TECHNICAL MEMORANDUM

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

TO: Jim Bet, Boeing Company

FROM: Eric Weber, L.G.

DATE: April 14, 2010

RE: CRITICAL AREA /WELLHEAD PROTECTION ORDINANCE REVIEW

INTRODUCTION

This technical memorandum presents the findings of a review of municipal well use and associated critical area and wellhead protection ordinances in the vicinity of The Boeing Company's (Boeing's) Auburn fabrication facility located at 700 15th Street SW, Auburn, Washington (facility). This review was conducted in response to Ecology's request concerning offsite groundwater use and regulation discussed at a December 17, 2009 meeting with Boeing and a follow up correspondence dated January 27, 2009. The facility is located within the City of Auburn and the City of Algona; the City of Pacific bounds the facility to the south. The location of the facility and municipal boundaries are shown on the vicinity map on Figure 1.

This review included identifying the location and characteristics of municipal and private Group A[1] wells within a mile of the facility (i.e., the study area). Specific requirements or ordinances associated with these water supply systems were evaluated and compared with facility practices.

IDENTIFICATION OF WELLS

Multiple data sources were reviewed to verify the location of existing Group A wells within the general location of the facility. Online database and map research was conducted using the United States Geologic Survey (USGS) National Water Information System, the King County iMAP website, the state Department of Health (WDOH) website and the state Department of Ecology (Ecology) well log database. The city water departments of Auburn, Algona and Pacific were also contacted along with a representative of the South Auburn Water Association (SAWA). The SAWA is a small Group A system located east of the facility that provides water to unincorporated King County within the City of Auburn. The location of the SAWA and identified Group A wells within one mile of the facility are shown on Figure 2.

[1] A Group A well is defined by DOH as providing water to 15 or more connections and at least 25 people.

WATER SUPPLY SYSTEMS AND ASSOCIATED REGULATIONS

Auburn and Pacific are the two large municipal purveyors within one mile of the facility. There are also a few small private Group A water systems within the study area. A description of Auburn, Pacific and Algona water systems and associated regulations are presented below. Other small Group A water systems within one mile of the facility are also summarized.

City of Auburn

The City of Auburn has eight production wells located within the Auburn-Kent Valley. These wells are part of their Valley Wellfield source of supply. However, only three of these wells are within the study area (Carollo Engineers 2009). These wells are identified as City of Auburn wells 3A, 3B and 4. All three of these wells are located east of the facility. Also, City of Auburn well 1 is slightly more than one mile from the facility. All four of these wells are shown on Figures 2 and 3.

Wells 3A and 3B were constructed in 1983 and 1984. They are located about 50 ft apart and were both constructed to a depth of 394 ft. They are screened between 285 and 368 ft depth (Carollo Engineers 2009). Each well has a capacity of about 1,500 gpm; however, the City does not currently operate these wells because of high manganese levels. The depth of these wells indicates they are screened beneath the uppermost aquifer and Osceola Mudflow aquitard. The well depth combined with the lack of pumping capacity indicates these wells are not likely to be impacted by releases from the facility.

Well 4 is located approximately 2,000 ft north of wells 3A and 3B. This well was constructed in 1985. It is screened from 272 to 334 ft and has a capacity of 2,600 gpm (Carollo Engineers 2009). Well 4 is regularly used by the City. The depth of the well indicates that it is screened below the uppermost aquifer and Osceola Mudflow aquitard. Therefore, it is unlikely to be impacted by releases from the facility.

Of the eight Valley Wellfield wells, only well 1 is likely screened in the uppermost aquifer. Well 1 is located just east of the study area near the intersection of M Street and 12th Street SE (Figures 2 and 3). This 18-inch well, constructed in 1960, is screened between 103 and 134 ft. The well pumped at a maximum capacity of 1,400 gpm. The water right associated with this well is 1,120 acre-ft/year or 693 gpm. Full use of the water right would have resulted in an average annual pumping rate of 693 gpm. Due to declining water production, the well was discontinued in 1998. Pumping from this well may have had an impact on groundwater gradients on the facility when it was used between 1960 and 1998.

An estimate of City of Auburn wellhead protection zones was presented in the *2nd Revised Ecology Review Draft RI Report* (Landau Associates 2009). This initial estimate was based on the fixed-radius method (WDOH 1995) and well locations originally identified in RI Work Plan (Geomatrix 2003).

However, the City of Auburn does not use the fixed-radius method in their current wellhead protection plan. They use the numerical modeling method which is generally considered to be a more accurate then the fixed-radius method (WDOH 1995). Based on the approach presented in the *2nd Revised Ecology Review Draft RI Report* (Landau Associates 2009) the 10-year time-of-travel capture zone of one of the City's wells was shown to extend on to the facility where the AMB property is now located. The current understanding of City of Auburn's wells and associated capture zones indicates that the 10-year time-of-travel zone does not extend on to the facility.

Auburn's current wellhead protection report was completed by Robinson Noble Saltbush (2008) and is included as an appendix in the *Auburn Comprehensive Water Plan* (Carollo Engineers 2009). The wellhead protection report estimated wellhead protection areas based on numerical modeling. Based on numerical modeling results presented in the updated wellhead protection report, the 10-year time-of-travel for the Valley Wellfield system remains east of the facility. The delineation of the 10-year time-of-travel is shown on Figure 3. Note that no Valley Wellfield wells are currently operating in the uppermost aquifer.

In the City of Auburn Municipal Code (AMC) Chapter 16.10, groundwater protection areas are defined as critical areas and separated into four zones. Groundwater protection zone 1 represents the land area overlying the one-year time-of-travel zone of any well or spring owned by the city; groundwater protection zone 2 represents the land area in the central part of the city beneath which the principal aquifer used by the city for water supply is overlain by highly permeable sand and gravel; groundwater protection zone 3 represents the land area overlying the region between the one-year and 10-year time-of-travel zone of any well or spring owned by the city. Groundwater protection zone 4 represents the land area within the city limits not designated as water resource protection zones 1, 2 and 3 (AMC Chapter 16.10.080.F.4). Delineation of groundwater protection zones are shown on critical area maps maintained by the city. The portion of the facility within the Auburn city limits (i.e., the facility not located in Algona) would be classified as zone 4 (Thorn 2010). The only critical area requirement for groundwater protection zone 4 is for business owners to implement best management practices for water resource protection (these best management practices are not defined) (AMC Chapter 16.10.120.E.2). It should be noted that "site investigative work" is exempt from critical area provisions "provided that any disturbance of the critical area is the minimum necessary to carry out the work or studies" (Auburn Chapter 16.10.040.A.8). The City does not require an application for this critical area exemption.

City of Pacific

The City of Pacific has three Group A wells within the study area clustered at their wellfield south of the Boeing Auburn facility. These wells are identified as the East Well, West Well and South

Well in the City's wellhead protection plan that is included as part of their updated *Water System Plan* (City of Pacific 2008). The depth of these wells are 47 ft, 56 ft and 53 ft respectively. The East Well was drilled in 1978, the West Well was drilled in 1988, and the South Well was drilled in 2003. The pumping capacity of these wells is 825 gpm, 920 gpm and 1,700 gpm respectively; these wells serve approximately 6,000 residents. The installation of the South Well corresponded to expansion of the City's service area to include the Illako Elementry School and several parcels near the school that were previously serviced by the City of Auburn (Carollo Engineers 2009).

All three of these wells are located in close proximity to each other on City of Pacific property directly south of the facility. The East and West Wells are identified in the King County database. The South Well is located in near proximity to these two wells (Schunke 2010) but was not listed on the King County database. All three wells are identified and discussed in the City of Pacific *Water System Plan* (Pacific 2008).

The City of Pacific's wells are screened in the uppermost aquifer. Wellhead protections zones for 6-months, 1-year, 5-year and 10-year time-of-travel zones were estimated by the city for each well using the fixed radius method (Pacific 2008). The South Well had the largest calculated zones because it has the highest pumping rate. Almost the entire facility falls within the 10-year time-of-travel zone for this well. The delineation of the South Well wellhead protection zones are shown on Figure 4.

The identified 10-year time-of-travel zone for the South Well extends over almost the entire facility. However, this estimate is apparently based on a pumping rate of 1,700 gpm[2]. The average annual pumping rate for the entire City of Pacific system was estimated at 435 gpm based on an average daily demand calculation (Pacific 2008). The city currently has certificated water rights for 2,080 acre-ft/year (equivalent to an annual pumping rate of 1,288 gpm). These certificated water rights also allow pumping up to 2,000 gpm as along as the annual quantity is not exceeded. Based on current water system demand and available water rights, the actual 10-year time-of-travel for the City of Pacific's water system is appreciably smaller than the wellhead protection area listed in their water system plan. This conclusion is consistent with the results of groundwater level monitoring performed on the Boeing Auburn facility (Landau Associates 2009). This monitoring indicates that the capture zone of the City of Pacific wells is limited to the very southern portion of the facility.

The City of Pacific Municipal Code (PMC) defines a critical groundwater recharge area as the 10- year time-of-travel well protection zone (PMC Chapter 23.30.010.A). The current code only includes City wells 2 and 3 (i.e., East and West Wells) and references the 1998 water system plan. However the City reserves the right to update the area without revising the code as new information is available. It is,

[2] Landau Associates could not precisely replicate the wellhead protections zones based on information provided in the City of Pacific Water Supply Plan (2008).

therefore, likely that the City would consider information in the 2008 water system plan along with the South Well time-of-travel zone as applicable. Consequently, almost the entire Boeing Auburn facility is likely considered within the critical groundwater recharge area for the City of Pacific wells.

The City of Pacific requires critical area reports be completed for non-exempt proposed developments (PMC 23.10.090) and additionally requires a hydrogeologic assessment report for activities within critical groundwater recharge areas. Exempt activities include "required environmental remediation" (PMC 23.10.070.Q). Corrective action completed at the facility is interpreted to fall under this exemption. Therefore, there are no City of Pacific Critical Area Code requirements that affect corrective action.

A complication in interpreting the City of Pacific Critical Area Code is that the entire critical groundwater recharge area beneath the Boeing Auburn facility is outside Pacific's city limits. Therefore, they do not have jurisdiction to enforce code requirements at the facility. According to the City engineer, Jim Morgan, there is no agreement with Auburn or Algona to enforce code requirements (Morgan 2010). The Boeing Company has installed seven "Sentry" wells to evaluate the potential impact of the facility on these wells (Landau Associates 2009). The wells are sampled semiannually for volatile organic compounds (VOCs). Sentry well data are tabulated and sent to the City of Pacific on a semi-annual basis. The most recent results were non-detect (Landau Associates 2010). In the past, very low levels of VOCs have occasionally been detected at the Sentry wells, however there has never been a significant concern that Pacific drinking water quality would be affected. There is no mention of the Sentry well sampling program in the City code or the 2008 water system plan. The City engineer was not aware of any written agreement between Boeing and the City of Pacific. In addition to the Sentry well program, the City has a monitoring plan that includes VOC sampling once every three years. The samples are collected between the wells and entry to the distribution system. The last scheduled sampling was in 2009.

City of Algona

The City of Algona water system serves a population of 2,900. Until 1996, Algona provided water through a well directly west of the facility. The 10-inch well was 65 ft deep (Carollo Engineers 2009) and screened in the uppermost aquifer. In 1996, the City of Auburn took over responsibility for providing water to Algona through an intertie system (i.e., a pipe connecting the two cities water distribution systems) and pumping the Algona well was discontinued. As part of an agreement between the cities, the Algona water right was transferred to the City of Auburn. This water right allowed for pumping of 175 acre-ft/year on an annual basis (i.e., 108 gpm). Pumping of this well may have had a minor affect on groundwater gradients at the facility. The City of Algona does not define a specific

critical or sensitive area based on groundwater protection or recharge. The location of the former Algona wells is at the corner of 3rd Avenue South and Washington Boulevard. The location is shown on Figure 2.

A well log for the Algona well was not found in Ecology files. An abandonment log was also not located and this well has apparently not been abandoned (Carollo Engineers 2009). According to the City of Algona, there are at least two other private wells within the city limits (Algona 2010). The location of these private wells is unknown.

Other Water Systems

According to the City of Auburn Water System Plan, there are many smaller water systems and single domestic wells operating within Auburn's city limits that are not regulated by the City. The plan identified five Group A systems. Two of these systems, South Auburn Water Association (SAWA) and a well operated by Danner Corporation are located within the study area. Additionally, Landau Associates identified a third Group A system within the study area (Auburn Mobile Park) through King County and WDOH records. There is no wellhead protection area information associated with these wells; however these water systems are regulated by the WDOH. The WDOH regulations defines a sanitary control area of 100 ft around any drinking water well [WAC 246-290-135(2)] where numerous activities are restricted. None of these other Group A system sanitary control areas are near the facility or areas where corrective action is being implemented. The location of these three other Group A systems are shown on Figure 2. A brief description of these systems is provided below.

The SAWA is located directly east of the facility. They had one main pumping well (drilled in 1970) and a backup or emergency well (drilled in 2005). Their main well is listed as 92 ft deep and is likely screened in the uppermost aquifer. The system has approximately 47 connections and serves a population of about 159 according to the DOH website. Based on an assumed average daily demand of 250 gallons/day per connection (similar to City of Pacific assumptions for water use) this system would pump at an average annual rate of about 8 gpm. SAWA does not have a wellhead protection plan but they do monitor for VOCs every three years in compliance with WDOH regulations. The approximate system service area is shown on Figure 2.

The Danner Corporation is an aerospace equipment manufacturer that specializes in composites and vacuum bagging systems. The company is located south of the White River. The company well is listed on the King County database as being 260 ft deep so it is likely screened beneath the uppermost aquifer. It is not clear if this well is used for drinking water or process water. DOH records indicate only a single connection for this well.

The Auburn Mobile Park is located directly east of the facility. They operate their own well. According to a spokesperson with the mobile park, their well is 58 ft deep and serves 91 connections.

Based on an assumed average daily demand of 250 gallons/day per connection (similar to City of Pacific assumptions for water use), this system would pump at an average annual rate of about 16 gpm. This well is likely screened in the uppermost aquifer. Auburn Mobile Park does not have a wellhead protection plan but they do monitor for VOCs every three years in compliance with WDOH regulations.

CONCLUSION

Based on the findings of this review, corrective action activities at the facility are in compliance with local regulations as outlined in the Auburn Municipal Code and the Pacific Municipal Code. There are no other specific groundwater related regulations for the three other Group A systems that were identified in the study area that would affect corrective action activities. Based on our understanding of the various municipal and Group A systems in the vicinity of the Boeing Auburn facility, releases from the facility are not threatening or likely to threaten any of these systems.

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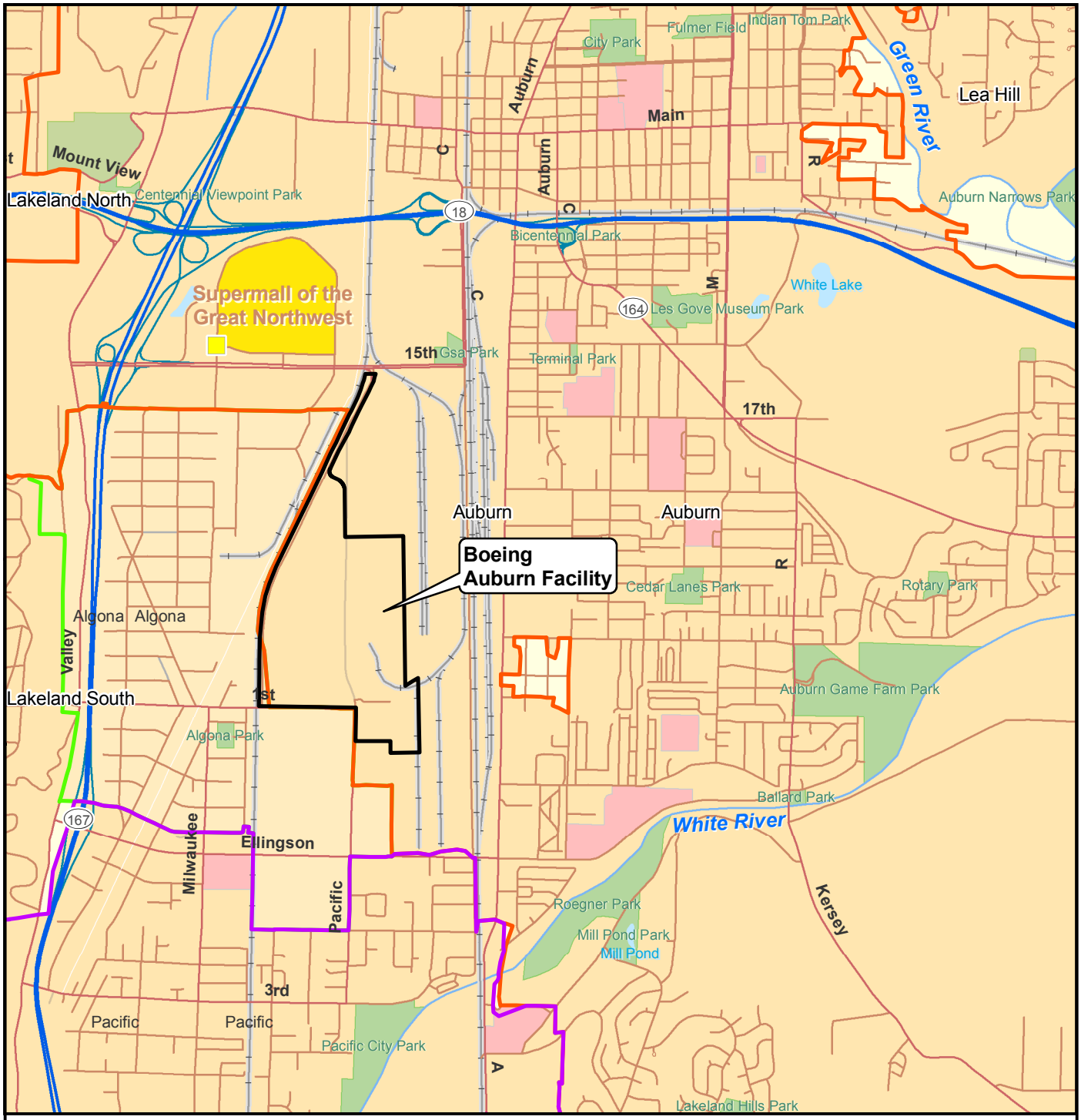
ATTACHMENTS

Figure 1 – Vicinity Map
Figure 2 – Well Locations
Figure 3 – Wellhead Protection Area Boundaries City of Auburn
Figure 4 – Wellhead Protection Area Boundaries City of Pacific



Data Source: ESRI 2008

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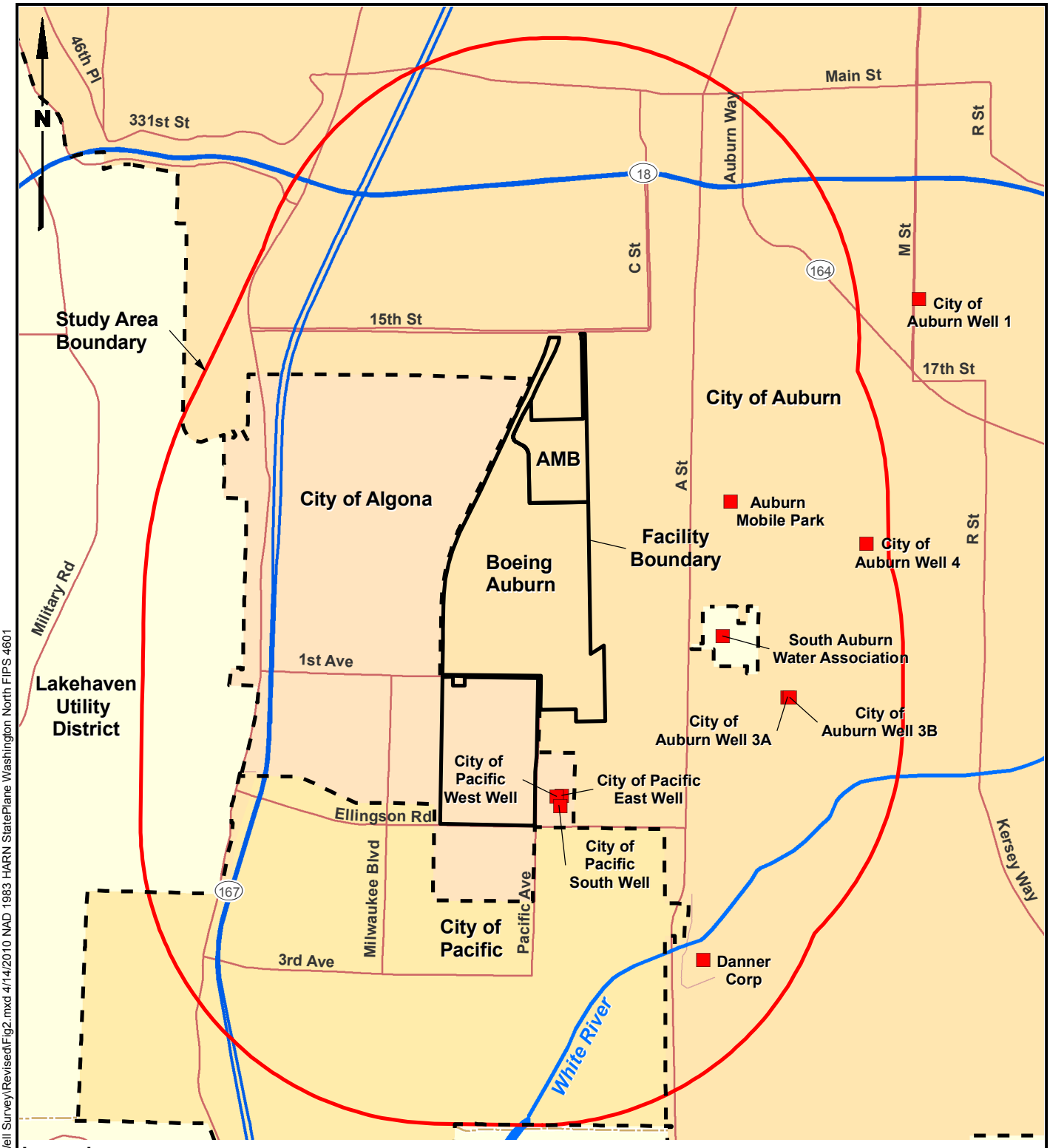
Beneficial Well Survey Boeing Auburn Auburn, Washington	**Vicinity Map**	Figure 1



Legend

Group A Well

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 2,500 5,000

Scale in Feet

Data Source: ESRI; King County

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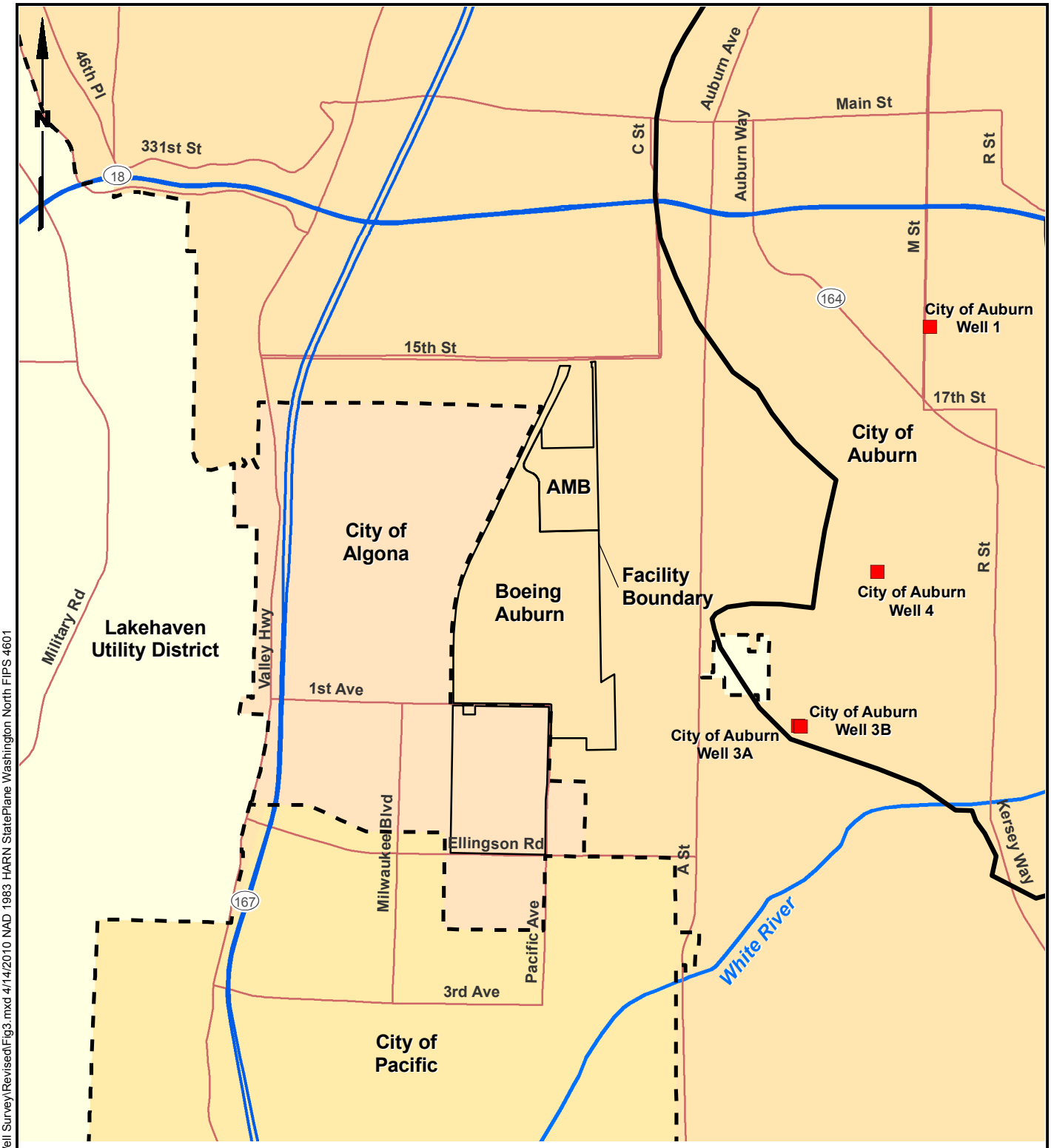
Beneficial Well Survey Boeing Auburn Auburn, Washington	**Well Locations**	Figure 2



Legend

Western Extent of 10 Year
Wellhead Protection Boundary
City of Auburn Valley Wellfield

Note
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 2,500 5,000
Scale in Feet

Data Source: ESRI; King County

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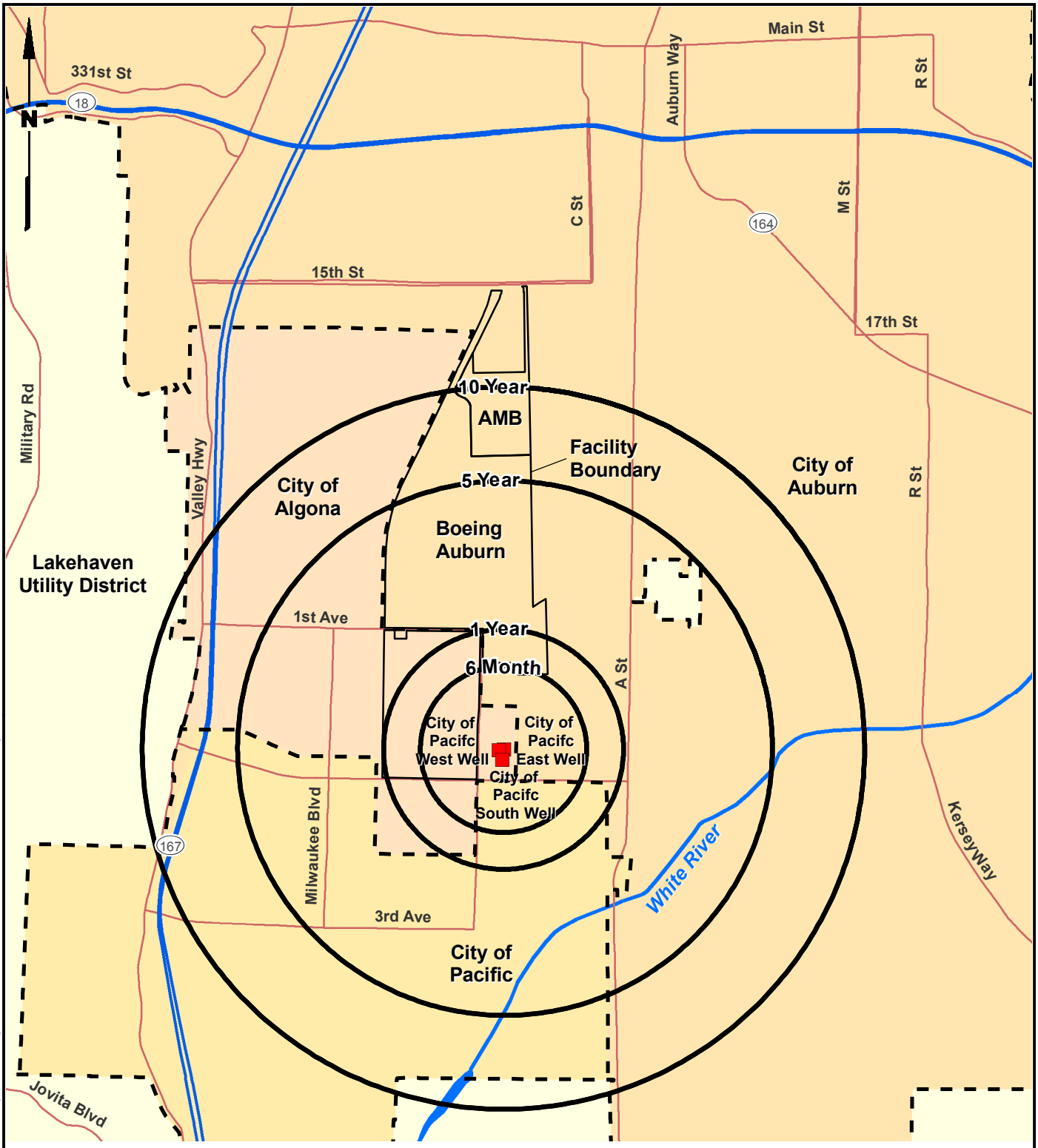
Beneficial Well Survey Boeing Auburn Auburn, Washington	**Wellhead Protection Area Boundary City of Auburn**	Figure 3



Legend

Wellhead Protection Boundary
City of Pacific Wellfield

Note
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 2,500 5,000
Scale in Feet

Data Source: ESRI; King County

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Beneficial Well Survey Boeing Auburn Auburn, Washington	**Wellhead Protection Area Boundary City of Pacifc**	Figure 4