012, 2020, 2025, 2032

	2012	2020	2025	2032
Operational Storage (20% of Average Day)	808,100 Gal.	1,107,700 Gal.	1,192,125 Gal.	1,322,255 Gal.
Fire Reserve Storage (1)	1,393,920 Gal.	1,455,054 Gal.	1,505,645 Gal.	1,600,000 Gal.
Reserve Emergency Storage	765,000 Gal.	839,160 Gal.	903,120 Gal.	1,001,700 Gal.
Total Required Storage	2,967,020 Gal.	3,401,914 Gal.	3,600,890 Gal.	3,923,955 Gal.
Less Available Storage (2)	2,800,000 Gal.	2,800,000 Gal.	4,050,000 Gal.	4,050,000 Gal.
Total (Deficit), Surplus (+)	(-) 167,000 Gal.	(-) 601,914 Gal.	(+) 450,000 Gal.	(+) 126,045 Gal.

1)Fire Storage Requirement: 2012: 5,808 GPM x 60 mins/hr x 4 hrs duration = 1,393,920 gals. 2032 Fire Flow:6,667 GPM x 240 minutes = 1,600,000 gallons
2)After addition or proposed additional storage in incremental year of study period.

The proposed schedule for addition of water storage is shown below:

Table 7-3
Proposed Water Storage Addition Schedule

Site	2012 (Existing)	2020	2025	2032
Ridge Drive 1.5MG-Res #1	1,500,000 Gal	1,500,000 Gal	1,500,000 Gal	1,500,000 Gal
Elevated Storage Tank: 550,000 gallon-Res #2	550,000 Gal	550,000 Gal	550,000 Gal	550,000 Gal
Bair Park .75 MG-Res #3	750,000 Gal	750,000 Gal	750,000 Gal	750,000 Gal
Future 1.25 MG Reservoir	N/A	N/A	1,250,000 Gal	1,250,000 Gal.
TOTAL	2,800,000 Gal	2,800,000 Gal	4,050,000 Gal	4,050,000 Gal

Alternate Water Storage Method

A viable alternative to ground level water storage is the widely used concept of elevated storage. Although a second elevated reservoir is not planned nor included in the proposed Capital Improvement Plan and is not even a funded alternate, a discussion of its merits is included for the purposes of possible consideration as a future option. Elevated water

storage offers a distinct advantage over ground level water storage in that all of the stored water is available for delivery to customers without the need for pressure boosting and proper site selection can optimize water delivery and lessen pressure losses due to pipeline friction. An analysis of the Keizer community indicates that the current City Hall site is the best overall site for an alternate elevated reservoir for the following reasons:

1. The city already owns and controls the property

2. The site is adjacent to major transmission pipeline routes on Dearborn Avenue and Chemawa Road.

3. A well is currently at this site, an elevated reservoir can be placed next to the well consolidating the facilities.

4. The site is geographically located in the approximate center of the lower portion of the city providing good flow distribution throughout the city.

5. Based on preliminary soil analysis, the site's type and thickness of soil can provide adequate support and restraint of an elevated reservoir.

While an elevated reservoir costs more per gallon than a comparable ground level reservoir, the advantage of secure and constantly available gravity water storage necesitates consideration. The minimum recommended size for an elevated reservoir is 250,000 gallons, which equates to approximately 20 minutes of Year 2012 or 15 minutes of Year 2032 peak hour demand. This volume would provide constant pressurized water supply while emergency pumping equipment engages and begins operation. The estimated cost for a 250,000 gallon reservoir set at elevation 285' (150' height) is $1,500,000. This elevation matches the operating hydraulic elevation of the current water system. A reservoir set at a minimum allowed elevation of 250' (110' height) would cost approximately $1,250,000. It should be noted that use of an elevated reservoir would not necessarily substitute for a ground level reservoir unless comparable gallonage is used. The best possible scenario for the city would involve a combination of elevated water storage set at elevation 275'-285' (water surface) combined with ground level storage to create a total water storage as outlined in Table 7-2. This type of combined water storage provides emergency water storage at adequate elevation for pump control plus ground level water storage with booster pumping for peak-hour or fire flow demands.

Chapter Eight

Hydraulic Analysis
And
Distribution System Evaluation

Hydraulic Analysis of the Water System

General

Extensive hydraulic analysis has been performed on the City of Keizer's water distribution system. These analyses included evaluation of the existing system at maximum day, maximum day with fire flow, and peak hour demands as well as future 2032 maximum day and peak hour demands. Recommendations for specific distribution system improvements are based on data obtained from the computer modeling.

Analysis of the water system was performed using computer modeling simulation via KYPIPE Version 6.001 Pipe 2010 modeling software. The actual modeling layout and procedure was performed by Brooke Saltarello, 4B Engineering & Consulting, LLC in Keizer, Oregon. The Program has a maximum limitation of 2,000 pipes, 2,000 junctions (nodes), 250 pumps, and 250 tanks. The Hazen Williams formula was used to calculate friction losses. The nominal coefficient of friction (C values) used in the model was 110 for steel pipe and 130 for ductile iron pipe. This value is typical and appropriate for the respective pipe material and age. All pipe sizes were entered as nominal sizes, i.e. 6 inch inside diameter for all 6" sizes, regardless of actual type. Minor losses such as tees, ells, and valves have been disregarded.

To verify the accuracy of the model, computer calculated residual pressures were compared to actual field flow tests performed by City and Engineering personnel.

System Models

To be effective, system models must evaluate four system components: the supply system (sources and reservoirs); water demands, the distribution system, and the variations within the system; such as elevation and friction factors. Variations in each of these four components were used in computing the existing future scenarios and represented expansions or additions to the system.

Assumptions of the Computer Modeling Analysis

1. Elevations of all nodes were based on topographical information obtained from USGS maps. Elevations were ascertained at city pipeline locations, not from individual residences. Residual pressures are determined at pipelines, therefore, losses due to elevation and friction head to each individual residence must be determined individually.

2. Internal conditions of individual pipelines cannot be realistically determined, therefore, average friction factors based on pipe material type and verification employing field testing were used. Several field flow tests using existing 6" and 12" pipe were performed during the previous master plan update in February, 2000. Calculated friction factors (C values) ranged from a low of 95.5 to a maximum of 131. The selected nominal friction coefficient of 110 was determined to reflect the actual roughness value of the steel pipe within the distribution system. The value

used for ductile iron pipe was 130. This value is also consistent with typical "C" values for 20-30 year old ductile iron pipe.

3. Because of the uncertainty of an amended water-use agreement with the City of Salem, the existing physical interties were not included during any simulations. Use of these interties, during an emergency or high-use period, however, would have a great impact on these simulations and both cities are encouraged to pursue implementation of an automatic exchange agreement.

4. Contributions and losses from smaller pipes (3" and smaller) were disregarded from this model. Residual pressures were calculated at major pipeline points. Additional losses due to service meters, service lines, elevation increases, and smaller distribution lines must be calculated and subtracted from original residual pressures to obtain actual residual pressures at individual residences.

5. Minimum required residual pressure during maximum day and peak hour demands at all locations was 30 psi at all flow conditions. Minimum desired residual pressure was 40 psi at all flow conditions. Minimum required residual pressure during fire flow conditions was 25 psi. Maximum desired pipeline velocity was placed at 5 FPS during all scenarios.

6. Node demands were based on group estimates for specific areas. Individual residences were grouped together at nodes based on number of residences in close proximity to the node. There are a total of 795 nodes in all present day models, 900 nodes in future simulations.

7. Each node (existing and future) was assigned a flow value to approximate estimated flow to a group of residential homes under varying conditions. The following flow values were used for each individual simulation:

A. Maximum Day: (2012)	8.04 GPM per node .62 GPM per service connection
B. Year 2012 Peak Hour:	16.08 GPM per node 1.23 GPM per service connection
C. Year 2032 Maximum Day:	9.28 GPM per node .62 GPM per service connection
D. Year 2032 Peak Hour:	18.55 GPM per node 1.24 GPM per service connection

Simulations C and D also included increased flows at selected nodes to approximate projected residential growth near the node.

Future year simulations incorporated all currently known proposed developments at their respective locations as well as estimated future demands at critical nodes. These demands varied from 10 GPM to 300 GPM and were placed to simulate expected demands during future the maximum day and extreme peak hour conditions. Future demands were placed based in areas of projected future growth. As previously stated, most of these

demands were placed in the northern area of the city. Fire flows were simulated during all maximum day computer runs.

Due to the unique nature of the Keizer water system, typical hydraulic boundaries (Hydraulic Grade Lines) such as fixed elevated reservoir water levels cannot be used. Pump curve data for all wells and booster pumps (current and future) have been placed into the models. Wells and/or booster pumps were selected to operate in each model run in accordance with current water system programming and flow sequencing.

In order to present a worst-case scenario, all model runs were allowed to operate at 50-60 psi where, under actual conditions, additional wells or booster pumps would be activated, increasing the system pressure.

Year 2012 Distribution System Modeling Data

Current year hydraulic analysis was performed on the distribution system to determine the adequacy of the system in delivering required flows with adequate residual pressures. For Year 2012, computer modeling was performed for specific scenarios:

1. Peak Hour Demand (12,750 GPM)

2. Maximum Day Demand with coincidental 6000 GPM @ McNary High School

Peak Hour Demand-Existing System

Peak hour demands (12,750 GPM) were simulated for the current distribution system configuration and population. This simulation demonstrated typical pressures within the grid ranged between 45-70 psi. Most of the residual pressures were generally within acceptable ranges, with the lowest residual pressures occurring within predictable areas, such as the higher elevations in the northern region of the city. The model verifies the substantial contribution to local pressures that are provided by the Northern Pressure Zone upgrade. All flows were within acceptable ranges for the pumps under operation during this scenario.

Year 2012 Maximum Day Demands with 6000 GPM Coincidental Fire Flow at McNary High School

This model was performed to determine the water distribution system's capability of delivering maximum day demands combined with a high fire flow. This 6000 GPM demand was placed at two nodes in the vicinity of McNary High School. This location also coincides with previous ISO tests that indicated moderate deficiencies in available fire flow in this area. Residual pressures throughout the distribution system were well above the minimum allowable of 30 psi with numerous nodes displaying values as high as 60-70 psi. For the most part, pipeline velocities and pressure loss were well under 5 FPS and not excessive in most distribution system pipelines. Velocities as high as 8.5 FPS in a few pipelines, however, were observed. This simulation confirmed that the water system can support high fire demands as long as sufficient pumps are available.

Year 2012 Distribution System Summary- Existing System

The various models performed on the current distribution system presents the following conclusions:

1. The existing distribution system is adequate for current average and maximum day demands.

2. Due to an efficient configuration and adequate size of piping, the existing distribution system can accept total flows from all of the sources without significant pressure increases within the grid.

3. Maximum day demands, combined with fire flow or peak hour demands, create acceptable pressure declines throughout the city with several locations displaying residual pressures between 60-70 psi.

4. Contributions from several wells are required during maximum day demands with coincidental fire flow or peak hour demands to avoid dangerously low pressures.

5. Immediate corrections to the distribution system are not required to provide any needed factor of safety.

Year 2012 Hydraulic Analysis Summary

1. The existing distribution system can accommodate current average and maximum day demands with minimal pressure loss throughout the city. All node residual pressures were well above the minimum pressure level of 30 psi.

2. A maximum day demand combined with a high intensity (6000 GPM) fire flow results in acceptable pressure drops throughout the city as long as sufficient pumps are operating. Residual pressures at several locations lower into values between 40-50 psi.

3. The distribution system is currently capable of accepting more than 15,000 GPM of total source capacity due to low pressure increases seen in the grid.

Year 2032 Hydraulic Modeling Data

For Year 2032, 3 distinct computer simulations were performed to determine any further needed improvements and the effectiveness of the proposed improvements.

These were: Peak Hour
Maximum Day
Maximum Day with 6000 GPM Fire Flow at McNary High School

Year 2032 Distribution System Modeling Data

Several computer simulations were performed for anticipated water system demands for the Year 2032. These models included elements of new residential development and assumed commercial water demands. For Year 2032 computer models, the following values were assumed:

Population: 48,082
"C" value for all Pipe maintained at 130 (ductile iron)
Average Day per Capita Use: 110 GPCD
Maximum Day per Capita Use: 250 GPCD
Peak Hour Factor: 2x Maximum Day Demand
Fire Flow: 6000 GPM
All new improvements available and active, including upgrade of all pipelines.

Year 2032 Maximum Day (8352 GPM)

This model was the first model (and lowest projected daily flow model) performed for Year 2032.

Pressure distribution throughout the city was between 40-75 psi with average values between 60-70 psi. Pipeline velocities were between .10-6.0 FPS with virtually all pipes within the gird contributing to flow distribution. This model, however, underscores the need for pressure boosting, particularly in the northern area of the city. During maximum day events, the pressure within the city will rise between 3-5 psi higher than normal with all sources operable. This situation will be worse with all pumps operating at system demands less than actual maximum day demands.

Year 2032 Peak Hour (16,695 GPM)

The computer simulation performed on Year 2032 Peak Hour demands indicates favorable pressure distribution throughout the city. Pressure values average between 50-64 psi with the lowest pressure of 40-45 psi occurring in the Wheatland Road vicinity. Pipeline velocities were well distributed, with typical velocities between .2-2.0 FPS. Adequate flow was observed in all pipelines indicating some measure of contribution to the system.

Year 2032 Maximum Day Demands with 6000 GPM Fire Flow at McNary High School

This simulation was performed using the same basic criteria as the Year 2012 model except various local water demands were adjusted upwards to simulate projected growth in that specific area. The results from this computer simulation indicated good pressure and velocity distribution throughout the grid. Virtually all of the pipelines within the system contributed to the system demands.

Typical velocities were in the range of 1-5 FPS with the highest observed velocity occurring on a dedicated well pump discharge line. Residual pressures throughout the city were well above acceptable minimum levels and averaged between 60-70 psi. Residual pressures at the point of fire flow withdrawal (McNary High School) were between 50-55 psi, well above the minimum level of 20 psi.

Year 2032 Hydraulic Analysis Summary

1. The distribution system, after completion of all proposed improvements, can accommodate all projected average day, maximum day and peak hour demands for the Year 2032 assuming simultaneous operation of all required wells/booster pumps at their respective flow demand. System-wide residual pressures are acceptable and pipeline velocities are within normal limits.

2. Fire flow availability throughout the city is greatly enhanced following the incorporation of the phased improvements. Fire flows as high as 6000 GPM are available in most locations within the city. Fire flows up to 4000 GPM are available in the Keizer Station and Northern areas of the city

3. A minor increase in system-wide pressure may be developed during simultaneous operation of all wells at flows less than peak hour demands.

Chapter Nine

Related Issues

Related Issues

This section covers topics that are ancillary to the overall Master Plan.

Cross Connection Control Program

The City currently has an active cross connection program in effect. Given the variations of system pressure, OHA regulations, and potential for backflow, a cross connection program is definitely warranted. The Cross Connection program is currently operated and supervised by three city employees who are certified as cross connection inspectors. Potential cross connection problems of greatest concern would include: industrial and commercial facilities, facilities with fire sprinkler systems or supplemental booster pumps, and areas with marginal or greater pressures due to friction loss and/or elevation.

Corrosion Control

Given the current water quality of the wells, the corrosive effect of water on most system components is not felt to be severe. This is due to the average pH, calcium hardness, and alkalinity of the well water. In addition, recent testing for compliance with the lead and copper rule indicate a low potential for copper leaching since implementing sequestering for iron/manganese control at several wells. Although the sequesterant is used for iron and manganese control, it is also somewhat beneficial as a corrosion inhibitor. Further testing may need to be performed to determine any changes in the corrosivity of the water.

Operator Certification and Training

The current level of operator certification required for the City of Keizer is Water Distribution III. Water Treatment I certification is also required due to the fluoridation and sequesterant treatment facilities at several well sites. According to information obtained from the OHA data base, the City of Keizer, as of November of 2012, employs a total of 13 certified operators, with 4 certified at WD3, 3 certified at WD2, and 6 at WD1. There are four operators currently certified for the WT1 (Water Treatment 1) level. Bill Lawyer presently is the DRC operator (direct responsible charge) for both WD3 and WT1 levels for the city.

This level of certification (WDIII) is appropriate for the City and adequate up to a service population of 50,000. Additionally, faced with current and changing regulations for monitoring and operation, continuing education and training should be pursued by all personnel. This should include; but not limited to: water microbiology and treatment, confined space, lockout tag-out, and other OSHA laws, electrical theory, trench protection and shoring methods, and emergency planning.

Conservation Plan

The City of Keizer is currently (December, 2012) updating their Water Management and Conservation Plan. The plan includes elements of water conservation, procedure for voluntary or mandatory water rationing, and general information about the water system. In addition, to encourage conservation of water, the following steps are recommended:

1. Implement a zonal leak detection program.

2. Establish and implement water rates based on sliding fee. Charge at minimum flat rate for first 1,000 gallons or 100 cubic feet then an increasing unit amount above base flow.

3. Test all service meters at a 10 year maximum interval, using a statiscal percentage of all service meters from various locations within the city. For accuracy a minimum of 1% (.01) should be evaluated.

4. Test all Master and production meters at 5 year maximum interval.

5. Hold public forums and encourage conservation through direct mailings and billing stuffers.

6. Periodically tour and examine the distribution system network to visually discover leaks. Perform leak detection survey and correction.

7. Encourage the installation of low flow devices such as: low flow shower heads, low flow toilets, and efficient irrigation practices such as drip irrigation on all new and existing services. Consider possible rebate or purchase program for water conservation devices.

Emergency Plan

The City of Keizer's water system is susceptible to various types of emergencies. These include: power outages, flooding, and storm damage. A procedure for each scenario should be addressed and all personnel fully informed and trained. The following items are specific incidents that may affect the water system with specific recommended corrective action. Each plan must have a person in responsible charge that will assume leadership and direction. In the case of Keizer, the Public Works Supervisor or Director should assume this role. Communication methods other than telephone or cell phones should be available. This can be short wave, citizens band, or two-way radio.

Power Outages

This is expected to be the most common and frequent emergency. Since standby power facilities are available at several wells, the City should undertake the following steps during a power outage:

1. Verify if the outage is a local type affecting only one or two wells or widespread throughout the city.

2. If localized, activate all available back-up sources, notify the serving utility of outage.

3. If widespread, notify the serving utility (PGE or Salem Electric) and ask for estimated time for service restoration.

4. If outage is expected to last for several hours, activate the back-up engines as necessary to maintain system pressure.

5. Notify the customers through door -to-door contact and/or public address to conserve water and limit use.
6. If necessary, activate water inter-connection with the City of Salem.

Flooding

1. All well heads should be at least 1'-2' above highest anticipated 100 Year flood level.

2. All electrical facilities and equipment should be well above flood level.

3. All water lines in flood prone areas should be inspected regularly for adequate restraint and support.

Earthquakes

1. Verify structural integrity of all storage vessels - Repair any cracking or settlement.

2. All pumps and mechanical equipment should be firmly anchored to a support base.

3. Pipelines on exposed slopes are especially prone to failure and/or sliding. These pipes should be buttressed and adequately supported.

4. Reinforce support of all creek crossings.

5. After an earthquake, immediately inspect all storage facilities to determine structural condition. If failure is imminent, emergency draining may be required. Only drain if absolutely necessary as fire protection and fresh water will be scarce.

6. Develop a standby plan with the Fire District to dedicate locations such as the Willamette River for alternate source of fire protection supply if water system is not functioning.

7. All new structures should be designed for UBC Seismic Zone 3. All reservoirs should be periodically examined and repaired where necessary.

Storm Damage Prevention

Maintain areas surrounding well sites, and storage facilities free of loose or broken tree limbs that could interrupt power and/or damage facilities. Remove dead trees or trees with bad root system that could fall on a facility during a storm.

1. Periodically examine all electrical services and poles at facilities. Notify utility if loose connections, guy cables, poles, or damage to other electrical equipment is apparent.

2. Verify security of all facilities; bolt down buildings to foundation, if necessary Install weather stripping on doors and/or windows.

System Contamination and Security

1. Maintain security at all sites. Prevent unauthorized entry to all well, reservoir, and pump sites. Fence all sites not currently secured. Install lockable gates across access roads. Bar all windows into building. Install dead bolt locks.
2. Post all sites with appropriate signage that states" High Voltage", "No Trespassing" or similar warning language.
3. Maintain control of all keys; maintain inventory and list of holders.
4. Change or re-key locks at 5-10 year intervals or after any breach of security.
5. Implement and maintain a cross connection program.
6. If contamination occurs, determine severity, type and likely origin. Discontinue use of source if under suspicion. Verify presence with follow-up Testing before re-activation of source.
7. Notify required regulatory agencies and public, if appropriate.

Wells

1. Maintain all well heads in sanitary condition, screen all vents and access ports.
2. Limit animal and human activity in the vicinity of well areas.

Operation and Maintenance

Effective management of a water system requires several considerations. These include advance planning and budgeting, good record keeping, adequate expansion and replacement funding, proper maintenance procedures, and efficient operation. The following recommended procedures for effective system management are:

1. Maintain complete and accurate water distribution mapping. Update map as required when new pipes to system are added. Verify and identify all valve locations. Correct errors on mapping when excavations uncover unknown or incorrect data.
2. Maintain water rights on all sources, perform testing as required by regulatory agencies. Secure and maintain easements where water mains cross private properties, etc.
3. Develop accurate records of water production from all sources. Develop historical records against water revenue to track system loss.
4. Establish and implement a systematic meter testing program.

5. Develop and maintain good communications with all regulatory agencies such as: Health Division, Water Resources Department, etc.

6. Prepare Operation and Maintenance manual for entire system. Include items such as: emergency procedures, pump data, service instruction, etc.

7. Secure and maintain list of emergency assistance with phone numbers including electricians, pump servicemen, utility contacts, etc.

8. Develop a set of basic standards as they relate to the water system. In general, these standards should include requirements for pipeline material and installation, fire hydrants, cross-connection control, service lines and meters, pipeline locating, and coordination of utilities.

9. Perform daily/weekly inspections of all facilities. Record operating hours and production. Check well pumping levels. Check water levels in reservoirs.

10. Update maps at least once yearly.

11. Exercise all motors at least weekly.

12. Seasonally check all electrical connections, condition, etc.

Emergency Plan

The City of Keizer developed an Emergency Plan in August, 2011 that addressed procedures during a sustained power outage, fire, or equipment failure.

Chapter Ten

Capital Improvement Program

Capital Improvement Program:

The Capital Improvement Plan (CIP) for the 2012 Keizer Water System Master Plan Update has been developed to coincide with the known and well-established strengths and historical success of the existing water system while recognizing the need to provide for future growth. In order to accommodate the projected growth and financial limitations, the CIP has been divided into four (4) phases of implementation:

Phase I: 2012-2015

Project No.	Year	Description	Estimated Cost
1	2012-15	Wiessner-Ridge Drive Intertie: 3,250' of 12" ductile iron pipe ran alongside Salem Parkway	$366,000.00
2	2013	Install low-volume "jockey" pump at Bair Park P.S.	$33,000.00
3	2012-15	Hydrogeologic Study for VOC Identification & Extent	$79,000.00
4	2013-15	Install standby generator with automatic transfer switch at Reitz/Bair Park site	$110,000.00
5	2013-15	(3) Extraction wells and air strippers for VOC removal	$324,000.00
6	2013-15	Abandon Lauderback Well and Relocate 7,500 gallon pressure tank to Burnside site	$60,000.00
7	2013-15	Continue Steel waterline replacement program: 14,500'± of 6"-12" (variable lengths of each size)	$1,010,000.00

Sub-Total without Alternate 4A:	$1,982,000.00
(+) 10% Engineering and Administration	$198,200.00
(+) 10% Contingency	$198,200.00
Total Phase I:	**$2,378,400.00**

Phase II: 2015-2020

Project No.	Year	Description	Estimated Cost
1	2015-20	Continue steel waterline replacement program: 14,500'± of 6"-12" (variable lengths of each size)	$1,010,000.00
2	2015-20	Install the Second (2nd) pressure tank at the Lacey Court Pump Station	$30,000.00

Sub-Total	$1,040,000.00
(+) 10% Engineering and Administration	$104,000.00
(+) 10% Contingency	$104,000.00
Total Phase II:	**$1,248,000.00**

Phase III: 2020-2026

Project No.	Year	Description	Estimated Cost
1	2020-26	1.25 Million Gallon Reservoir and 2000 GPM Pump Station (Site and timing TBD)	$1,750,000.00
2	2020-26	Continue steel waterline replacement program: 29,000' of 6"-12" (variable length)	$2,020,000.00

Sub-Total	$3,195,000.00
(+) 10% Engineering and Administration	$319,500.00
(+) 10% Contingency	$319,500.00
Total Phase III:	**$3,834,000.00**

Phase IV: 2026-2032

Project No.	Year	Description	Estimated Cost
1	2026-32	Continue steel waterline replacement program: 29,000' of 6"-12" (variable length)	$2,020,000.00

Sub-Total	$2,020,000.00
(+) 10% Engineering and Administration	$202,000.00
(+) 10% Contingency	$202,000.00
Total Phase IV:	**$2,424,000.00**

Total of Phases I-IV: $9,884,000.00

Conditions of Estimates

1. Construction costs are based on an average of similar local municipal projects completed between 2000-2012 and adjusted for 2012 cost using an ENR Construction Cost Index of 9376 (October, 2012), Unless otherwise indicated, estimates do not include the costs of land acquisition, right-of-way or easement purchase, or costs associated with funding or financing. Service line replacement and new hydrants are included on applicable new mains and sub-mains. New pipeline costs are based on the use of ductile iron pipe with minimal asphalt removal and restoration. While substantial effort has been performed to prepare accurate estimates, the City is cautioned that additional factors such as: rock excavation, specific design and construction criteria; inflation, and local work and economic conditions can have a substantial impact on the actual construction costs. Caution should be employed when using these estimates. Estimates are subject to a +20% to -15% variation in accordance with criteria established by the American Association of Cost Estimating Engineers.

2. The 2012 Keizer Water Master Plan Update Capital Improvement Program has been developed and planned to accommodate the projected population and water service growth within the current (2012) city limits and urban growth boundary. Any future expansion of the urban growth or water service boundaries will require a separate analysis and capital improvement program for the intended expansion.

Chapter Eleven

Financial Planning

Financial Planning

The proposed improvements outlined in the preceding sections of this study will require substantial sums of money to implement. This portion of the study will provide information on various funding sources and options the City can pursue to finance the improvements.

A complete revenue analysis is beyond the scope of this study. The City should employ the services of a rate analyst to evaluate current operating costs, depreciation, and improvement program to assist in establishing revised systems development charges or water rates before the City begins extensive improvements.

Financing Capital Improvements

If the city requires funding there are several options that exist to adequately fund the proposed capital improvements outlined in this study. These include the sale of General Obligation, Bancroft, or Revenue Bonds; government loans or grants; use of system development charges and system revenue. Each type will be addressed separately.

General Obligation (G.O.) Bonds

This form of debt is backed by the "full faith and credit" of the taxing entity and as the name implies, is a general obligation of the entity. Generally, these types of bonds are obtained at a slightly better interest rate than Revenue Bonds. Issuance of these types of bonds must be approved by a simple majority of the registered voters within the City. Current Oregon statute places a ceiling limitation of G.O. debt which is based on the size of the City as well as the total valuation within the City.

Financing by General Obligation bonds is accomplished by the following procedure:

1. The City's engineer prepares a detailed cost estimate to determine the total funds required for construction.

2. An election is held within the City.

3. When voter approval is granted, bonds are offered for sale and the money for actual design and construction is obtained prior to preparation of final engineering plans and the start of construction.

General Obligation Bonds are usually retired through ad valorem taxation and/or water use revenues. Ad valorem taxation affects all property within the City that will ultimately benefit by the water system, whether the property is presently developed or not. Taxes levied from G.O. Bonds are outside the limits imposed by Measure Five. Construction costs are more equally distributed among all property owners and the program does not impose a penalty on existing residential or business development if they are not benefited. General Obligation Bonds are typically issued for repayment within 20 - 40 years.

Bancroft Act (Improvement Bonds)

Under an Oregon law known as the Bancroft Act, cities and districts may assess a portion of the cost of water lines against the property directly benefited. All property within the assessment area is assessed on an equal basis, regardless of whether it is developed or not. Many communities will assess and allow repayment on a deferred basis. Assessments are applied as a property lien against benefited properties and must be repaid through non-taxing revenues. Many times, cash payments are made by affected property owners and the City issues bonds and levies assessments only on the unpaid balance. If the Improvement Bond Option is taken, the City sells Bancroft Bonds to finance construction costs and the property owner may repay the assessment in 20 semi-annual installments with simple interest. This option is limited by the *effect* of Measure Five that limits assessments to *$10/$1000* assessed value without voter approval. Given the limitations of Improvement Bonds, this type of financing is generally not advantageous for improvements of this type.

Revenue Bonds

This type of debt is backed by the revenues generated by proceeds from the system itself. These bonds constitute a lien against earnings of the utility, which they are financing. Bonds may be issued for varying periods of time and at interest rates depending upon the bond market. Bonds are repaid by revenue (after operation and maintenance expenses) derived from the City. The City protects the bond purchasers by agreeing to establish and maintain water rates sufficient to pay the annual bond payment plus a 30 - 50% reserve.

Limited Tax Bond

Under current Oregon law, bonds may be issued and sold up to one-half of one percent of Real Market Value (RMV) of the affected entity without election or vote. Taxes which are levied to meet the debt service, however, are subject to the limits of Measure Five.

Government Loans or Grants

Several government agencies, both state and federal, are available for possible financing of water system improvements:

1. **Rural Economic & Community Development:** The RECD provides financial assistance for water supply and waste disposal facilities in rural areas and towns up to 10,000 people. Borrowers must be unable to obtain needed funds from other sources at reasonable rates and terms; have legal capability to borrow and repay loans, pledge security for loans, and operate the facilities; and be financially sound through taxing, assessments, revenues or other forms of income to pay 0 & M costs an retire the debt. Maximum term on a loan is 40 years and loan rates reflect the current market.

2. **Oregon Community Development Block Grant Program (CDBG):** Preference to these grants is given to projects which primarily benefit low and moderate income persons and projects needed to resolve violations of health

standards. The maximum grant amount is $500,000 which can include costs relative to right-of-way, engineering, construction, and grant administration.

3. **Special Public Works Fund:** This program provides loan and grant assistance to eligible municipalities or districts for the construction of publicly owned infrastructure needed to create or retain permanent jobs or improve the community's ability to keep or attract business and industry. This type of funding would most likely not be as attractive as others due to the minimum interest rate of 6.5% and documented job creation requirement.

4. **Drinking Water State Revolving Fund (DWSRF):** The primary purpose of this fund is to make loans to water systems for construction projects to improve health and to meet safe drinking water standards. After State legislative approval, the Oregon Economic Development Dept. (OEDD) will assume administrative responsibility for this program in Oregon.

Also available for financing consideration are: Water Resources Department Water Development Loan Fund and Economic Development Administration Public Works Grant.

Systems Development Charge (SDC)

Oregon law allows municipalities and service districts the ability to charge a reimbursement system development charge, an improvement system development charge, or a combination of the two. The methodology and implementation of SDC's in Oregon is regulated by Oregon Revised Statues 223.297-314 which became effective on July 1, 1991. The reimbursement SDC's is developed to recover the costs of existing capital improvements or improvements under construction. An improvement SDC's is designed to recover the costs associated with planned capital improvements. Under current Oregon law, local governments are allowed the ability to assess SDC's for the following types of improvements:

1. Water supply, treatment, and distribution

2. Wastewater collection, transmission, treatment, and disposal.

3. Drainage and flood control

4. Transportation

5. Parks and Recreation

Guidelines for the calculation and implementation of SDC's must follow specific criteria outlined in the Statute and administrative rules. The legislation requires the reimbursement SDC's to be established by an ordinance or resolution setting forth the methodology used to calculate the charge. This procedure must consider the cost of existing facilities, prior contributions by existing users, the value of unused capacity, and other relevant factors. The primary objective of the methodology must be that future system users contribute no more than an equitable share of the capital costs of existing facilities.

Additional provisions of the law require the deposit of SDC's revenues into dedicated accounts; annual accounting of revenues and expenditures, creation of an administrative appeals procedure to allow a citizen or other interested part the opportunity of challenging an expenditure of SDC's revenues, and expenditure of reimbursement fees only on improvements associated with the specific system that the fees were assessed.

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Appendix

MARI 63385

WELL 1a

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

Westerberg Drilling, Inc.
36728 S. Kropf Rd.
Molalla, OR 97038

WELL I.D. # L 101905

START CARD # 205918

Instructions for completing this report are on the last page of this form.

(1) LAND OWNER Well Number Carlhaven West #1
Name City of Kelzer
Address 930 Chemawa Rd NE
City Kelzer State OR Zip 97307

(2) TYPE OF WORK ☑ New Well
☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment ☐ Conversion

(3) DRILL METHOD
☐ Rotary Air ☐ Rotary Mud ☑ Cable ☐ Auger ☐ Cable Mud
☐ Other

(4) PROPOSED USE
☐ Domestic ☑ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION Special Construction: ☑ Yes ☐ No
Depth of Completed Well 250 ft.
Explosives used: ☐ Yes ☑ No Type Amount

BORE HOLE Diameter	From	To	SEAL Material	From	To	Sacks or Pounds
20	0	20	bentonite	0	5	28 sacks
16	20	100	cement	-5	100	137 sacks
10	100	280	cement	254	280	11 sacks

How was seal placed: Method ☐ A ☐ B ☑ C ☐ D ☐ E
☑ Other bentonite placed dry
Backfill placed from 280 ft. to 254 ft. Material cmnt 11 sacks
Gravel placed from 250 ft. to 254 ft. Size of gravel 6/9 c.s.s.

(6) CASING/LINER

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	10	+2	148	.250	☑	☐	☑	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:	none				☐	☐	☐	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☑ Outside ☐ None
Final location of shoe(s) 16" @ 94' cut off 10" @ 254' cut off

(7) PERFORATIONS/SCREENS
☐ Perforations Method
☑ Screens Type v wire Material S.S.

From	To	Slot Size	Number	Diameter	Tele/pipe size	Casing	Liner
140	144	.010		10	ts	☐	☐
144	160	.030		10	ts	☐	☐
160	170	.100		10	ts	☐	☐
170	190	.080		10	ts	☐	☐
cont.	page 2					☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☑ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
750	100		44 hours

Temperature of water 56 Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL (legal description)
County Marion
Tax Lot 200 Lot
Township 7 S Range 3 W WM
Section 2 SE 1/4 NW 1/4
Lat ___° ___' ___" or _____ (degrees or decimal)
Long ___° ___' ___" or _____ (degrees or decimal)
Street Address of Well (or nearest address)
950 Brandon St, Kelzer

(10) STATIC WATER LEVEL
31' 11 1/4" ft. below land surface. Date 10-12-10
ft. below land surface. Date
Artesian pressure n/a lb. per square inch Date

(11) WATER BEARING ZONES
Depth at which water was first found

From	To	Estimated Flow Rate	SWL
148	240	750	32

(12) WELL LOG Ground Elevation

Material	From	To	SWL
gravel fill	0	1	
soil brown dry	1	3	
clay & gravel brown	3	11	
gravel with clay brown	11	42	
clay brown	42	43	
cemented gravel with clay	43	61	
sand & grvl brn loosely cmtd gry	61	76	
gravel with clay grey	76	78	
clay grey	78	92	
gravel with clay grey	92	96	
cemented grvl tight w/clay grey	96	148	
grvl crse w/sand brn & gry loose	148	150	
crse sand w/fine sand & grvl brn	150	152	
cemented gravel w/clay grey	152	174	
crse grvl cmtd loosely no clay	174	182	
cont. page 2			

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Date Started 8-23-10 Completed 10-25-10

(unbonded) Water Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number Date

Signed

(bonded) Water Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 688 Date 11-15-10

Signed Steven M. Stadeli

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MARI 63385

Westerberg Drilling, Inc.
36728 S. Kropf Rd.
Molalla, OR 97038

WELL 1b

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

WELL I.D. # L 101905

START CARD # 205918

Instructions for completing this report are on the last page of this form.

(1) LAND OWNER Well Number Carlhaven West #1
Name City of Keizer
Address 930 Chemawa Rd NE
City Keizer State OR Zip 97307

(2) TYPE OF WORK ☐ New Well
☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment ☐ Conversion

(3) DRILL METHOD
☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Auger ☐ Cable Mud
☐ Other

(4) PROPOSED USE
☐ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION Special Construction: ☐ Yes ☐ No
Depth of Completed Well _____ ft.
Explosives used: ☐ Yes ☐ No Type _____ Amount _____

BORE HOLE Diameter	From	To	SEAL Material	From	To	Sacks or Pounds

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☐ Other
Backfill placed from _____ ft. to _____ ft. Material
Gravel placed from _____ ft. to _____ ft. Size of gravel

(6) CASING/LINER

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☐ Outside ☐ None
Final location of shoe(s)

(7) PERFORATIONS/SCREENS
☐ Perforations Method
☐ Screens Type Material

From	To	Slot Size	Number	Diameter	Tele/pipe size	Casing	Liner
cont.	from	page 1				☐	☐
190	220	.100		10	ts	☐	☐
220	240	.060		10	ts	☐	☐
240	250	.010		10	ts	☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time

Temperature of water _____ Depth Artesian Flow Found _____
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL (legal description)
County Marion
Tax Lot 200 Lot
Township 7 S Range 3 W WM
Section 2 SE 1/4 NW 1/4
Lat ___° ___' ___" or _____ (degrees or decimal)
Long ___° ___' ___" or _____ (degrees or decimal)
Street Address of Well (or nearest address)
950 Brandon St, Keizer

(10) STATIC WATER LEVEL
_____ ft. below land surface. Date
_____ ft. below land surface. Date
Artesian pressure _____ lb. per square inch Date

(11) WATER BEARING ZONES
Depth at which water was first found

From	To	Estimated Flow Rate	SWL

(12) WELL LOG Ground Elevation

Material	From	To	SWL
cont. from page 1			
cemented gravel with clay	182	207	
silt grey	207	208	
gravel grey loose	208	215	
gravel brn med silty w/sand brn	215	240	
silt tan	240	243	
grvl tight cemented	243	245	
clay brn tan red marbled	245	249	
gravel with clay	249	258	
clay red brown stiff	258	280	

Date Started 6-23-10 Completed 10-25-10

(unbonded) Water Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number Date

Signed

(bonded) Water Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 688 Date 11-15-10

Signed Steven N Stadeli

NOV 22 2010

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Pump Data Sheet - Submersible 60 Hz

Company: 4B Engineering
Name:
Date: 11/1/2012

Customer: City of Keizer
Well #1-Carlhaven West
Installation Year: 2010

WELL 1 PUMP

Pump:

Size: 7THC (4 stage)

Type: Submersible
Synch speed: 3600 rpm

Speed: 3450 rpm
Dia: 4.875 in

Curve: E6207TFPC2

Impeller:

Specific Speeds:

Ns: 3655
Nss: —

Dimensions:

Suction: —
Discharge: —

Vertical Turbine:

Bowl size: 7.13 in
Max lateral: 0.38 in
Thrust K factor: 4.56 lb/ft

Search Criteria:

Flow: —

Head: —

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: —

Motor:

Standard: NEMA
Enclosure: SUB

Size: 75 hp
Speed: 3600
Frame: "8""

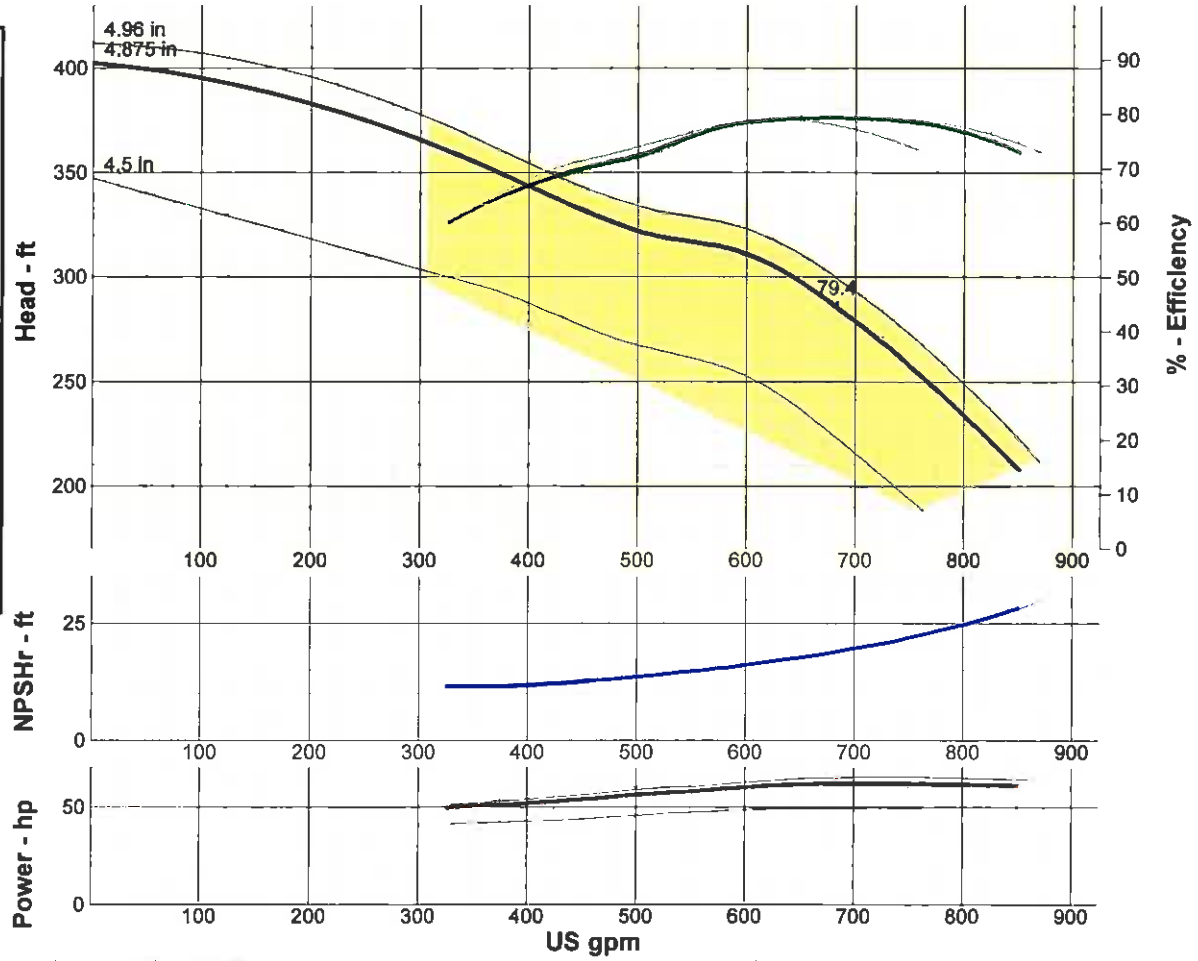
Sizing criteria: Max Power on Design Curve

Pump Limits:

Temperature: 120 °F
Pressure: 310 psi g
Sphere size: 0.83 in

Power: —
Eye area: —

--- Data Point ---	
Flow:	653 US gpm
Head:	296 ft
Eff:	79.2%
Power:	61.5 hp
NPSHr:	17.9 ft
--- Design Curve ---	
Shutoff head:	402 ft
Shutoff dP:	174 psi
Min flow:	—
BEP:	79.4% @ 683 US gpm
NOL power:	62.1 hp @ 732 US gpm
-- Max Curve --	
Max power:	65.3 hp @ 751 US gpm



Discharge Sizes-5",6". Curves are certified for water at 60°F only. Consult factory for performance with any other fluid.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
817	3450	225	75.6	61.4	25.9
681	3450	286	79.4	61.9	18.9
545	3450	317	75.7	57.7	14.7
409	3450	341	67.3	52.3	12.1
272	3450	—	—	—	—

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537 785)
Instructions for completing this report are on the last page of this form

MAIL
55036

WELL 2

(START CARD) # 122662 (122662Z)

(1) OWNER: Well Number 2-Wll Man

Name City of Keizer
Address 930 Chemawa Rd NE
City Keizer State OR Zip 97303

(2) TYPE OF WORK:

X New Well | Deepening | Alteration (repair/recondition) | Abandonment

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WATER RESOURCES DEPT
SALEM, OREGON

(3) DRILL METHOD:

Rotary Air | Rotary Mud | X Cable | Auger | Other

(4) PROPOSED USE:

Domestic | Community | Industrial | X Irrigation | Thermal | Injection | Livestock | X Other Muni.

(5) BORE HOLE CONSTRUCTION:

Special Construction approval Yes X No Depth of Completed Well 191 ft.
Explosives used Yes X No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
12 in	0'	191'				
			Cement with 5% Bentonite	-2'	95'	38 Sacks Cem.

How was seal placed: Method A B X C D E
Other
Backfill placed from 191 ft. to 195 ft. Material Colorado Silica
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing	8 in	+1'	120'	.250	X		X	
Liner								

Final location of shoe(s) 120'

(7) PERFORATIONS/SCREENS:

Perforations X Screens Method Type V-Slot Material 304 S.S

Depth From	To	Slot size	Number	Diameter	Telescope/pipe size	Casing	Liner
120'	140'	80		6 in	PS		
140'	145'	50		6 in	PS		
145'	160'	100		6 in	PS		
160'	175'	Blank		6 in	PS		
175'	185'	80		6 in	PS		

(8) WELL TESTS: Minimum testing time is 1 hour

X Pump | X Bailer | Air | Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
70 GPM	0	Bailer	
400 GPM	69'		6 hours

Temperature of Water 55 deg. Depth Artesian Flow found
Was a pump test made? Yes By whom
Did any strata contain water not suitable for intended use? Too little
Salty Muddy Odor Colored X Other Shallow
Depth of strata 27'-85'

(9) LOCATION OF WELL by legal description:

County Marion Latitude Longitude
Township 7S N or S. Range 3W E or W of WM.
Section 10 NE 1/4 NE 1/4
Tax lot 6200 Lot 9 Block 2 Subdivision Hidden A
Street Address of Well (or nearest address) 3668 5th Ave N

(10) STATIC WATER LEVEL:

26 ft. below land surface. Date 5/18/2000
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found 27'

From	To	Estimated Flow Rate	SWL
27'	85'	N/A	18'
98'	185'	400 GPM	33'

(12) WELL LOG:

Ground elevation

Material	From	To	SWL
Top Soil	0	4	
Clay; brown sand	4	19	
Cobbles; small and sand; brown	19	27	
Gravel; large loose	27	41	
Gravel; med to large cemented	41	55	
Gravel; large and cobbles	55	65	
Gravel; large and sand;brown	65	72	
Clay; brown and gravel; med	72	77	
Gravel; large	77	86	
Clay; blue sticky	86	95	
Clay; grey, sandy	95	98	
Gravel and sand; black	98	116	
Clay; sandy grey	116	119	
Gravel and sand; med	119	126	
Gravel cemented with brown	126	135	
Gravel; large to small and sand	135	141	
Gravel; large, cement; brown clay	141	162	
Sand; brown and fine to course	162	169	
Gravel and sand; brown	169	175	
Gravel; large and loose	175	187	
Gravel; cemented, sandy clay; brown	187	191	
Sand;brown, some gravel	191	195	

Date started 3/3/2000 Completed 5/31/2000

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction alteration or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to my best knowledge and belief.

Signed WWC Number 1454
Date 8-2-00

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction alteration or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

Signed Michael W. Wilson WWC Number 633
Date July 31, 2000

ORIGINAL - WATER RESOURCES DEPARTMENT FIRST COPY - CONSTRUCTOR SECOND COPY - CUSTOMER

Pump Data Sheet - Submersible 60 Hz

WELL 2 PUMP

Company: 4B Engineering
Name:
Date: 11/1/2012

Customer: City of Keizer
Well #2-Willamette Manor
Installation Year: 2000

Pump:

Size: 7CLC (3 stage)

Type: Submersible
Synch speed: 3600 rpm

Speed: 3450 rpm
Dia: 5.125 in

Curve:

Impeller:

Specific Speeds:

Ns: 2422
Nss: —

Dimensions:

Suction: —
Discharge: —

Vertical Turbine:

Bowl size: 7.13 in
Max lateral: 0.5 in
Thrust K factor: 3.5 lb/ft

Pump Limits:

Temperature: 120 °F
Pressure: 415 psi g
Sphere size: 0.43 in

Power: —
Eye area: —

Search Criteria:

Flow: —

Head: —

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: —

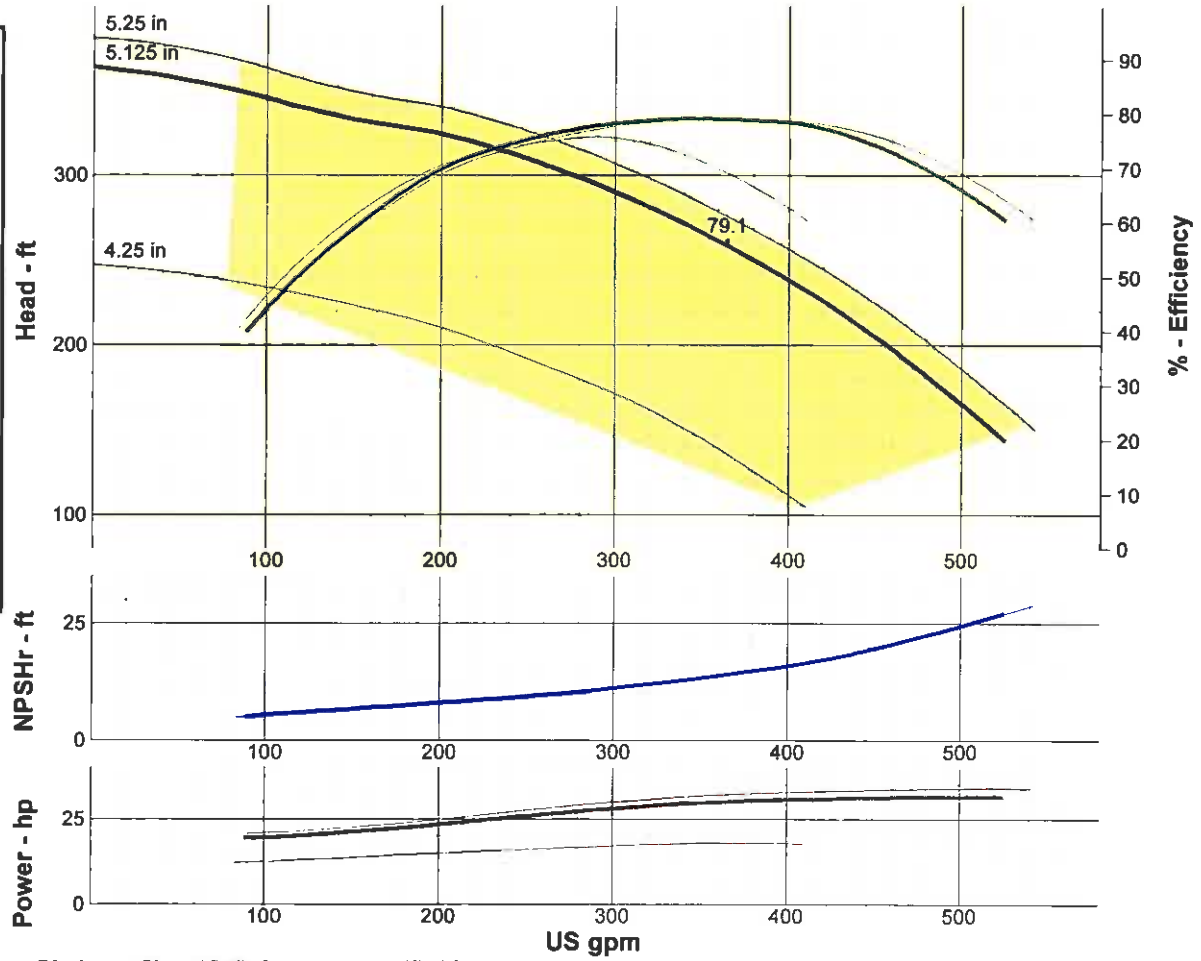
Motor:

Standard: NEMA
Enclosure: SUB

Size: 40 hp
Speed: 3600
Frame: "6""

Sizing criteria: Max Power on Design Curve

---- Data Point ----	
Flow:	351 US gpm
Head:	265 ft
Eff:	78.8%
Power:	29.6 hp
NPSHr:	13.5 ft
---- Design Curve ----	
Shutoff head:	364 ft
Shutoff dP:	157 psi
Min flow:	---
BEP:	79.1% @ 365 US gpm
NOL power:	31.5 hp @ 479 US gpm
-- Max Curve --	
Max power:	34 hp @ 542 US gpm



Discharge Sizes-5",6". Curves are certified for water at 60°F only. Consult factory for performance with any other fluid.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
504	3450	161	64.8	31.5	25
420	3450	225	77.2	30.9	17.3
336	3450	272	78.5	29.1	12.9
252	3450	309	75.6	26	9.59
168	3450	330	63.2	22	7.36

MARI 59353

WELL 4a

3

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

WELL I.D. # L 79776

START CARD # 174092

Instructions for completing this report are on the last page of this form.

(1) LAND OWNER Well Number Keizer Station
Name City of Keizer
Address 930 Chemawa Rd NE
City Keizer State OR Zip 97303

(2) TYPE OF WORK ☑ New Well
☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment ☐ Conversion

(3) DRILL METHOD
☐ Rotary Air ☐ Rotary Mud ☑ Cable ☐ Auger ☐ Cable Mud
☐ Other

(4) PROPOSED USE
☐ Domestic ☑ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION Special Construction: ☐ Yes ☑ No
Depth of Completed Well 270 ft.
Explosives used: ☐ Yes ☑ No Type Amount

BORE HOLE Diameter	From	To	SEAL Material	From	To	Sacks or Pounds
16"	0	150	Cement	150	0	145 sacks
12"	150	270				

How was seal placed: Method ☐ A ☐ B ☑ C ☐ D ☐ E
☐ Other
Backfill placed from ft. to ft. Material
Gravel placed from 270 ft. to 155 ft. Size of gravel 8x12

(6) CASING/LINER

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12"	+1	160	.375	☑	☐	☑	☐
					☐	☐	☐	☐
	8"	270	265	.312	☑	☐	☑	☐
	8"	239	234	.312	☑	☐	☑	☐
Liner:	8"	200	185	.312	☑	☐	☑	☐
	8"	155	150	.312	☑	☐	☑	☐

Drive Shoe used ☐ Inside ☑ Outside ☐ None
Final location of shoe(s) 272'

(7) PERFORATIONS/SCREENS
☐ Perforations Method Factory Slot
☑ Screens Type V-wire Material 304 SS

From	To	Slot Size	Number	Diameter	Tele/pipe size	Casing	Liner
265	239	.060		8"	PS	☐	☑
234	200	.060		8"	PS	☐	☑
185	150	.060		8"	PS	☐	☑
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☑ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
750	100'	189'	28 Hr

Temperature of water 54 F Depth Artesian Flow Found
Was a water analysis done? ☑ Yes By whom 4B Engineering
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL (legal description)
County Marion
Tax Lot 600 Lot
Township 6 S Range 3 W WM
Section 36 SE 1/4 NW 1/4
Lat ° ' " or . (degrees or decimal)
Long ° ' " or . (degrees or decimal)
Street Address of Well (or nearest address) Keizer Station- Chemawa Rd & Radiant Drive NE

(10) STATIC WATER LEVEL
28.3 ft. below land surface. Date 10-13-05
ft. below land surface. Date
Artesian pressure lb. per square inch Date

(11) WATER BEARING ZONES
Depth at which water was first found 34'

From	To	Estimated Flow Rate	SWL
144	250	750+	28.3

(12) WELL LOG Ground Elevation

Material	From	To	SWL
Lt. Brown, sandy silt	0	32	
Brown silt w/ sand & gravel	32	44	
Silty Gravel & cobbles	44	48	
Sand & large gravels	48	54	
Silty gravels, cobbles & sand	54	98	
Grey sandy silt	98	105	
Fine to med grey black sand	105	109	
Grey stiff sandy silt w/ small gravels and organics	109	122	
Grey tight sandy silt/ lrg cobbles	122	131	
Silty sand, gravel & cobbles	131	138	
Silty gravel, sand & cobbles	138	162	28.3
Clean sand & gravle w/ lrg cobbles	162	175	28.3
Siltbound gravel, cobbles & sand	175	201	28.3
Clean sand w/ small gravel	201	213	
Continued on page 2			

Date Started 8/8/05 Completed 10/18/05

(unbonded) Water Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number 1829 Date 10/24/05
Signed

(bonded) Water Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 1523 Date 10/24/05
Signed

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NOV 25 2005
WATER RESOURCES DEPT
SALEM, OREGON

MARI 59353

WELL 4b

23

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

WELL I.D. # L 79776

START CARD # 174092

Instructions for completing this report are on the last page of this form.

(1) LAND OWNER Well Number Keizer Station
Name City of Keizer
Address 930 Chemawa Rd NE
City Keizer State OR Zip 97303

(2) TYPE OF WORK ☑ New Well
☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment ☐ Conversion

(3) DRILL METHOD
☐ Rotary Air ☐ Rotary Mud ☑ Cable ☐ Auger ☐ Cable Mud
☐ Other

(4) PROPOSED USE
☐ Domestic ☑ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION Special Construction: ☐ Yes ☑ No
Depth of Completed Well 270 ft.
Explosives used: ☐ Yes ☑ No Type Amount

BORE HOLE Diameter	From	To	SEAL Material	From	To	Sacks or Pounds
16"	0	150	Cement	150	0	145 sacks
12"	150	270				

How was seal placed: Method ☐ A ☐ B ☑ C ☐ D ☐ E
☐ Other
Backfill placed from ft. to ft. Material
Gravel placed from 270 ft. to 155 ft. Size of gravel 8x12

(6) CASING/LINER

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12"	+1	160	.375	☑	☐	☑	☐
					☐	☐	☐	☐
	8"	270	265	.312	☑	☐	☑	☐
	6"	239	234	.312	☑	☐	☑	☐
Liner:	8"	200	185	.312	☑	☐	☑	☐
	8"	155	150	.312	☑	☐	☑	☐

Drive Shoe used ☐ Inside ☑ Outside ☐ None
Final location of shoe(s) 272'

(7) PERFORATIONS/SCREENS
☐ Perforations Method Factory Slot
☑ Screens Type V-wire Material 304 SS

From	To	Slot Size	Number	Diameter	Tele/pipe size	Casing	Liner
265	239	.060		8"	PS	☐	☐
234	200	.060		8"	PS	☐	☐
185	150	.060		8"	PS	☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☑ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
750	100'	189'	28 Hr

Temperature of water 54 F Depth Artesian Flow Found
Was a water analysis done? ☑ Yes By whom 4B Engineering
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL (legal description)
County Marion
Tax Lot 600 Lot
Township 6 S Range 3 W WM
Section 36 SE 1/4 NW 1/4
Lat ° ' " or . (degrees or decimal)
Long ° ' " or . (degrees or decimal)
Street Address of Well (or nearest address) Keizer Station- Chemawa Rd & Radiant Drive NE

(10) STATIC WATER LEVEL
28.3 ft. below land surface. Date 10-13-05
ft. below land surface. Date
Artesian pressure lb. per square inch Date

(11) WATER BEARING ZONES
Depth at which water was first found 34'

From	To	Estimated Flow Rate	SWL
144	250	750+	28.3

(12) WELL LOG Ground Elevation

Material	From	To	SWL
Continued from page 1			
Silt bound gravels, cobbles	213	218	
Fine to med. sand/bits of clay	218	222	
Clean sand, gravel & cobbles	222	234	
Stiff brown clay	234	239	
Silt bound gravels, cobbles	239	260	
Clean sand & gravel	260	264	
Gray blue clay	264	268	
Silt bound gravels, cobbles	268	270	

RECEIVED
NOV 25 2005
WATER RESOURCES DEPT
SALEM, OREGON

Date Started 9/8/05 Completed 10/18/05

(unbonded) Water Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number 1829 Date 10/24/05
Signed Jim Neidlein

(bonded) Water Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 1523 Date 10/24/05
Signed Robert Stetler

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City of Keizer

WELL 4 PUMP

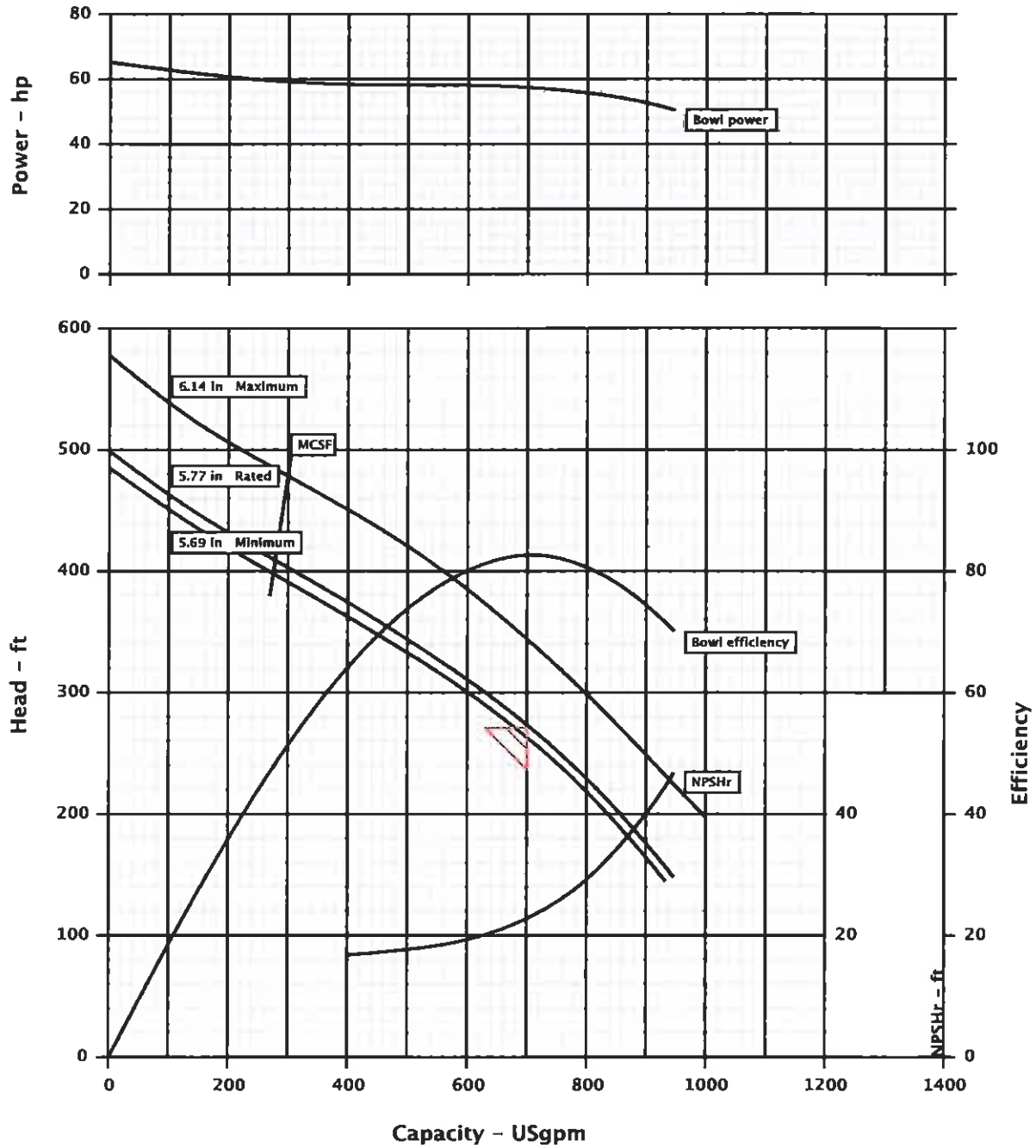
FLOWSERVE

Pump size & type	: 08EHL
Based on curve no.	: EC-2383
Number of stages	: 4

Customer	: 4B Engineering	Capacity	: 700.0 USgpm
Item number	: Keizer Station-Well #4	Head	: 270.00 ft
Service	:	Specific gravity	: 0.999
Flowserve reference	: Default 0.1	Pump speed	: 3550 rpm
Date	: November 5, 2012	Test tolerance	: Hydraulic Institute Level A

CURVES ARE APPROXIMATE, PUMP IS GUARANTEED FOR ONE SET OF CONDITIONS; CAPACITY, HEAD, AND EFFICIENCY

Bowl performance shown below is corrected for materials, viscosity and construction.



Bowl head of 273.9 ft corresponds with 270.0 ft head at discharge flange adjusted for elevation and friction losses.

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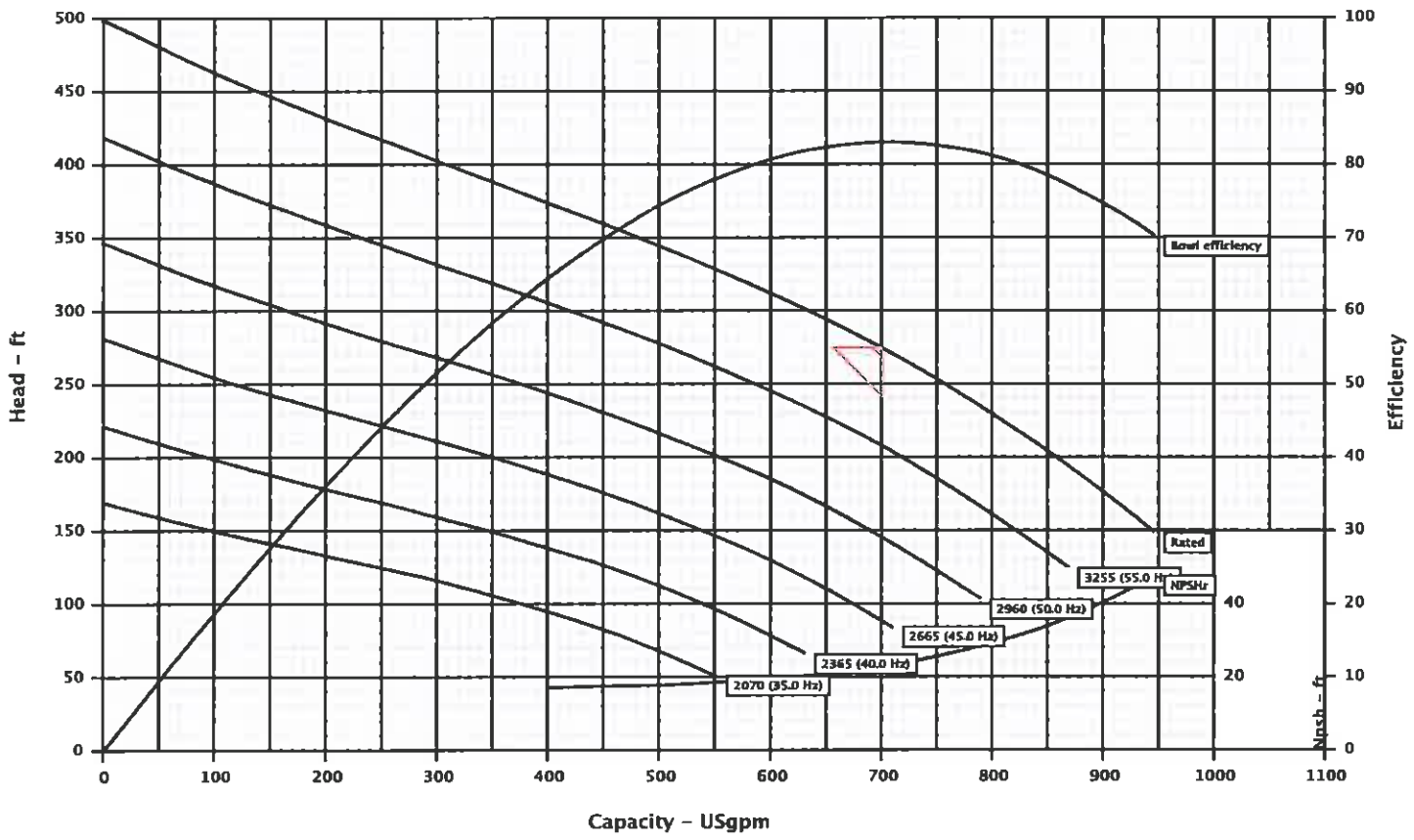
WELL 4 PUMP

City of Keizer

Customer	: 4B Engineering			Pump size & type	: 08EHL
Item Number	Keizer Sta.-Well #4			Based on curve no.	: EC-2383
Service				Number of stages	: 4
Flowserve Reference	: Default 0.1				
Date	: November 5, 2012	Capacity	: 700.0 USgpm	Specific gravity	: 0.999
		Head	: 270.00 ft	Pump speed	: 3550 rpm

CURVES ARE APPROXIMATE, PUMP IS GUARANTEED FOR ONE SET OF CONDITIONS, CAPACITY, HEAD, AND EFFICIENCY



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FlowSelex v2.2

WELL 5a

WELL REPORT
STATE OF OREGON

MAR... 16771 MAR JAN 2 ... 1982
16771 WATER RESOURCES DEPT
SALEM, OREGON
State Permit No. .....

(1) OWNER:
Name Keizer Water Dist.
Address 649 Chemawa Rd NE
City Salem State Ore.

(2) TYPE OF WORK (check):
New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary Air ☐ Driven ☐
Rotary Mud ☐ Dug ☐
Cable ☑ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☑
Irrigation ☐ Test Well ☐ Other ☐
Thermal: Withdrawal ☐ Reinjection ☐

(5) CASING INSTALLED:
Steel ☑ Plastic ☐
Threaded ☐ Welded ☑
12 " Diam. from +1 ft. to 120 ft. Gauge .250
..... " Diam. from ..... ft. to ..... ft. Gauge .....

LINER INSTALLED:
..... " Diam. from ..... ft. to ..... ft. Gauge .....

(6) PERFORATIONS:
Perforated? ☐ Yes ☑ No
Type of perforator used
Size of perforations in. by in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

(7) SCREENS:
Well screen installed? ☑ Yes ☐ No
Manufacturer's Name Johnson
Type 12" - 60 Slot 120'-140' Model No. 304
Diam. 10" Slot Size 30 Set from 170 ft. to 188 ft.
Diam. 10" Slot Size 25 Set from 188 ft. to 205 ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☑ Yes ☐ No If yes, by whom?
Yield: 600 gal./min. with 90 ft. drawdown after 24 hrs.
" " " "
Air test gal./min. with drill stem at ft. hrs.
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ..... ft.

(9) CONSTRUCTION:
Special standards: Yes ☐ No ☑
Well seal—Material used Cement
Well sealed from land surface to 80 ft.
Diameter of well bore to bottom of seal 16 in.
Diameter of well bore below seal 12 in.
Number of sacks of cement used in well seal 104 sacks
How was cement grout placed?
Pumped.
Was pump installed? Yes Type ..... HP ..... Depth ..... ft.
Was a drive shoe used? ☑ Yes ☐ No Plugs ..... Size: location ..... ft.
Did any strata contain unusable water? ☐ Yes ☐ No
Type of Water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☑ No Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

(10) LOCATION OF WELL:
County Marion Driller's well number
¼ ¼ Section 2 T. 7 R. 3 W W.M.
Tax Lot # Lot Blk Subdivision
Address at well location: Cherry Ave

(11) WATER LEVEL: Completed well.
Depth at which water was first found 22 ft.
Static level 25 ft. below land surface. Date 1-22-82
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 12
Depth drilled 232 ft. Depth of completed well 210 ft.
Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Sandy clay	0	22	
Small to Large Gravel	22	35	
Sand Small to Large Gravel	35	43	
Small to Med Gravel	43	66	
Hard Clay	66	75	
Cemented Gravel	75	95	
Small to Large Gravel	95	115	
Cemented Gravel	115	117	
Small to Large Gravel & sand	117	140	
Cemented Gravel	140	165	
Sandy Gravel	165	167	
Clay & Gravel	167	168	
Small to Large Gravel	168	189	
Sand Some Small Gravel	189	208	
Gravel Some Clay Large	[illegible]	[illegible]	
Cemented Gravel	208	212	
Red Cinders	212	232	
Well Back Filled from 210 Flow Red Cinders		232 - Gone.	

Work started 10-16 19 82 Completed 1-22 19 82
Date well drilling machine moved off of well 1-22 19 82

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Norman A. Terrell Sr. Date 1-27, 19 82
(Drilling Machine Operator)
Drilling Machine Operator's License No. 455

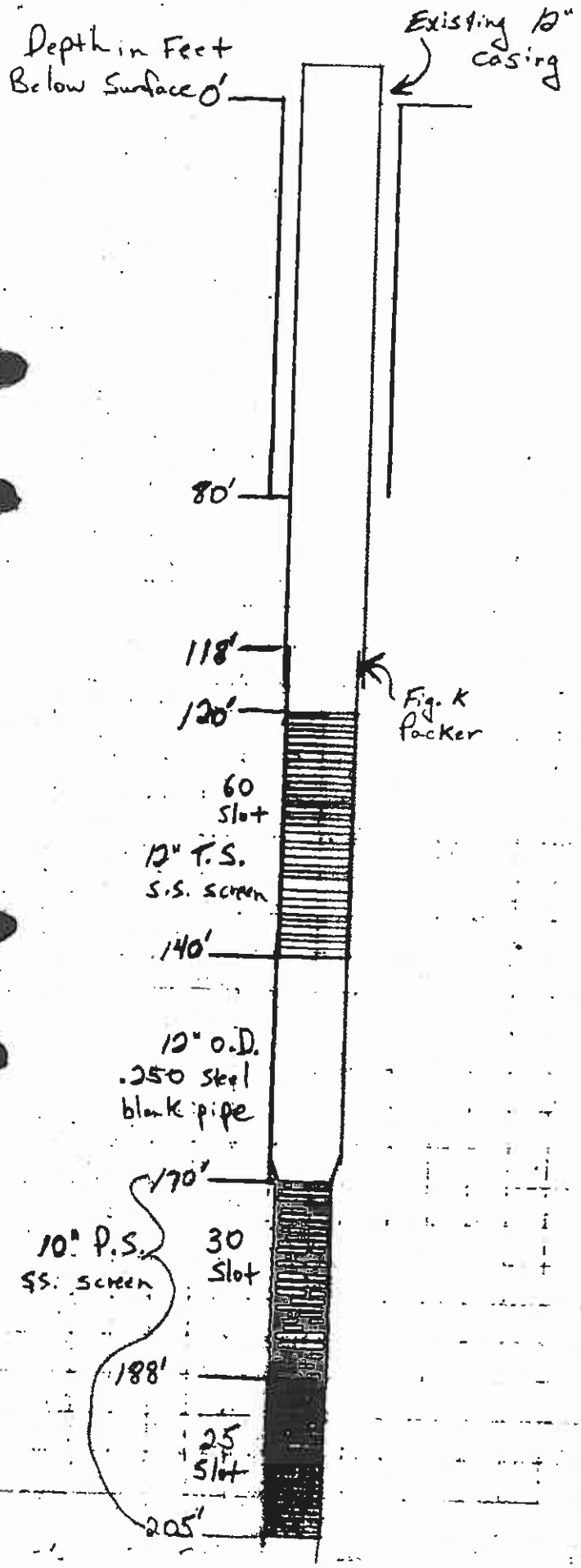
Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name EOLA WELL DRILLING (Person, firm or corporation) (Type or print)
Address 4510 DALLAS RD. N.W., SALEM, OR 97304
[Signed] Janet M Berndt (Water Well Contractor)
Contractor's License No. 619 Date 1-27, 1982

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310 within 30 days from the date of well completion.

SP**12658-690

WELL 5b

RECEIVED
JAN 29 1982
WATER RESOURCES DEPT
SALEM, OREGON



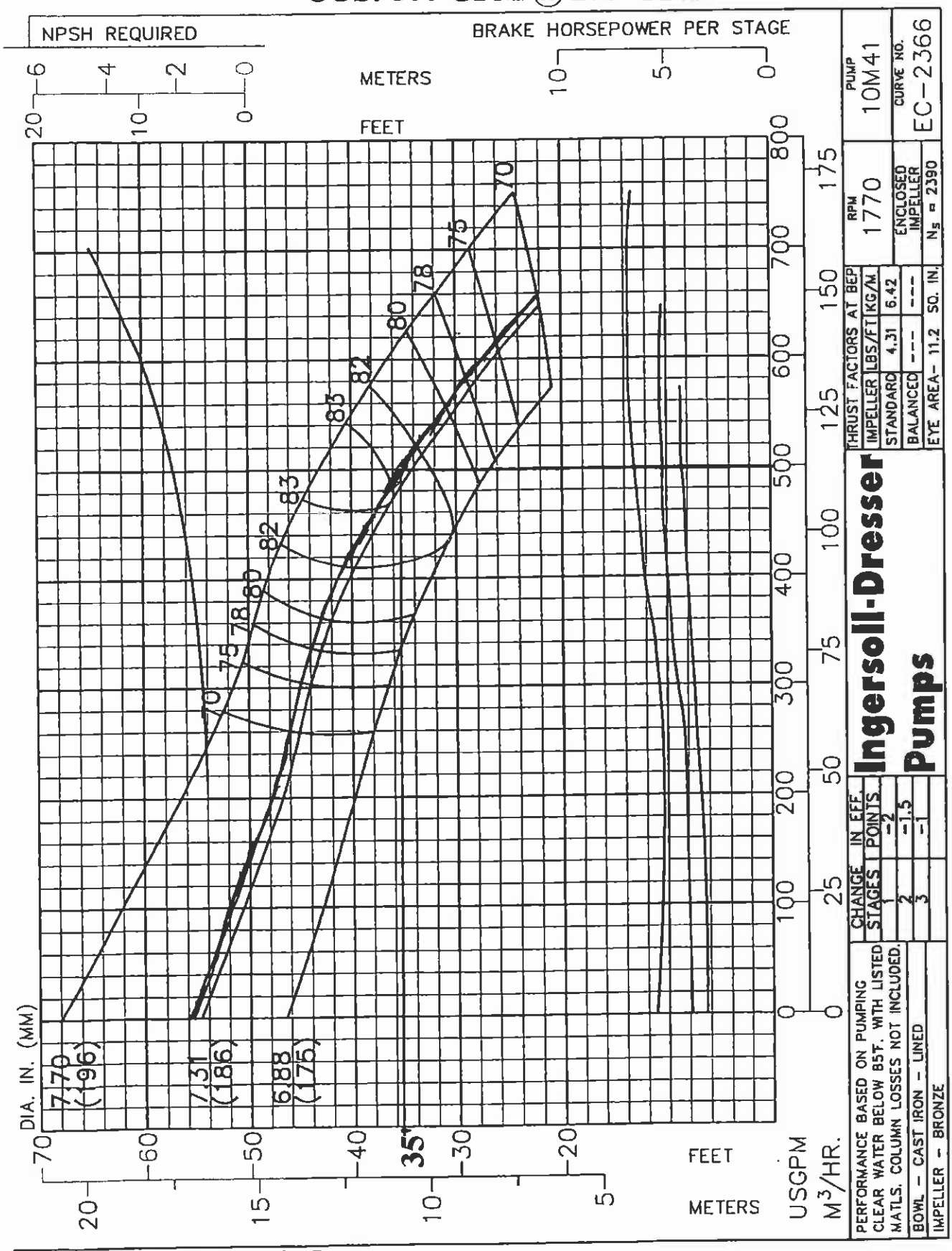
Keizer Water District
Cherry Ave. Production W

Vertical Well Profile
12-15-81 - N.T.S.
E. Butts

City of Keizer
Cherry Ave. Pump Station-Well #5
10M41-8 Stage--7.37" Imp. Dia.
COS: 500 GPM @ 270' TDH

WELL 5 PUMP

Ingersoll-Dresser Pumps



© 1993 Ingersoll-Dresser Pump Company
Printed in U.S.A.

Back of Sheet 520.23

WELL 6a

MAPL 6318C

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

Westerberg Drilling, Inc.
36728 S. Kropf Rd.
Molalla, OR 97038

WELL I.D. # L 101904

START CARD # 201581

Instructions for completing this report are on the last page of this form.

(1) LAND OWNER Well Number Carlhaven East #6
Name City of Keizer
Address 930 Chemawa Rd NE
City Keizer State OR Zip 97307

(2) TYPE OF WORK ☑ New Well
☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment ☐ Conversion

(3) DRILL METHOD
☐ Rotary Air ☐ Rotary Mud ☑ Cable ☐ Auger ☐ Cable Mud
☐ Other

(4) PROPOSED USE
☐ Domestic ☑ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION Special Construction: ☑ Yes ☐ No
Depth of Completed Well 280 ft.
Explosives used: ☐ Yes ☑ No Type Amount

BORE HOLE Diameter	From	To	SEAL Material	From	To	Sacks or Pounds
20"	0	20	Bentonite	0	6	22 sacks
16"	20	96	Cement	6	96	151 sacks
12"	96	300				

How was seal placed: Method ☐ A ☐ B ☑ C ☐ D ☐ E
☑ Other Bentonite Placed Dry
Backfill placed from 280 ft. to 300 ft. Material Cement Grout
Gravel placed from 163 ft. to 280 ft. Size of gravel 8/12 & 6/9 css

(6) CASING/LINER

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12"	+2	173	.250	☑	☐	☑	☐
					☐	☐	☐	☐
					☑	☐	☐	☐
					☐	☐	☐	☐
Liner:	None				☐	☐	☐	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☐ Outside ☐ None
Final location of shoe(s) 283' Cut Off

(7) PERFORATIONS/SCREENS
☐ Perforations Method V-Wire
☑ Screens Type Material SS

From	To	Slot Size	Number	Diameter	Tele/pipe size	Casing	Liner
160'	252'	.060				☐	☐
252'	280'	.040				☐	☐
Bottom of plate w/bail hook						☐	☐
welded on a 280' stainless						☐	☐
steel.						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☑ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
300	111		24 hr

Temperature of water 56 Depth Artesian Flow Found
Was a water analysis done? ☑ Yes By whom 4-B Engineering
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL (legal description)
County Marion
Tax Lot 4500 Lot
Township 7 S Range 3 W WM
Section 2 SW 1/4 NE 1/4
Lat ° ' " or (degrees or decimal)
Long ° ' " or (degrees or decimal)
Street Address of Well (or nearest address) 1150 Brandon St.
Keizer, OR

(10) STATIC WATER LEVEL
38' 11" ft. below land surface. Date 08/02/10
ft. below land surface. Date
Artesian pressure lb. per square inch Date

(11) WATER BEARING ZONES
Depth at which water was first found 13'

From	To	Estimated Flow Rate	SWL
All sand & gravel layers			Varies
below static water level.			

(12) WELL LOG Ground Elevation

Material	From	To	SWL
Gravel Roadbed	0	2	
Soil Brown	2	3	
Silt Brown Tan	3	5	
Silt Sandy	5	8	
Clay Brown & Grey Marbled	8	12	
Clay with Gravel Brown	12	13	
Gravel with Sand Med Coarse	13	56	
Clay with Gravel Brown	56	60	
Gravel & Sand Med Coarse Brown & Grey	60	71	
Clay Grey	71	80	
Sand Grey & Black Medium Fine w/layers of Grey Clay	80	89	
Sand Grey Medium some Gravel & Clay	89	91	
Gravel & Sand Medium Coarse	91	131	

Date Started 05/20/10 Completed 08/09/10

(unbonded) Water Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number Date AUG 25 2010
Signed

(bonded) Water Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 688 Date 08/24/10
Signed Steven N. Stadeli

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER 06/16/2004

36728 S. Kropf Rd., Molalla, OR 97038 • Phone: (503) 829-2526 FAX (503) 829-7514

WELL ID#	OWNER/BUSINESS NAME	MAILING ADDRESS	CITY/STATE/ZIP
L101904	City of Keizer	930 Chemawa Rd NE	Keizer, OR 97307

WELL ADDRESS	COUNTY	TOWNSHIP	RANGE	SECTION	1/4	1/4	TAX LOT
1150 Brandon St, Keizer, OR	MARION	7S	3W	2	SW	NE	4500

(12) WELL LOG INFO. CONTINUED FROM PREVIOUS PAGE:			
MATERIAL	FROM	TO	SWL
Clay Brown	131'	132'	
Cemented Sand & Gravel Dirty	132'	139'	
Cemented Sand & Gravel Grey Brown	139'	163'	
Sand & Gravel Grey Brown Cemented	163'	182'	
Silt & Gravel Brown	182'	183'	
Sand & Gravel Grey Brown Cemented	183'	189'	
Silt Brown	189'	192'	
Sand & Gravel Brown Cemented	192'	196'	
Sand & Gravel Cemented	196'	211'	
Silt Brown Sandy & Small Gravel	211'	213'	
Gravel Brown Cemented	213'	218'	
Silt Brown Sandy & Gravel	218'	219'	
Gravel Brown Cemented	219'	223'	
Sand & Gravel Brown Cemented	223'	228'	
Silt Gray Green	228'	234'	
Gravel Grey & Silt	234'	237'	
Sand & Gravel Grey Cemented	237'	245'	
Silt Grey	245'	247'	
Sand & Gravel Grey Semi Loose	247'	252'	
Clay Grey	252'	259'	
Sand Grey Black w/Gravel & Clay	259'	264'	
Sand Grey Black Med/Fine Packed &	264'	275'	
Loosely Cemented			
Clay Brown Stiff	275'	291'	
Clay Brown/Red	291'	297'	
Clay Tan Grey Sticky	297'	300'	

AUG 25 2010

Pump Data Sheet - Submersible 60 Hz

WELL 6 PUMP

Company: 4B Engineering
Name:
Date: 11/1/2012

Customer:City of Keizer
Well #6-Carlhaven East
Installation Year: 2010

Pump:

Size: 6CHC (7 stage)

Type: Submersible
Synch speed: 3600 rpm

Speed: 3450 rpm
Dia: 4.0625 in

Curve: E6206CCPC2

Impeller:

Specific Speeds:

Ns: 2340
Nss: —

Dimensions:

Suction: 4 in
Discharge: 3 in

Vertical Turbine:

Bowl size: 5.88 in
Max lateral: 0.25 in
Thrust K factor: 2.1 lb/ft

Pump Limits:

Temperature: 120 °F
Pressure: 420 psi g
Sphere size: 0.22 in

Power: —
Eye area: —

Search Criteria:

Flow: —

Head: —

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: —

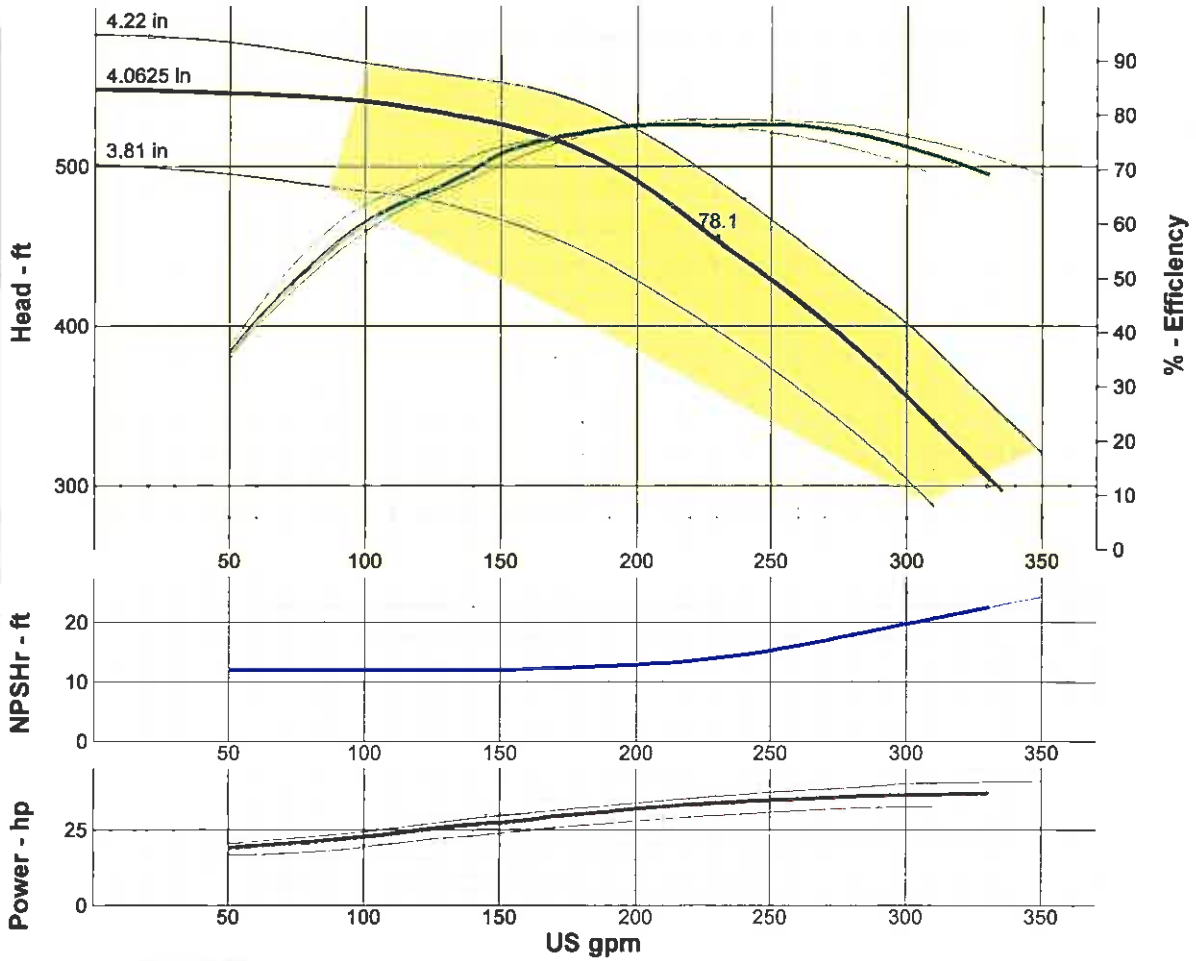
Motor:

Standard: NEMA
Enclosure: SUB

Size: 40 hp
Speed: 3600
Frame: "6""

Sizing criteria: Max Power on Design Curve

Data Point	
Flow:	300 US gpm
Head:	355 ft
Eff:	74%
Power:	36.3 hp
NPSHr:	19.7 ft
Design Curve	
Shutoff head:	548 ft
Shutoff dP:	237 psi
Min flow:	—
BEP:	78.1% @ 230 US gpm
NOL power:	36.8 hp @ 330 US gpm
Max Curve	
Max power:	41 hp @ 350 US gpm



Discharge Sizes-3",4". Curves are certified for water at 60°F only. Consult factory for performance with any other fluid.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
317	3450	327	71.3	36.6	21.3
264	3450	410	77.7	35.1	16.5
211	3450	477	78	32.5	13.3
158	3450	522	74.1	28.1	12.1
106	3450	539	61.7	23.3	12

RECEIVED

JAN 12 1981

WATER RESOURCES DEPT
SALEM, OREGON

WELL 7

WATER WELL REPORT
STATE OF OREGON

State Permit No. 16734 (16734)

(1) OWNER:
Name Keizer Water District
Address 641 Chemawa Rd. N.E.
City Salem, Or. State

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary Air ☐ Driven ☐
Rotary Mud ☐ Dug ☐
Cable ☒ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☐ Test Well ☐ Other ☐
Thermal: ☐ Withdrawal ☐ Reinjection ☐

(5) CASING INSTALLED:
Steel ☒ Plastic ☐
Threaded ☐ Welded ☒

20" Diam. from 0 ft. to 30 ft. Gauge .375
18" Diam. from +3 ft. to 145 ft. Gauge .375

LINER INSTALLED:
" Diam. from ft. to ft. Gauge

(6) PERFORATIONS:
Perforated? ☐ Yes ☒ No
Type of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? ☒ Yes ☐ No
Manufacturer's Name Johnson
Type Hi Cap Stainless Model No. 304
Diam. 16 Slot Size 100 Set from 145 ft. to 185 ft.
Diam. 16 Slot Size 100 Set from 205 ft. to 255 ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? Schneider
Yield: 1500 gal./min. with 71 ft. drawdown after 48 hrs.
" " " "
Air test gal./min. with drill stem at ft. hrs.
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Special standards: Yes ☐ No ☒
Well seal—Material used Cement Grt
Well sealed from land surface to 30 ft.
Diameter of well bore to bottom of seal 36 in.
Diameter of well bore below seal 18 in.
Number of sacks of cement used in well seal 84 sacks
How was cement grout placed? Pumped from bottom up to ground surface.
Was pump installed? no Type HP Depth ft.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☒ Yes ☐ No
Type of Water? Hi Iron depth of strata 190'-205'
Method of sealing strata off Blank Casing
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Marion Driller's well number Wiessner 1
NW ¼SW ¼ Section 1 T. 7S R. 3W W.M.
Tax Lot # Lot Blk Subdivision
Address at well location: End of Wiessner Dr.

(11) WATER LEVEL: Completed well.
Depth at which water was first found 49 ft.
Static level 50 ft. below land surface. Date 12-10
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 259 ft. Depth of completed well 255 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Soil med brn	0	2	
Sandy loam brn	2	4	
Clay med brn	4	40	
Clay sandy brn	40	45	
Sand silty brn	45	49	
Gravel Cemented med brn	49	83	
Gravel large sand grey	83	115	
Clay grey sticky	115	125	
Clay grey sandy	125	132	
Conglom course grey	132	151	
Conglom course brn	151	170	
Sandy clay, small gravel cemented brn	170	179	
Gravel large sand brn	179	188	
Gravel med uniform brn	188	200	
Gravel large sand brn	200	233	
Sand brn med	233	237	
Conglom course grey	237	245	
Gravel large sand brn	245	259	

Work started 9-23 1980 Completed 12-12 1980
Date well drilling machine moved off of well 12-12-80 19

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Steven M. Stadeli (Drilling Machine Operator) Date 12-19 1980
Drilling Machine Operator's License No. 860

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name Stadeli Pump & Construction (Person, firm or corporation) (Type or print)
Address Silverton, Oregon 97381
[Signed] Charles E. Stadeli (Water Well Contractor)
Contractor's License No. 519 Date 12-19, 1980

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310 within 30 days from the date of well completion.

SP*12658-690

WELL 7 PUMP

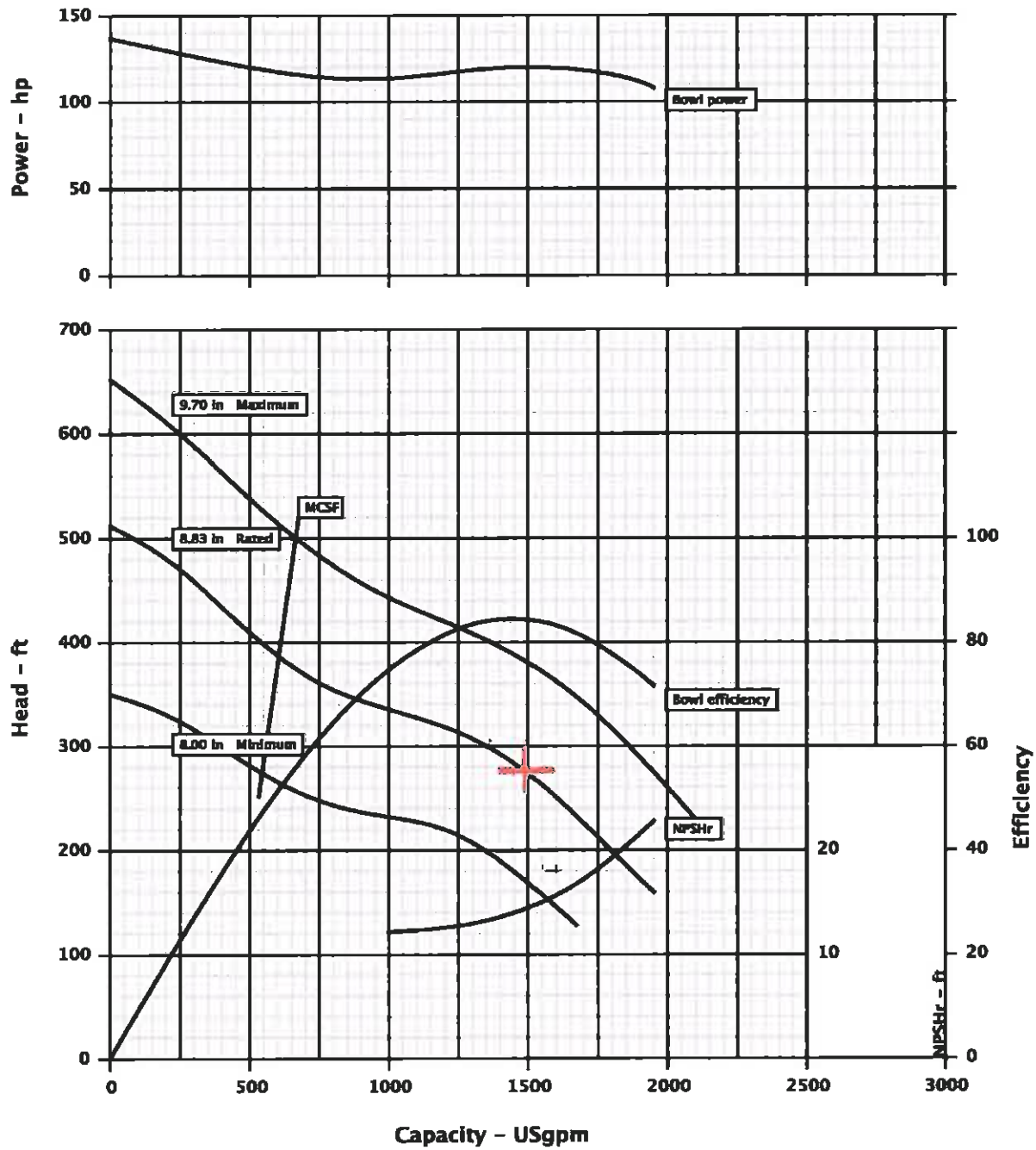
FLOWSERVE

Pump size & type	: 12ENL
Based on curve no.	: EC-1389
Number of stages	: 7 8.83" Impeller Diameter

Customer	: 4B Engineering	Capacity	: 1500 Gallons per Minute
Item number	: Wiessner–Well #7	Head	: 275' TDH
Service	:	Specific gravity	: 1.000
Flowserve reference	: Default 0.1	Pump speed	: 1770 rpm
Date	: November 1, 2012	Test tolerance	: Hydraulic Institute Level A

CURVES ARE APPROXIMATE. PUMP IS GUARANTEED FOR ONE SET OF CONDITIONS: CAPACITY, HEAD, AND EFFICIENCY

Bowl performance shown below is corrected for materials, viscosity and construction.



Bowl head of 239.96 ft corresponds with 231.0 ft head at discharge flange adjusted for elevation and friction losses.

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FlowSelex v2.2

MARI 59708

WELL 8a

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765 & OAR 690-205-0210)

WELL LABEL # L 82750

START CARD # 181254

(1) LAND OWNER

Owner Well I.D. Delta Well #8

First Name _____ Last Name _____

Company City of Keizer

Address 930 Chemewa Rd

City Keizer State OR Zip 97307

(2) TYPE OF WORK

[X] New Well [ ] Deepening [ ] Conversion
[ ] Alteration (repair/recondition) [ ] Abandonment

(3) DRILL METHOD

[X] Rotary Air [ ] Rotary Mud [ ] Cable [ ] Auger [ ] Cable Mud
[X] Reverse Rotary [ ] Other _____

(4) PROPOSED USE

[ ] Domestic [ ] Irrigation [X] Community
[ ] Industrial/ Commericial [ ] Livestock [ ] Dewatering
[ ] Thermal [ ] Injection [ ] Other _____

(5) BORE HOLE CONSTRUCTION

Special Standard [X] Attach copy

Depth of Completed Well 328. ft.

BORE HOLE

Dia	From	To
16.	0	165.
12.	165.	328.

SEAL

Material	From	To	Amt	sacks/ lbs
Cement	0	60.	20.	S
Bentonite Chips	60.	70.8	57.	S
Cement	70.8	165.	227.	S
				S

How was seal placed: Method [ ] A [ ] B [X] C [ ] D [ ] E

[ ] Other _____

Backfill placed from 167.7 ft. to 170. ft. Material sugar sand

Filter pack from 328. ft. to 189. ft. Material pea gravel Size pea gravel

Explosives used: [ ] Yes Type _____ Amount _____

(6) CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
●	○	12.	X	3.3	165.	.375	●	○	X	
○	●	10.		168.5	178.5	.365	●	○	X	
○	●	10.		193.5	208.5	.365	●	○	X	
○	●	10.		268.5	278.5	.365	●	○	X	
○	●	10.		318.5	326.5	.365	●	○	X	

Shoe [ ] Inside [X] Outside [ ] Other Location of shoe(s) 155.5

Temp casing [X] Yes Dia 16. From 0 To 155.5

(7) PERFORATIONS/SCREENS

Perforations Method _____

Screens Type Wire Wrap Material 304 SS

Perf/ Scree	Casing /Liner	Screen Dia	From	To	Scrn/slot width	Slot lengt h	# of slots	Tele/ pipe size
Screen	Liner	10.	178.5	193.5	.15			10.
Screen	Liner	10.	208.5	248.5	.125			10.
Screen	Liner	10.	248.5	268.5	.09			10.
Screen	Liner	10.	278.5	318.5	.15			10.

(8) WELL TESTS: Minimum testing time is 1 hour

(●) Pump ( ) Bailer ( ) Air ( ) Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)
1,000.	84.1	169	24.

Temperature 56 °F Lab analysis [ ] Yes By _____

Water quality concerns? [ ] Yes (describe below)

From	To	Description	Amount	Units

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SALEM, OREGON

(9) LOCATION OF WELL (legal description)

County MARION Twp 6.00 S N/S Range 3.00 W E/W WM

Sec 26 NE 1/4 of the SW 1/4 Tax Lot 4000

Tax Map Number _____ Lot _____

Lat 45 ° 1 ' 3.000 " or 45.0175 DMS or DD

Long -123 ° 1 ' 16.00(" or -123.02111111 DMS or DD

(●) Street address of well ( ) Nearest address

939 Delta Drive NE, Keizer, OR

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening				
Completed Well	04-24-2006			72.9

Flowing Artesian? [ ]

WATER BEARING ZONES Depth water was first found 70.

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
12-16-2005	70.	150.	1,000.			72.9
04-24-2006	155.	323.	1,000.			72.9

(11) WELL LOG

Ground Elevation _____

Material	From	To
asphalt / top soil fill	0	3.
brown clay	3.	12.
brown tan clay sticky some silt	12.	55.
brown sandy clay	55.	70.
brown sands	70.	72.
small gravels w/ some sand	72.	80.
gravel, cable sands, some cementation	80.	100.
sand / gravels - medium to large	100.	117.
brown gravels, rusty, course to medium sand	117.	150.
gray clay	150.	155.
small gravels w/ clay - some cementation	155.	159.
gravels and sand - brown	159.	164.
black gravels & sand - medium/course w/ black	164.	
sand layers		193.
larger gravels w/ sand - 2-3" w/ some cementation	193.	194.
gravels (1.5") w/ clay binder	194.	222.
larger gravels; brown course sands w/ some	222.	
cementation		256.
brown clay w/ some gravel	256.	262.

Date Started 12-05-2005 Completed 04-26-2006

(unbonded) Water Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 1530 Date 5-23-06

Password : (if filing electronically) _____

Signed Steve Pittard

(bonded) Water Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

License Number 523 Date 5-15-06

Password : (if filing electronically) _____

Signed _____

Contact Info

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version: 0.85

MARI 59708

WELL 8b

WATER SUPPLY WELL REPORT - continuation page

WELL I.D. # L 82750

START CARD # 181254

(5) BORE HOLE CONSTRUCTION

BORE HOLE Dia	From	To	SEAL Material	From	To	Amt	sacks/ lbs

FILTER PACK

From	To	Material	Size

(6) CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

(7) PERFORATIONS/SCREENS

Perf/ Scree	Casing /Liner	Screen Dia	From	To	Scrn/slot width	Slot lengt h	# of slots	Tele/ pipe

(8) WELL TESTS: Minimum testing time is 1 hour

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

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WATER RESOURCES DEPT
SALEM, OREGON

(10) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(11) WELL LOG

Material	From	To
gravels w/ brown clay	256.	270.
brown sand (med) w/ small gravels	270.	276.
gravels (large - 4-6") & sands w/ some cementation	276.	284.
smaller gravels w/ course to medium sand	284.	315.
gravels & medium sand w/ some clay	315.	323.
brown clay, sandy	323.	328.

Comments/Remarks

Double K-Packer - 19 3/8" long
- top at 168.5 feet

12" Shoe (Outside) - Cut at 323 feet.

Screen Diameters are 10" pipe size

Pump Data Sheet - Submersible 60 Hz

WELL 8 PUMP

Company: 4B Engineering
Name:
Date: 11/1/2012

Customer: City of Keizer
Well #8-Delta
Installation Year: 2010

Pump:

Size: 7THC (4 stage)

Type: Submersible
Synch speed: 3600 rpm

Speed: 3450 rpm
Dia: 4.8125 in

Curve: E6207TFPC2

Impeller:

Specific Speeds:

Ns: 3655
Nss: —

Dimensions:

Suction: —
Discharge: —

Vertical Turbine:

Bowl size: 7.13 in
Max lateral: 0.38 in
Thrust K factor: 4.56 lb/ft

Pump Limits:

Temperature: 120 °F
Pressure: 310 psi g
Sphere size: 0.83 in

Power: —
Eye area: —

Search Criteria:

Flow: —

Head: —

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: —

Motor:

Standard: NEMA
Enclosure: SUB

Size: 60 hp
Speed: 3600
Frame: "6""

Sizing criteria: Max Power on Design Curve

---- Data Point ----

Flow:	653 US gpm
Head:	286 ft
Eff:	79.2%
Power:	59.5 hp
NPSHr:	17.9 ft

---- Design Curve ----

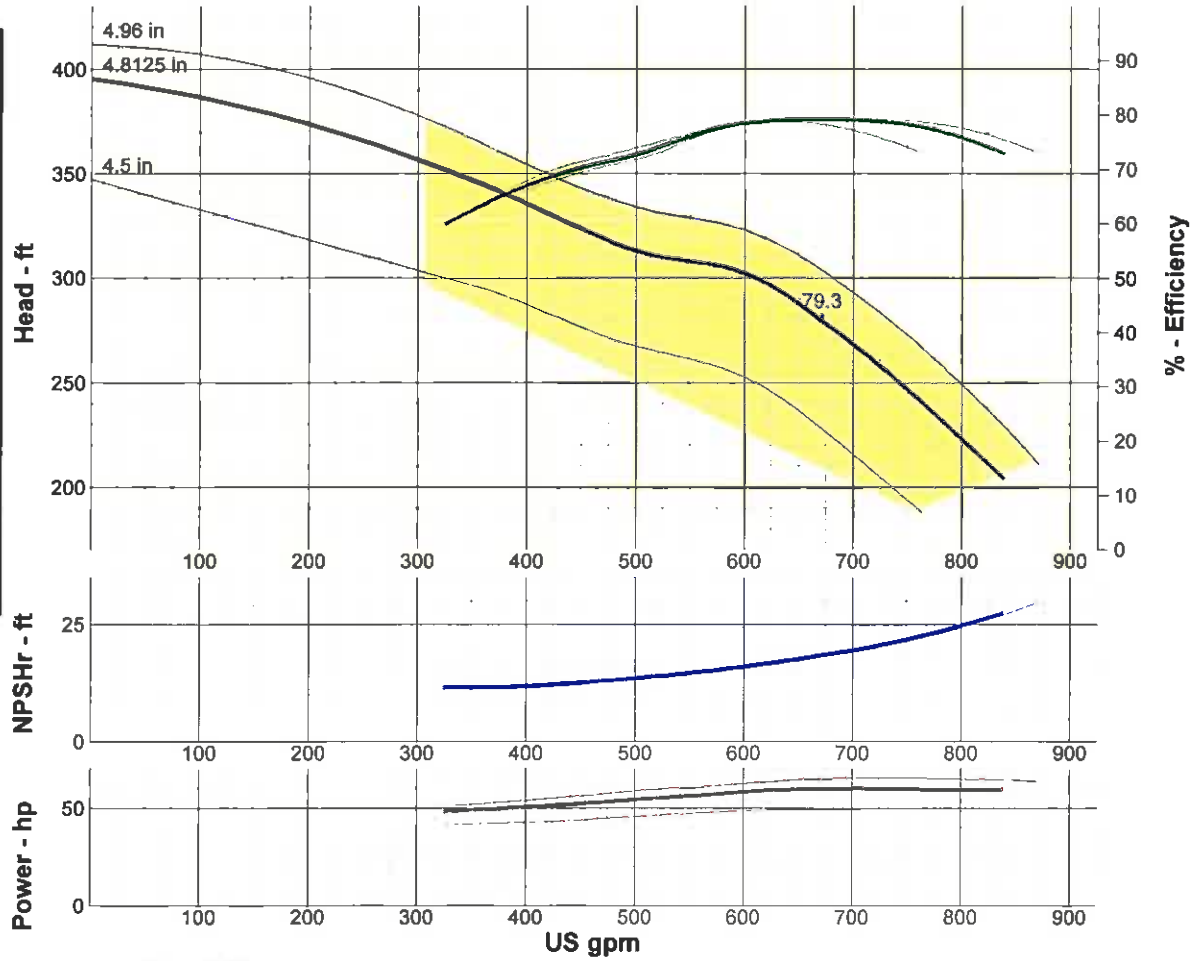
Shutoff head:	395 ft
Shutoff dP:	171 psi
Min flow:	—

BEP: 79.3% @ 671 US gpm

NOL power:
59.8 hp @ 718 US gpm

-- Max Curve --

Max power:
65.3 hp @ 751 US gpm



Discharge Sizes-5",6". Curves are certified for water at 60°F only. Consult factory for performance with any other fluid.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
805	3450	220	75.5	59.3	25.2
671	3450	280	79.3	59.7	18.5
537	3450	309	75.3	55.6	14.5
403	3450	335	67.1	50.6	12
268	3450	—	—	—	—

WELL 9a

WATER WELL REPORT
STATE OF OREGON

RECEIVED
MAY 04 1981
WATER RESOURCES DEPT
SALEM, OREGON

State Well No. 6S/3W-34

State Permit No. MARI (5389)

(1) OWNER:
Name: Keizer Water District
Address: 641 Chemawa Rd NE
City: Salem State: Oregon

(2) TYPE OF WORK (check):
New Well [X] Deepening [ ] Reconditioning [ ] Abandon [ ]
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL: Reverse *
Rotary Air [X] Driven [ ]
Rotary Mud [ ] Dug [ ]
[X] Bored [ ]

(4) PROPOSED USE (check):
Domestic [ ] Industrial [ ] Municipal [X]
Irrigation [ ] Test Well [ ] Other [ ]
Thermal: [ ] Withdrawal [ ] Reinjection [ ]

(5) CASING INSTALLED:
Steel [X] Plastic [ ]
Threaded [ ] Welded [X]

16" ID Diam. from +3'6" ft. to 119'5" Gauge .312
16" ID Diam. from 200 ft. to 205 ft. Gauge .312
LINER INSTALLED
30" Diam. from +2'9" ft. to 96 ft. Gauge .400

(6) PERFORATIONS:
Perforated? [ ] Yes [X] No
Type of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? [X] Yes [ ] No
Manufacturer's Name: UOP Johnson
Type: Double Extra Strong Model No.: HI-CAP
Diam. 16" P.S. Slot Size .150 Set from 119'5" ft. to 200 ft.
Diam. Slot Size Set from ft. to ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? [X] Yes [ ] No If yes, by whom? SEI
1500 gal/min. with 39 ft. drawdown after 36 hrs.
" " " "
Air test gal./min. with drill stem at ft. hrs.
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Special standards: Yes [ ] No [X]
Well seal—Material used: neat cement
Well sealed from land surface to: 96 ft.
Diameter of well bore to bottom of seal: 36+ in.
* Diameter of well bore below seal: 30+ in. to 145' 20" to 232
Number of sacks of cement used in well seal: 1620 sacks
How was cement grout placed? Pumped between 30" casing and borehole wall from 96' up.
Was pump installed? No Type HP Depth ft.
Was a drive shoe used? [X] Yes [ ] No Plugs Size: location ft.
Did any strata contain unusable water? [ ] Yes [X] No
Type of Water? depth of strata
Method of sealing strata off
Was well gravel packed? [X] Yes [ ] No Size of gravel: 1/2-3/4
Gravel placed from top ft. to bottom ft.

(10) LOCATION OF WELL:
County: Marion Driller's well number: 8106
NE ¼ SE ¼ Section 34 T. 6S R. 3W W.M.
Tax Lot # Lot Blk Subdivision
Address at well location: NW corner of McNary High School Property (McNary Site)

(11) WATER LEVEL: Completed well.
Depth at which water was first found 16 ft.
Static level 14'5" ft. below land surface. Date 4/15/8
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing: -
Depth drilled 232 ft. Depth of completed well 205 ft.
Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
* Well was drilled to 186' with reverse circulation rotary. Because of large rocks, hole deviated excessively between 150 and 186' resulting in the loss of some drill stem and bit. The hole was then backfilled from 186' to approximately 145' and a cable tool rig drilled a 20" hole from 145' to 232'.			
See sheet Attached for well log			

Work started 1/15 19 81 Completed 4/16 19 81
Date well drilling machine moved off of well 4/16 19 81

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Donald G. Davis (Drilling Machine Operator) Date 4/30 19 81
Drilling Machine Operator's License No. 1085

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name Schneider Equipment, Inc. (Person, firm or corporation) (Type or print)
Address 21881 River Rd NE, St. Paul, Or
[Signed] Stephen J. Schneider (Water Well Contractor)
Contractor's License No. 649 Date 4-30 19 81

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310 within 30 days from the date of well completion.

SP*12658-690

WELL 9b

Keizer Water District
Mc Nary Site

#8106

Material	From	To
top soil, brown, sandy	0	5
Clay, brown, sandy, w/ some gravel	5	10
Sand & gravel, brown	10	15
Gravel & sand, coarse up to 8", loose	15	68
Clay, blue-gray w/ some gravel	68	71
Large Gravel & sand, black w/ traces of clay, gray	71	76
Large gravel & sand, med-coarse, black	76	91
Clay, gray	91	98
Gravel & sand, medium, loosely cemented	98	113
Gravel up to 4" + sand, black, med-fine loosely cemented	113	115
Clay, brownish gray, fine sandy	115	118
Gravel & sand, cemented up to 4"	118	128
Gravel up to 8" & sand, med-coarse, black, loosely cemented	128	138
Gravel up to 10" w/ some sand, loose	138	153
Gravel up to 8" w/ sand, coarse, brown, some cemented	153	173
Gravel up to 8" w/ sand, fine-medium	173	185
Large gravel, w/ sand, med-fine	185	191
Large gravel, w sand, w/ clay, brown, red & gray	191	200
Large gravel, w/ clay, brown	200	232

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WATER RESOURCES DEPT
SALEM, OREGON

Pump Data Sheet - Turbine 60 Hz

WELL 9 PUMP

Company: 4B Engineering
Name:
Date: 11/1/2012

Customer: City of Keizer
Well #9-McNary
Installation Year: 1999

Pump:

Size: 14RJLO (3 stage)

Type: Lineshaft
Synch speed: 1800 rpm

Speed: 1770 rpm
Dia: 9.82 in

Curve: 3123

Impeller:

Specific Speeds:

Ns: 2730
Nss: —

Dimensions:

Suction: —
Discharge: —

Vertical Turbine:

Bowl size: 13.6 in
Max lateral: 1 in
Thrust K factor: 16.2 lb/ft

Pump Limits:

Temperature: 120 °F
Pressure: 340 psi g
Sphere size: 0.98 in

Power: —
Eye area: —

Search Criteria:

Flow: —

Head: —

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: —

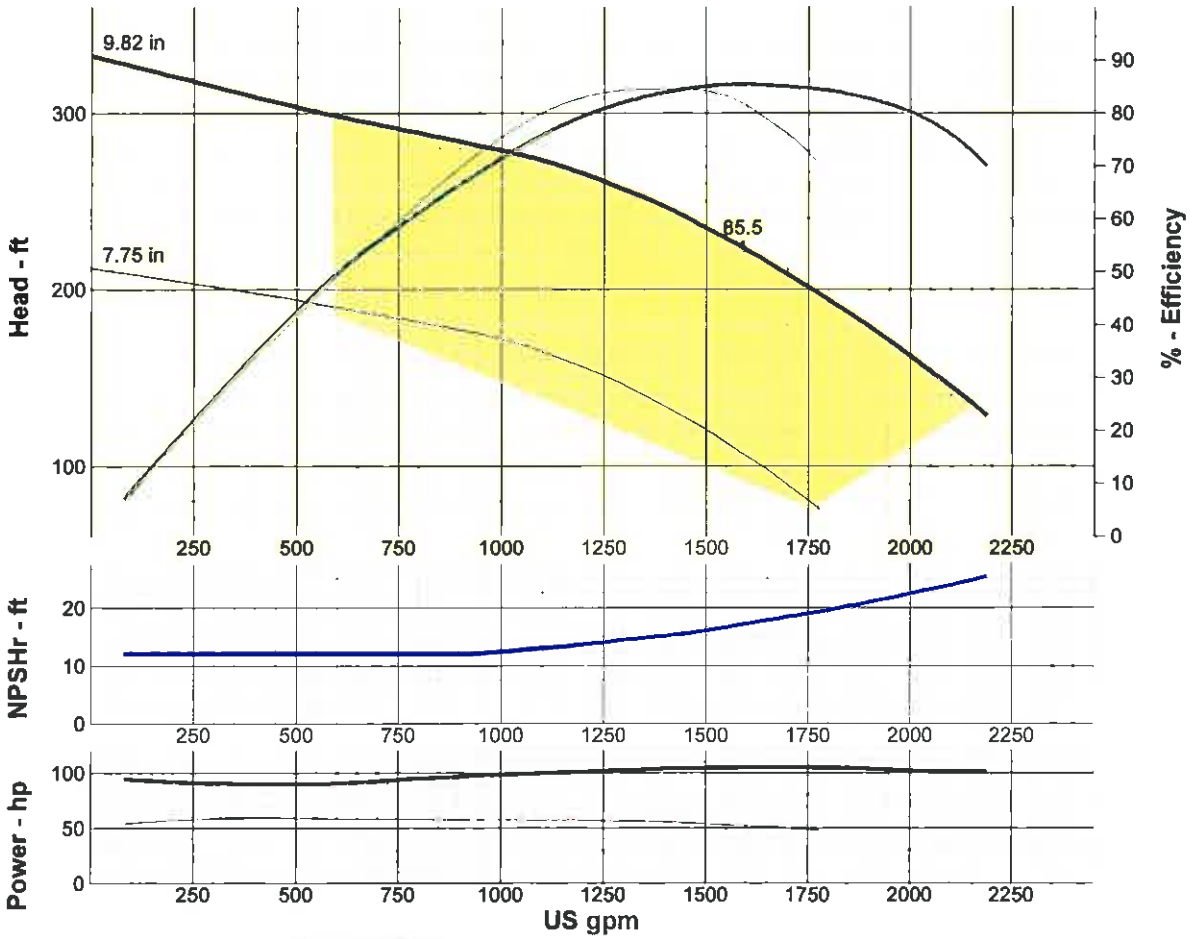
Motor:

Standard: NEMA
Enclosure: WPI

Size: 125 hp
Speed: 1800
Frame: 405

Sizing criteria: Max Power on Design Curve

---- Data Point ----	
Flow:	1603 US gpm
Head:	222 ft
Eff:	85.4%
Power:	105 hp
NPSHr:	17.2 ft
---- Design Curve ----	
Shutoff head:	332 ft
Shutoff dP:	144 psi
Min flow:	—
BEP:	85.5% @ 1590 US gpm
NOL power:	105 hp @ 1700 US gpm
-- Max Curve --	
Max power:	105 hp @ 1700 US gpm



Suction Size-10" Discharge Sizes-8",10",12". Curves are certified for water at 60°F only. Consult factory for performance with any other fluid.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
2100	1770	145	75.8	101	23.9
1750	1770	201	84.6	105	19
1400	1770	247	84	104	15.2
1050	1770	276	73.7	99.2	12.7
700	1770	293	55.7	92.8	12

WELL 10

WATER WELL REPORT
STATE OF OREGON

MAR. 1675
6779 MAR

RECEIVED
MAR 31 1981
WATER RESOURCES DEPT
SALEM, OREGON

State Well No. .....

State Permit No. .....

(1) OWNER:
Name Keizer Water District
Address 641 Chemawa Rd. NE
City Salem State Or

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Rotary Mud ☐ Dug ☐
[redacted] ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☐ Test Well ☐ Other ☐
Thermal: Withdrawal ☐ Reinjection ☐

(5) CASING INSTALLED:
Steel ☒ Threaded ☐ Plastic ☐ Welded ☒

30 " Diam. from +2 ft. to 85 ft. Gauge .375
[redacted] " Diam. from +2 ft. to 120 ft. Gauge .375

LINER INSTALLED:
..... " Diam. from ..... ft. to ..... ft. Gauge .....

(6) PERFORATIONS:
Perforated? ☐ Yes ☒ No
Type of perforator used
Size of perforations in. by in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

(7) SCREENS:
Well screen installed? ☒ Yes ☐ No
Manufacturer's Name Johnson
Type Hi-Cap Low carbon steel Model No. .....
Diam. 16" Slot Size 150 Set from 120 ft. to 250 ft.
Diam. ..... Slot Size ..... Set from ..... ft. to ..... ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
[redacted] pump test made? ☒ Yes ☐ No If yes, by whom? Schneider
Yield: 2500 gal./min. with 69 ft. drawdown after 48 hrs.
" " " "
Air test gal./min. with drill stem at ft. hrs.
[redacted]r test gal./min. with ft. drawdown after hrs.
[redacted]ian flow g.p.m.
Temperature of water Depth artesian flow encountered ..... ft.

(9) CONSTRUCTION:
Special standards: Yes ☐ No ☒
Well seal—Material used Cement Grt
Well sealed from land surface to 85 ft.
Diameter of well bore to bottom of seal 36 in.
Diameter of well bore below seal 26"+ in.
Number of sacks of cement used in well seal 431 sacks
How was cement grout placed? Pumped from 85' up to ground surface with grt pump

Was pump installed? no Type ..... HP ..... Depth ..... ft.
Was a drive shoe used? ☐ Yes ☒ No Plugs ..... Size: location ..... ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of Water? depth of strata
Method of sealing strata off
Was well gravel packed? ☒ Yes ☐ No Size of gravel: ½" minus pea rock
Gravel placed from 0 ft. to 255 ft.

(10) LOCATION OF WELL:
County Marion Driller's well number Chemawa 1
NW ¼ NW ¼ Section 2 T. 7S R. 3W W.M.
Tax Lot # Lot Blk Subdivision
Address at well location: 641 Chemawa Rd. NE

(11) WATER LEVEL: Completed well.
Depth at which water was first found 95 ft.
Static level 21 ft. below land surface. Date
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 0
Depth drilled 255 ft. Depth of completed well 255 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Soil Med. Brn	0	2	
Clay Med. Brn	2	13	
Gravel Lrg Grey	13	19	
Gravel Lrg Sand Brn	19	68	
Conglm Med. Brn	68	77	
Conglm Med. Blue	77	80	
Clay Sticky Grey	80	95	
Conglm Med. Brn	95	116	WB
Gravel Lge Sand Brn	116	148	WB
Gravel Med. to Lge Grey	148	176	WB
Gravel Med. Sand Brn	176	215	WB
Gravel Lge Sand Brn	215	255	WB

Work started 1-5 19 81 Completed 3-3 1981
Date well drilling machine moved off of well 2-9 1981

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] ..... Date 3/5, 19 81
(Drilling Machine Operator)
Drilling Machine Operator's License No. 720

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name Stadeli Pump & Construction Inc.
(Person, firm or corporation) (Type or print)
Address Silverton, Or. 97381
[Signed] Charles E. Stadeli
(Water Well Contractor)
Contractor's License No. 519 Date 3/5/, 19 81

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310 within 30 days from the date of well completion.

SP*12658-690

Pump Data Sheet - Turbine 60 Hz

Company: 4B Engineering
Name:
Date: 11/1/2012

Customer: City of Keizer
Well #10-Chemawa
Installation Year: 2000

WELL 10 PUMP

Pump:

Size: 14RJHC (3 stage)

Type: Lineshaft
Synch speed: 1800 rpm

Speed: 1770 rpm
Dia: 9.75 in

Curve: E6414RCPC2

Impeller:

Specific Speeds:

Ns: 3032
Nss: —

Dimensions:

Suction: —
Discharge: —

Vertical Turbine:

Bowl size: 13.6 in
Max lateral: 1 in
Thrust K factor: 13 lb/ft

Pump Limits:

Temperature: 120 °F
Pressure: 340 psi g
Sphere size: 0.98 in

Power: —
Eye area: —

Search Criteria:

Flow: —

Head: —

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: —

Motor:

Standard: NEMA
Enclosure: WPI

Size: 200 hp
Speed: 1800
Frame: 445

Sizing criteria: Max Power on Design Curve

---- Data Point ----

Flow:	2305 US gpm
Head:	250 ft
Eff:	85.8%
Power:	170 hp
NPSHr:	33.1 ft

---- Design Curve ----

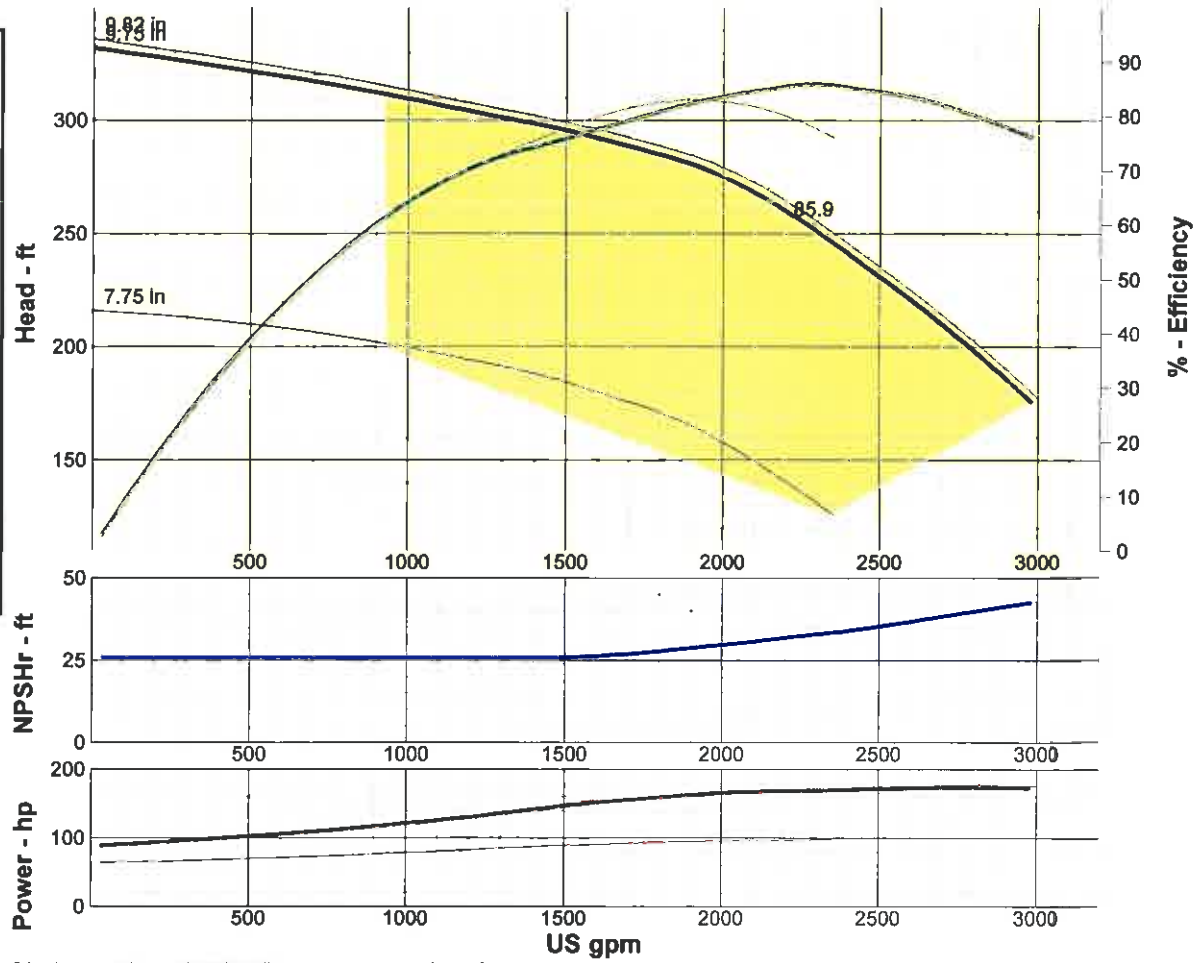
Shutoff head:	332 ft
Shutoff dP:	144 psi
Min flow:	—

BEP: 85.9% @ 2287 US gpm

NOL power:
175 hp @ 2804 US gpm

-- Max Curve --

Max power:
178 hp @ 2820 US gpm



Discharge Sizes-8",10",12". Curves are certified for water at 60°F only. Consult factory for performance with any other fluid.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
2861	1770	190	78.7	174	40.9
2384	1770	242	85.3	171	34
1907	1770	280	82.5	163	28.9
1430	1770	298	74.7	144	26
954	1770	311	62.4	120	26

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED
AUG 28 1973
STATE ENGINEER
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

5206

WELL 11
State Well No. 6S/3W-25
State Permit No.

(1) OWNER:
Name KENNETH NIELSON
Address 5220 JOAN DR. N. SALEM, OREGON

(2) TYPE OF WORK (check):
New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☑ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☑
Irrigation ☐ Test Well ☐ Other ☐

(5) CASING INSTALLED:
Threaded ☐ Welded ☑
10" Diam. from +15 ft. to 155 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(6) PERFORATIONS:
Perforated? ☑ Yes ☐ No
Type of perforator used Mills
Size of perforations 5/8 in. by 2 in.
250 perforations from 140 ft. to 150 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☑ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☑ Yes ☐ No If yes, by whom? Miller & West
Yield: 600 gal./min. with 26 ft. drawdown after 48 hrs.
" " "
" " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used CEMENT
Well sealed from land surface to 30 ft.
Diameter of well bore to bottom of seal 18 in.
Diameter of well bore below seal 10 in.
Number of sacks of cement used in well seal 32 sacks
Number of sacks of bentonite used in well seal 0 sacks
Brand name of bentonite
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☑ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☑ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County MARION Driller's well number
¼ ¼ Section 25 T. 6S R. 3W W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 45 ft.
Static level 24 ft. below land surface. Date 7-23-73
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 10
Depth drilled 155 ft. Depth of completed well 155 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. *Report each change in position of Static Water Level and indicate principal water-bearing strata.*

MATERIAL	From	To	SWL
SOIL	0	1	
BROWN – CLAY	1	33	
" – SAND & GRAVEL PART CEMENTED	33	103	
BROWN – HARD SAND WITH SOME GRAVEL	103	107	
BLUE – CLAY	107	119	
SAND & GRAVEL CEMENTED	119	139	
BLACK – HARD SAND & GRAVEL	139	153	
HARD SAND & GRAVEL CEMENTED	153	155	

Work started 6-19- 1973 Completed 7-23- 1973
Date well drilling machine moved off of well 7-25- 1973

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Bill Sitter (Drilling Machine Operator) Date 7-25, 1973
Drilling Machine Operator's License No. 651

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name Miller & West (Person, firm or corporation) (Type or print)
Address 5875 GAFFIN RD. S.E.
[Signed] Harlan R. Miller (Water Well Contractor)
Contractor's License No. 37 Date 7-25-, 1973

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

WELL 11 PUMP

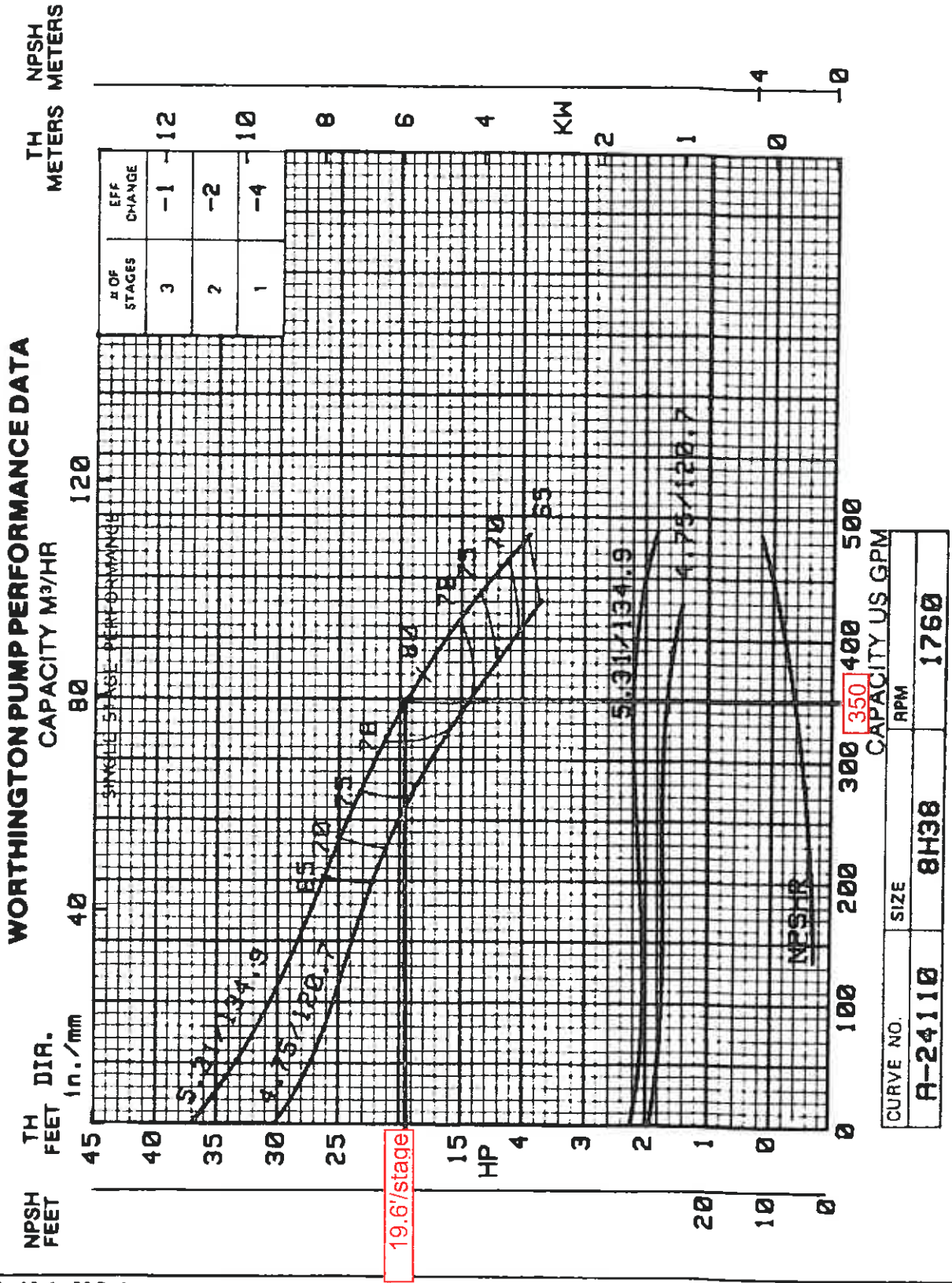
2400-8 Page 42
May 1986
8H38
1760 RPM

Customer City of Keizer
Project Lauderback-Well #11
Cust. Proposal/Order No.
Customer Item No.

Worthington S.O.
Proposal/Order No.
Certified By
Date

8H38-13 Stage-5.31" Imp. Dia.--COS: 350 GPM @ 255' TDH

Liquid/Service Sp. Gr. Visc. SSU
Capacity Head Temp. °F/°C Consistency %



Litho'd. in U.S.A.

WORTHINGTON

WELL 12a

MARI 64141
RECEIVED
MAR 26 2012
WATER RESOURCES DEPT
SALEM, OREGON

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

WELL I.D. # L 106360
START CARD # 207830

Instructions for completing this report are on the last page of this form

(1) LAND OWNER Well Number #12
Name City of Keizer
Address 930 Chemawa Rd NE
City Keizer State OR Zip 97307

(2) TYPE OF WORK ☑ New Well
☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment ☐ Conversion

(3) DRILL METHOD
☐ Rotary Air ☐ Rotary Mud ☑ Cable ☐ Auger ☐ Cable Mud
☐ Other

(4) PROPOSED USE
☐ Domestic ☑ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION Special Construction: ☑ Yes ☐ No
Depth of Completed Well 335 ft.
Explosives used: ☐ Yes ☑ No Type Amount

BORE HOLE Diameter	From	To	SEAL Material	From	To	Sacks or Pounds
20	0	33	bentonite	0	5	15 sacks
16	33	122	cement	5	122	131 sacks
10	122	372				

How was seal placed: Method ☐ A ☐ B ☑ C ☐ D ☐ E
☑ Other bentonite placed dry
Backfill placed from 342 ft. to 372 ft. Material cement grout
Gravel placed from 335 ft. to 342 ft. Size of gravel sand & 3/8

(6) CASING/LINER

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	10	+2	160	.250	☑	☐	☑	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☑ Outside ☐ None
Final location of shoe(s) 16" @ 103' 10" @ 364' (cut off)

(7) PERFORATIONS/SCREENS
☐ Perforations Method V wire
☑ Screens Type wire wrap Material S.S.

From	To	Slot Size	Number	Diameter	Tele/pipe size	Casing	Liner
152	160	.010	riser	10	tele	☐	☐
160	185	.070		10	tele	☐	☐
185	195	.010		10	tele	☐	☐
195	295	.070		10	tele	☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☑ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
900	84		25 hr

Temperature of water 55 Depth Artesian Flow Found
Was a water analysis done? ☑ Yes By whom 4B Engineering
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☑ Other
Depth of strata: above 122 ft

(9) LOCATION OF WELL (legal description)
County Marion
Tax Lot 6300 Lot
Township 6 S Range 3 W WM
Section 35 NE 1/4 NE 1/4
Lat ° ' " or (degrees or decimal)
Long ° ' " or (degrees or decimal)
Street Address of Well (or nearest address)
6288 17th Ave NE, Keizer

(10) STATIC WATER LEVEL
31' 2.5" ft. below land surface. Date 03-17-12
ft. below land surface. Date
Artesian pressure lb. per square inch Date

(11) WATER BEARING ZONES
Depth at which water was first found 28'

From	To	Estimated Flow Rate	SWL
160	330	900>	31' 2.5"

(12) WELL LOG Ground Elevation

Material	From	To	SWL
top soil brown	0	2	
sub soil brown	2	5	
silt brown	5	18	
sandy silt brown	18	28	
gravel with silt brown	28	29	
silt brown	29	33	
gravel with silt	33	44	
silt brown	44	47	
gravel w/silt some loose streaks	47	91	
cemented gravel	91	103	
clay grey dense	103	111	
clay grey green	111	114	
sticky grey clay	114	117	
clay grey	117	127	
gravel & sand grey	127	139	
cont. page 2			

Date Started 12-8-11 Completed 3-19-12

(unbonded) Water Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number Date

Signed

(bonded) Water Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 688 Date 3-20-12
Signed Steven N. Stadeli

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER 06/16/2004

WELL 12b

MARI 64141
RECEIVED
MAR 26 2012
WATER RESOURCES DEPT
SALEM, OREGON

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

WELL I.D. # L 108380
START CARD # 207630

Instructions for completing this report are on the last page of this form.

(1) LAND OWNER Well Number #12
Name City of Keizer - PAGE 2
Address 930 Chemawa Rd NE
City Keizer State OR Zip 97307

(2) TYPE OF WORK ☑ New Well
☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment ☐ Conversion

(3) DRILL METHOD
☐ Rotary Air ☐ Rotary Mud ☑ Cable ☐ Auger ☐ Cable Mud
☐ Other

(4) PROPOSED USE
☐ Domestic ☑ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION Special Construction: ☐ Yes ☐ No
Depth of Completed Well ____ ft.
Explosives used: ☐ Yes ☐ No Type ____ Amount ____

BORE HOLE Diameter	From	To	SEAL Material	From	To	Sacks or Pounds

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☐ Other
Backfill placed from ____ ft. to ____ ft. Material ____
Gravel placed from ____ ft. to ____ ft. Size of gravel ____

(6) CASING/LINER

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☐ Outside ☐ None
Final location of shoe(s) ____

(7) PERFORATIONS/SCREENS
☐ Perforations Method v wire
☑ Screens Type wire wrap Material S.S.

From	To	Slot Size	Number	Diameter	Tele/pipe size	Casing	Liner
295	313	.010		10	tele	☐	☐
313	330	.100		10	tele	☐	☐
330	335	.010	tail	10	tele	☐	☐
s.s	bottom	plate	&double	K	packer	☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time

Temperature of water ____ Depth Artesian Flow Found ____
Was a water analysis done? ☐ Yes By whom ____
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other ____
Depth of strata: ____

(9) LOCATION OF WELL (legal description)
County Marion
Tax Lot 6300 Lot ____
Township 6 S Range 3 W WM
Section 35 NE 1/4 NE 1/4
Lat ____ ° ____ ' ____ " or ____ (degrees or decimal)
Long ____ ° ____ ' ____ " or ____ (degrees or decimal)
Street Address of Well (or nearest address) 6288 17th Ave NE, Keizer

(10) STATIC WATER LEVEL
____ ft. below land surface. Date ____
____ ft. below land surface. Date ____
Artesian pressure ____ lb. per square inch Date ____

(11) WATER BEARING ZONES
Depth at which water was first found ____

From	To	Estimated Flow Rate	SWL

(12) WELL LOG Ground Elevation ____

Material	From	To	SWL
cont. from page 1			
grey sand & gravel more cmtd	139	163	
sand & gravel brown with clay	163	186	
clay brn sandy occasional gravel	186	195	
brown sand & gravel with clay	195	216	
sand & gravel brown loosely	216		
cemented with brown clay some			
intermitten grey clay binder		297	
clay grey	297	313	
sand & gravel grey	313	331	
grey clay	331	333	
sand with gravel grey cemented	333	336	
sand grey med to fine cemented	336		
layered with silt packed		341	
silt brown	341	343	
cont. page 3			

Date Started 12-6-11 Completed 3-19-12

(unbonded) Water Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number ____ Date ____

Signed ____

(bonded) Water Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 988 Date 3-20-12

Signed Steven M. Stadel

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WELL 12c

MARI 64141

RECEIVED
MAR 26 2012
WATER RESOURCES DEPT
SALEM, OREGON

WESTERBERG DRILLING INC
36728 S. Kropf Rd., Molalla, OR 97038 • Phone: (503) 829-2526 FAX (503) 829-7514

WELL ID#	OWNER/BUSINESS NAME	MAILING ADDRESS	CITY/STATE/ZIP
106360	City of Keizer	930 Chemawa Rd NE	Keizer, OR 97307

WELL ADDRESS	COUNTY	TOWNSHIP	RANGE	SECTION	1/4	1/4	TAX LOT
6288 17th Ave NE,Keizer	Marion	6S	3W	35	NE	NE	6300

(12) WELL LOG INFO. CONTINUED FROM PREVIOUS PAGE:

MATERIAL	FROM	TO	SWL
cont. from page 2			
sand grey fine packed with silt lenses	343	348	
silt brown sandy	348	351	
sand grey fine packed with silt lenses	351	362	
silt brown	362	364	
clay grey dense sticky with wood	364	368	
clay grey green sticky	368	372	

Pump Data Sheet - Submersible 60 Hz

WELL 12 PUMP

Company: 4B Engineering
Name:
Date: 11/1/2012

Customer: City of Keizer
Well #12-17th Avenue
Installation Year: 2012

Pump:

Size: 8FDLC (5 stage)

Type: Submersible
Synch speed: 3600 rpm

Speed: 3450 rpm
Dia: 5.06 in

Curve: E6208FFPC0

Impeller:

Specific Speeds:

Ns: 3750
Nss: —

Dimensions:

Suction: —
Discharge: —

Vertical Turbine:

Bowl size: 7.5 in
Max lateral: 0.56 in
Thrust K factor: 7.9 lb/ft

Pump Limits:

Temperature: 120 °F
Pressure: 400 psi g
Sphere size: 0.5 in

Power: —
Eye area: —

Search Criteria:

Flow: —

Head: —

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: —

Motor:

Standard: NEMA
Enclosure: SUB

Size: 100 hp
Speed: 3600
Frame: "8""

Sizing criteria: Max Power on Design Curve

— Data Point —

Flow:	903 US gpm
Head:	301 ft
Eff:	75.9%
Power:	90.3 hp
NPSHr:	34.1 ft

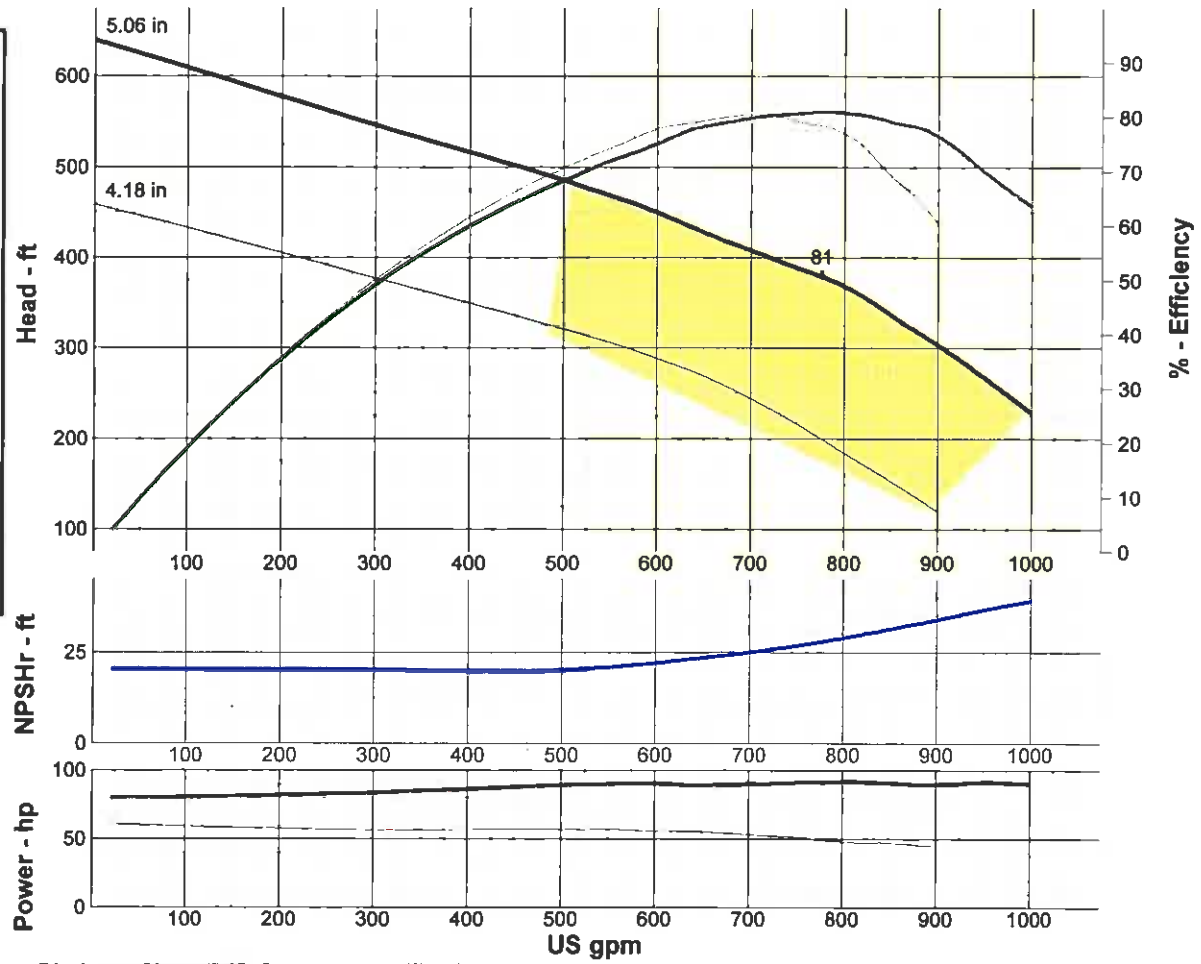
— Design Curve —

Shutoff head:	640 ft
Shutoff dP:	277 psi
Min flow:	—
BEP:	81% @ 776 US gpm

NOL power:
92.1 hp @ 809 US gpm

-- Max Curve --

Max power:
92.1 hp @ 809 US gpm



Discharge Sizes-5",6". Curves are certified for water at 60°F only. Consult factory for performance with any other fluid.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
960	3450	259	68.6	91.3	37
800	3450	368	80.7	92	28.9
640	3450	432	77.9	89.6	23.2
480	3450	491	66.2	88.7	20.4
320	3450	540	51.2	84.5	20.2

STATE OF OREGON

WATER WELL REPORT

(as required by ORS 537.765)

MAR1 1787

MAY 29 1992

WATER RESOURCES DEPT
SALEM, OREGON

WELL 14a

(START CARD) # 26328

(1) OWNER: Well Number

Name City of Keizer

Address 930 Chemawa Rd. N.E.

City Keizer State OR Zip 97303

(2) TYPE OF WORK:

☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD:

☐ Rotary Air ☐ Rotary Mud ☒ Cable

☐ Other

(4) PROPOSED USE:

☐ Domestic ☐ Community ☐ Industrial ☐ Irrigation

☐ Thermal ☐ Injection ☒ Other Municipal

(5) BORE HOLE CONSTRUCTION:

Special Construction approval ☐ Yes ☒ No Depth of Completed Well 310 ft.

Explosives used ☐ Yes ☒ No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
16	0	52	Cement	0	52	42 Sacks
12	52	340				

How was seal placed: Method ☐ A ☐ B ☒ C ☐ D ☐ E

☐ Other

Backfill placed from 310 ft. to 340 ft. Material 3/4 minus Crushed

Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12	+2	195	.375	☒	☐	☒	☐
					☐	☐	☐	☐
	10	190	195	.250	☒	☐	☒	☐
	10	250	275	.250	☒	☐	☒	☐
Liner:	10	295	310	.250	☒	☐	☒	☐
					☐	☐	☐	☐

Final location of shoe(s) 325

(7) PERFORATIONS/SCREENS:

☐ Perforations Method Pull Back

☒ Screens Type V Slot Material 304 S Steel

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
195	230	80		10"	pipe Size	☐	☐
230	250	50		10"	pipe Size	☐	☐
275	295	80		10"	pipe Size	☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour

☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
1200	30'		12 1 hr.

Temperature of Water 55 Depth Artesian Flow Found

Was a water analysis done? ☐ Yes By whom

Did any strata contain water not suitable for intended use? ☐ Too little

☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other

Depth of strata:

(9) LOCATION OF WELL by legal description:

County Marion Latitude Longitude

Township 6-S N or S. Range 3-W E or W. WM.

Section 26 SE ¼ NE ¼

Tax Lot Lot Block Subdivision

Street Address of Well (or nearest address) 7171 River Rd. Keizer OR

(10) STATIC WATER LEVEL:

60 ft. below land surface. Date 5-9-92

Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found 60 ft

From	To	Estimated Flow Rate	SWL
60	141	Cased off	56
176	319	1200+	60

(12) WELL LOG:

Ground elevation

Material	From	To	SWL
See Attached Sheets			

Date started Feb 28 Completed May 9

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Material used and information reported above are true to my best knowledge and belief.

WWC Number

Signed Date

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performe during this time is in compliance with Oregon well construction standards. This repor is true to the best of my knowledge and belief. # 1273

Signed Floyd Sigler / Michael Waldrop WWC Number 4633

Date 5/20/92

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WELL 14b

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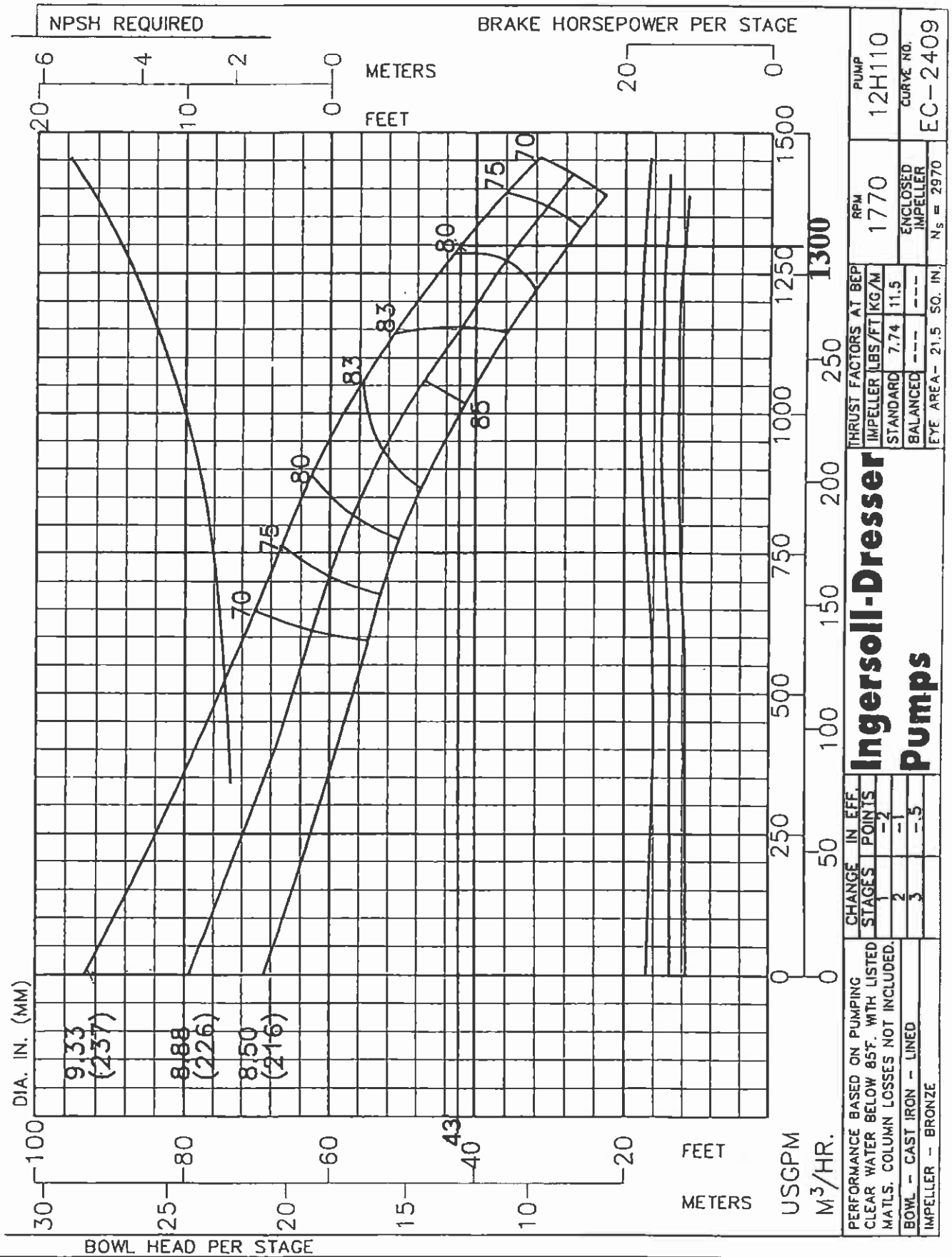
MAY 29 1992
WATER RESOURCES DEP
SALEM, OREGON

Material	From	To	SWL
Brown Clay	0	13	
Brown Silty Clay	13	42	
Brown Clay - heavy	42	51	
Dark brown sand + clay	51	60	
Fine brown sand + silt Some water	60	73	54.6
Small - medium gravel with brown sand	73	74	
Fine brown sand, silt with small P- gravel	74	80	
Gravel small to large with brown Fine to coarse sand and Silt	80	91	
Gravel small to large with brown clay binder	91	105	56'
Gravel medium to large with brown medium to coarse sand - Some cementation	105	134	56
Sand and gravel - rusty and broken	134	139	56
Rusty gravel and Sand with brown sandy clay	139	141	56
Blue clay - dense	141	149	
Blue Sandy clay	149	150	
Blue clay with small claystone chunks	150	161	
Blue Sandy clay	161	171	
Blue Sandy clay with some gravel	171	173	
Dark gray sandy clay	173	176	
Small to large gravel - black sand + blue clay	176	198	60
Small - medium gravel Fine to coarse black Sand	198	203	60
Small - large gravel and Sand	203	221	60
Slightly cemented gravel	221	222	60
Gravel small to large with brown Fine Sand	222	251	60
Gravel + Sand with some clay + cementation	251	257	60
Brown Sandy clay	257	260	
Gravel brown clay and sand	260	278	

City of Keizer
Meadows Pump Station-Well #14
12H110-6 Stage--9.33" Imp. Dia.-COS: 1300 GPM @ 258' TDH

WELL 14 PUMP

Sheet 520.47
December 1, 1993
New Sheet



WELL 15

SEP 21 1999

MAR 54341

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

WATER RESOURCES DEPT
SALEM, OREGON

Instructions for completing this report are on the last page of this form.

WELL I.D. # L 10949
START CARD # 85427

(1) OWNER: Well Number
Name City of Keizer
Address P.O. Box 21000
City Keizer State OR. Zip 97307-1000

(2) TYPE OF WORK
☑ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:
☐ Rotary Air ☐ Rotary Mud ☑ Cable ☐ Auger
☐ Other

(4) PROPOSED USE:
☐ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☑ Other Municipal

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☑ No Depth of Completed Well 260 ft.
Explosives used ☐ Yes ☑ No Type ____ Amount ____

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
16"	0'	127	Cement	0	129	62
12"	127	260				

How was seal placed: Method ☐ A ☐ B ☑ C ☐ D ☐ E
☐ Other
Backfill placed from ____ ft. to ____ ft. Material ____
Gravel placed from ____ ft. to ____ ft. Size of gravel ____

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12"	189'	129'	.375	☑	☐	☑	☐
					☐	☐	☐	☐
	12"	179	+½'	.260	☑	☐	☑	☐
	10"	189-5	183-10	.260	☑	☐	☑	☐
Liner:	10"	260	250	.260	☑	☐	☑	☐
					☐	☐	☐	☐

Final location of shoe(s) 189'

(7) PERFORATIONS/SCREENS:
☐ Perforations Method Mills Knife
☑ Screens Type V-slot Material 304 SS

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
144	177	.062	472			☑	☐
189-5	250	.126		10"	PS	☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☑ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
830	108'		6 hr.
660	88.5		1

Temperature of water 56° Depth Artesian Flow Found ____
Was a water analysis done? ☑ Yes By whom Waterlab
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other ____
Depth of strata: ____

(9) LOCATION OF WELL by legal description:
County Marion Latitude ____ Longitude ____
Township 6S N or S Range 3W E or W. WM.
Section 36 SE 1/4 SW 1/4
Tax Lot 92452 Lot 2222 Block ____ Subdivision ____
Street Address of Well (or nearest address) 5175 Ridge Dr. NE Keizer, OR.

(10) STATIC WATER LEVEL:
35 ft. below land surface. Date July 30, 99
Artesian pressure ____ lb. per square inch. Date ____

(11) WATER BEARING ZONES:
Depth at which water was first found ____

From	To	Estimated Flow Rate	SWL
144'	250'	800+	35

(12) WELL LOG:
Ground Elevation ____

Material	From	To	SWL
Brown silty clay w/	0'	32'	
Brown clay w/gravel	32'	34'	
Small-medium gravel w/brown sand	34'	37'	
Gravel + sand w/ brown clay	37'	107'	
Blue-gray clay	107'	109'	
Gray clay-dense	109'	117	
Gray clay w/ some gravel	117	130	
Small-med. grav., black sand w/ gray clay	130'	164'	
Small-med dim gravel-gray + brown	164	177	35'
Gravel, sm-med w/ sand + clay	177'	180'	35'
Brown sm.-med gravel	180	207'	
Gravel w/ some clay	207	216	
Gravel sm-med	216	252	36'
Muddy sand-gravel	252	260	

Date started March 10, '99 Completed June 26, 1999

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number ____
Signed ____ Date ____

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 633
Signed Michael Wallace Date Sept. 8, '99

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER

Pump Data Sheet - Submersible 60 Hz

WELL 15 PUMP

Company: 4B Engineering
Name:
Date: 11/1/2012

Customer: City of Keizer
Well #15-Ridge Drive
Installation Year: 1999

Pump:

Size: 7THC (2 stage)

Type: Submersible
Synch speed: 3600 rpm

Speed: 3450 rpm
Dia: 4.875 in

Curve: E6207TFPC2

Impeller:

Specific Speeds:

Ns: 3655
Nss: —

Dimensions:

Suction: —
Discharge: —

Vertical Turbine:

Bowl size: 7.13 in
Max lateral: 0.38 in
Thrust K factor: 4.56 lb/ft

Search Criteria:

Flow: —

Head: —

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: —

Motor:

Standard: NEMA
Enclosure: SUB

Size: 40 hp
Speed: 3600
Frame: "6""

Sizing criteria: Max Power on Design Curve

Pump Limits:

Temperature: 120 °F
Pressure: 310 psi g
Sphere size: 0.83 in

Power: —
Eye area: —

— Data Point —

Flow:	621 US gpm
Head:	150 ft
Eff:	76.9%
Power:	30.6 hp
NPSHr:	16.8 ft

— Design Curve —

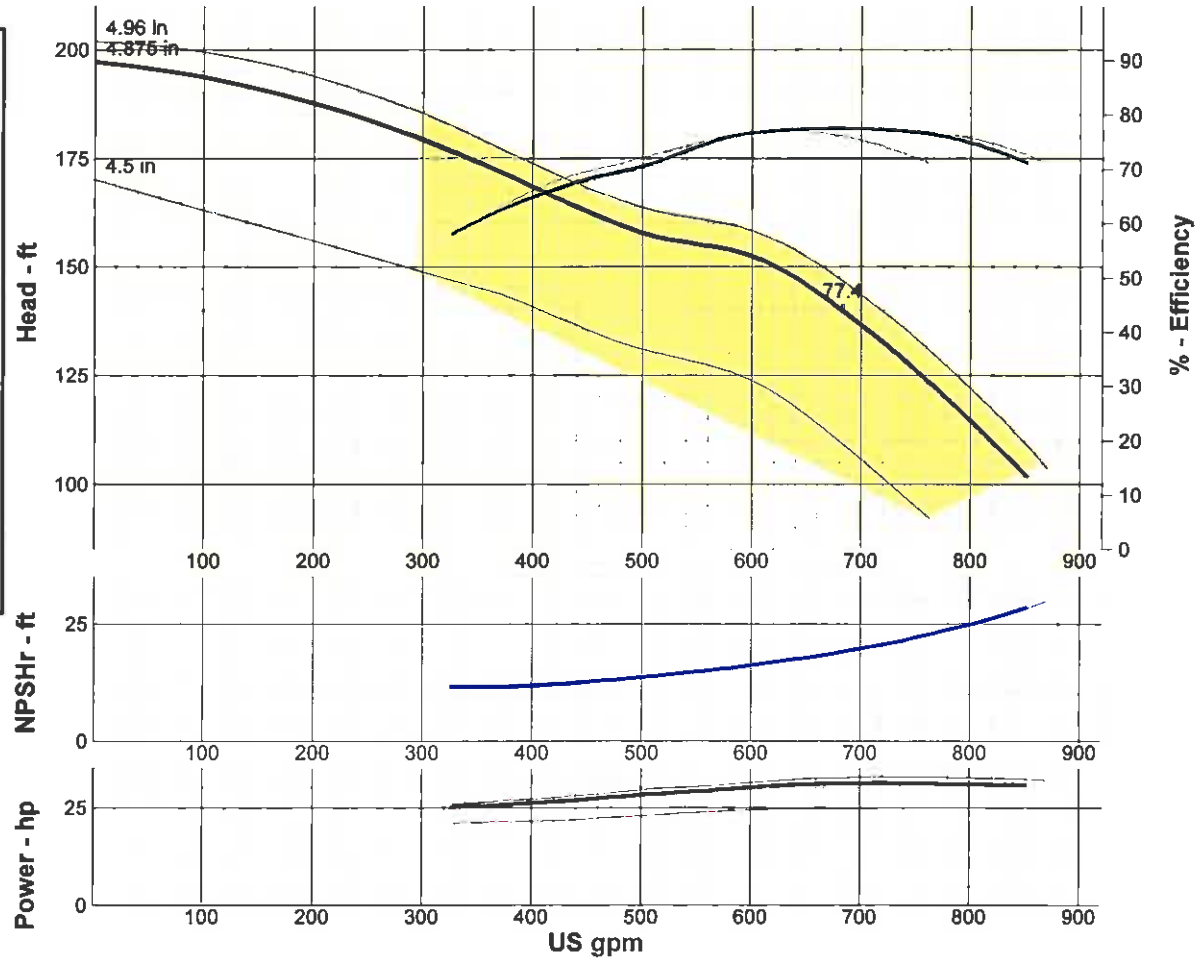
Shutoff head:	197 ft
Shutoff dP:	85.3 psi
Min flow:	—

BEP: 77.4% @ 683 US gpm

NOL power:
31.2 hp @ 732 US gpm

— Max Curve —

Max power:
32.8 hp @ 751 US gpm



Discharge Sizes-5",6". Curves are certified for water at 60°F only. Consult factory for performance with any other fluid.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
817	3450	110	73.6	30.9	25.9
681	3450	140	77.4	31.1	18.9
545	3450	155	73.7	29	14.7
409	3450	167	65.3	26.4	12.1
272	3450	—	—	—	—

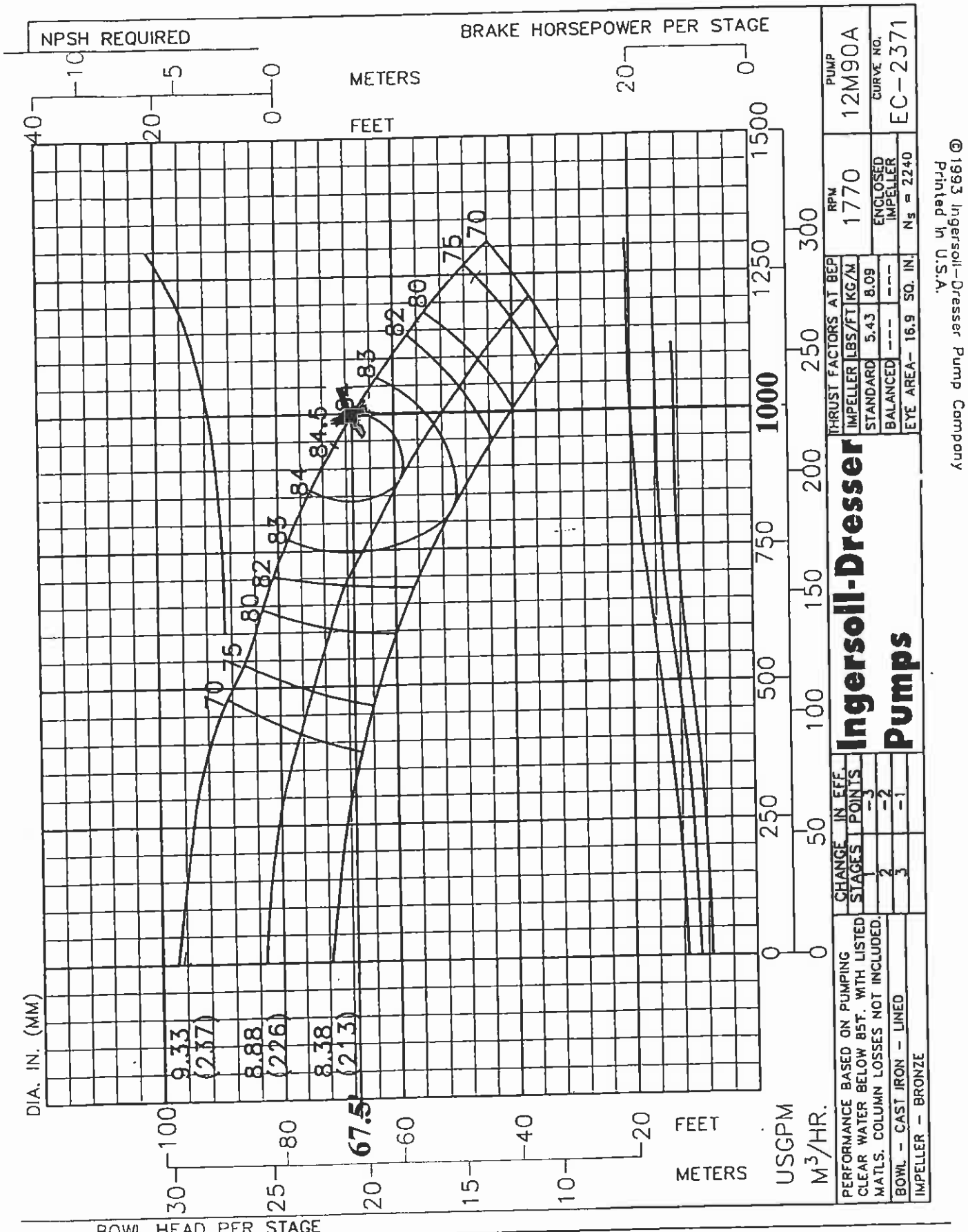
City of Keizer SITE 15 BOOSTER PUMPS 1 & 2

Ridge Drive Reservoir/Pump Station-Well/Site #15

Ingersoll-Dresser Pumps

Booster Pumps #1 & 2--Electric Drive

12M90A-2 Stage-9.33" Imp. Dia-COS: 1000 GPM @ 135' TDH

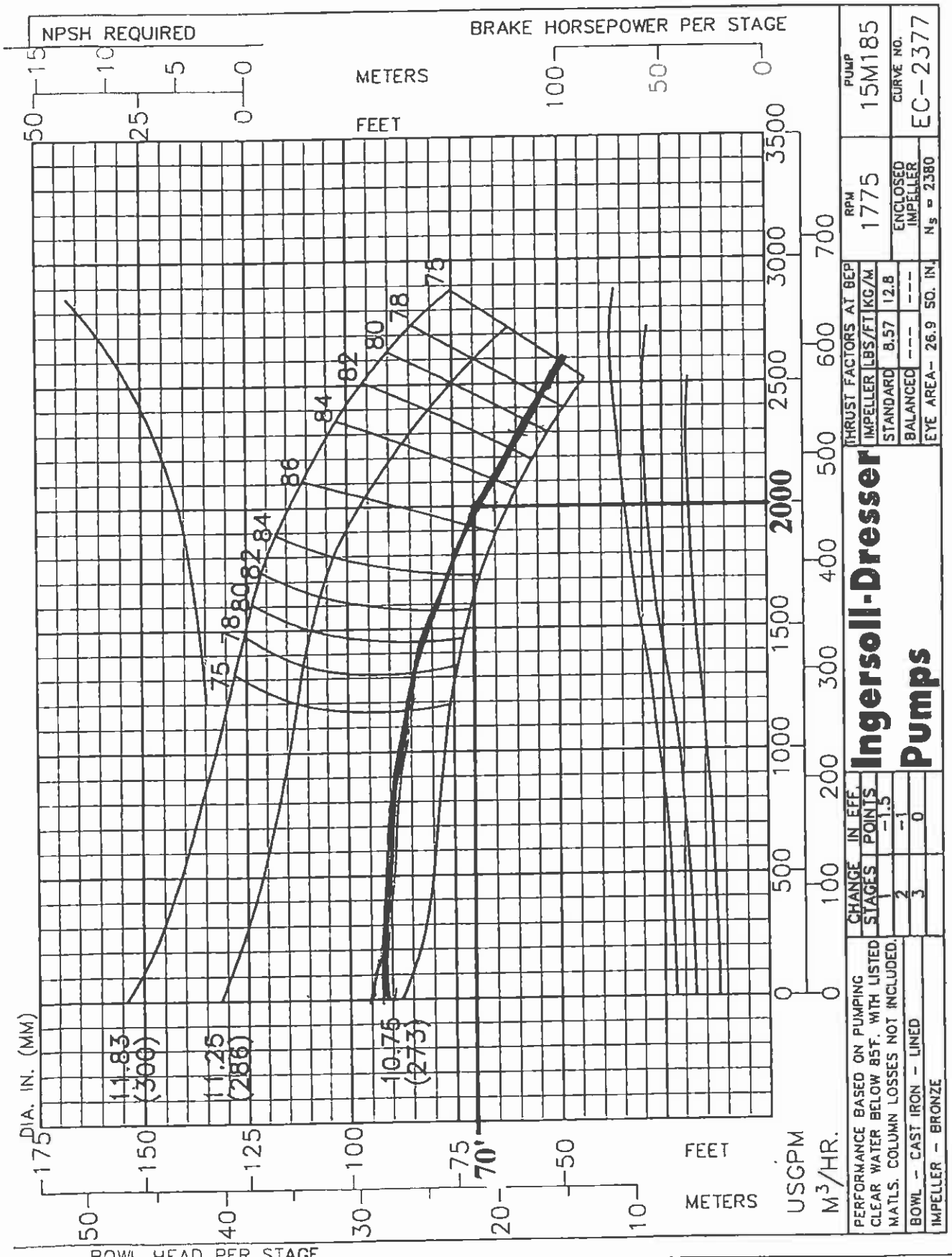


Printed In U.S.A. © 1993 Ingersoll-Dresser Pump Company

City of Keizer

Ridge Drive Reservoir/Pump Station-Well/Site #15
Booster Pump #3--Diesel Engine Drive
15M185--2 Stage--10.85" Imp. Dia.-COS: 2000 GPM @ 140' TDH

Ingersoll-Dresser Pumps



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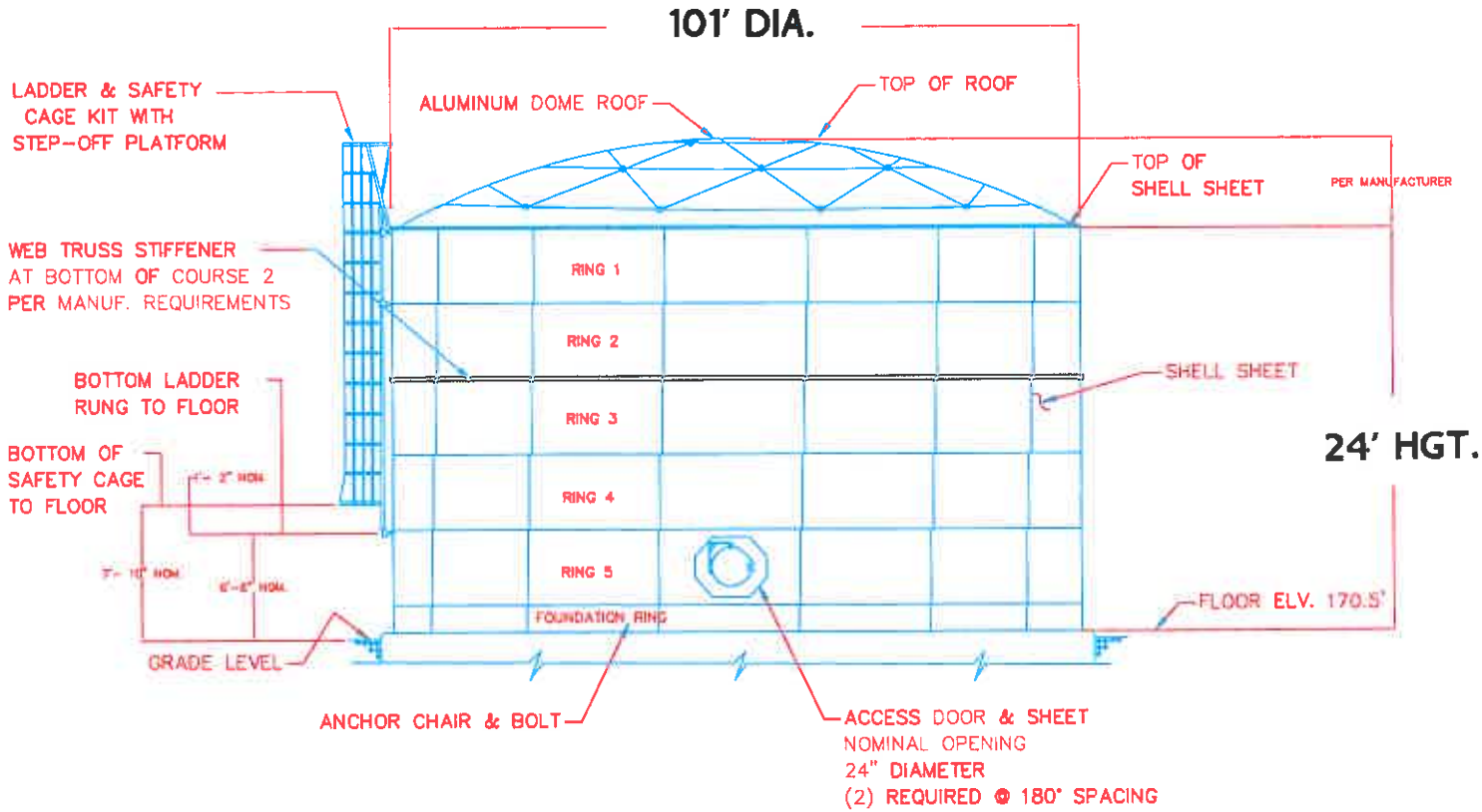
Back of Sheet 520.71



RESERVOIR – PROFILE (TYPICAL)

NOTES:
1. CONTRACTOR SHALL SUBMIT DETAILED ENGINEERING DRAWINGS AND CALCULATIONS STAMPED BY AN OREGON LICENSED ENGINEER. DRAWINGS SHALL SHOW ALL MANUFACTURER'S STANDARD CONSTRUCTION DETAILS.

STETTLER COMPANY
1810 LANA AVENUE, NE
SALEM, OREGON 97303
(503) 585-5550

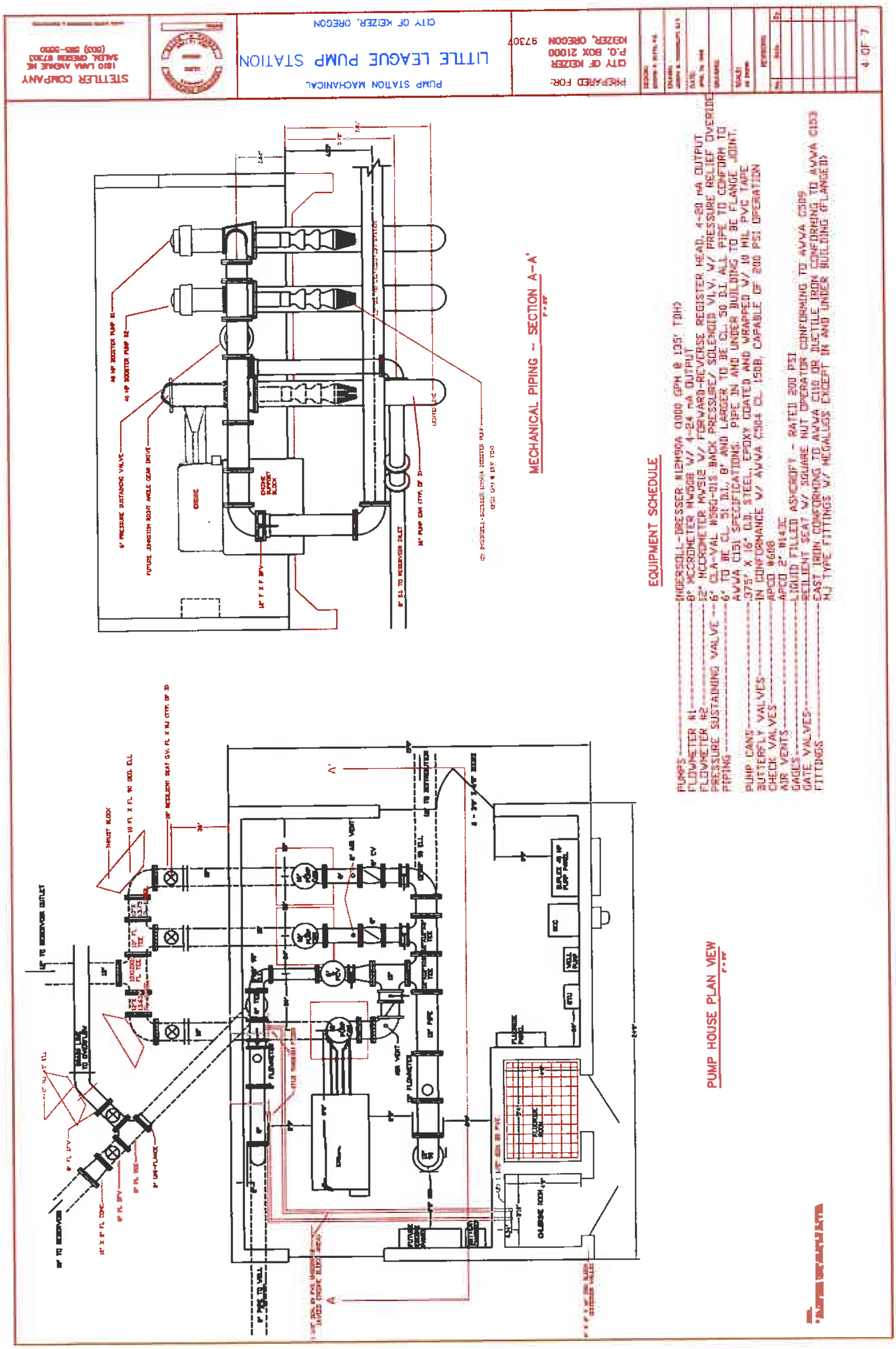
*** WARNING ***
CALL BEFORE YOU DIG
1-800-332-2344

City of Keizer
Ridge Drive Reservoir

SITE 15 1,500,000 GALLON RESERVOIR

CIV

SITE 15 BOOSTER PUMP STATION



RECEIVED 57704

WELL 16

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)
Instructions for completing this report are on the last page of this form

NOV 13 2003

WATER RESOURCES DEPT
SALEM, OREGON

WELL ID # L 55502
START CARD # 141251

(1) OWNER: Well Number

Name City of Keizer
Address 930 Chemawa Rd. NE
City Keizer State OR Zip 97303

(2) TYPE OF WORK:

☒ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:

☐ Rotary Air ☐ Rotary Mud ☒ Cable ☐ Auger
☐ Other

(4) PROPOSED USE:

☐ Domestic ☒ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☒ Other Muni.

(5) BORE HOLE CONSTRUCTION:

Special Construction approval ☐ Yes ☒ No Depth of Completed Well 410 ft.
Explosives used ☐ Yes ☒ No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
14"	0'	180'	Cement	0'	180'	135 sacks
10"	180'	410'	powdered	0'		
			bentonite		180'	13 sacks-5%

How was seal placed: Method ☐ A ☐ B ☒ C ☐ D ☐ E
☐ Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	10"	+2'	320'	.25"	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☒ Outside ☐ None
Final location of shoe(s) 320'

(7) PERFORATIONS/SCREENS:

☐ Perforations Method
☒ Screens Type v-slot Material 304SS

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
313.5	315'	k-pck	2	10"	Tele.	☐	☒
315'	320'	0		10"	Tele.	☐	☒
320'	330'	25		10"	Tele.	☐	☐
330'	400'	50		10"	Tele.	☐	☐
400'	410'	0		10"	Tele.	☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour

☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
700gpm	183'		24 hrs.

Temperature of Water 55deg Depth Artesian Flow found
Was a water analysis done? ☒ Yes By whom Waterlab
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL by legal description:

County Marion Latitude Longitude
Township 6S N or S. Range 3W E or W. of WM.
Section 23 SW 1/4 SE 1/4
Tax lot 200 Lot Block Subdivision
Street Address of Well (or nearest address) Near 1065 Bair Rd.; Keizer, Ore.

(10) STATIC WATER LEVEL:

79' ft. below land surface. Date 10/24/2003
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found 93'

From	To	Estimated Flow Rate	SWL
93'	114'	10+gpm	72'
320'	400'	700+gpm	79'

(12) WELL LOG:

Ground elevation

Material	From	To	SWL
Lt. brown silty clay	2'	43'	
Dark brown silty clay	43'	75'	
Topsoil	0'	2'	
Dark brown clay, very sticky	75'	85'	
Gravel w/muddy brown sand	85'	93'	
Gravel, brown sand w/some clay	93'	114'	72'
Gravel, sand, highly cemented, very little water	114'	130'	72'
Gravel, brown sand; cemented w/soft brown clay	130'	138'	
Gravel sand, tightly cemented; no water	138'	146'	
Silty clay, blue-black, very sticky and heavy	146'	178'	
Gravel, black sand; cemented w/ soft blue clay	178'	224'	
Silty clay, brown w/ cemented gravel and sand, black	224'	260'	
Gravel, sand, brown; cemented w/ soft brown clay	260'	306'	
Gravel, sand, cemented	306'	330'	79'
Gravel, sand, cemented, w/blue clay	330'	404'	79'
Clay, blue-brown, dense	404'	410'	
Continued on next page			

Date started 6/13/2003 Completed 10/24/2003

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

Signed Dallas Beier WWC Number 561
Michael Waldroop-Dallas Beier Date 11/2/2003

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

Signed Michael Waldroop WWC Number 633
Michael Waldroop-Dallas Beier Date 11/2/2003

ORIGINAL - WATER RESOURCES DEPARTMENT FIRST COPY - CONSTRUCTOR SECOND COPY - CUSTOMER

Pump Data Sheet - Submersible 60 Hz

Company: 4B Engineering
Name:
Date: 11/5/2012

Customer: City of Keizer
Reitz Well (aka: Bair Park)–Well/Site #16
Installation Year: 2012 (Replacement Unit)

WELL 16 PUMP

Pump:

Size: 8RJLC (4 stage)

Type: Submersible
Synch speed: 3600 rpm

Speed: 3500 rpm
Dia: 5.1875 in

Curve: E6208REPC1

Impeller:

Specific Speeds:

Ns: 2815
Nss: —

Dimensions:

Suction: —
Discharge: —

Vertical Turbine:

Bowl size: 7.5 in
Max lateral: 0.62 in
Thrust K factor: 4 lb/ft

Search Criteria:

Flow: 500 US gpm

Head: 300 ft

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: —

Motor:

Standard: NEMA
Enclosure: SUB

Size: 50 hp
Speed: 3600
Frame: "6""

Sizing criteria: Max Power on Design Curve

Pump Limits:

Temperature: 120 °F
Pressure: 425 psi g
Sphere size: —

Power: —
Eye area: —

— Data Point —

Flow:	500 US gpm
Head:	303 ft
Eff:	79.6%
Power:	48 hp
NPSHr:	20.4 ft

— Design Curve —

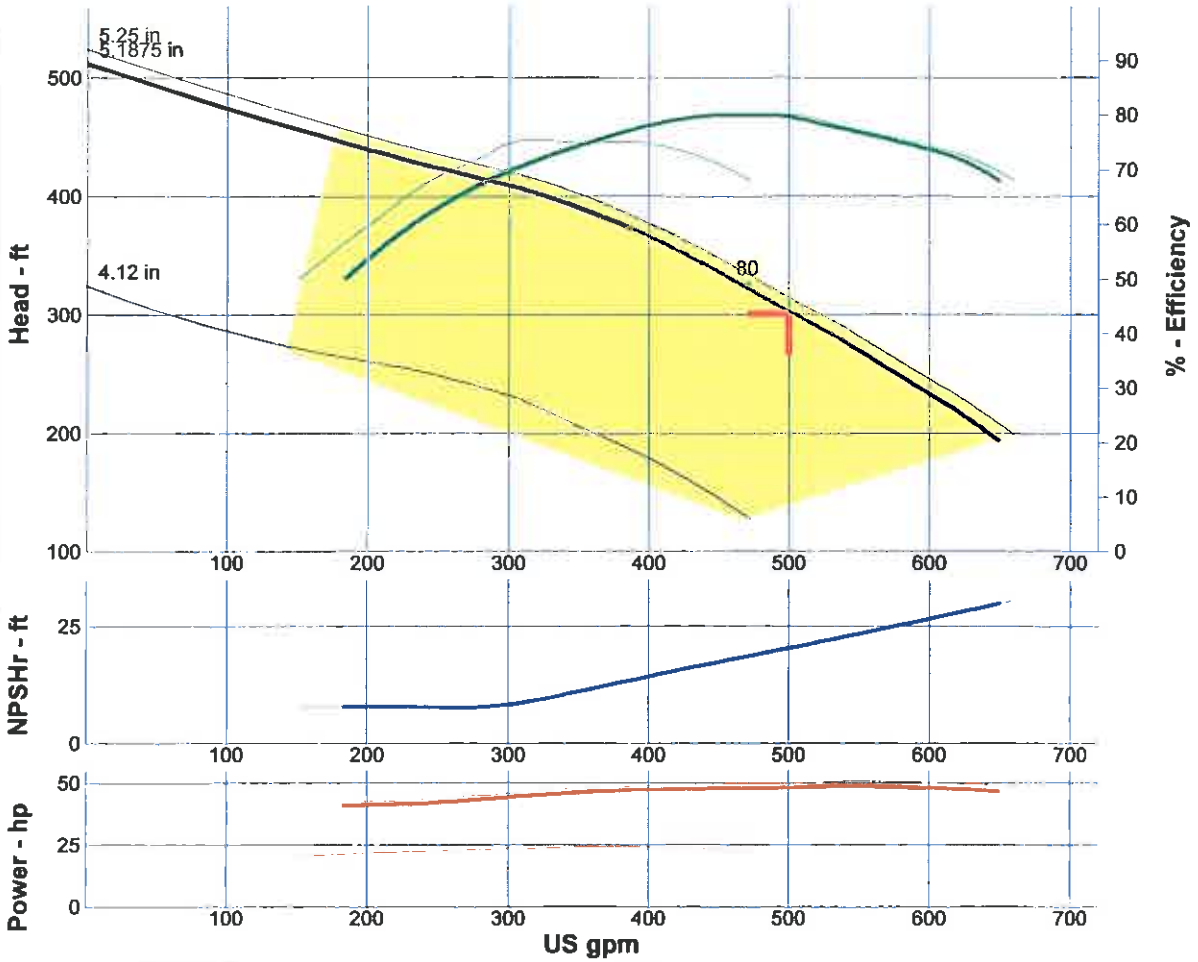
Shutoff head:	512 ft
Shutoff dP:	222 psi
Min flow:	—

BEP: 80% @ 471 US gpm

NOL power:
48.7 hp @ 529 US gpm

— Max Curve —

Max power:
50.5 hp @ 538 US gpm

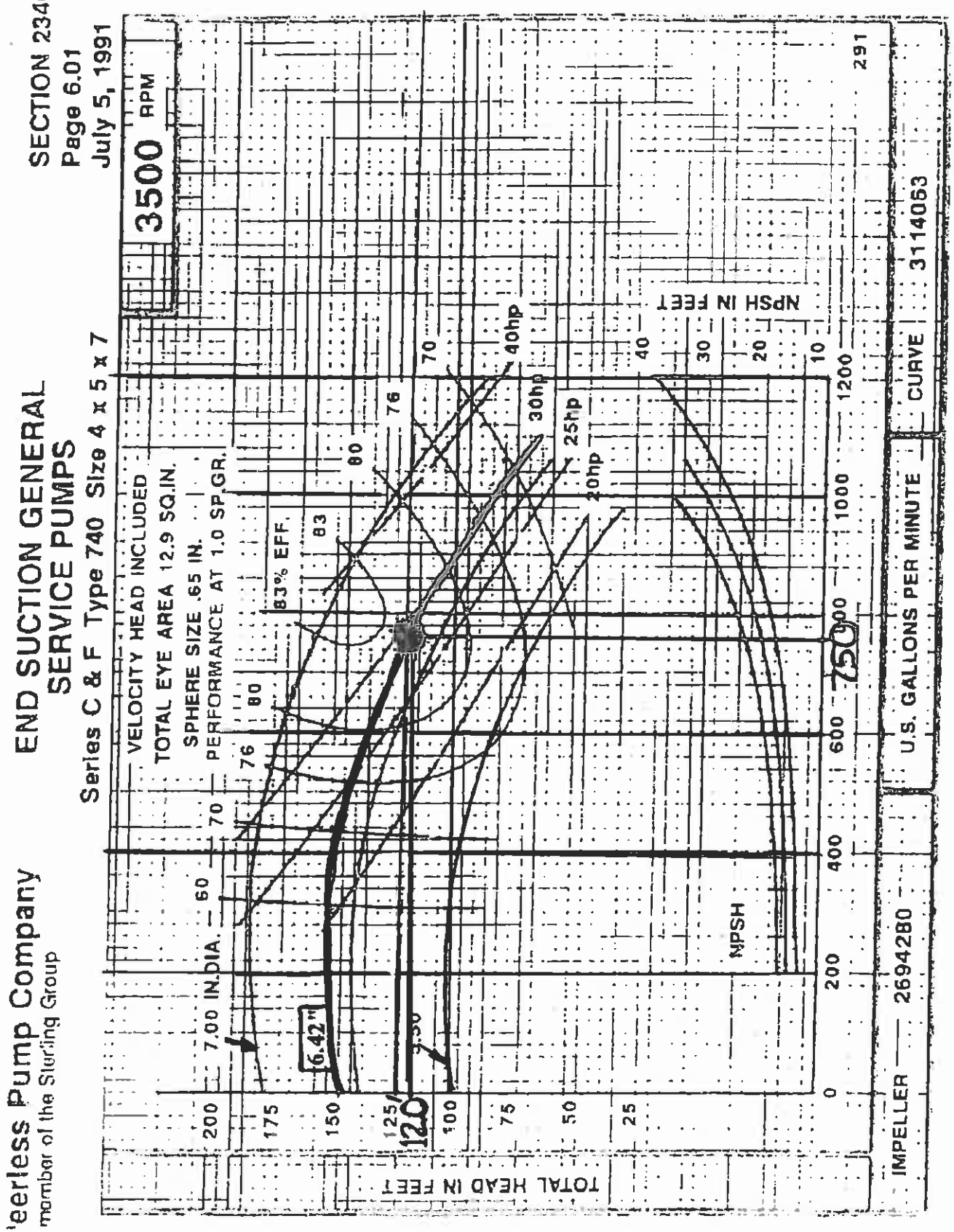


Discharge Sizes-5",6". Curves are certified for water at 60°F only. Consult factory for performance with any other fluid.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
600	3500	233	73.5	47.9	26.6
500	3500	303	79.6	48	20.4
400	3500	365	78.2	47.2	14.4
300	3500	408	69.8	44.2	8.57
200	3500	439	53.7	41.3	7.91

City of Keizer
Bair Park Reservoir/Pump Station-Reitz Well-Site #16
Booster Pumps #1 & 2-Peerless C740M-6.42" Imp. Dia.
Equipped with 30 HP-COS: 750 GPM @ 120' TDH



SITE 16 750,000 GALLON RESERVOIR

4B ENGINEERING & CONSULTING, LLC
3000 MARKET STREET, SUITE 528
SALEM, OREGON 97301
503-589-1115

"WARNING"
CALL BEFORE YOU DIG
1-800-332-2344

REGISTERED PROFESSIONAL ENGINEER
OREGON
13,250
JULY 17, 1998
EDWARD P. BUTTS

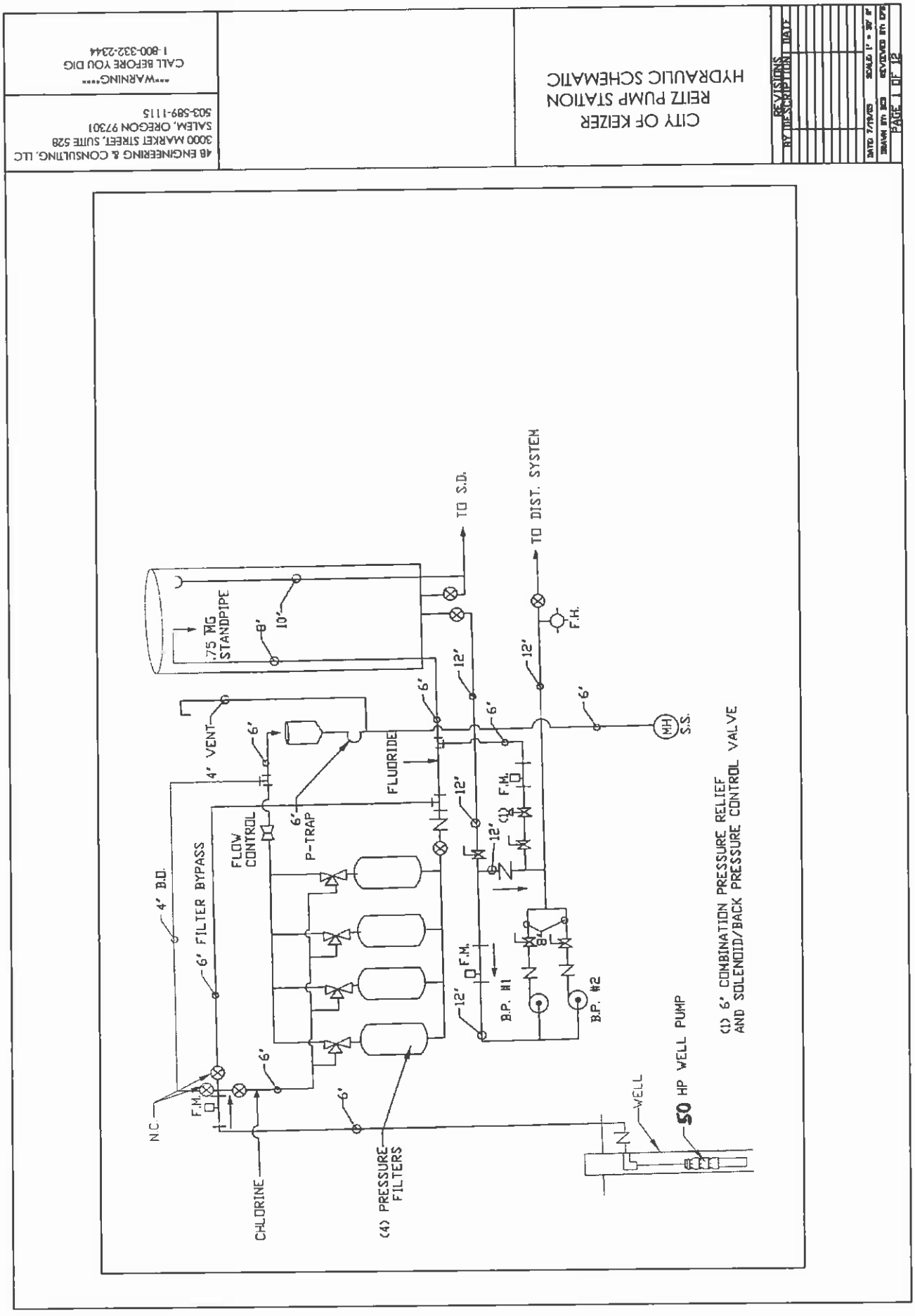
CITY OF KEIZER
BAIR PARK RESERVOIR
ELEVATION VIEW
"AS-BUILT"

REVISIONS
BY DESCRIPTION DATE

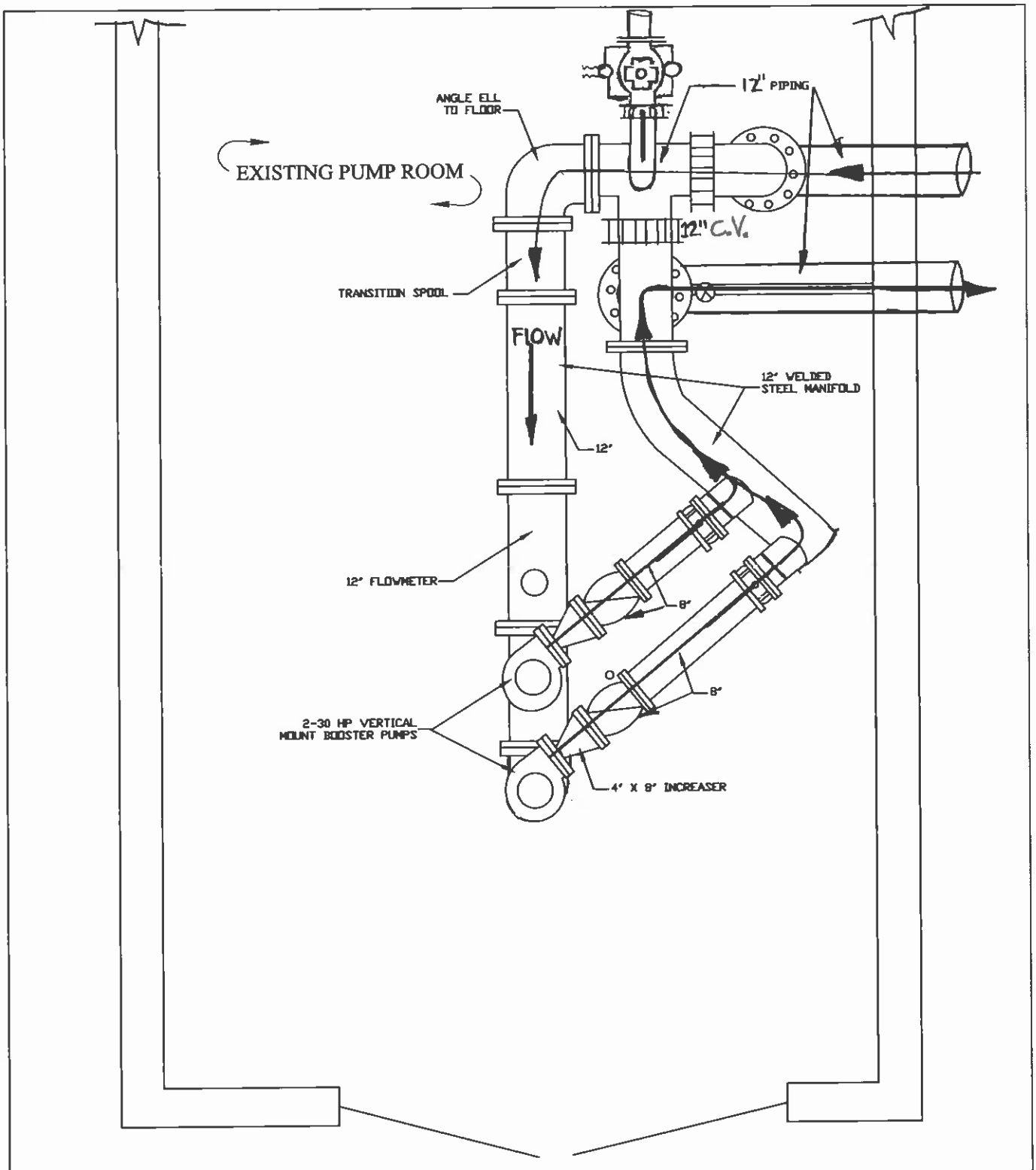
DATE: 4/25/06 SCALE: AS SHOWN
DRAWN BY: BD REVIEWED BY:
SHEET 10 OF 24

SCALE: 1" = 5' 0"

SITE 16 HYDRAULIC SCHEMATIC



SITE 16 BOOSTER PUMP STATION



CITY OF KEIZER
BOOSTER PUMP LAYOUT

REVISIONS
BY DESCRIPTION DATE

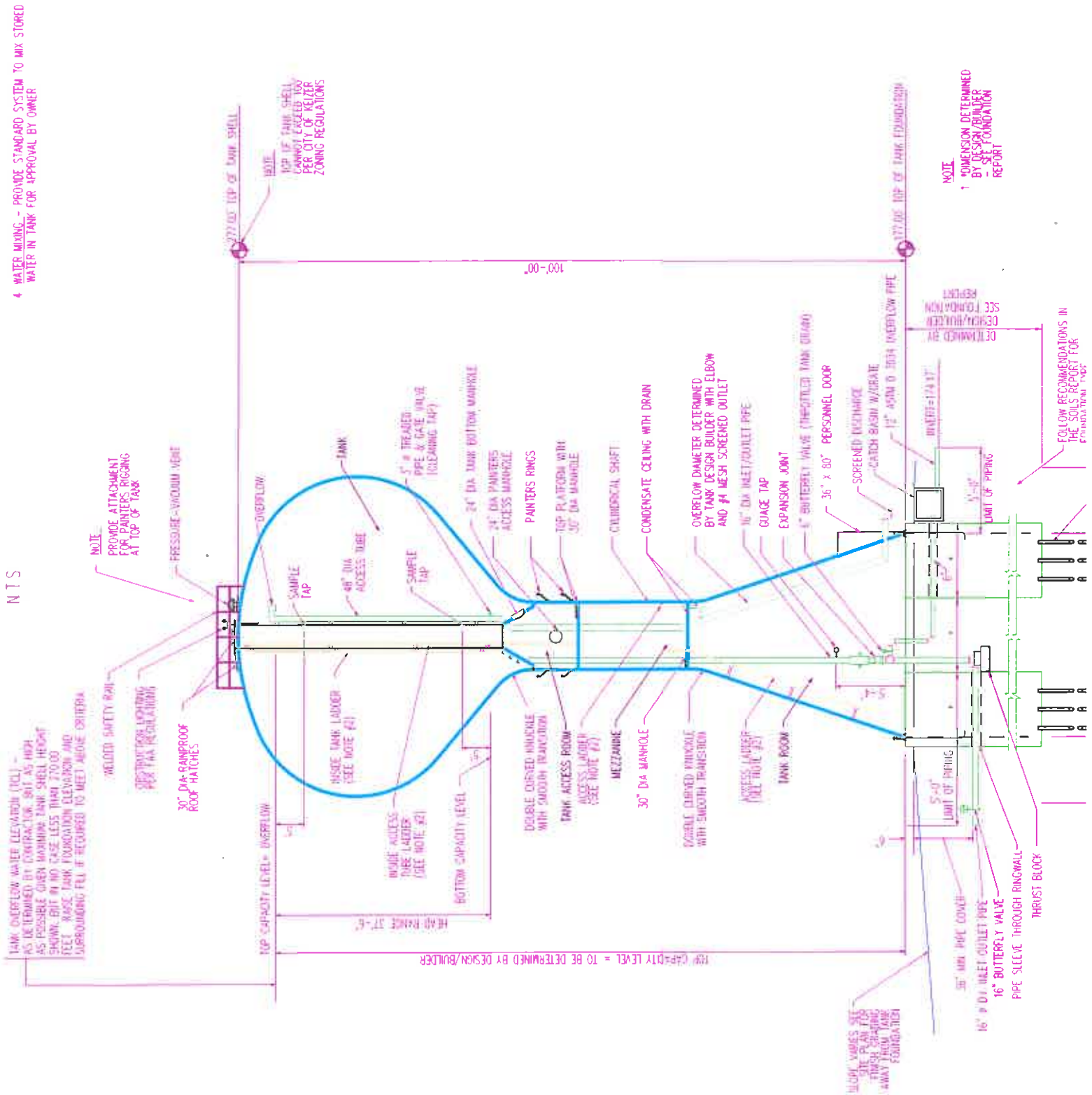
JOB:
FILE:
DATE: 12/4/2024
DRAWN BY: BG
REVIEWED BY: EPB
SCALE: AS SHOWN

PROFESSIONAL ENGINEER
15,290
OREGON
JULY 17, 1984
EDWARD P. BUTTS

48 ENGINEERING & CONSULTING, LLC
3000 MARKET STREET, SUITE 528
SALEM, OREGON 97301
503-589-1115

WARNING
CALL BEFORE YOU DIG
1-800-332-2344

SITE 17 ELEVATED STORAGE TANK/EST



DEC 06 1989

WELL 18

MAR (536) 6S/3W/33

STATE OF OREGON

WATER WELL REPORT

(as required by ORS 537.765)

WATER RESOURCES DEPT.
SALEM, OREGON

(START CARD) # 16980

(1) OWNER:

Well Number:

Name City of Salem

Address

City Salem State OR Zip 97310

(2) TYPE OF WORK:

☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☒ Cable

☐ Other

(4) PROPOSED USE:

☐ Domestic ☐ Community ☐ Industrial ☐ Irrigation

☐ Thermal ☐ Injection ☒ Other test production

(5) BORE HOLE CONSTRUCTION:

Special Construction approval Yes ☐ No ☒ Depth of Completed Well ____ ft.

Explosives used Yes ☐ No ☒ Type ____ Amount ____

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
16"	0	100	cement grout	0	100	83 sacks
			bentonite			5 sacks

How was seal placed: Method ☐ A ☐ B ☒ C ☐ D ☐ E

☐ Other

Backfill placed from ____ ft. to ____ ft. Material ____

Gravel placed from ____ ft. to ____ ft. Size of gravel ____

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12	+2	127	.250	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s) 16" 100' 12" 170'

(7) PERFORATIONS/SCREENS:

☐ Perforations Method ____

☒ Screens Type ____ Material stainless

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
122	128			10		☒	☐
128	158	100		10		☐	☐
158	168			10		☒	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour

☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
400		165	1 hr.

Temperature of water ____ Depth Artesian Flow Found ____

Was a water analysis done? ☐ Yes By whom ____

Did any strata contain water not suitable for intended use? ☐ Too little

☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other ____

Depth of strata: ____

(9) LOCATION OF WELL by legal description:

County Marion Latitude ____ Longitude ____

Township 6S N or S, Range 3W E or W, WM.

Section 33 NE ¼ SE ¼

Tax Lot 1500 Lot ____ Block ____ Subdivision ____

Street Address of Well (or nearest address) 5000 block, 17th Av (in nut orchard)

(10) STATIC WATER LEVEL:

27 ft. below land surface. Date 11-20-89

Artesian pressure ____ lb. per square inch. Date ____

(11) WATER BEARING ZONES:

Depth at which water was first found 31

From	To	Estimated Flow Rate	SWL
106	125		27
31	42		27
171			27

(12) WELL LOG:

Ground elevation ____

Material	From	To	SWL
Silty clay brown	0	18	
Gravels clay brown	18	31	
Gravels med-small sand brn	31	42	27
Cemented gravels	42	52	
Cleaner gravels	52	71	
Sand brown	71	73	
Gravels cemented brwon	73	76	
Gravels cemented grey	76	92	
Clay grey	92	106	
Gravels small-med gray sand	106	128	27
Packed sand grey clay	128	131	
Gravels tight grey sand with	131		
cemented streaks grey		159	
Gravels cemented brown	159	168	
Sand with clay brown	168	171	
Sand gravels brown	171		27

Date started 10-26-89 Completed 11-20-89

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, c abandonment of this well is in compliance with Oregon well constructio standards. Materials used and information reported above are true to my bes knowledge and belief.

Signed ____ WWC Number 758

Date 11-30-89

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonmen work performed on this well during the construction dates reported above. a work performed during this time is in compliance with Oregon wa construction standards. This report is true to the best of my knowledge an belief.

Signed ____ WWC Number 723

Date 12-4-89

ORIGINAL & FIRST COPY - WATER RESOURCES DEPARTMENT SECOND COPY - CONSTRUCTOR THIRD COPY - CUSTOMER 9809C 3/8

Pump Data Sheet - Submersible 60 Hz

Company: 4B Engineering
Name:
Date: 11/7/2012

Customer: City of Keizer
Lacey Court (Well #18) Well/Pump Station
Proposed Well Pump-Installation Year: 2012-13

WELL 18 PUMP

Pump:

Size: 7TLC (5 stage)

Type: Submersible
Synch speed: 3600 rpm

Speed: 3450 rpm
Dia: 4.75 in

Curve: E6207TAPC2

Impeller:

Specific Speeds:

Ns: 3575
Nss: —

Dimensions:

Suction: —
Discharge: —

Vertical Turbine:

Bowl size: 7.13 in
Max lateral: 0.38 in
Thrust K factor: 4.5 lb/ft

Search Criteria:

Flow: 525 US gpm

Head: 290 ft

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: —

Motor:

Standard: NEMA
Enclosure: SUB

Size: 60 hp
Speed: 3600
Frame: "6""

Sizing criteria: Max Power on Design Curve

Pump Limits:

Temperature: 120 °F
Pressure: 310 psi g
Sphere size: —

Power: —
Eye area: —

— Data Point —

Flow:	525 US gpm
Head:	293 ft
Eff:	78%
Power:	49.8 hp
NPSHr:	13.9 ft

— Design Curve —

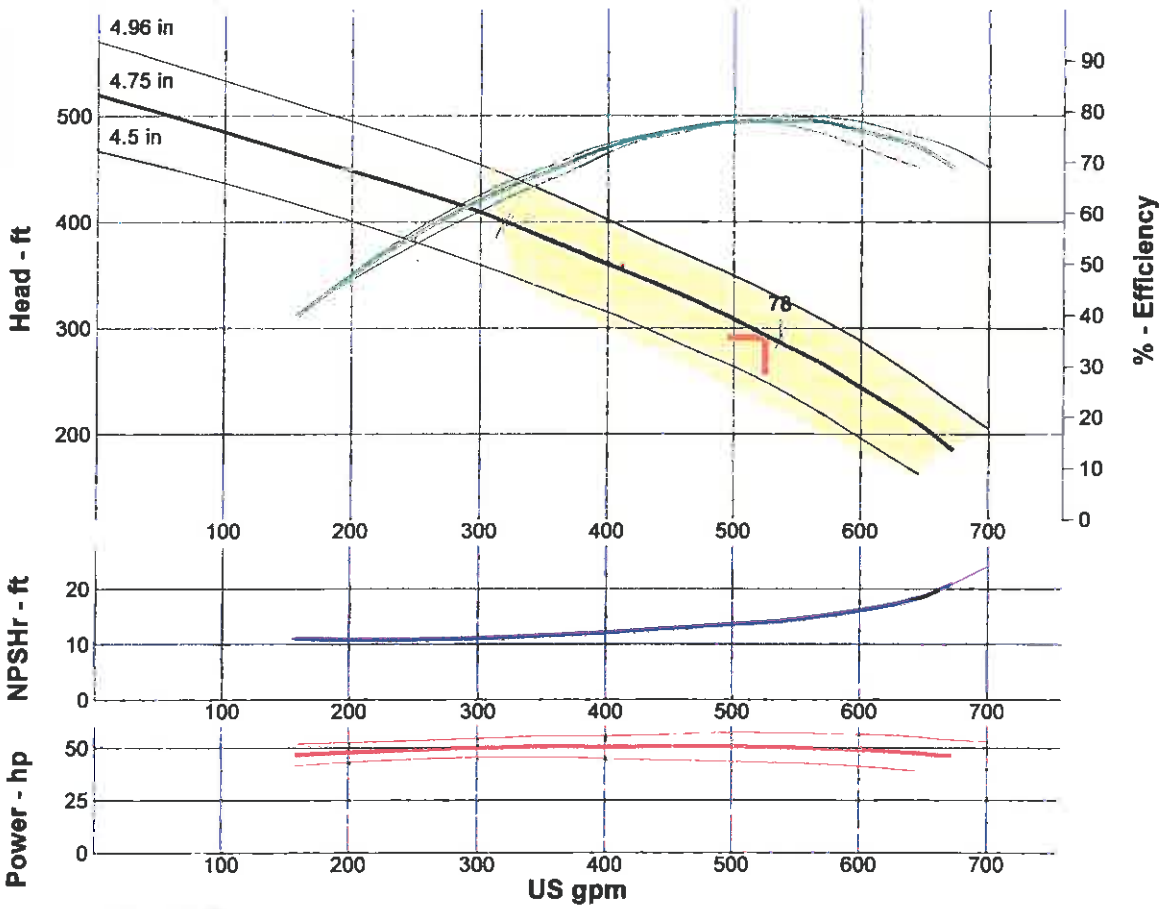
Shutoff head:	520 ft
Shutoff dP:	225 psi
Min flow:	—

BEP: 78% @ 537 US gpm

NOL power:
50.1 hp @ 360 US gpm

– Max Curve –

Max power:
56.7 hp @ 505 US gpm



Discharge Sizes-5",6". Curves are certified for water at 60°F only. Consult factory for performance with any other fluid.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
630	3450	221	74	47.4	17.5
525	3450	293	78	49.8	13.9
420	3450	350	74.3	49.9	12.3
315	3450	402	64.2	49.6	11.2
210	3450	443	48	47.4	11.1

PAGE 1 OF 2

WELL I.D. # L 82935

START CARD # W166123

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

Instructions for completing this report are on the last page of this form.

(1) LAND OWNER Well Number 6
Name CITY OF KEIZER
Address 930 CHEMAWA RD
City KEIZER State OR Zip 97307

(2) TYPE OF WORK
☒ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:
☐ Rotary Air ☐ Rotary Mud ☒ Cable ☐ Auger
☐ Other

(4) PROPOSED USE:
☐ Domestic ☒ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☒ No Depth of Completed Well 290 ft.
Explosives used ☐ Yes ☒ No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
16	0	90	CEMENT	0	90	85
12	90	290				

How was seal placed: Method ☐A ☐B ☐C ☐D ☐E
☒ Other TREMIE FROM 90' TO SURFACE
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12	+2	170	.375	☒	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☒ Outside ☐ None
Final location of shoe(s) CUT / LEFT ON BOTTOM

(7) PERFORATIONS/SCREENS:
☐ Perforations Method
☒ Screens Type V-WIRE Material STAINLESS

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
170	175	.050	#	12" TELE		☐	☐
175	200	.100		12	TELE	☐	☐
200	240	.035		12	TELE	☐	☐
240	265	BLANK		10"		☒	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.
820	120'		24

Temperature of water 53° Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

RECEIVED
JAN 22 2008
WATER RESOURCES DEPT
SALEM, OREGON

(9) LOCATION OF WELL by legal description:
County Marion Latitude Longitude
Township 7 N or (S) Range 3 E or (W) WM.
Section 2 NW 1/4 NW 1/4
Tax Lot 1600 Lot Block Subdivision
Street Address of Well (or nearest address) SW Corner of Chemawa Rd NE & Richmond Rd NE

(10) STATIC WATER LEVEL:
29 ft. below land surface. Date 6-15-06
Artesian pressure lb. per square inch Date

(11) WATER BEARING ZONES:
Depth at which water was first found 34'

From	To	Estimated Flow Rate	SWL
34	71	150	29
170	240	500	29
265	280	200	29

(12) WELL LOG:
Ground Elevation

Material	From	To	SWL
BROWN SANDY SILT	0	9	
BROWN SANDY SILT / GRAVELS	9	18	
SILTY SAND W/ GRAVELS	18	51	
COURSE SAND / GRAVELS	51	62	
SILTY SAND / SMALL GRAVEL	62	71	
GREY CLAY W/ LRG GRAVELS	71	73	
SILTY GREY SAND & GRAVELS	73	78	
GREY CLAY	78	98	
GREY SILT / LRG GRAVELS	98	125	
CLEAN SAND / GRAVEL	126	131	
SILTY GRAVEL / SAND	131	146	
CLEAN SAND / GRAVEL	146	152	
SILTY COBBLES / GRAVELS	152	191	
CLEAN GRAVEL / SAND	191	210	
SILTY COBBLES / GRAVEL	210	214	
CLEAN SAND / GRAVEL	214	219	
LARGE COBBLES / GRAVEL	219	227	
SILTY GRAVELS / COBBLES	227	232	
CLEAN SAND / GRAVEL	232	238	

Date started 3-15-06 Completed 6-23-06

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number 1829
Signed Terry R Wells Date 7-6-06

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 6225
Signed Mark Jensen Date 7-7-06

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER

MARI 60019

WELL 19b

PAGE 2 OF 2

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

WELL I.D. # L L82935
START CARD # W166123

Instructions for completing this report are on the last page of this form.

(1) LAND OWNER Well Number 6
Name CITY OF KEIZER
Address 930 CHEMAWA RD
City KEIZER State OR Zip 97307

(2) TYPE OF WORK
☒ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:
☐ Rotary Air ☐ Rotary Mud ☒ Cable ☐ Auger
☐ Other

(4) PROPOSED USE:
☐ Domestic ☐ Community ☒ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☐ No Depth of Completed Well ____ ft.
Explosives used ☐ Yes ☐ No Type ____ Amount ____

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
	SEE PAGE 1					

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☐ Other
Backfill placed from ____ ft. to ____ ft. Material ____
Gravel placed from ____ ft. to ____ ft. Size of gravel ____

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	SEE PAGE 1				☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☐ Outside ☐ None
Final location of shoe(s)

(7) PERFORATIONS/SCREENS:
☐ Perforations Method
☒ Screens Type V-WIRE Material STAINLESS

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
265	280	.175		12	TELE	☐	☐
250	290	BLANK		10"		☒	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.

Temperature of water ____ Depth Artesian Flow Found ____
Was a water analysis done? ☐ Yes By whom ____
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other ____
Depth of strata: ____

(9) LOCATION OF WELL by legal description:
County MARION Latitude ____ Longitude ____
Township 7 N or (S) Range 3 E or (W) WM.
Section 2 NW 1/4 NW 1/4
Tax Lot ____ Lot ____ Block ____ Subdivision ____
Street Address of Well (or nearest address) SW Corner of Chemawa Rd NE & Richmond Rd. NE

(10) STATIC WATER LEVEL:
____ ft. below land surface. Date ____
Artesian pressure ____ lb. per square inch Date ____

(11) WATER BEARING ZONES:
Depth at which water was first found ____

From	To	Estimated Flow Rate	SWL
SEE	PAGE 1		

(12) WELL LOG:
Ground Elevation ____

Material	From	To	SWL
SILTY COBBLES / GRAVEL	238	246	
SILT BOUND GRAVELS	246	250	
SILTY COBBLES	250	259	
GREY SAND SILT	259	269	
GREY SILTY SAND / GRAVEL	269	277	
BLUE CLAY W/ GRAVEL	277	281	
FINE TO MED SAND	281	285	
GREY STIFF CLAY	285	290	

RECEIVED
OCT 26 2006
WATER RESOURCES DEPT
SALEM, OREGON

Date started ____ Completed ____

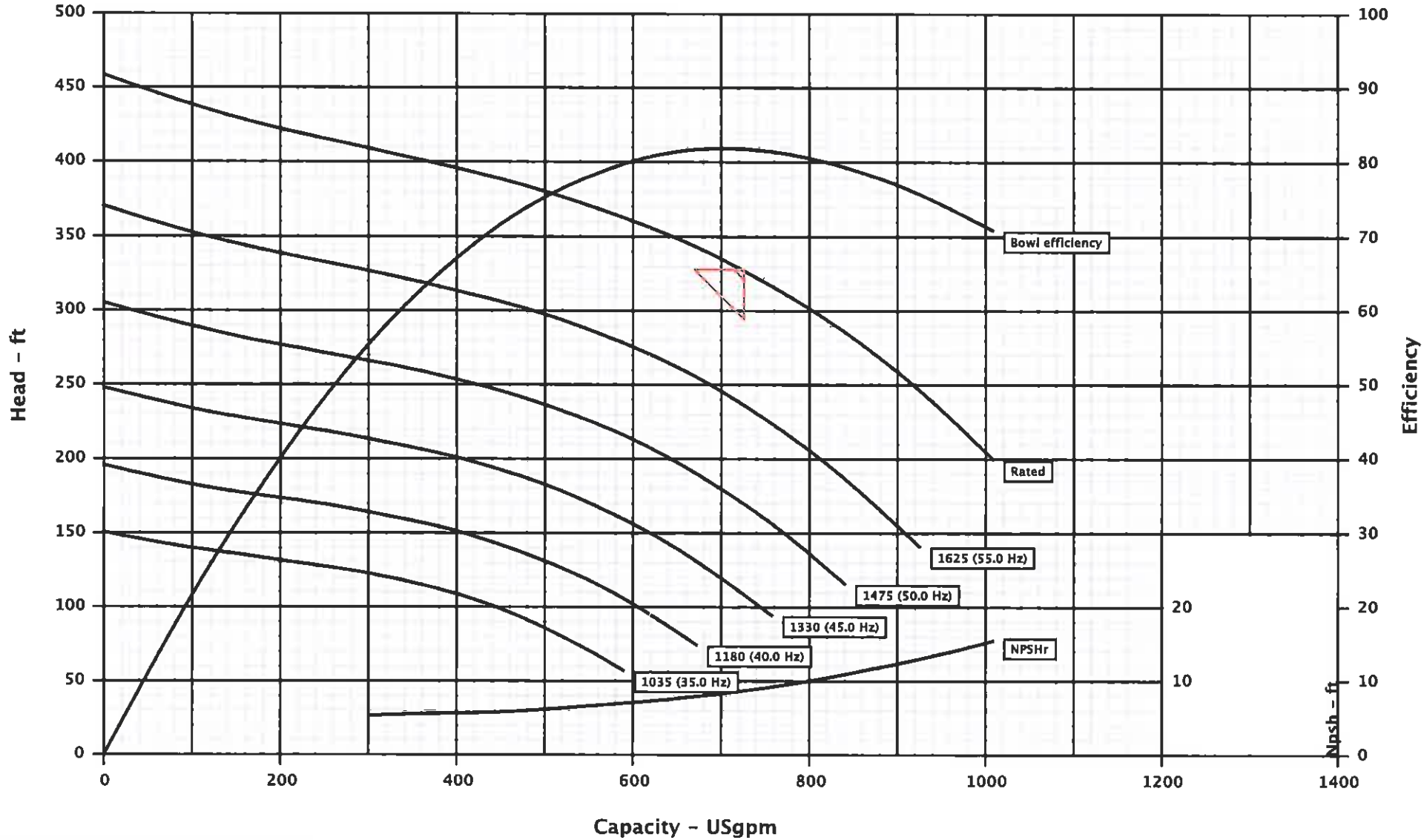
(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number 1829
Signed ____ Date 7-6-06

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 1625
Signed ____ Date 7-7-06

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER

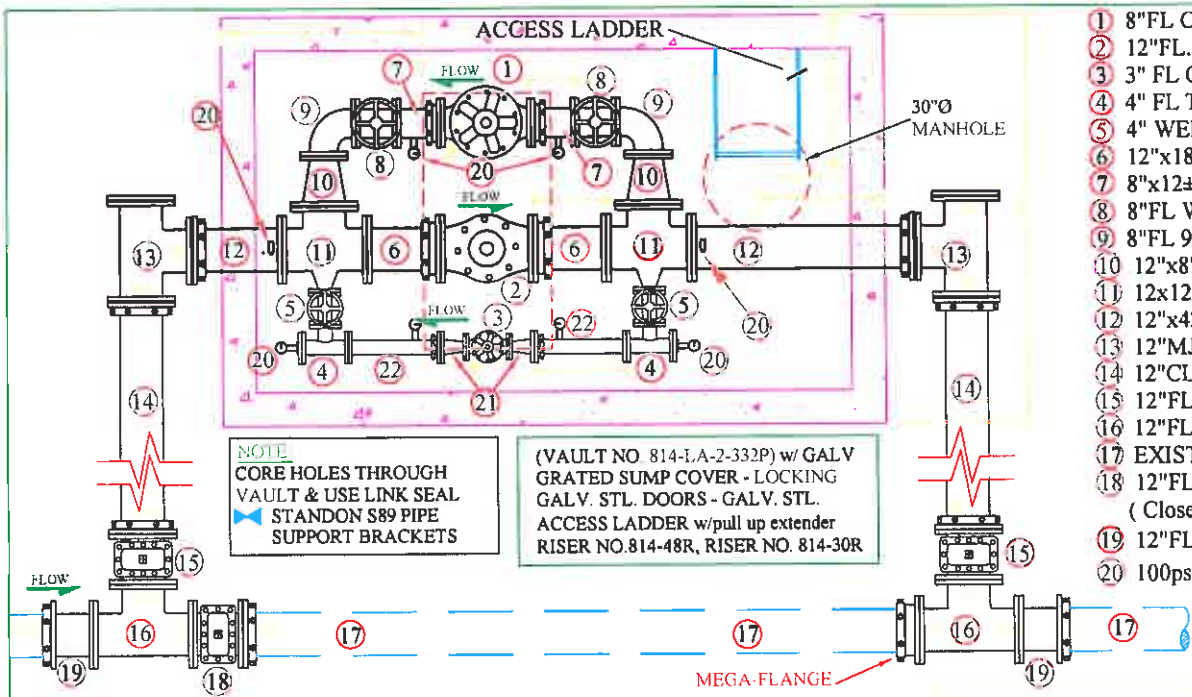
Customer	: 4B Engineering			Pump size & type	: 10EHM
Item Number	City Hall-Well #19			Based on curve no.	: EC-2653
Service	:			Number of stages	: 8
Flowserve Reference	: Default 0.1				
Date	: November 5, 2012	Capacity	: 725.0 USgpm	Specific gravity	: 0.999
		Head	: 320.00 ft	Pump speed	: 1770 rpm

CURVES ARE APPROXIMATE. PUMP IS GUARANTEED FOR ONE SET OF CONDITIONS; CAPACITY, HEAD, AND EFFICIENCY



City of Kelzer

WELL 19 PUMP

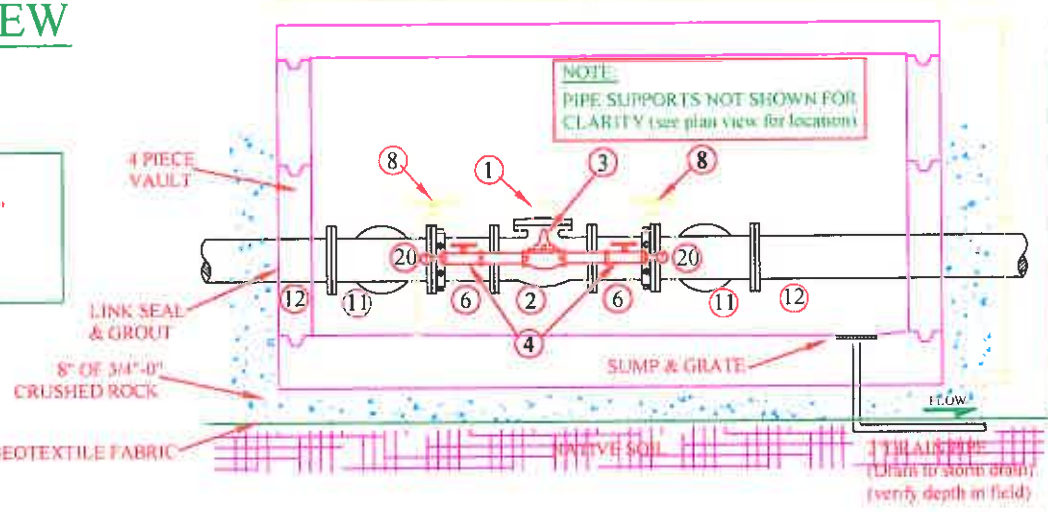


VAULT PLAN VIEW

1. 8"FL CLA-VAL MDL.#90-01AB (15-75 PSI SPRING)
2. 12"FL. SWING CHECK VALVE
3. 3" FL CLA-VAL MDL.#90-01AS (15-75 PSI SPRING)
4. 4" FL TEE w/ BLIND FLANGE
5. 4" WEDGE G.V. w/ HAND WHEEL
6. 12"x18±" FLxPE w/ MEGA-FLANGE & 3"FIPT TAP
7. 8"x12±" FLxPE SPOOL w/ MEGA-FLANGE
8. 8"FL WEDGE G.V. w/ HAND WHEEL
9. 8"FL 90° ELBOW
10. 12"x8" FL CONCENTRIC REDUCER
11. 12x12x12x4" FL CROSS
12. 12"x42±" FLxPE SPOOL w/ MEGA-LUG
13. 12"MJ TEE w/ MEGA-LUG & MJ PLUG
14. 12"CL-52 D.I. PIPE w/ MEGA-LUG (Verify length in field)
15. 12"FLxMJ WEDGE G.V. w/ 2" OP NUT
16. 12"FL TEE
17. EXISTING 12" D.I. PIPE (@ River Rd.)
18. 12"FLxMJ WEDGE G.V. w/ 2"OP NUT & MEGA-LUG (Close Valve when PRV in Use)
19. 12"FLxMJ ADAPTER
20. 100psi LIQUID FILLED GAUGE w/ BRASS BALL VALVE
21. 4x3" FL CONCENTRIC REDUCER
22. 4x26"± FLxPE SPOOL w/ MEGA-FLANGE

NOTE:

USE OLYMPIC 910 VALVE BOXES AT BURIED VALVES
98% COMPACTION REQ'D OF ALL FILL "NATIVE OR ROCK"
EXIST. PIPELINE CONNECTION SHALL BE COORDINATED TO MINIMIZE SHUTDOWN TIME OF 12" PIPELINE



VAULT PROFILE VIEW

0 3"

SCALE: 1"=3'-0"

STETTLER COMPANY
1810 LANA AVENUE, NE.
SALEM, OREGON 97303
(503) 585-5550

REGISTERED PROFESSIONAL ENGINEER 13,250 OREGON JULY 11, 1978 EDWARD P. BUTTS

CITY OF KEIZER
P.O. BOX 21000
KEIZER, OR. 97307

RIVER ROAD PRV

RIVER ROAD /DELTA/ PRV STATION

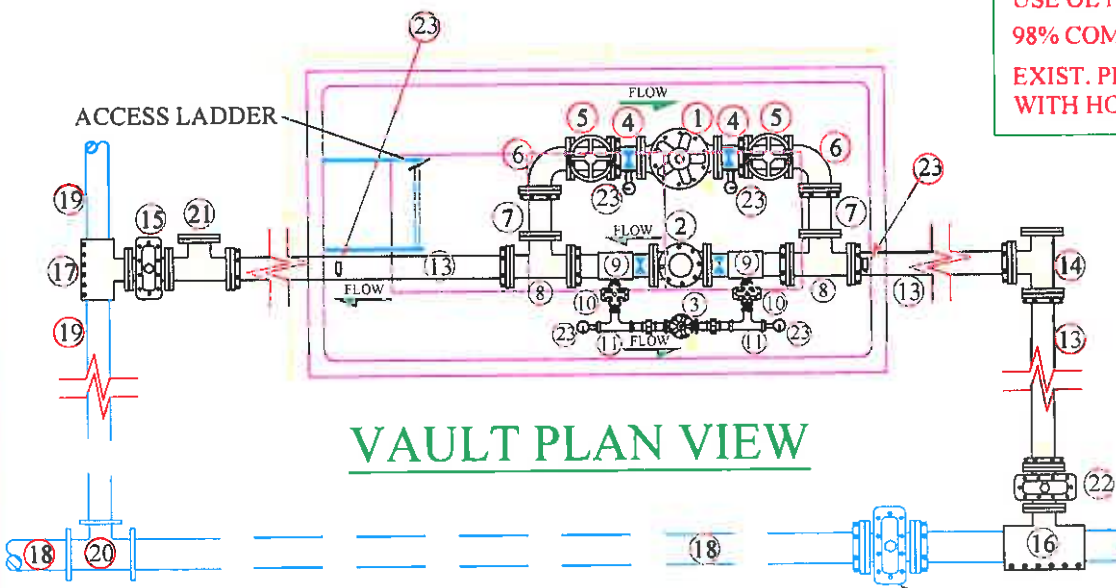
SHEET 1/2

NOTE:

USE OLYMPIC 910 VALVE BOXES AT BURIED VALVES

98% COMPACTION REQ'D OF ALL FILL "NATIVE OR ROCK"

EXIST. PIPELINE HOT-TAP SHALL BE COORDINATED WITH HOT-TAP CONTRACTOR



VAULT PLAN VIEW

(VAULT NO. 612-LA-3-332P) w/ GALV GRATED SUMP COVER- LOCKING
GALV. STL. DOORS - GALV. STL
ACCESS LADDER w/ pull up extender
Vault No.612-ML

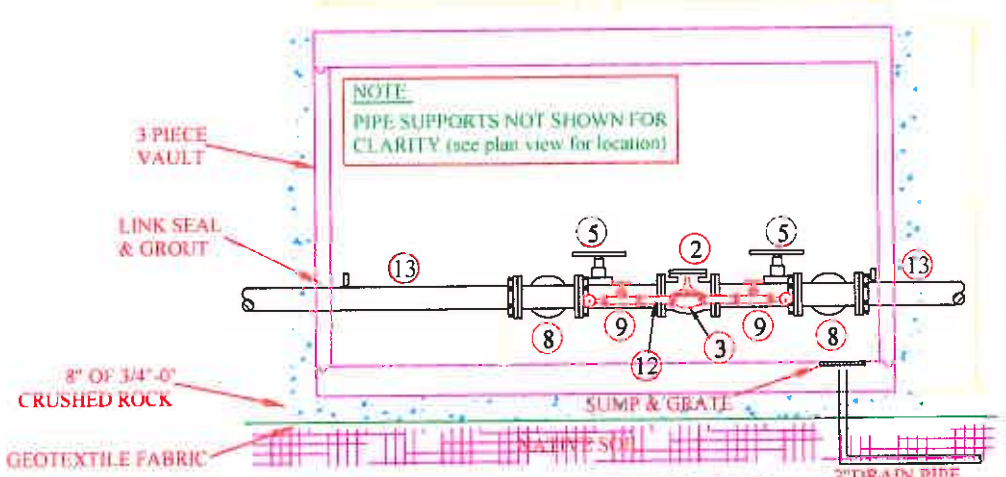
NOTE:
CORE HOLES THROUGH VAULT & USE LINK SEAL
STANDON S89 PIPE SUPPORT BRACKETS

Exist. G.V. shown for reference (verify actual location)
(Close Valve when PRV in Use)

0 3'

SCALE: 1"=3'-0"

1. 6"FL CLA-VAL MDL.#90-01AB (15-75 PSI SPRING)
2. 6"FL. SWING CHECK VALVE
3. 2" FIPT CLA-VAL MDL.#90-01AS (15-75 PSI SPRING)
4. 6"x8±" FLxPE SPOOL w/ MEGA-FLANGE
5. 6" FL WEDGE G.V. w/ HAND WHEEL
6. 6"FL 90° ELBOW
7. 6"x12±" FLxPE SPOOL w/ MEGA-FLANGE
8. 6"FL TEE w/ MEGA-FLANGE
9. 6"x22±" FLxPE SPOOL w/ 6x2" SADDLE
10. 2" FIPT WEDGE G.V. w/ HAND WHEEL
11. 2" FIPT BRASS TEE
12. 2" MIPT BRASS PIPE
13. 6" CL/52 D.I. PIPE
14. 6" MJ TEE w/ MEGA-LUGS & MJ PLUG
15. 6"FL WEDGE G.V. w/ 2"OP NUT
16. 8"x6" HOT-TAP SADDLE
17. 6" HOT-TAP SADDLE
18. EXISTING CITY 8" A.C. LINE (@ Wheatland Rd.)
19. EXISTING CITY 6" STEEL LINE
20. EXISTING CITY 8"x6" CONNECTION
21. 6"FL TEE w/ MEGA-FLANGE & BLIND FLANGE
22. 6"FLxMJ WEDGE G.V. w/ MEGA-LUG
23. 100psi LIQUID FILLED GAUGE & BRASS BALL VALVE



VAULT PROFILE VIEW

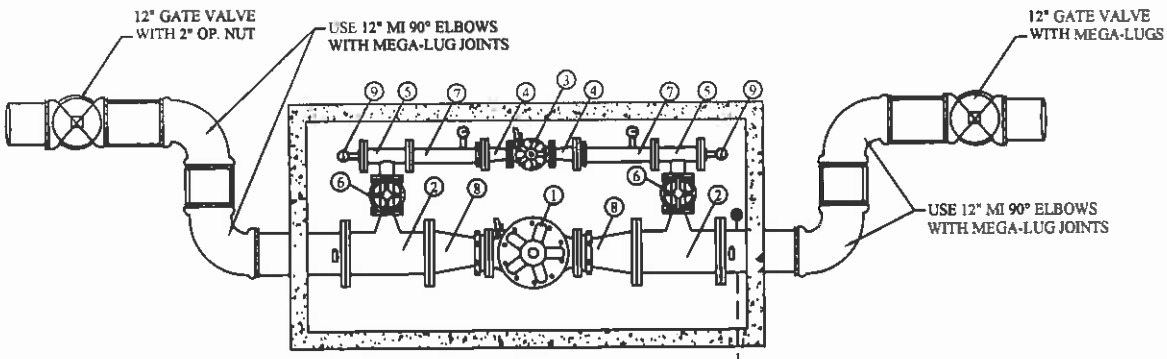
STETTLER COMPANY
1810 LANA AVENUE, NE.
SALEM, OREGON 97303
(503) 585-5550

REGISTERED PROFESSIONAL ENGINEER 13,250 OREGON

CITY OF KEIZER
P.O. BOX 21000
KEIZER, OR. 97307

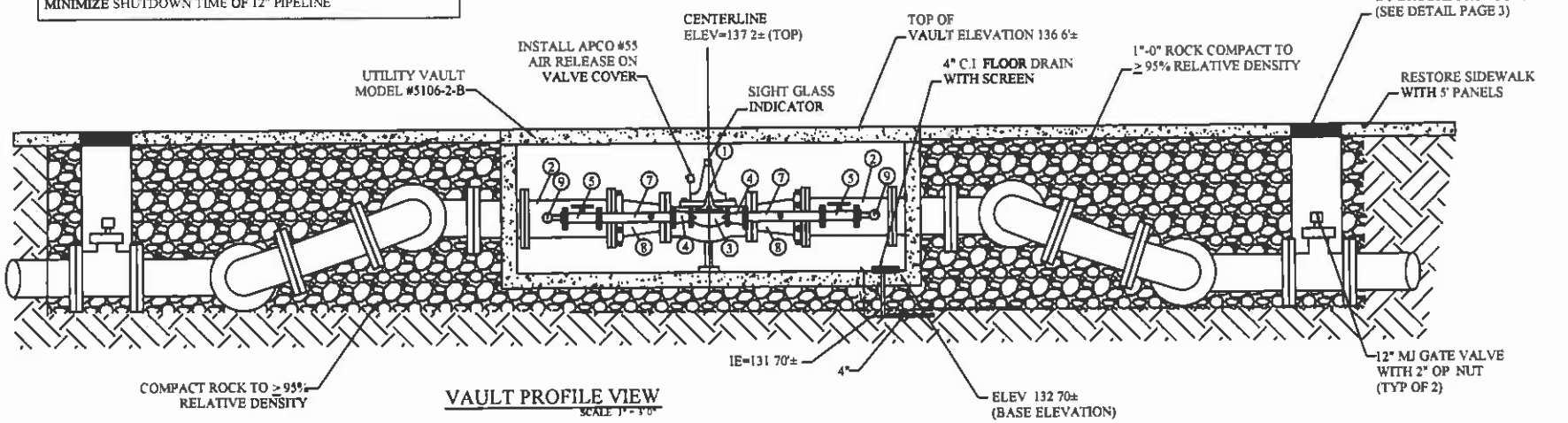
WHEATLAND ROAD PRV STATION

SHEET



VAULT PLAN VIEW
SCALE 1" = 3'-0"

NOTE: USE OLYMPIC 910 VALVE BOXES AT BURIED VALVES
95% COMPACTION REQUIRED OF ALL FILL "NATIVE OR ROCK"
EXISTING PIPELINE CONNECTION SHALL BE COORDINATED TO MINIMIZE SHUTDOWN TIME OF 12" PIPELINE



VAULT PROFILE VIEW
SCALE 1" = 3'-0"

① 8" FL. CLA-VAL MDL. #90-52 BDY COMBO PRV & REVERSE CHECK VALVE (15-75 PSI SPRING) WITH LOW FLOW BYPASS & SIGHT GLASS INDICATOR
② 12" X 12" X 4" FL C.I. TEE
③ 3" FL. CLA-VAL MDL. #90-01AS (15-75 SPRING)
④ 4" X 3" FL CONCENTRIC REDUCER
⑤ 4" FL. TEE WITH BLIND FLANGE
⑥ 4" G.V. WITH HAND WHEEL
⑦ 4" X 26"± FL X PE SPOOL WITH MEGA-FLANGE
⑧ 12" X 8" FL. CONCENTRIC REDUCER
⑨ 100psi LIQUID FILLED GAUGE WITH BRASS BALL VALVE

4B ENGINEERING & CONSULTING, LLC
civil and environmental engineering
3000 MARKET STREET
SUITE 527
SALEM, OREGON 97301
PH (503) 589-1115
FAX (503) 589-1118

CITY OF KEIZER
HORIZON RIDGE PRV STATION
SYSTEM DETAILS

SCALE: AS SHOWN
PROJECT NO.
DRAWING FILE NAME:

CHECKED BY:
APPROVED BY:
PLOT DATE:
REVISION

SHEET 2

HORIZON RIDGE PRV STATION

INTERGOVERNMENTAL AGREEMENT FOR EMERGENCY WATER SUPPLY

AGREEMENT between **CITY OF SALEM** (Salem), an Oregon municipal corporation, and **CITY OF KEIZER** (Keizer), an Oregon municipal corporation.

Recitals:

(1) The parties hereto previously entered into an Emergency Water Agreement dated February 6, 1987. Such agreement was amended by a letter agreement dated October 17, 2001, an Amendment to Emergency Water Agreement dated on or about December 2001, and an Amendment to Emergency Water Agreement dated on or about August 31, 2007.

(2) The parties hereto intend to terminate the Emergency Water Agreement dated February 6, 1987, and all amendments thereto, and enter into a new Intergovernmental Agreement for Emergency Water Supply on the terms and conditions set forth herein.

(3) Salem's primary water source is located on the North Santiam River at Geren Island.

(4) Keizer's primary water source is from underground wells located in the Keizer area.

(5) Both cities have ample water supplies to serve their respective communities.

(6) Both cities desire to further develop their backup water supply capabilities through a water supply interconnect between both water systems to handle severe emergency conditions.

(7) In order to develop a backup water supply, certain construction activities will need to be conducted.

NOW, THEREFORE, in consideration of the following mutual promises and obligations, Salem and Keizer agree as follows:

Section 1. Emergency Supply. Each City will provide to the other surplus water during periods of emergency as provided under this Agreement. A period of emergency includes, but is not limited to, drought, system repair, or temporary loss of supply because of power loss, contamination, or other system breakdown. The vicinity of the two pump stations for the interconnections is shown on Exhibit "A."

Section 2. Sale Price. Water sold to either party will be at Keizer's commercial commodity rate less ten percent, or the commodity rate Salem charges Suburban East Salem Water District, whichever is less.

Section 3. Construction of Improvements at the Cherry Avenue Booster Pump Station. On or before December 30, 2012, Salem shall construct, and be responsible for all construction management for the booster pump station structure at Keizer's Cherry Avenue Booster Pump Station as shown on Exhibit "B" for the purpose of housing the necessary disinfection chemicals. The structure shall meet all applicable zoning and building codes. The existing control logic being used in the booster pump station shall remain. The existing temporary structure shall be removed. The booster pump station portion of the building will be the property of Salem and shall be maintained by Salem. Salem shall seek Keizer's concurrence on all architectural features of the building and landscaping and Keizer's concurrence shall not unreasonably be withheld.

Section 4. Construction of Improvements at the Wiessner Pump Station.

4.1 On or before September 30, 2014, Salem shall construct, and be responsible for all construction management for approximately 2,200 feet of 18-inch ductile iron water main connecting Wiessner Pump Station site to the City of Salem 42-inch trunk main consistent with the alignment shown in Exhibit "A" and "C," as well as the flow meter as shown in Exhibit "C," which after construction shall be maintained by Salem.

4.2 On or before September 30, 2016, Salem shall construct, and be responsible for all construction management for up to 3,500 gallons per minute maximum capacity booster pump station at the Wiessner pump station site in a location consistent with that described in Exhibit "C," for the purpose of housing the necessary disinfection chemicals. The structure shall meet all applicable zoning and building codes. The control logic for the pump operation shall be the same as at the Cherry Avenue Booster Pump Station site. The pump station will be the property of Salem. Salem shall seek Keizer's concurrence on all architectural features of the building and landscaping and Keizer's concurrence shall not unreasonably be withheld.

4.3 On or before September 30, 2014, Keizer shall construct, and be responsible for all construction management for approximately 3,000 feet of 12-inch ductile iron water main connecting Wiessner Pump Station to the Ridge Drive Reservoir, consistent with that described in Exhibit "A" and "C," which after construction shall be maintained by Keizer.

4.4 On or before September 30, 2014, Keizer shall develop and provide the necessary easements on the Wiessner Pump Station site for Salem to gain access and place the booster pump station facility, piping, power supply, and other pertinent facilities consistent with the alignment shown in Exhibit "C."

4.5 On or before September 30, 2014, Keizer shall construct, and be responsible for all construction management for the 12-inch interconnection pipe work at the Wiessner Pump Station, including flow meter and pressure reducing valve consistent with the alignment shown in Exhibit "C," which after construction shall be maintained by Keizer.

Section 5. Ownership and Maintenance. The termination point of operation and ownership is the down-stream side of the respective water meters (see Exhibit "B" and "C"). Each City will maintain their own facilities at the booster pump station sites, including underground power and communication lines.

Section 6. Back Flow Prevention. An active back flow prevention program shall be established in each system and shall be continued for the life of the Agreement in accordance with *Oregon Revised Statutes* and *Oregon Administrative Rules*.

Section 7. Water Meter. Each City shall install a water meter to measure flows at the inter-tie locations indentified in Exhibit "B" and "C." Each City will be responsible for the cost of installation, maintenance, operation, and annual testing of that City's water meter.

Section 8. Notification. When water is needed due to an emergency, the City needing water will first notify the other City to ensure that adequate water is available. Once adequate water is identified, both Cities shall take all steps necessary to deliver the emergency water supply. If emergency water becomes unavailable, each City shall notify the other as soon as feasible.

Section 9. Water Quality Analysis. Upon request, the results of chemical analysis and bacteria counts will be supplied by the City selling emergency supply water to the City purchasing the emergency supply water.

Section 10: Merger. This agreement sets forth the entire understanding of the parties with respect to its subject matter, supersedes any and all prior understandings and agreements, whether written or oral, between the parties with respect to such subject matter, and may not be altered, modified, supplemented, or amended in any manner whatsoever, except by mutual agreement of the parties in writing. Any such modification, supplementation, or amendment, if made, shall be effective only in the specific instance and for the specific purpose given, and shall be valid and binding only if signed by the parties. The failure of the City to enforce any provision of this contract shall not constitute a waiver by the City of that or any other provision.

Section 11: Severability. If any provision of this agreement shall be invalid or unenforceable in any respect for any reason, the validity and enforceability of any such provision in any other respect and of the remaining provisions of this agreement shall not be in any way impaired.

Section 12: Compliance with Applicable Law. The parties shall comply with all federal, state, and local laws, ordinances, and regulations applicable to this agreement, including, but not limited to state public contracting laws and applicable federal and state civil rights laws.

Section 13: Term and Termination. The term of this Agreement shall start on the date of the last signature hereon, and end on December 30, 2037. Salem or Keizer may terminate this Agreement by written mutual consent of the parties or upon either party providing upon not less than one hundred eighty (180) days written notice to the other party and specifying the termination date.

Section 14: Termination of Emergency Water Agreement Dated February 6, 1987. The Emergency Water Agreement dated February 6, 1987, the letter agreement dated October 17, 2001, and the Amendment to Emergency Water Agreement dated on or about December 2001, and the Amendment to Emergency Water Agreement dated on or about August 31, 2007, are terminated on the effective date of this Agreement.

IN WITNESS WHEREOF, the parties have, by approval of their respective governing bodies, caused this Agreement to be executed:

City of Keizer

By: _____
Chris Eppley, City Manager
City of Keizer

Date 3-22-12

City of Salem

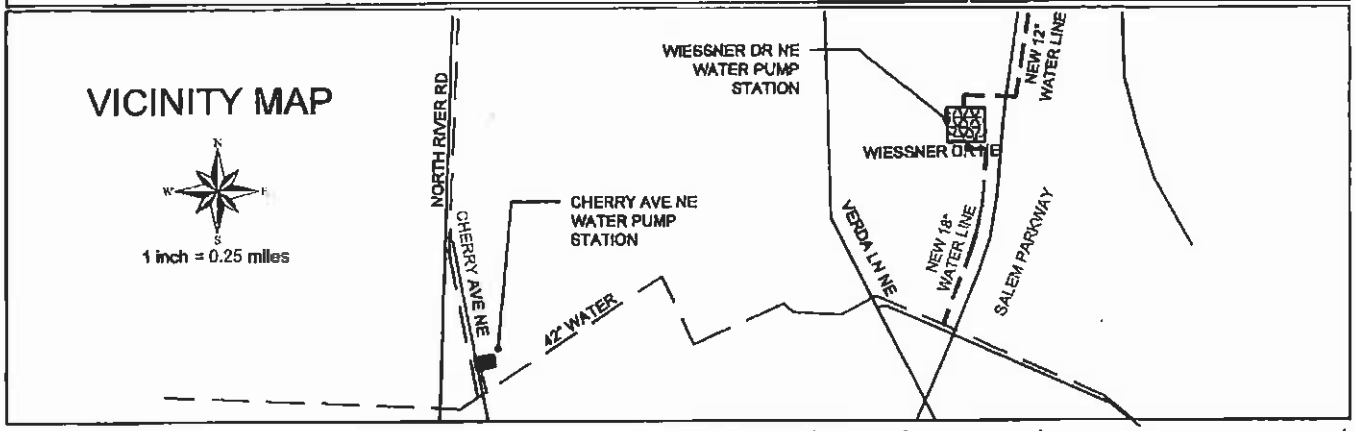
By: Linda Norris
Linda Norris, City Manager
City of Salem

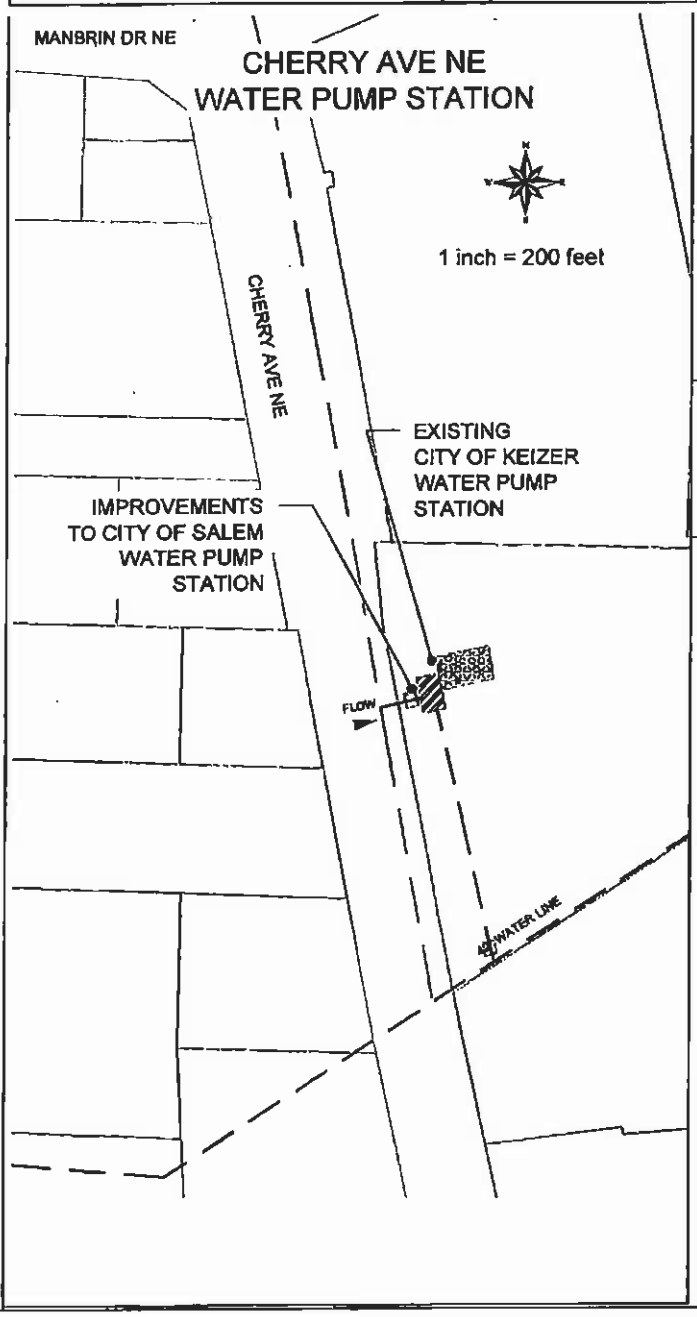
Date 3/21/2012

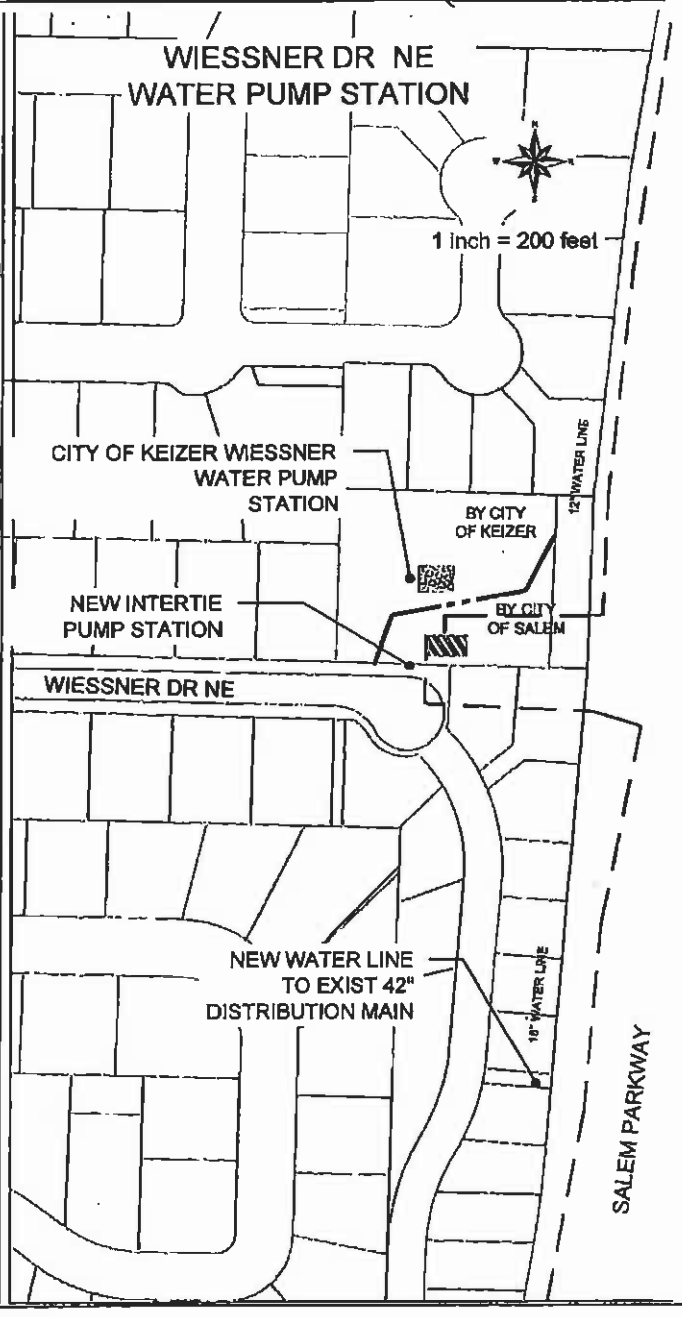
JP/TLC/G:\Group\director\Judy\2012 Corresp\AGREEMENT Sean B changes 7 with esj changes_2 Final.docx

EMERGENCY WATER SUPPLY
AGREEMENT MAP
BETWEEN CITY OF KEIZER and CITY OF SALEM

EXHIBIT A

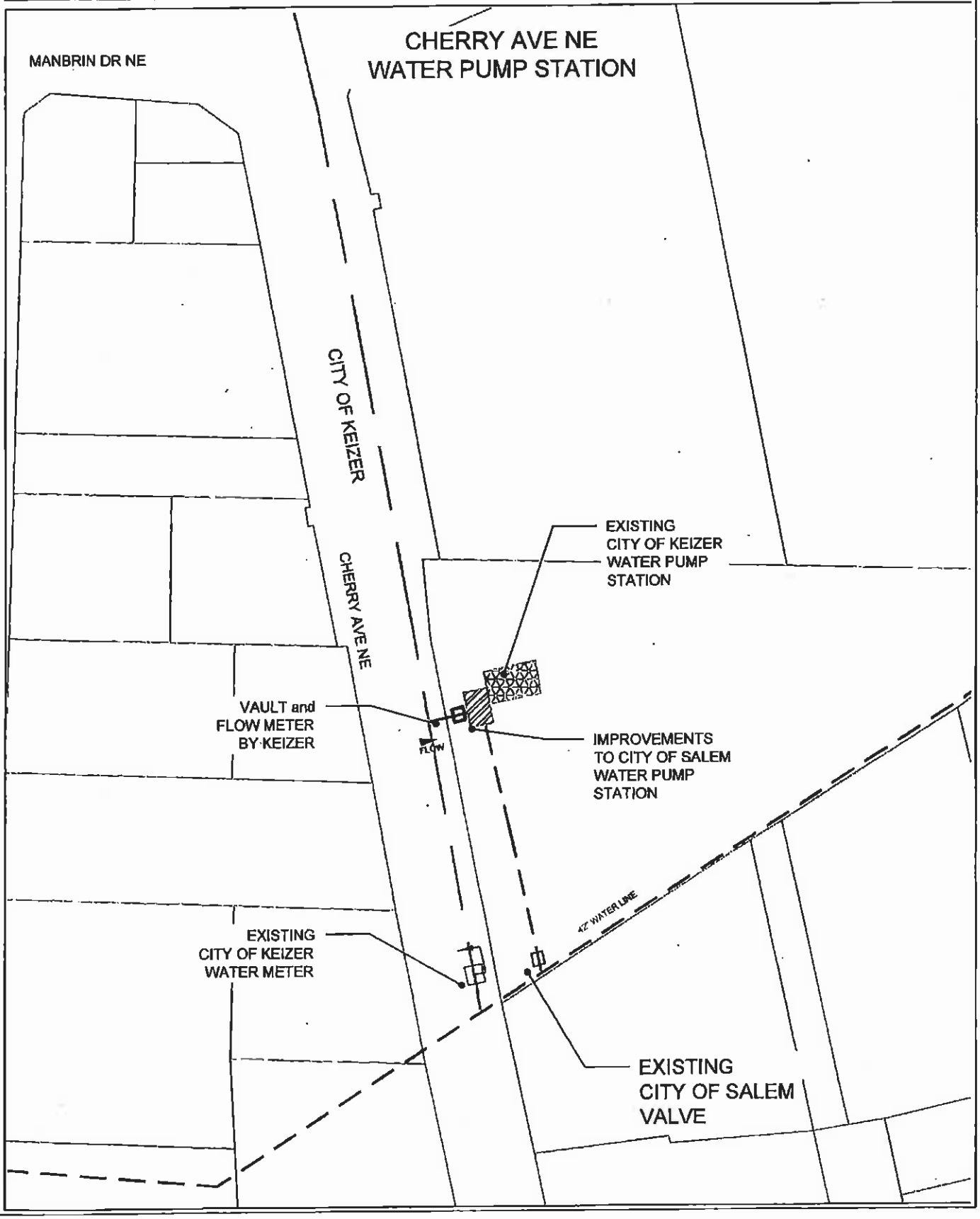






EMERGENCY WATER SUPPLY
AGREEMENT MAP
BETWEEN CITY OF KEIZER and CITY OF SALEM

EXHIBIT B



EMERGENCY WATER SUPPLY
AGREEMENT MAP
BETWEEN CITY OF KEIZER and CITY OF SALEM

EXHIBIT C