4.3 Groundwater

This section provides an analysis of potential impacts to groundwater. Groundwater impacts from the proposed KFIP development have been evaluated and weighed to determine whether the proposed KFIP Project would have significant groundwater quantity or quality impacts affecting river functions and on-site wetlands.

Groundwater is water that collects or flows beneath the Earth's surface, filling the porous spaces in soil, sediment, and rock. Groundwater that is stored in and moves through these subsurface layers is called an aquifer. Groundwater aquifers are recharged by infiltration of rain, melting snow and ice through the ground surface. Groundwater discharges into streams, rivers, and oceans, and/or is pumped from these layers via wells to provide drinking water.

Groundwater below the KFIP site is stored in subsurface geologic and soil layers, most of which are annual sediment deposits from post-glacial alluvial floods. These layers recharge and drain in response to surface conditions, annual weather patterns, and the ability of these materials to infiltrate and transport water in subsurface layers below the KFIP site. Complex geology and soil characteristics both on site and in the contributing basin (surfaces outside of the site that send hydrology toward the site) determine how, when, and where groundwater would infiltrate and flow through the site and thus would define how groundwater functions may be affected by surface development.

There are three geomorphic surfaces on the KFIP site where infiltration systems may be employed. For purposes of this discussion, the surfaces would be called the *high terrace*, the *middle terrace* (a slightly lower elevation subarea in the central eastern high terrace surface), and the *floodplain* (Figure 4-26).

4.3.1 Study Area

The study area for groundwater includes the KFIP site and surrounding upslope basins, which influence groundwater recharge, groundwater depth and how fast or slow groundwater flows through the KFIP site and to the associated floodplain and Puyallup River. The contributing recharge basin includes the KFIP site (mapped as Quaternary alluvium – Qa) and higher elevation uplands to the south (mapped primarily as glacial outwash – Qgoi, and glacial till – Qgt) (Figure 4-26).

Groundwater recharges as it infiltrates and drains toward and through the KFIP site from these surfaces. Groundwater discharges from the KFIP site to the Puyallup River and to its floodplain located along the northeastern side of the KFIP Project site.

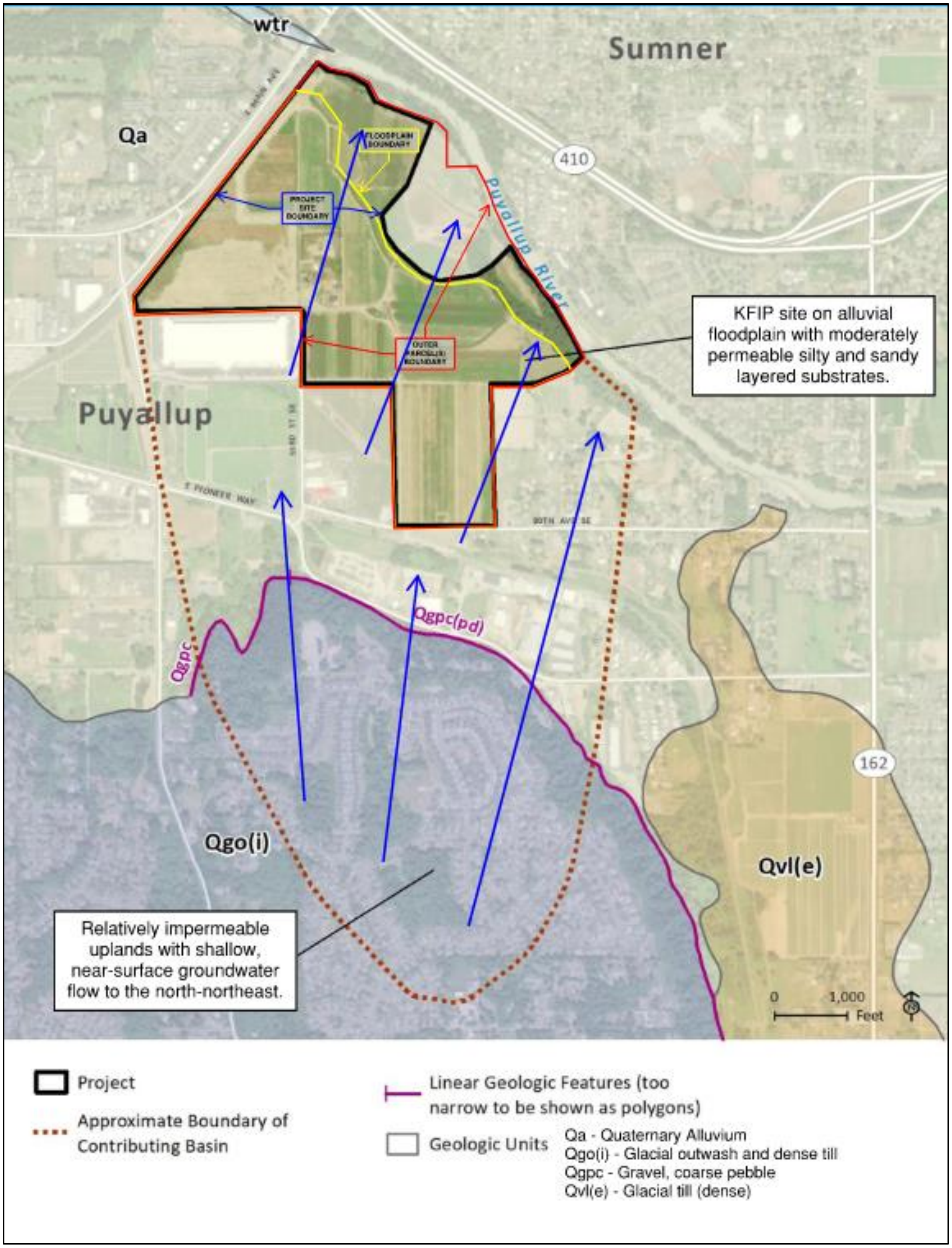

Figure 4-26. 100K WADNR Geology Mapping in the Contributing Groundwater Basin

4.3.2 Relevant Plans Policies, and Regulations

This section and Table 4-10 provided below summarizes federal, state, and local regulations related to groundwater that are relevant to the KFIP Project.

Table 4-10. Overview of Relevant Regulations

Law and Regulation	Description
Federal	
Sections 404 and 401 of the Clean Water Act (CWA; 33 Code of Federal Regulations [CFR] 26, Subchapter 4, Section 1344)	Section 404 is administered primarily by the USACE and Section 401 by Ecology as a state-agent of the USEPA. These agencies review and permit projects proposing in-water work related to fill in WOTUS.
State	
Section 401 of the Clean Water Act (CWA; 33 CFR 26, Subchapter 4, Section 1344)	Section 401 is administered at a federal level by the USEPA, which has delegated review authority to Ecology. Ecology reviews and certifies Section 401 water quality permits for projects proposing in-water work in WOTUS.
Washington State Water Pollution Control Act (90.48 RCW)	Ecology regulates wetlands under the state Water Pollution Control Act (RCW 90.48) and the SMA (RCW 90.58). Ecology also provides guidance to local jurisdictions under SEPA to identify wetland-related issues early in permit and review processes. Administrative orders are issued under RCW 90.48.120. Ecology requires that all projects affecting surface waters in the state must comply with the provisions of the state's Water Pollution Control Act, including those waters or wetlands that are not subject to the federal CWA regulations.
Water Quality Standards for Groundwaters of the State of Washington (WAC 173-100 and 200)	WAC 173-100 establishes procedures to designate groundwater management areas and to develop programs designed to protect groundwater quality. WAC 173-200 defines water quality standards for groundwater, which specifies an anti-degradation policy.
Washington Underground Injection Control Program (WAC 173-218)	WAC 173-218 protects groundwater quality by regulating the disposal of fluids into the subsurface. State groundwater protection regulations apply when drinking water aquifers are at risk, or when groundwater flows to surface waters that are used as a drinking water source, or when groundwater flows to surface waters which contain listed species.
Washington State Department of Ecology NPDES Permit Program	The NPDES permit program controls water pollution by regulating sources that discharge pollutants into WOTUS (CWA, 33 USC Sections 1251 et seq. and WAC2 197-11-200 through 240). The state Department of Ecology develops and administers NPDES municipal stormwater permits in Washington state. These permits regulate discharges to both surface waters (via surface conveyances) and to groundwaters (via infiltration facilities) of the state.

Law and Regulation	Description
Local (County and City)	
Pierce County Stormwater Management and Site Development Manual (PCSWDM)	The PCSWDM includes LID requirements for stormwater treatment systems which are intended to promote stormwater infiltration where practicable and to return filtered stormwater to the groundwater aquifer close to where the water (i.e., rainfall) originates. The manual also provides rules designed to protect wetland hydrology, from both a water quality and water quantity standpoint.
Pierce County Comprehensive Plan Policies	The Pierce County Comprehensive Plan is a tool to assist County Councilmembers, planning commissioners, County staff, and others in making land use and public infrastructure decisions. It provides the framework for the County's Development Regulations.
City of Puyallup Stormwater Management Program Plan (SWMPP)	The SWMPP provides guidance on how the City manages its stormwater to meet requirements of the City's NPDES Phase 2 permit, as administered by Ecology.
City of Puyallup Critical Areas Regulations (PMC Chapter 21.06 CRITICAL AREAS)	The Puyallup Critical Areas regulations (PMC Chapter 21.06) are similar to those of Pierce County, as both are designed to meet standards defined in the GMA. However, some regulatory details are different.
City of Puyallup Comprehensive Plan	The City of Puyallup Comprehensive Plan includes government planning policies that call for the protection, preservation and enhancement of water resources and other natural environment components. It is "the long-term vision and plan for managing the built and natural environment in the City of Puyallup", and provides policy guidance used by City staff to make decisions related to growth and development.

Federal

Clean Water Act (Code of Federal Regulations)

Section 431.02 of the federal CWA, and corresponding State of Washington regulations (outlined below) establishes the mechanism for regulating discharges of pollutants to groundwater through the NPDES, a permit program that regulates point sources of polluted water that may be discharged into WOTUS.

CWA regulations apply to groundwater when groundwater flows to surface waters that contain listed species, drinking water aquifers are at risk, or groundwater flows to surface waters that are used as a drinking water source. The KFIP site is within the northeastern boundary of the Central Pierce County Aquifer Area Sole Source Aquifer (Figure 4-27Figure 4-27), which is bounded by the Nisqually River to the southwest, Puget Sound to the west, and the Puyallup River to the east.

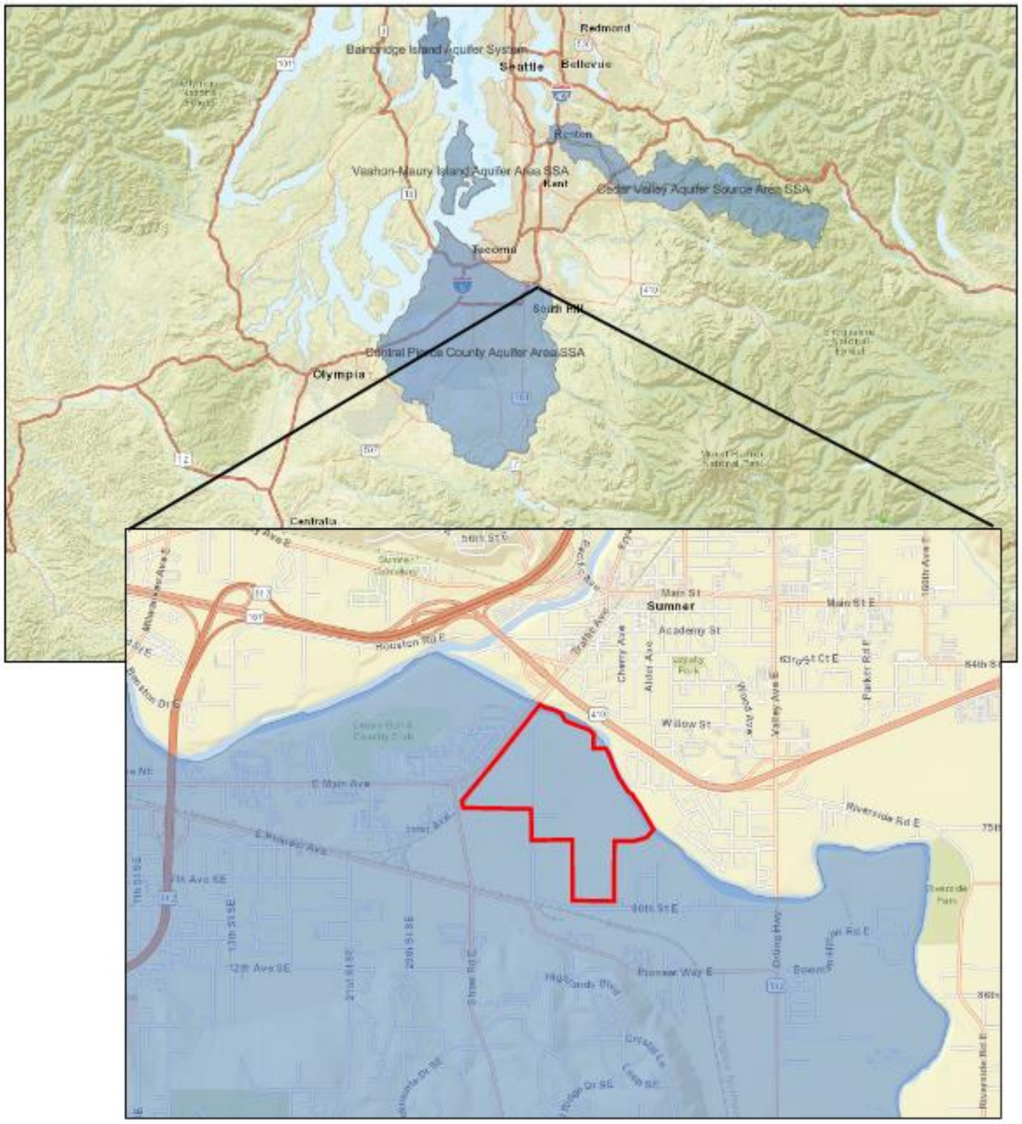

Figure 4-27. Sole Source Aquifer Map (Pierce County GeoSpatial Data mapping)

The Safe Drinking Water Act of 1974 (under the USEPA) protects sole-source drinking water aquifers, including rivers, lakes, reservoirs, springs, and groundwater wells that serve 25 or more individuals. This regulation gives USEPA review authority over any "*projects that are to receive federal financial assistance and which have the potential to contaminate the aquifer.*" The aquifers designated as sole source by USEPA have been incorporated into state and local regulations. State and local critical area regulations are also intended to protect local drinking water systems in addition to USEPA designation, rules, and regulations.

State

Washington State Department of Ecology

Water Quality Standards for Groundwaters of the State of Washington (WAC 173-100 and 200)

WAC 173-100 establishes procedures to designate groundwater management areas and develop groundwater management programs with the goal of protecting groundwater quality.

WAC 173-200 defines water quality standards for groundwater, which specifies an anti-degradation policy.

Washington Underground Injection Control Program (WAC 173-218)

WAC 173-218 protects groundwater quality by regulating the disposal of fluids into the subsurface.

Similar to federal regulations, state groundwater protection regulations apply when drinking water aquifers are at risk, or when groundwater flows to surface waters that are used as a drinking water source, or when groundwater flows to surface waters that contain listed species.

Washington State Department of Ecology NPDES Permit Program

The NPDES permit program controls water pollution by regulating sources that discharge pollutants into WOTUS (CWA, 33 USC Sections 1251 et seq. and WAC2 197-11-200 through 240). Ecology develops and administers NPDES municipal stormwater permits in Washington State. These permits regulate discharges to both surface waters (via surface conveyances) and to groundwaters (via infiltration facilities) of the state.

There are two types of permits:

- Phase I Municipal Stormwater Permits regulate discharges from MS4s owned or operated by large cities and counties, including Pierce County.
- Phase II Municipal Stormwater Permits regulate discharges from certain ”small” MS4s in Washington, including the City of Puyallup.

The current Phase I and Phase II permits were effective August 1, 2019, and will expire on July 31, 2024. New permits will replace the old, applying any regulatory updates to previous permit requirements. These permits require local governments to manage and control stormwater runoff so that it does not pollute downstream waters, including groundwater.

Local (County and City)

The KFIP site is located in unincorporated Pierce County within the City of Puyallup’s UGA, and is served by and affects city infrastructure and critical areas in the City of Puyallup and its UGA. Groundwater quality and quantity protection is generally addressed at a local level in a wide range of city or county stormwater and critical area management regulations, but also in related code that regulates disposal of pollutants or hazardous waste.

Various Pierce County regulations that impact management of groundwater will be reviewed first followed by a short comparative discussion about equivalent or parallel regulation in the City of Puyallup. But City regulations do not apply until such a time as the UGA is annexed into the City.

Pierce County Regulatory Review

Pierce County Stormwater Management and Site Development Manual (PCSWDM)

An updated PCSWDM was adopted, effective on July 1, 2021. In relation to the discussion below, changes between the 2015 and 2021 versions were insignificant.

The PCSWDM includes LID requirements for stormwater treatment systems, which are intended to promote stormwater infiltration where practicable and to return filtered stormwater to the groundwater aquifer close to where the water (i.e., rainfall) originates. Pierce County promotes the use of LID techniques in newly developed areas to reduce impermeable pavement and roof cover, and to maximize permeable areas to increase potential for stormwater infiltration into the ground.

The manual also provides rules designed to protect wetland hydrology, from both a water quality and water quantity standpoint. Floodplain wetlands, such as Wetlands A, B, and C on site, are usually dependent on a combination of surface and groundwater inflows. The stormwater management system for new development is required under the manual to maintain wetland hydroperiods (i.e., the hydrologic volumes, timing, and duration that define and support functions and values of the on-site floodplain wetlands).

Despite promoting infiltration of stormwater, the PCSWDM also allows for direct surface stormwater outfall to the Puyallup River with "basic" water quality treatment. The PCSWDM requires that volumes equivalent to 91 percent of the runoff volume as estimated by an approved continuous runoff model (which approximately equates to the 6-month, 24-hour storm event), must receive some form of "basic" treatment prior to release to the Puyallup River.[14]

The Puyallup River is deemed flow control exempt, and therefore only "basic" treatment of early stormwater runoff volumes (equivalent to the 6-month, 24-hour storm as described above) is required by the PCSWDM prior to releasing to the Puyallup River. Volume flows greater than this minimum can be released directly to the river without basic treatment, and infiltration is not required. Therefore, in areas such as the KFIP site that was previously farmed and infiltrated most direct rainfall, recharge of groundwater would be minimal once the KFIP site is fully developed.

The current stormwater management proposal is to infiltrate roof runoff from four of the warehouse roofs in trenches sited along the top of slope at the northeast edge of the high terrace. The four roofs account for less than half of the total KFIP impervious surface area, and most of the proposed trenches are not sited hydrologically upslope from the target wetlands. Direct discharge into the Puyallup River of more than half of the runoff volumes from future impervious surfaces at the KFIP site may result in loss of more than half of current wetland hydrology volumes and may affect the timing and duration of future wetland hydrology. The current infiltration facility design does not provide modeled data to show

[14] To understand the relation between the 91 percent runoff volume and the 6-month, 24-hour storm event (as estimated by an approved continuous runoff model, and storm intensity and duration), please refer to City of Tacoma 2003 Storm Water Management Manual, Appendix I-B Water Quality Treatment Design Storm, Volume, and Flow Rate https://cms.cityoftacoma.org/enviro/Surfacewater_1/SWMM2003/V1-AppB.pdf.

how the wetland hydroperiods of the on-site wetlands would be preserved by this proposal, as required by the PCSWDM.

In order to preserve on-site wetland hydrology on the floodplain (Wetlands A, B, and C) and at Wetland D, targeted and properly located wet season infiltration facilities that would capture and infiltrate surface runoff are needed to seasonally recharge groundwater at key locations on the high terrace (future site of warehouses, roads, and parking areas). Under current conditions, groundwater that was recharged by seasonal infiltration through the high terrace surface provides hydrology to the on-site wetlands from approximately mid-winter through early summer months (i.e., to Wetlands A, B, and C on the floodplain to the east, and also to Wetland D located in the southeastern portion of the high terrace).

The PCSWDM does allow for direct discharge to the Puyallup River, but allowing for direct discharge does not relieve the applicant of ensuring the wetland hydroperiods are analyzed and ensuring that the existing on-site wetland hydrology sources are supported or replaced in kind, as required in the PCSWDM.

The PCSWDM lists minimum stormwater management requirements and provides guidance as to how to accomplish these goals in Pierce County. Specific to this Project, the following guidance about protection of wetland hydroperiods is noted:

- In Section B.4.2 Guide Sheet 3B: Protecting Wetlands from Changes in Water Flows (Hydroperiod), the manual states that a wetland's hydroperiod must be protected and maintained, and that the "*total volume of water into a wetland on daily basis should not be more than 20 percent higher or lower than the pre-project volumes*" and "*total volume of water into a wetland on a monthly basis should not be more than 15 percent higher or lower than the pre-project volumes.*"

These stormwater management regulations indicate that a project site must be managed to protect on- and off-site wetlands and downstream waterbodies from both direct and indirect impacts from changes in water quantity and quality caused by the development. Therefore, these regulations apply directly to potential impacts from the KFIP site stormwater management plan, which, as proposed, does not effectively address the requirements for defining and protecting the hydroperiods of the on-site wetlands.

Pierce County Critical Areas Regulations Issues (PCC Chapters 18E.10- 18E.120)

Under the GMA (RCW 36.70A.060), local governments are required to established policies and development guidelines to protect the functions and values of critical areas: rivers, streams, lakes, wetlands, floodplains, aquifer recharge areas, and others. The Pierce County Critical Areas Regulations, Title 18E includes regulations designed to provide protection pertaining to surface and groundwater on the KFIP site, including the following critical areas, all of which are present on the KFIP site:

- Wetlands (PCC 18E.30),
- Regulated fish and wildlife species and habitat conservation areas (PCC 18E.40),
- Flood hazard areas (PCC 18E.70),

- Erosion hazard areas (PCC 18E.110), and
- Landslide hazard areas (PCC 18E.80).

Wetland hydrology at the KFIP site floodplain is groundwater driven, and these wetlands also provide for important wildlife habitat on site, and affect floodplain and erosion control functions.

Pierce County regulates the Central Pierce County Aquifer Area Sole Source Aquifer under PCC Chapter 18E.50 Aquifer Recharge and Wellhead Protection Areas. The aquifer is bounded by the Nisqually River to the southwest, Puget Sound to the west, and the Puyallup River to the east (Figure 4-27).

PCC Chapter 18E.50 has specific regulations for development in the aquifer recharge area, *including a maximum impervious area of 60 percent in areas zoned as Employment Center (EC),* per PCC 18E.50.040 Aquifer Recharge and Wellhead Protection Area Standards, such as the KFIP site. The following uses are prohibited within aquifer recharge and wellhead protection areas:

- Landfills (other than inert and demolition landfills)
- Underground injection wells (Class I, III, and IV)
- Metals mining
- Wood treatment facilities
- Pesticide manufacturing
- Petroleum refining facilities (including distilled petroleum facilities)
- Storage of more than 70,000 gallons of liquid petroleum or other hazardous products

Pierce County regulates Landslide Hazard Management Areas under PCC 18E.80.040.B.7, which specifies that "*stormwater retention facilities, including infiltration systems utilizing perforated pipe, are prohibited unless the slope stability impacts of such systems have been analyzed and mitigated by a geotechnical professional and appropriate analysis indicates that the impacts are negligible*."

The slopes along the northeast edge of the high terrace include several Landslide Hazard Areas Indicators (PCC 18E.80.020.A) and meet the definition of a Potential Landslide Hazard Area (PCC 18E.80.020.B). As mentioned above, the current proposed method to provide hydrology to the floodplain wetland involves infiltration trenches located at the top of slope at the northeastern edge of the high terrace. The proposed infiltration trench sites may not meet setback requirements described in code, and have not been assessed by a geotechnical professional (as required by PCC 18E.80.040.B.7) to ensure they would provide effective infiltration function and would not impact slope stability.

Pierce County Comprehensive Plan Policies

The Pierce County Comprehensive Plan was developed under the provisions of the GMA (Chapter 365-196, WAC). The Comprehensive Plan is a tool to assist County Councilmembers, planning commissioners, County staff, and others involved in making land use and public infrastructure decisions. It provides the framework for the County's Development Regulations. The current Pierce County Comprehensive Plan (effective October 1, 2021) defines goals and policies used by the County when making decisions related to growth and development, as relates to long-range county planning.

The GMA outlines 14 goals for the development and adoption of a comprehensive plan and development regulations, but specific to this section 4.3 Groundwater, the following planning goals specifically apply:

- Open Space and Recreation: Retain open space, enhance recreational opportunities, conserve fish and wildlife habitat, increase access to natural resource lands and water, and develop parks and recreation facilities.
- Environment: Protect the environment and enhance the state's high quality of life, including air and water quality, and the availability of water.

The Environmental Element (Chapter 7) of Pierce County's Comprehensive Plan describes approaches for maintaining the natural environment, including sections on how to protect and manage fish and wildlife habitat and wetlands. Specific primary goals in the Environmental Element related to groundwater management include (but are not limited to):

<u>Overall Goals:</u>

- *GOAL ENV-1: Conserve and protect critical and environmentally sensitive areas.*
  - *Policy ENV-1.5: Coordinate with other entities to protect critical areas, address environmental issues, and fulfill ecosystem restoration obligations*

<u>Water Quality Goals:</u>

- *GOAL ENV-5: Protect aquifers and surface waters to ensure that water quality and quantity are maintained or improved.*
  - *Policy ENV-5.6: Require performance standards for new development and retrofitting of existing facilities.*
  - *Policy ENV-5.11: Protect water quality and quantity necessary to support healthy fish populations.*
  - *Policy ENV-5.13: Reduce runoff pollutants into surface and groundwater.*
  - *Policy ENV-5.14: Require the use of low impact development principles and best management practices for stormwater drainage including use of infiltration systems, such as bioretention, rain gardens, and permeable pavement, to maintain water quality for fish and wildlife.*

<u>Fish and Wildlife Goals:</u>

- *GOAL ENV-8: Maintain and protect habitat conservation areas for fish and wildlife.*
  - *Policy ENV-8.2: Place regulatory emphasis on protecting and achieving no net loss of critical habitat areas.*

<u>Hazardous Areas [including floodplains and steep slopes] Goals:</u>

- *GOAL ENV-10: Avoid endangerment of lives, property, and resources in hazardous areas.*
  - *Policy ENV-10.2.1: Require appropriate standards for site development and structural design in areas where the effects of the hazards can be mitigated.*

  - *Policy ENV-10.2.4: Direct sewer lines, utilities, and public facilities away from hazardous areas.*

<u>Wetlands Goals:</u>

- *GOAL ENV-11: Establish appropriate long-term protection to ensure no net loss of wetlands.*
  - *Policy ENV-11.4: Require wetland mitigation for impacts that cannot be avoided.*

<u>Best Available Science, Review, and Adaptive Management Goals:</u>

- *GOAL ENV-14: Designate and protect all critical areas using best available science.*
  - *Policy ENV-14.1: Give special consideration to conservation and protection of anadromous fisheries.*
- *GOAL ENV-15: Recognize the value of adaptive management for providing flexibility in administering critical area and shoreline regulations.*
  - *Policy ENV-15.2: Prioritize post-project compliance monitoring.*
  - *Policy ENV-15.3: Utilize new technologies and methodologies where appropriate to resolve environmental problems.*
  - *Policy ENV-15.5: Require that regulated activities occur with avoidance of impacts as the highest priority, and apply lower priority measures only when higher priority measures are determined to be infeasible or inapplicable.*

<u>Storm Drainage and Surface Water Management Goals:</u>

- *GOAL U-32: Improve surface water and groundwater quality.*
  - *Policy U-32.2: Reduce and eventually eliminate harm to water quality from stormwater discharges. Do this through use of on-site infiltration and best management practices and source control of pollutants; control of development density and location; preservation of stream corridors, wetlands and buffers; and development, maintenance of a system of stormwater retention and detention facilities, and retrofit of existing facilities to eliminate or reduce untreated stormwater flows*
- *GOAL U-35: Manage stormwater in consideration of the varied uses associated with natural drainage systems.*
  - *Policy U-35.2.5: Promote infiltration, bioretention, dispersion, and permeable pavement.*
- *GOAL U-37: Reduce or eliminate the stormwater drainage impacts from roadways onto adjacent properties and into surface waters.*
- *GOAL U-38: Make the use of Low Impact Development (LID) techniques in public and private developments the preferred and most widely used method of land development.*

<u>City of Puyallup Regulatory Review</u>

As described above, the KFIP site is located in unincorporated Pierce County, within the City of Puyallup's UGA. It is served by and affects city infrastructure and critical areas in the City of Puyallup and its UGA. Groundwater protection is generally addressed at a local level in a wide range of city or county stormwater and critical area management regulations, but also in related code that regulates disposal of pollutants or hazardous waste.

Various Pierce County Regulations that impact management of groundwater were reviewed first above, but are followed below by a short, comparative discussion about equivalent or parallel regulation in the City of Puyallup. But City regulations do not apply until such a time as the UGA is annexed into the City.

City of Puyallup Stormwater Management Program Plan (SWMPP)

The City of Puyallup's SWMPP is updated each year, to describe actions Puyallup would take to maintain compliance during the 2020 Permit period, as required by the City's Phase 2 NPDES Permit (i.e., August 1, 2019, through July 31, 2024). The 2023 SWMPP provides guidance on how the City manages its stormwater to meet requirements of the City's NPDES Phase 2 permit, as administered by Ecology. Under the SWMPP, the City has made LID the preferred approach for new development, in order to "*minimize impervious surfaces, native vegetation loss, and stormwater runoff in all types of development situations where feasible."*

The Phase 2 Permit allows the City to discharge stormwater runoff into Waters of the State (i.e., streams, rivers, lakes, wetlands) as long as the City implements certain programs designed to protect water quality. This goal is to be attained by reducing discharge of pollutants "*to the maximum extent practicable*" by using specific BMPs. This would include requiring implementation of source control BMPs from current operations or, as needed, requiring construction of treatment and/or infiltration facilities to reduce pollutants associated with existing land use.

City of Puyallup Critical Areas Regulations (Chapter 21.06 CRITICAL AREAS)

Under the GMA (RCW 36.70A.060), local governments are required to establish policies and development guidelines to protect the functions and values of critical areas: rivers, streams, lakes, wetlands, floodplains, wildlife habitat, erosion and landslide hazard areas, and others. The Puyallup Critical Areas regulations (Puyallup Municipal Code Chapter 21.06 Critical Areas, [PMC Chapter 21.06]) includes regulations similar to those of Pierce County, as both are designed to meet standards defined in the GMA. However, some regulatory details are different.

The PMC Chapter 21.06 regulations were most recently updated in 2022. These regulations apply to lands directly west of the KFIP site, which are within the City of Puyallup, and will apply to any future KFIP site development after annexation into the City. Ideally, the PMC Chapter 21.06 regulations are not in conflict with similar and parallel County regulations, which apply to the current KFIP site located in the City's UGA.

Under PMC Section 21.06.930, (Article IX Wetlands), the City of Puyallup defines standard wetland protections, such as assigning buffer widths in relation to Category rating score (Categories I, II, III, and IV) and land use intensity (Low, Moderate, and High). Buffer widths range from a minimum of 25 feet up to 300 feet.

The City does not regulate (i.e., buffer or impose mitigation requirements) wetlands smaller than 1,000 square feet (if not along a riparian corridor or part of a wetland mosaic), and does not regulate Category IV wetlands smaller than 4,000 square feet as long as the wetland is not associated with a shoreline, is not part of a wetland mosaic, does not score more than five or more points when rated, does not contain priority or critical habitat, and the impacts are fully mitigated in accordance with conditions from Ecology and USACE.

Critical Aquifer Recharge Areas (CARAs) include groundwater areas that are regulated per PMC Sections 21.06.110-1150 (Article XI. Critical Aquifer Recharge Areas). The City regulates its mapped CARAs by establishing protective criteria, such as prohibiting certain facilities that would reduce recharge to drinking water aquifers, recharge that provides baseflow to a stream, or recharge that would affect groundwater quality.

PMC Sections 21.06.1010-1080 (Article X. Fish and Wildlife Species and Habitat Conservation Areas) defines standards for protection of fish and wildlife habitat, including activities allowed in stream buffer areas and a recognition of the importance of wetland habitats.

PMC Sections 21.06.1210-1270 (Article XII. Geologically Hazardous Areas) defines areas that are susceptible to erosion, landslides, earthquakes, volcanic activity, or other potentially hazardous geological processes. Point discharges from surface water facilities and roof drains onto or up-slope from an erosion or landslide hazard area is prohibited except when water can be tightlined to a point where there are no erosion hazard areas, or where the discharge flow rate matches predeveloped conditions with adequate energy dissipation, or where discharge is dispersed across a steep slope onto a low-gradient undisturbed buffer where the released water would infiltrate in the buffer and not increase slope saturation (as certified by a geotechnical professional).

PMC Chapter 21.07 (Flood Damage Protection, a separate chapter from the Critical Areas Chapter) describes limitations on development in a regulated floodplain. The regulations are intended to protect human life and health, minimize public costs associated with flood control and relief projects, minimize damage to public facilities, and meet requirements for maintaining eligibility for flood insurance and disaster relief. These rules are intended to control alterations to natural hydrologic functions in floodplains.

City of Puyallup Comprehensive Plan policies

The current CPCP (2020) is described as "*the long-term vision and plan for managing the built and natural environment in the City of Puyallup.*" It provides policy guidance used by City staff to make decisions related to growth and development. Key strategies listed to maintain the city's environmental assets—as related to groundwater management—are summarized below:

- Use a science-based approach to ensure no net loss of critical areas' ecological functions and values
- Maintain and strive to enhance a healthy natural ecosystem through environmental stewardship programs that engage the citizens of Puyallup
- Adoption of a "no-net loss" approach

Chapter 2 describes approaches for managing the environment. Goals and Policies that relate to groundwater management at the KFIP site include (but are not limited to):

Sustainability and Environmental Stewardship:

- *NE-2: Lead and support efforts to protect and improve the natural environment, protect and preserve environmentally critical areas, minimize pollution, and reduce waste of energy and materials.*

Critical Areas:

- *NE-3: Protect, integrate and restore critical areas and their aesthetic and functional qualities through conservation, enhancement and stewardship of the natural environment.*
  - *NE–3.3: Implement monitoring and adaptive management to programs and critical areas mitigation projects to ensure that the intended functions are retained and, when required, enhanced over time.*

Geologically Hazardous Areas:

- *NE-4: Preserve and enhance the natural scenic qualities, ecological function and value, and the structural integrity of hillsides to protect life, property and improvements from landslide, erosion and volcanic hazards.*
  - *NE–4.2: Require appropriate levels of study and analysis as a condition to permitting construction within Geologically Hazardous Areas (and etc.).*
  - *NE–4.8: Establish setbacks around the perimeter of site-specific Landslide Hazard Areas to avoid the potential to undermine these areas, cause erosion and sedimentation…and etc.*

Critical Aquifer Recharge Areas:

- *NE-5: Preserve and protect aquifer recharge and well-head protection zones from hazardous substances and land uses which could denigrate ground water quality.*
  - *NE-5.5: Encourage retention of open spaces, tree protection areas, and other areas of protected native vegetation with a high potential for groundwater recharge.*
  - *NE-5.6: Utilize low impact development techniques—such as pervious surfacing materials and rain gardens—to mimic natural processes of stormwater infiltration.*

Wetlands:

- *NE-7: Identify and protect wetland resources and ensure "no net loss" of wetland function, value and area within the city.*
  - *NE-7.3: Use mitigation sequencing guidelines when reviewing projects impacting wetlands.*

Water Quality:

- *NE-8: Protect, improve and enhance the quality of all aquatic resources city-wide through best management practices, with a distinct emphasis on mimicking natural processes and use of low impact development techniques.*

4.3.3 Affected Environment

The KFIP site proposal is to construct seven warehouses and associated utility and pavement infrastructure. The site is located on currently farmed land adjacent to the Puyallup River, which is regulated by Pierce County as a shoreline of statewide significance and a fish-bearing stream (PCC Title 18S and Title 18E).

The affected environment, for purposes of this section (4.3 Groundwater) includes areas upslope to the south and on-site soil surfaces that would be expected to infiltrate and contribute groundwater flows toward the river (Figure 4-26 and Figure 4-28). At the KFIP site, groundwater aquifer recharge occurs annually when rainfall during winter months soaks into the ground and is stored in subsoils. The KFIP site groundwater aquifer is also recharged by groundwater inflows from the south (Figure 4-26 and Figure 4-28). Groundwater stored below the site eventually flows to the floodplain and Puyallup River to the north. The timing and magnitude of rainfall patterns in combination with geology and soil conditions would control whether precipitation infiltrates to the groundwater aquifer or flows over the surface and in farm ditches to nearby wetlands or streams. Groundwater flow rates are very slow while surface water flow rates are fast. Converting groundwater flows to surface water flows would change the timing of when winter rainfall reaches the river.

Geologic Conditions

Section 4.1 (Earth Resources) describes the overall geologic and soils setting, which controls how groundwater recharges from infiltration of rainfall. Figure 4-26 shows the geologic mapping of the contributing groundwater basin as needed to explain and show groundwater flow direction. The geology mapping of the contributing groundwater basin includes areas with highly permeable surfaces (sandy glacial outwash sediments), and other areas with limited infiltration potential (shallow glacial till soils to the south or silt loam sediment soils). The underlying glacial till layers are relatively impermeable, and therefore cause infiltrating stormwater to drain in subsurface layers toward the north-northeast, eventually feeding into the Puyallup River.

The KFIP site is covered with many layers of post glacial floodplain sediments and volcanic lahars (mudflows) that have repeatedly washed across the KFIP Project area since the end of the last glaciation about 10,000 years ago. These layered flood deposits affect groundwater storage, flow direction and infiltration potential at the KFIP site.

Figure 4-28 shows soil mapping on and near the KFIP site. The floodplain deposits range from fine textured silt loams on the high terrace (mapped as Briscot loam soils) to more sandy, recent floodplain deposits on the middle and lower floodplain terraces (mapped as Puyallup fine sand and Pilchuck fine sandy loam soils) (USDA 2021).

Under current farmed conditions, which include surface and subsurface agricultural drainage systems in the areas mapped as Briscot loam, most direct rainfall infiltrates and seasonally recharges the underlying groundwater aquifer. Effectiveness of infiltration varies across the site, dependent on site-specific soil variability. In areas where silt loam soils dominate, groundwater is typically shallower and infiltration is slower; in other areas where sand dominates, infiltration is more rapid. Connectivity of the subsurface flood deposit layers is random and also affects site specific infiltration rates. However, on average, Puyallup river flood sediments are dominantly sandy.

Farming practices and existing agricultural drainage systems on the KFIP site add to this complexity, as they affect surface infiltration potential as well as groundwater conditions and drainage potential near the surface drains and drainpipes.

Groundwater – Infiltration Potential

Groundwater aquifers at the KFIP site are recharged by infiltration of seasonal rainfall. The greater Puyallup area has a temperate marine climate, meaning that it typically has warm, dry summers, and cool, wet winters. Mean annual precipitation is 40.05 inches, with most rain fall occurring between October and March (NRCS, AgACIS 2021). Therefore, most groundwater recharge occurs during the winter months. The recharged aquifer drains slowly subsurface toward nearby slopes or surface water, discharging to local floodplains, stream, wetlands, and rivers, typically during winter, spring, and early summer months.

Infiltration of surface runoff is needed to seasonally recharge groundwater volumes that are stored in subsurface soil layers in the high terrace. This stored groundwater slowly seeps to floodplain wetlands from the sloped outside edge of the high terrace throughout most of the winter and into early spring months and provides hydrology to the on-site floodplain wetlands (Wetlands A, B, and C). Both groundwater and surface water contribute hydrology to Wetland D.

The current KFIP stormwater management system proposes conveyance of most future surface stormwater runoff directly to the Puyallup River through a piped outfall. This stormwater would be collected from new impervious surfaces throughout the future warehouse complex. Direct outfall to the Puyallup River is allowed in the PCSWDM, but at the KFIP site, this action redirects surface runoff that previously infiltrated on site, and therefore potentially results in decreased groundwater volumes below the high terrace which feed to and support on-site wetlands.

The PCSWDM requires protection of the on-site wetland hydroperiods (as described previously) in Section B.4.2 Guide Sheet 3B: Protecting Wetlands from Changes in Water Flows (Hydroperiod). The manual states that a wetland's hydroperiod must be protected and maintained, and that the "*total volume of water into a wetland on daily basis should not be more than 20 percent higher or lower than the pre-project volumes*" and "*total volume of water into a wetland on a monthly basis should not be more than 15 percent higher or lower than the pre-project volumes.*" In order to ensure that the on-site wetland hydroperiods are being maintained, a hydroperiod analysis needs to be carried out. This work is performed prior to determining how much of the on-site stormwater runoff water can be sent to the direct discharge outfall versus to on-site infiltration facilities designed to sustain the wetland hydroperiods' timing, duration, and volumes.

In an effort to address this conflict, the original proposed stormwater system design was changed to provide trench infiltration at the northeastern high terrace edge, fed by roof runoff from four of the seven warehouse roofs. However, this design was proposed without a hydroperiod analysis, and the proposed infiltration trench locations are not in compliance with Pierce County Critical Areas Regulations in Section 18E.80.040.B.7: "*Stormwater retention facilities, including infiltration systems utilizing perforated pipe, are prohibited unless the slope stability impacts of such systems have been analyzed and mitigated by a geotechnical professional and appropriate analysis indicates that the* *impacts are negligible*." The proposed trench locations do not meet slope setbacks or trench design requirements near a steep slope, as defined in Section 18E.80.050.A Determining Buffer Widths. Furthermore, the trenches are located hydrologically downstream from the wetlands, which would have been determined if a hydroperiod analysis had been carried out, and thus may not provide enough groundwater hydrology at the right location to support current wetland conditions.

In combination, the issues discussed above indicate that the proposed infiltration system design is not adequately informed to ensure support of the on-site wetlands' hydrologic baseline.

Natural Resources Conservations Services (NRCS) Soil survey mapping (Figure 4-28; Table 4-11 and Table 4-12) provides a generalized assessment of potential depth to groundwater and infiltration potential across a broad soil map unit. But for purposes of design, site specific soil mapping and infiltration testing work is needed to determine the exact areas on site where the groundwater table is deep versus shallow, and where infiltration and recharge conditions may be good versus poor. Results of an on-site groundwater study (depth and permeability conditions) carried out by KFIP consultants are discussed below.

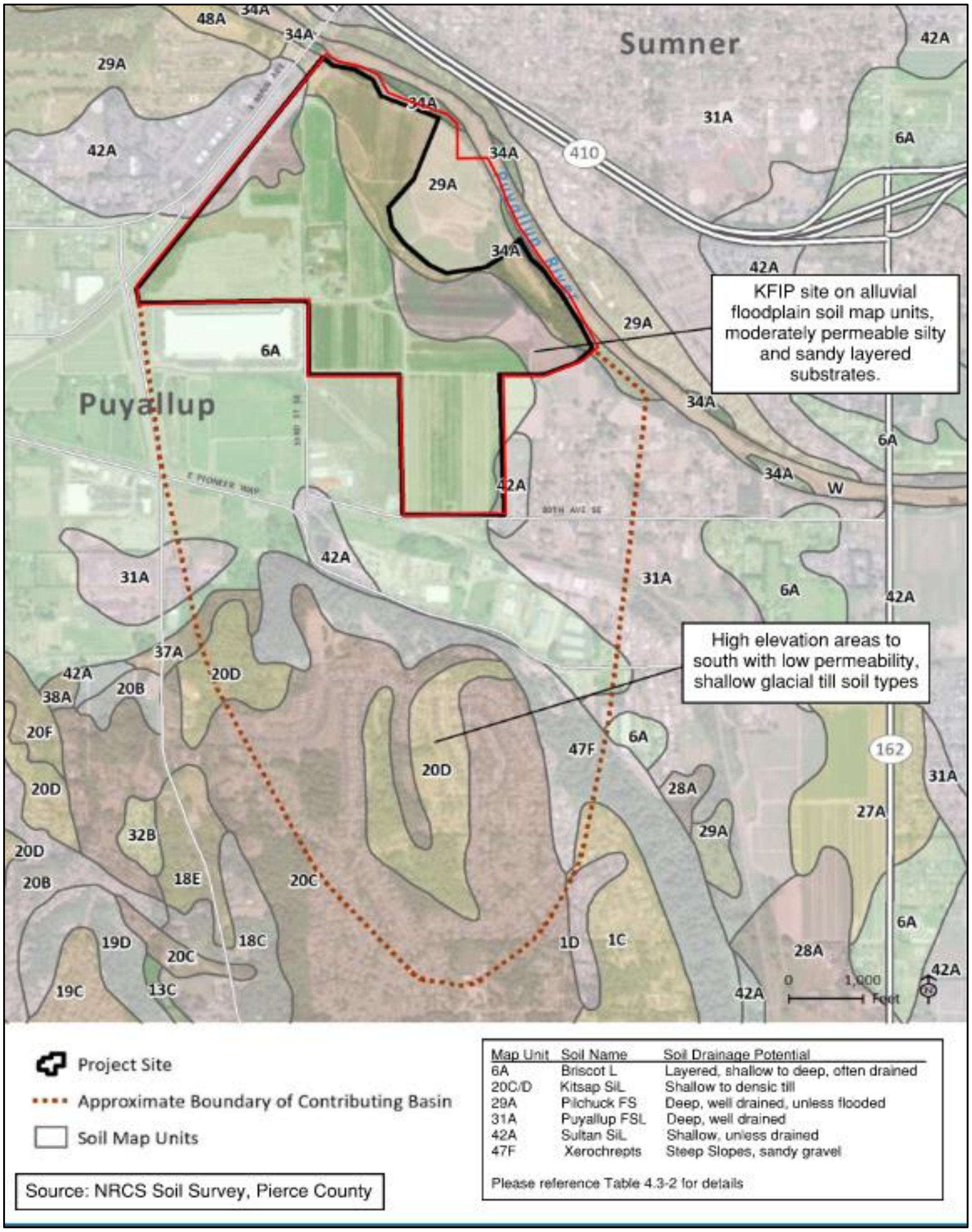

Figure 4-28. Soil Mapping at the KFIP Site and Groundwater Basin

Table 4-11. NRCS Pierce County Soil Survey Mapping Units Summary Descriptions

Soil Map Unit	Map Unit Name	Parent Material	NRCS Texture description
6A	Briscot loam	Floodplain sediment	Coarse-loamy, mixed
29A	Pilchuck fine sand	Recent floodplain sediment	gravelly and sandy alluvium
31A	Puyallup fine sandy loam	Recent floodplain sediment	Sandy alluvium
42A	Sultan silt loam	Floodplain sediment	Fine silty

Table 4-12 summarizes the expected groundwater depth and infiltration potential across the KFIP site based on generalized NRCS soil mapping. There are three geomorphic surfaces on the KFIP site where infiltration systems may be employed. For purposes of this discussion, the surfaces would be called the *high terrace*, the *middle terrace* (a slightly lower elevation subarea in the central eastern high terrace surface), and the *floodplain* (Figure 4-29).

Table 4-12. Expected Groundwater Depth and Permeability Characteristics based on NRCS Soil Mapping

Infiltration Area	Soil Map Units	Average Seasonal Groundwater Table Depth[a]	Typical Permeability Rate	Potential for Flooding at the Site
High **terrace** (Warehouses A, B, C, D, E, F, G	Briscot loam	0–1-foot depth unless drained[b]	Moderate	Low
	Sultan silt loam	2–4-foot depth	Moderately slow	Low
Middle Terrace (Warehouses C, D, E)	Puyallup fine sandy loam	>6 foot depth	High	Low
Floodplain	Pilchuck fine sand	Periodic surface floods, but typically >6-foot depth between floods	High	Frequent to occasional
	Riverwash		High	Frequent

[a] Groundwater table = the level at which the ground saturation begins (USEPA 2003).
[b] The high terrace is partially drained from past farming activities, and as a result, the seasonal water table is deeper and variable (NRCS Pierce County Soil Survey, online data accessed 2023).

These three surfaces are either currently actively farmed and artificially drained, or they are areas that have been cleared, partially drained, and farmed in the past. The high terrace and middle terrace are both targeted development surfaces for the KFIP warehouses. The primary difference between the two surfaces is that the middle terrace is mapped as Puyallup soils rather than Briscot soils (mapped across the high terrace) and is a several feet lower in elevation. Therefore, the middle terrace area would need to be filled several feet to bring the surface up to the same elevation as the high terrace prior to paving and building warehouses. Fill soils are typically compacted, and therefore do not infiltrate effectively or predictably near the surface unless carefully managed. For that reason, any infiltration trenches proposed in the fill area is unlikely to be effective unless trench bases are located below the fill depth zone.

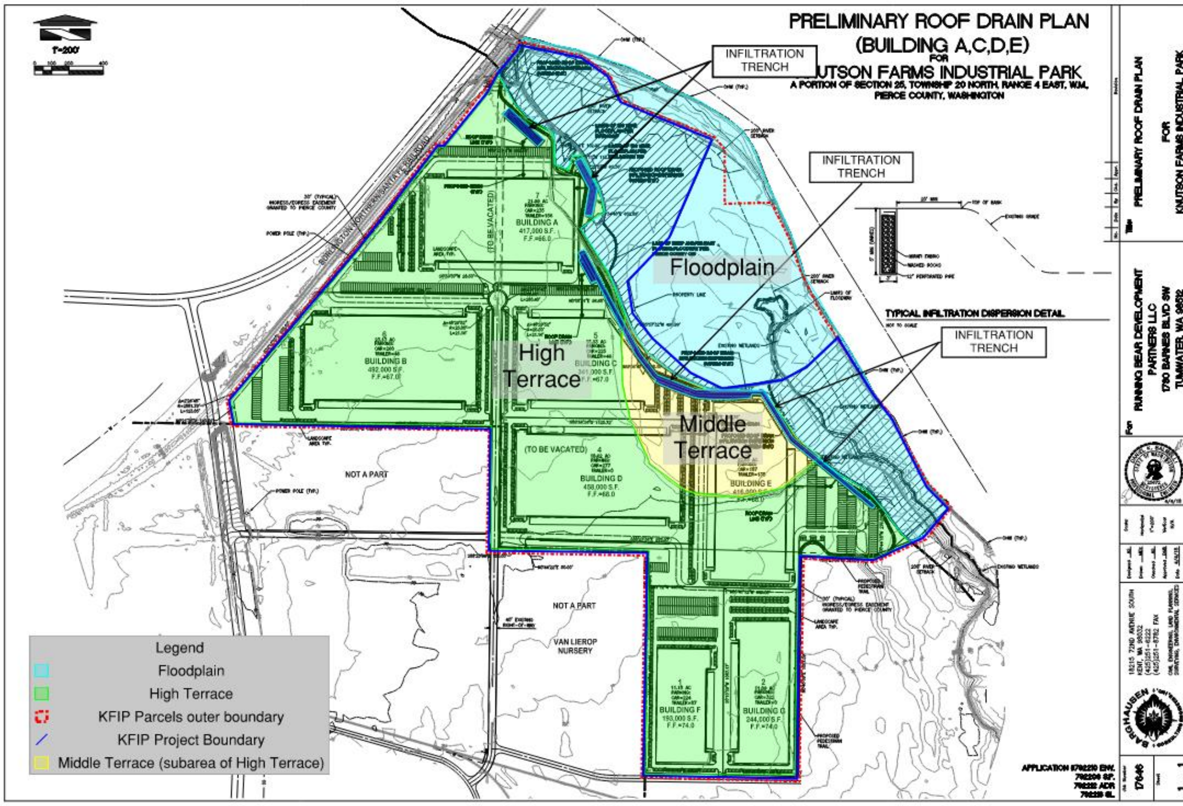

Figure 4-29. Adapted from Preliminary Roof Drain Plan, Showing Potential Infiltration Areas and Proposed Infiltration Trench Locations at the Outer Edge of the High Terrace.

The floodplain is not proposed for development, aside from the KFIP site stormwater outfall structure, which is discussed in more detail in Section 4.2 Plants and Animals, and Section 4.4 Surface Water. The southern end of the floodplain includes three wetlands (Wetlands A, B, and C). The hydrology that supports those wetlands is dependent on groundwater, which seeps from the outer edge of the high terrace and drains to collect on the lower elevation floodplain surface. The shallow groundwater aquifer below the high terrace is currently recharged through infiltration of seasonal rainfall that falls on the terrace surface. If the groundwater source is gone or diminished, the current floodplain wetland characteristics would not persist, and may disappear entirely.

Groundwater Depth Studies at KFIP Site

Earth Solutions NW, LLC (ESNW, KFIP consultant), documented depth to the groundwater table at the KFIP site in 37 soil pits dug to depths ranging between 7 and 15 feet across the site in July 2015 (late summer [i.e., when groundwater is expected to be deepest due to lack of recent infiltration]). Depth to groundwater documented in some of soil pits ranged between 6 and 13 feet below the surface, but 18 of the 37 soil pits (approximately 50 percent) were entirely dry in July 2015 and did not have a groundwater table within the soil pit depth limits. This work indicates that groundwater elevation is not controlled by river surface elevation, but instead indicates that groundwater on the site drains from the high terrace toward the river.

Past observations by City of Puyallup staff at the Viking warehouse site (located directly west of the KFIP Project site) indicated that the groundwater table during winter months at that site was within a few feet of the surface after development was complete. However, the Viking warehouse area is mapped as a Sultan silt loam, which is finer textured and less layered than the Briscot loam—the soil series that is mapped across most of the high terrace to the east. Reworking a silt loam soil when grading with heavy equipment often eliminates infiltration potential in the upper 2–3 feet of the final grade soil surface and would often result in a sealed surface in the base of an infiltration facility due to settling of fine silts and sand from suspended sediment in stormwater. Therefore, shallow groundwater and drainage conditions at the Viking site do not automatically apply to the adjacent KFIP site.

The groundwater mapping documented by ESNW reflects a pre-development condition. The post-development condition depends greatly on how the surface is graded and compacted. Infiltration trenches can still work if the base of the trench is sited in a more permeable layer below the zone of surface mixing and compaction.

The ESNW 2015 summer groundwater depth assessment can be taken to represent a lower or the lowest expected annual groundwater surface elevations at the KFIP site. Wet season assessment of ground water depth would provide a better understanding of ground water depth variability throughout the year.

Table 4-13 averages the ESNW reported July 2015 groundwater depths across each of the three potential infiltration surfaces on the KFIP site and converts average groundwater depth to average groundwater surface elevation, which makes it easier to compare results across the site as the ground surface elevation changes. Surface elevation on the high terrace ranged between 62–76 feet (68.6 feet average). Surface elevation on the middle terrace ranged from 56-64 ft (61 ft average). Elevation on the floodplain ranges from 50–56 feet (53.2 feet average). The OHWM elevation of the Puyallup River adjacent to the northern end of the KFIP site is defined as 38.5 feet, about 23 feet below the lowest high terrace surface elevation.

Table 4-13. Groundwater Depth at Infiltration Surface Areas on the KFIP Site

Infiltration Area	Average and Range of Groundwater Depth/Elevation (July 2015)	Approximate Average and Range of Surface Elevation	KFIP Development
High Terrace (26 soil pits)	10-foot average depth/58.6-foot average elevation (8- to 12-foot depth range in 10 pits; 16 dry pits)	68.6-foot average elevation (62- to 76-foot range)	Warehouses A, B, C, D, E, F, G
Middle Terrace (4 soil pits)	10.5-foot average depth/50.5-foot average elevation (9- to 12-foot depth range in 2 pits; 2 dry pits)	61-foot average elevation (56- to 64-foot range)	Parts of Warehouses C, D, E
Lower Floodplain (7 soil pits)	7.6-foot average depth/45.6-foot average elevation (6- to 9-foot depth range; no dry pits)	53.2-foot average elevation (50- to 56-foot range)	NA

Source: ESNW 2015 and 2021 Site Survey Topography Map
Note: NA = not applicable

The ESNW data indicates that depth to groundwater in the high and middle terraces is highly variable (3–4-plus-foot variation) but averaged around 10-foot depth below the surface during the July 2015 sampling period. On the floodplain, depth to groundwater during the same time period averaged around 7.5-foot depth (3-foot variation). These results indicate potential for effective on-site infiltration systems during winter months in some areas with deeper groundwater tables, which are an artifact of the layered alluvial soils. The varied groundwater elevations indicate that the groundwater layer is trapped in layered floodplain soil deposits that vary in thickness and depth. There is not a consistent one-elevation water table across the site, which indicates a need to utilize deep trench infiltration systems if the layered soils are to be fully utilized.

However, for best results with the proposed infiltration facilities, this information should be substantiated by winter water studies designed to document how the depth to the water table fluctuates across the site and across the winter season. For the best results, the winter monitoring would be carried out using water level dataloggers at individual proposed trench locations. At the least, the areas currently targeted for siting infiltration trenches, as shown in Figure 4-29, should be tested, both for infiltration potential and soil stability. The water table testing would serve to define areas where sandy soils along the edge of the high terrace may fail under additional hydraulic loading. Areas with fill soils in the middle terrace area would not provide for effective infiltration unless the trench base is sited in permeable native soils 2–3 feet below the base of the compacted fill zone.

On the lower floodplain, the groundwater table in July 2015 was documented at 6–9-foot depth below the surface. According to KFIP site plan topography maps, the floodplain slopes with the river from south to north. Surface elevation in the northern portion of the floodplain ranges from 50–56 feet, while the adjacent river surface elevation in July 2015 (a period of low river flows) was approximately 31–32 feet elevation (per USGS 12096505 Puyallup E. Main river gauge data). This shows that the river surface in July 2015 was about 20–26 feet lower than the floodplain surface during the July sampling period, while the groundwater depths in the floodplain ranged between 6–9 feet. Thus, groundwater tables in the floodplain during late summer are higher than the river. This provides support for the assumption that under current conditions, the groundwater table would provide discharge volumes to the river during late summer months. Late summer groundwater discharge volumes from the KFIP site would be reduced once the site is developed, as most winter surface water runoff from the high and middle terraces would be sent to the Puyallup River rather than infiltrated and stored in groundwater for late summer discharge to the floodplain and river.

ESNW monitored changes in groundwater depth over the winter of 2015–2016 in three of the 37 soil pits. The three monitored soil pits were all located on the floodplain, and thus do not document or directly address groundwater depth variations in the high or middle terraces below the future KFIP warehouse development area. However, based on the floodplain data, the average water table in the floodplain was reported as rising from about 9-foot late summer depth (as reported in July 2015) up to 5-foot winter depth. This limited sample does not represent conditions across the whole KFIP site, but suggests that under current conditions, groundwater tables on the high terrace are also likely to rise a few feet during winter months, as this condition is driven by infiltration of winter precipitation on both the high/middle terrace and the floodplain. This seasonal rise and fall of the groundwater table below the KFIP site may no longer occur once the site is fully developed and most stormwater from the high and middle terrace surfaces is rerouted to the piped outfall at the Puyallup River.

Under the current proposal, this change in groundwater hydrology at the KFIP site is expected to result in eventual loss of the floodplain wetlands (A, B, and C) and would also impact hydrology at Wetland D, a depressional wetland located in the southeastern corner of the high terrace that is dependent on both groundwater and surface water inflows.

Regional Groundwater Aquifer and Recharge Studies

Under current conditions at the KFIP site, seasonal rainfall infiltrates into the high and middle terraces to recharge groundwater, filtering through layered flood deposits on site. These surfaces, which are targeted for future paving and building, are either currently actively farmed and artificially drained or are areas that have been cleared and farmed in the past.

Welch et al. (2015) completed a large study of groundwater conditions and hydrologic drivers in the Puyallup River watershed, which included assessment and mapping of various surface and subsurface geology and related water bearing layers. They mapped the KFIP site surface as the AL1 aquifer—a water-bearing layer composed of an alluvial silt, sand, and gravel deposit. The AL1 is described as being generally less than 100 feet thick but increasing in thickness farther downstream. At the KFIP site, the AL1 layer is mapped as ranging between 5–45 feet thick (Figure 4-30).

Typical horizontal rates of groundwater flow in the AL1 aquifer were reported as being 350 feet per day. This estimated flow rate indicates that groundwater at the outside edge of the KFIP area would take 7–9 days to flow through the site to the Puyallup River, a relatively fast groundwater flow rate if all soil conditions are equal.

Below the AL1 surface alluvial deposits is the MFL confining unit—which is essentially an artifact of the Electron mudflow—a lahar that flowed down the Puyallup Valley about 500–600 years ago. This MFL layer protects water quality in deep aquifer groundwater wells with bases below the KFIP site, and will be discussed further below. Based on Ecology well logs (Ecology 2021a), the on-site water wells are assumed to be drawing from the aquifer below the MFL layer, and thus are assumed to be protected from surface conditions.

The Puyallup River Gauge (No. 12096505) is located at the East Main Avenue bridge, directly downstream from the northern end of the KFIP site. The discharge rates at this gauge station in comparison to the rates expressed at the Alderton River Gauge (No 12096500, the nearest gauge, located about 1.5 miles upstream) provide a direct assessment of the timing and volumes of groundwater contributions from the KFIP site to the Puyallup River and to reaches downstream from the KFIP Project site.

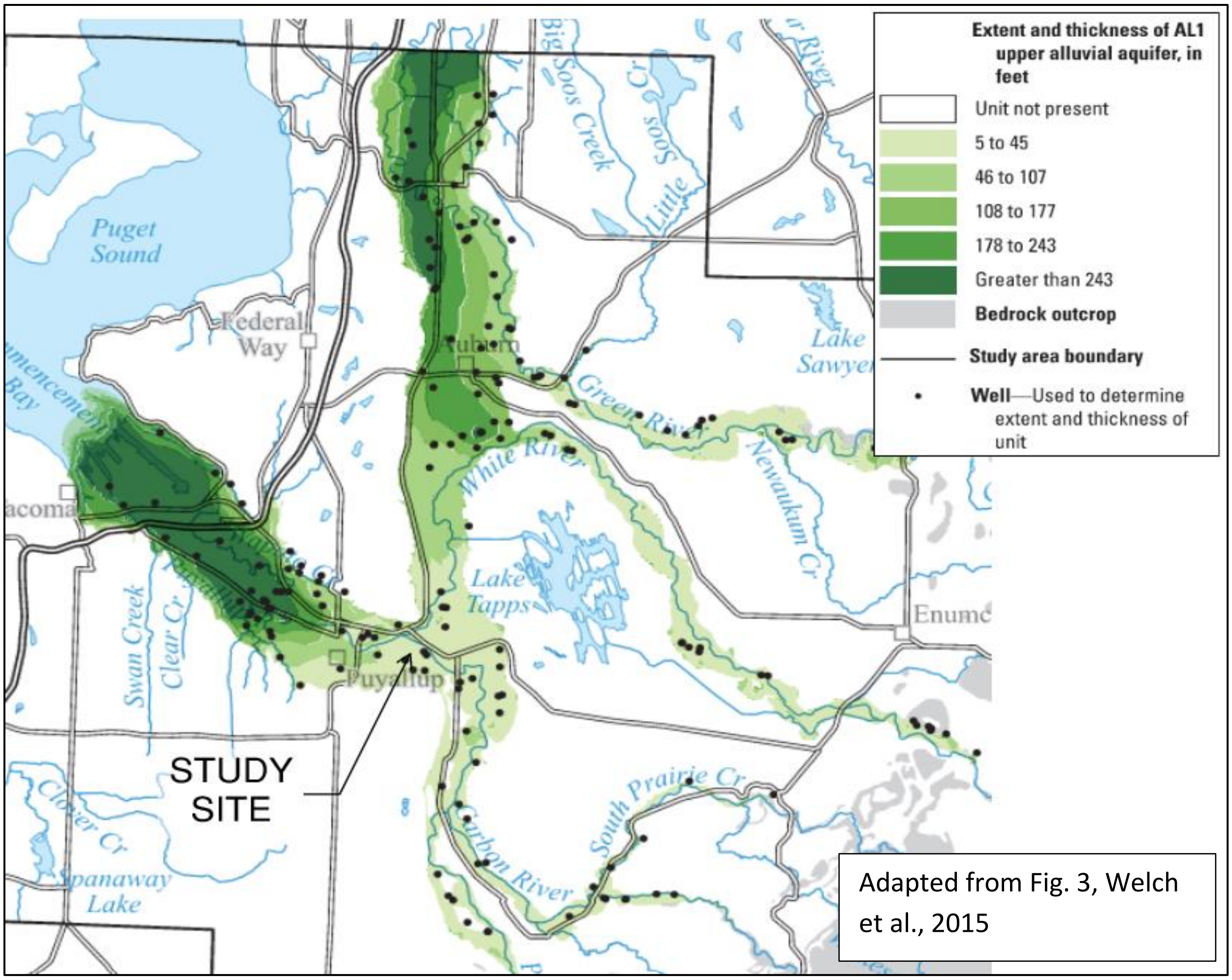

Figure 4-30. Mapping of the AL1 Aquifer Thickness at the KFIP Site

Welch et al. (2015, Table 5, page 41) river gauge data can be used to estimate potential groundwater discharge rates in the order of 1–2 ft^3/s from the KFIP site during the driest time of the year in late summer to early fall, based on the measured gain between the Alderton and E Main Avenue gauges in October 2011 and October 2012 (as reported in Welch et al. 2015). However, the reported measurement error at those two stations is about the same as the reported gain, indicating that this section could be either a gaining or losing reach from year to year.

This data indicates that groundwater discharge contributions from the KFIP site to the Puyallup River are small in comparison to total flows in the River, which are reported as ranging between about 500 ft^3/s and 600 ft^3/s at the E Main Bridge gauge during the same low flow period in October 2011. However, these contributions to floodplain wetland provide critical support.

In comparison to the rest of the year, October groundwater discharge rates (reported in Welch et al.) are expected to be very low. According to long-term climate data (NRCS AgACIS, Tacoma station), average monthly rainfall during the three wettest months of the year (November, December, January) is 6.15 inches. Average monthly rainfall in the three driest months of the year (July, August, September) is 0.96 inches. Thus, wet season rainfall is about 6.4 times higher than dry season rainfall. October discharge rates are a result of minimal preceding rain fall (and minimal groundwater recharge from infiltration) during the late, dry summer months.

According to the 2018 *Offsite Conveyance Report* for the KFIP site (Barghausen, 2018), the estimated future discharge rates for the 5yr to 100yr storms ranged between 39 ft^3/s and 73 ft^3/s respectively. Compared to the 1 to 2 ft^3/s late summer groundwater discharge rates to the River estimated from the data provided in Welch, 2015, the KFIP estimated future surface discharge rates during winter months would be 26 to 49 times higher, and those flows would be concentrated through one outfall to the Puyallup River at the north end of the site, rather than spread and infiltrated across the high terrace and floodplain as occurs under current conditions. This represents a significant change to groundwater functions and timing across the seasons.

Stormwater System Design Revisions in Response to Appeals

In May 2017, the City of Puyallup and the Puyallup Indian Tribe appealed the County's Preliminary Short Plat approval for the KFIP Project site. The Tribe was concerned about potential impacts to the river and salmonids from new stormwater inflows. They were also concerned about changes to groundwater recharge resulting in water quality problems in the River. In July 2018 (County records Case # 863309, documented in November 21, 2018 Hearing Examiner Report and Decision [HEX November 2018] and associated documents), the Puyallup Indian Tribe withdrew their appeal with prejudice in exchange for KFIP complying with certain commitments regarding infiltration of stormwater at the KFIP site—including required infiltration and/or enhanced treatment of runoff from four warehouse roofs, and including a requirement that KFIP show that the stormwater system does not adversely affect Wetlands A, B, and C.

This appeal and subsequent agreement precipitated a change to the original KFIP stormwater system design, which previously had proposed to outfall 100 percent of the on-site runoff to the river. The new plan involved diverting runoff from four warehouse roofs to infiltration trenches to be located at top of slope along the eastern side of the high terrace. According to testimony recorded in the HEX November 2018 decision, the KFIP civil engineer (Dan Balmelli, Barghausen Engineering) stated that even though the stormwater manual does not require infiltration of stormwater on the site, preliminary geotechnical work indicates that some on-site soils have the capacity to infiltrate stormwater.

According to the KFIP *Offsite Conveyance Report*, total KFIP impervious area (buildings plus new pavement) is 106.87 acres (81.5 percent of net developable site area, 131.04 acres). Most of the remaining pervious surface area is in the floodplain. The report provides estimated surface discharge flow rates (not volumes) from the post-development Knutson property for the 5- to 100-year storms. The estimated discharge rates from the *Offsite Conveyance Report* include modeled runoff from the paved areas and three of the seven warehouse roofs, about 65 percent (69.5 acres) of the 106.87 acres total impervious surface area. Runoff collected from the other four warehouse roofs (Bldgs. A, C, D and E—about 35 percent [37.4 acres] of the total impervious surface area) is described in the report as being "dispersed to the floodplain." However, according to the agreement between the Puyallup Indian Tribe and KFIP, depending on results of slope stability and infiltration testing studies, although encouraged to infiltrate as much as possible, KFIP is only required to infiltrate "*50% of the two year storm event*" or to provide enhanced treatment prior to discharge into the River through the existing outfall.

However, there is no description of or definition for "*50% of the two year storm event*" in the current PCSWDM. Past manuals referenced a 6-month, 24-hour storm event (i.e., a 24-hour storm volume expected to fall at least two times every year). However, this is an outdated term, and has been replaced in the current PCSWDM manual by a requirement that 91 percent of the runoff volume as estimated by the WWHM continuous runoff model (which approximately equates to the 6-month, 24-hour storm event), must receive some form of 'basic' treatment prior to release to the Puyallup River. It is possible, but unclear, that the current manual minimum treatment standard in the PCSWDM is the intended minimum infiltration/treatment requirement per the agreement between KFIP and the Puyallup Tribe.

Per the agreement, if infiltration was found to be less than feasible, then runoff volumes from the four roofs could be released to the outfall, and estimated surface discharge rates during the 5- to 100-year storm events would increase by an additional 35 percent, i.e., or would be about 53 to 66 times greater than the pre-development groundwater discharge rates described in Welch et al. (2015). Under any scenario, these high future discharge rates indicate that the outfall would be receiving larger flows than what it is currently designed to receive.

In the absence of infiltration testing data, slope stability analysis results or wetland hydroperiod testing results, it is not possible to determine whether this infiltration proposal would provide adequate hydrology volumes needed by on-site wetlands. Therefore, under current conditions, the Project would likely result in a significant change to future on-site groundwater functions and conditions relative to current discharge timing, duration and rates in the Puyallup River and floodplain.

Groundwater Contamination

No instances of groundwater contamination at the KFIP site are currently listed in state databases in the study area vicinity (Ecology 2021). No contamination was reported during geotechnical investigations on the KFIP site (ESNW 2015).

Critical Aquifer Recharge Areas, Wellhead Protection Areas, and Water Wells

Aquifer recharge and wellhead protection areas are areas that have a critical recharging effect on groundwater used for potable water supplies and/or that demonstrate a high level of susceptibility or vulnerability to groundwater contamination from land use activities (Pierce County 2021). The KFIP site is within a CARA and wellhead protection area for the Central Pierce County Aquifer (Pierce County mapping, last referenced in 2023).

> A **confining layer** is material that stops any flow from passing through.

Washington state well log records for drinking water wells show that there are at least three deep water wells located on or near the KFIP site; and at least one of those is within the KFIP site boundaries (Ecology 2021b). The well logs show that all three wells are accessing a deep, artesian-pressure aquifer below a confining layer, which is assumed to protect the wells from surface impacts. These wells are used as both drinking water and as irrigation sources. Groundwater impacts at the KFIP site to the near-surface aquifer are not expected to impact local drinking water wells which access water in an aquifer below the confining layer.

KFIP Site Stormwater Management

The current stormwater management plan proposes to collect roof runoff from four of the seven warehouse roofs (Warehouses A, C, D and E) for infiltration to groundwater. The rest of the site runoff—from parking lots, road and the other three of the seven warehouse roofs (Warehouses B, F and G)—would be diverted to a piped outfall at the Puyallup River bank after receiving basic treatment.

Roof runoff is considered comparatively clean, and thus is not required to be pre-treated prior to infiltration. However, enhanced treatment of any roof runoff volumes that might be sent to the stormwater outfall is proposed (per a 2018 agreement with the Puyallup Tribe). The runoff volumes from the four warehouse roofs would be sent to infiltration trenches that are currently proposed for construction at the outer edge of the high terrace slope above the floodplain, east of the four warehouses.

As described previously, the infiltration trenches are intended to provide hydrology to the floodplain wetlands. But under the current design, most of the trenches are not located upslope from the wetlands, and thus would not provide groundwater hydrology at the right location to support wetland conditions. Furthermore, the proposed top of slope location is designated as a landslide hazard area. Therefore, the proposed siting of installation of trenches in that area may not be feasible as designed, and further studies would be needed to ensure that the top of slope position is stable, and that the hydrology would reach its intended targets—Wetlands A, B and C. A hydroperiod analysis for each wetland is needed to define the water volumes, timing and duration required to ensure that the wetlands persist with similar functions and values after development is complete.

Per the PCSWDM: "*Infiltration trenches should not be built on slopes steeper than 25% (4:1). A geotechnical analysis and report may be required on slopes over 15 percent or if located within 200 feet of the top of slope steeper than 40%, or in a landslide hazard area.*" In addition, a mounding analysis and infiltration testing is required for infiltration facilities to show that the trenches would infiltrate at the design rate.

The proposed infiltration/dispersion trenches do not appear to meet Critical Area regulations (Title 18E DEVELOPMENT REGULATIONS – CRITICAL AREAS) or PCSWDM assessment, design, and siting requirements. The required infiltration testing, wet weather groundwater study and mounding analysis is not known to have yet been carried out; nor have the steep, sandy slopes to the east been assessed by a geotechnical engineer to determine whether they have potential to fail under hydraulic loading from infiltration trenches.

In addition, trench design is required to address dispersion function, which is needed to describe how potential overflow from the infiltration trenches during periods of above average rainfall would be managed to avoid erosion problems on the slope below. For dispersion, the Stormwater Manual requires design of "*a vegetated flow path of at least 25 feet in length…between the outlet of the trench* *and any property line, structure, stream, wetland, or impervious surface. A vegetated flow path of at least 50 feet in length must be maintained between the outlet of the trench and any slope steeper than 15%. Sensitive area buffers may count towards flow path lengths*."

Because the trenches are sited at the top of slope, potential for erosion during overflow events is high, but there is no apparent dispersion design feature addressing this erosion control requirement.

4.3.4 Impacts

Methodology

This analysis evaluates potential for construction and operations at the KFIP site to impact plant and animal resources. Impacts were characterized by reviewing public reports and public database records on groundwater and hydrogeology in the study area and comparing existing study area conditions to the proposed KFIP actions, and by assessing potential for changes to critical groundwater functions. The potential for the KFIP to result in construction or long-term operational effects was assessed based on the location and volume of proposed infiltration facilities, dewatering systems and related soil processes and regulated geologic hazards that could affect slope stability and erosion. The potential for KFIP impacts to alter or damage the site groundwater system was determined based on the KFIP's design of infiltration facilities and existing geologic and soil conditions that would influence the relative risk. Potential impacts related to groundwater recharge of on-site wetlands and the Puyallup River are discussed in qualitative terms.

The following public records and literature were reviewed (and others):

- USGS National Water Information System, USGS gages in the Puyallup River near Puyallup, WA – parameters Discharge, Gage height and Flood Stage,
- NRCS Long-Term Climate data, AgACIS for Pierce County – WETS Station: TACOMA NO. 1, WA: 1971–2023
- Pierce County Office of the Hearing Examiner, July 11, 2018, The Puyallup Tribe of Indians v. Director, Pierce Co. Public Works and Knutsen Farms, Inc., Running Bear development Partners LLC, and Barghausen Consulting Engineers, Inc. Joint Stipulated Motion to Dismiss the Puyallup Tribe's Appeal (case no. 863309)
- Puyallup River Watershed Assessment (PRWC 2014)
- Climate Change Impact Assessment and Adaptation Options (Puyallup Tribe 2016)

The following technical reports were reviewed (and others):

- Biological Evaluation – Van Lierop Property Stormwater Outfall Project, Talasea Consultants, Inc. (2017)
- Detailed Mitigation Plan (TDMP 2018), Puyallup River Outfall, Talasea Consultants Inc., March 2018
- Critical Areas Assessment Report – Knutson Farms Industrial Park. Soundview Consultants (September 2016, Revised December 2016)
- Revised Knutson Industrial Transportation Impact Analysis, TENW Transportation and Engineering Northwest for Michelson Commercial Realty and Development, LLC (2017)

- Barghausen Engineering Project site survey map, stamped 03/23/2021
- Barghausen Engineering Conceptual Grading and Storm Drainage Plan, stamped 03/26/2021
- Barghausen Engineering *Offsite Conveyance Analysis Report*, prepared for Michelson Puyallup Partners, LLC, April 2, 2018
- Barghausen Engineering *Offsite Conveyance Analysis Report* for Van Lierop property, prepared for Running Bear Development Partners, March 1, 2018, revised June 14, 2018
- Welch, W.B., Johnson, K.H., Savoca, M.E., Lane, R.C., Fasser, E.T., Gendaszek, A.S., Marshall, C., Clothier, B.G., and Knoedler, E.N., 2015, Hydrogeologic framework, groundwater movement, and water budget in the Puyallup River Watershed and vicinity, Pierce and King Counties, Washington: U.S. Geological Survey Scientific Investigations Report 2015–5068, 54 p., 4 pls. (http://dx.doi.org/10.3133/sir20155068)
- WCI (West Consultants Inc.) August 17, 2021. Knutsen Farm Scour Analysis model of the Puyallup River near the BNSF Trestle Bridge, prepared for Viking LLC and Running Bear development Partners, LLC

A significant impact from construction and/or operations would occur if there was:

- Reduction or loss of wetland groundwater hydrology sources that would result in loss of on-site wetlands systems over time;
- Conversion of groundwater systems to surface water systems, resulting in impacts to the Puyallup River from significant increases in direct flow discharges and loss of late summer river recharge from groundwater systems;
- Noncompliance with critical areas regulations and stormwater regulations intended to protect and preserve wetland systems and their buffers; or
- If these impacts cannot be mitigated through compliance with critical areas ordinances or implementation of BMPs.

Impacts Analysis

No Action Alternative

Under the No Action Alternative, the construction of the KFIP would not occur. No KFIP-related impacts to groundwater resources would result.

Agriculture could continue on site, and groundwater would continue to be recharged by direct infiltration from farmed surfaces. Groundwater recharge through the upland terrace surfaces would continue to provide the same recharge volumes during similar time periods that currently support the existing floodplain wetlands to the east. There would be no significant excavation, grading, or clearing on site beyond what is normal and allowed for agricultural operations.

No documentation of a Farm Management Plan for the current agricultural operation was located, and therefore, cannot document the degree to which the current operation applies BMPs in relation to use of pesticides, herbicides, fertilizers, or other standard agricultural chemicals. Groundwater quality could be impacted by mismanagement of farm practices, but there is no known exceedance or documented pollution on the KFIP site related to agriculture.

If KFIP does not abandon the wells (as is planned), the two existing water wells would be retained and be utilized similar to existing conditions as either drinking water or irrigation wells. According to the Ecology Water Rights search tool, there is no water right for withdrawal from the Puyallup River at the KFIP site.

Pierce County has designated the KFIP site with an Urban Zone Classification of Employment Center (EC) (a "*concentration of low to high intensity office parks, manufacturing, other industrial*")(PCC 18A.10.080) and thus it is possible that other future development within the constraints of this zoning would occur, and agriculture would no longer be the primary land use.

Proposed Action

Construction Impacts

Groundwater Infiltration and Wetland Recharge Potential

The current proposal is likely to result in significant impacts to on-site wetlands, and most of those impacts would be initiated during construction phases. However, there is overlap in the schedule between construction and operations phases at this site.

The Applicant's has indicated that they plan to complete construction over a period of 4 years, with construction starting at the north end of the site (warehouses A to E), followed by construction of Warehouses F and G. Construction of each warehouse would take 15–18 months, with construction of some warehouses occurring simultaneously to meet the overall 4 year construction schedule. Up to 150 employees would be expected on site at any one time during construction.

Construction of each warehouse would occur in three stages:

1. Grading and filling
2. Installation of on-site utilities
3. Warehouse construction

Heavy construction equipment would compact the soil surface and reduce surface infiltration potential both during and after construction phases. According to current site plans, construction of the KFIP Project would require excavation (cut and fill) of up to 450,000 CY of soil. According to KFIP site groundwater studies (ESNW 2015 and 2018), depth to the groundwater table for the KFIP site ranges between 6–13 feet in summer, and based on limited winter groundwater monitoring in the floodplain, is expected to be about 3 feet higher (i.e., closer to the surface) during winter. Therefore, construction excavation activities that extend 6 feet or more below existing grades—such as may occur when building the proposed infiltration trenches or installing stormwater conveyance pipes—might result in groundwater contact and a need for control and diversion of groundwater. Excavation and dewatering during construction would change or interfere with the flow patterns of shallow groundwater and would cause localized drawdown of groundwater levels. When building the proposed infiltration trenches, this may also result in hydraulic or erosion impacts to steep slope areas.

Therefore, the two primary impacts caused by changes to groundwater functions during construction phases would be:

- Potential slope stability impacts along the top of slope or eastern slope face of the high terrace, and
- Changes to the timing and total volumes of groundwater recharge to the Puyallup River and to on-site wetlands in the eastern floodplain (Wetlands A, B, and C) and in the southeastern high terrace (Wetland D).

Impacts caused by changes in groundwater flow timing and flow volumes would continue during operations after construction, as described in more detail in the following section.

There has been no detailed infiltration testing or hydrogeological assessment of the targeted top of slope infiltration areas. These top of slope areas are mapped as landslide hazard areas, and thus, the currently proposed infiltration sites are prohibited by PCC, unless the slope stability impacts of such systems have been analyzed and mitigated by a geotechnical professional and appropriate analysis indicates that the impacts are "negligible" (PCC 18E.80.040.B.7). Furthermore, most of the proposed trenches are sited north and hydrologically downstream of the target wetlands, and thus may not provide adequate hydrology at the right location to ensure that the wetlands persist. Finally, some of the proposed top of slope areas would be comprised of partially compacted fill adjacent to Warehouses C, D, and E, and thus may not be suitable for infiltration.

A detailed hydrogeologic assessment of infiltration trench hydraulic loading effect on slope stability coupled with monitoring the floodplain wetlands' hydroperiod (hydrology volumes and timing) over at least one water year would be needed to answer these questions and/or to indicate a more suitable location and design for infiltration facilities. This work should be carried out before construction starts, to allow time for redesign and to avoid failures.

The KFIP site is currently estimated to provide 1 to 2 ft^3/s late summer groundwater discharge rates to the Puyallup River at the northern end of the KFIP site (Welch et al. 2015). Lacking any better information about groundwater volumes contributed to the floodplain, these groundwater discharge volume estimates might be used to very roughly estimate the minimum discharge needed to support hydrology in the on-site floodplain wetlands to the east during and after construction. However, a more standard and technically correct approach is needed to document the wetland hydroperiods over the course of at least one water year, in order to more precisely determine the hydrology volumes, timing and durations needed to maintain existing wetland conditions. Any reduction in groundwater inputs to the on-site wetlands during or after construction could have significant long-term impacts to on-site wetlands functions and values, with potential for entire loss of the wetland areas.

Once appropriate information is gathered to allow for proper design, siting, and construction of the infiltration trenches or other appropriate wetland hydrology support systems, the timing of construction may significantly adversely impact continuity of wetland hydrology. The trenches are currently intended to infiltrate roof runoff from Warehouses A, C, D, and E. However, unless some other accommodation is provided, the trenches would receive no roof runoff until the warehouse construction is complete. The timing of warehouse construction and associated infiltration facility construction is unknown but is considered likely to take at least 1 year or longer. However, wetland hydroperiods must be maintained with no break throughout construction, to ensure that the wetlands are maintained and protected as required by law.

Adjusting the schedule to prioritize construction of effective infiltration facilities and providing temporary diversion of other site water as needed to support on-site wetland hydrology during construction phases could reduce potential for loss of wetlands. These impacts could be moderated if properly addressed through construction scheduling and proper infiltration facility siting, testing and design. But the current proposed stormwater management plan does not provide that assurance.

Groundwater Contamination

Construction of the KFIP site would require the use of heavy equipment and dewatering, both of which could cause contamination of groundwater. Oil, fuel, and other chemicals could inadvertently spill or leak from construction equipment, leading to contamination of groundwater through seepage. Uncontrolled spills are unlikely because required SPCC Plans and local and state permit requirements would presumably be implemented and followed.

Construction stormwater also has the potential to transport contaminants into local groundwater. Construction Stormwater Permit conditions are designed to would minimize runoff and the introduction of pollutants into the stormwater. Construction stormwater would be managed by establishing the limits of construction and temporary erosion and sediment control measures.

Potentially contaminated materials during site excavation and grading could be encountered. Contaminated materials would be managed in accordance with the relevant regulations, including the NPDES Construction Stormwater General Permit.

Critical Aquifer Recharge Areas, Wellhead Protection Areas, and Water Wells

The lower Puyallup River does not currently experience low summer flow rates, primarily because it is supported by glacier and snowmelt inputs at Mount Rainier (Welch et al. 2015). That said, the current glacier surface area is about 40 percent of its original area (measured in 1896), and recent climate trends indicate more rapid melting rates (Beason et al. 2022). As long as the glacier persists, the minor decrease in groundwater discharge to the Puyallup River would be expected to have an undetectable impact on the overall flow of the river.

Ecology well records indicate that drinking water wells in and near the study area access deeper aquifers that are protected from surface impacts by a confining layer. KFIP has indicated that they will abandon any on-site wells, but the timing of well abandonment is unknown. During construction, the KFIP would not use any on-site water wells for water supply. No impacts on drinking water wells are expected.

Operations Impacts

Potential operational impacts to groundwater include the following:

- Permanent subsurface modifications related to drainage systems, which may reduce or eliminate groundwater sources that support the on-site floodplain wetlands

- Stormwater management design that redirects most surface runoff to the river rather than infiltrating, which would reduce historic infiltration volumes and timing of seeps to wetlands from the high terrace, and which may eliminate on-site floodplain and high terrace wetlands
- Oil leaks and spills in the warehouse complex over time, which may contaminate shallow groundwater if not managed properly

Groundwater Infiltration and Wetland Recharge Potential

The KFIP Project would significantly increase current impervious surface on site from a current estimated condition of less than 5 percent (mostly farmland with some compacted farm roads) to more than 75 percent once all warehouses, roads and parking areas are constructed. The remaining 25 percent permeable surface is in the floodplain, which is undeveloped aside from the stormwater outfall structure at the edge of the river in northern corner of the Project site but would continue to be farmed for an undefined time period. Under the Proposed Alternative, according to the KFIP traffic impact study, the maximum net vehicle trips is predicted to be 8,724 per day.

PCC 18E.50.040-A, Table 18E.50.040 Aquifer Recharge Area indicates that areas such as the KFIP site that are zoned as EC are allowed a maximum impervious surface coverage of 60 percent. Personal communication from Pierce County planning staff (2021) notes that these limits can be exceeded with proper engineering, but no details were provided about what type of engineering is required to assess or exceed that limit.

The current proposal is to infiltrate relatively clean roof runoff from Warehouses A, C, D, and E in trenches located at the top of the high terrace slope along the eastern side of the warehouse complex. The rest of the site, including all paved surfaces, any groundwater collected from the subsurface piped system, and the remaining warehouse roofs would be sent to the already constructed piped surface outfall structure on the floodplain at the edge of the Puyallup River.

This method of stormwater management would lead to faster runoff to the river, and a reduction in stored groundwater volumes below the high terrace on the KFIP site, which currently slowly flows to the floodplain and river over time. Based on data presented in Welch et al. (2015), the impact of permanent changes to timing and volumes of recharge sent to the Puyallup River would be minor relative to total flow volumes in the Puyallup River. However, without design changes to the currently proposed method and location of infiltration facilities (discussed above), on-site wetland hydrology would not be maintained, and the on-site wetland hydroperiods would change over time, eventually resulting in loss or reduction in surface area of on-site floodplain Wetlands A, B, and C on the eastern floodplain, and Wetland D on the high terrace.

As mentioned above, the currently proposed location and design of the infiltration trenches may not meet setback and safety requirements of Pierce County Landslide Hazard Area regulations and may not function as required to maintain the wetland hydroperiods. The trenches are sited at top of slope in a landslide hazard area, and so far, no infiltration testing or geotechnical assessment has been carried out to determine whether the sandy soils on the steep slope below the trenches would fail under hydrologic loading, or whether the trenches would provide adequate hydrology volumes at times and durations needed to maintain the current wetland hydroperiods. In addition, most of the trenches are not sited upslope from the target wetlands, but rather are located north and hydrologically downstream from the wetlands, so would not provide hydrology at the correct location.

The on-site wetland hydroperiods have not been studied or documented, and therefore, the minimum flow volumes and timing of flows needed to support current functions and values are unknown, making it impossible to determine whether or not the proposed infiltration facilities would perform as intended. Neither are there any known available plans for post installation monitoring, as would typically be required to determine whether the wetland hydroperiods change over time during long-term operations. Long-term monitoring is typically required when maintaining or supporting wetland hydrology is required under a project mitigation permit.

Under the current proposal, which would result in changes to groundwater volumes and timing of groundwater flows to the floodplain, the on-site wetlands are unlikely to persist in the future—a significant impact.

Groundwater Contamination

On-site delivery vehicles and equipment could generate substances that might contaminate groundwater through unmitigated impervious surface runoff. The KFIP does not propose to infiltrate untreated stormwater generated at the impervious paved surfaces, and therefore, no groundwater contamination would be expected from untreated infiltrated stormwater. Under the current proposal, no potentially polluted surface stormwater or septic effluent would be infiltrated to the ground, therefore, no impacts to groundwater quality during operation of the KFIP are anticipated.

PCC 18E.50.040 (Aquifer Recharge and Wellhead Protection Area Standards) describes general rules that prohibit certain kind of development (uses) that may cause hazardous substances to be released on site or to groundwater, such as certain businesses that might want to occupy KFIP warehouse space in the future. Typically, these activities and use limitations are addressed during future site occupancy permitting phases and through use of site-specific mitigation standards. It is assumed that the restrictions on certain uses will be applied, as required by law, and will be incorporated into future occupancy permit conditions.

Critical Aquifer Recharge Areas, Wellhead Protection Areas, and Water Wells

Similar to the discussion above during construction phases, the lower Puyallup River does not currently experience low summer flow rates, primarily because it is supported by glacier and snowmelt inputs at Mount Rainier (Welch et al. 2015). As long as the glaciers persist, the minor decrease in groundwater discharge to the Puyallup River as a result of redirection of surface water to the river rather than infiltration in upland areas would be expected to have an undetectable impact on the overall flow volumes in the river throughout the year.

The KFIP Project has indicated that they will abandon the on-site wells and will be served by municipal water during future operation phases. The wells must be decommissioned consistent with the requirements of Ecology. The KFIP site would, therefore, not be drawing water from the deep aquifer and this would result in no impact (or possibly a beneficial impact) to the volume of water available within the deeper aquifer for other uses.

Ecology well records indicate that drinking water wells in the study area access deeper aquifers that are protected from surface impacts by a confining layer. During operations, the KFIP site would not use any water wells for water supply. No impacts on drinking water wells are expected.

Alternative 1 – Rail Transport

Construction Impacts

Construction of Alternative 1 would result in similar construction impacts as the Proposed Action. Except for a small area between the KFIP site and the Meeker Southern railroad as well as construction of the track extensions from the BNSF mainline/Meeker Southern interchange, most of the ground disturbance for the construction of the rail line would occur within the same construction footprint as the Proposed Action; therefore, the impacts would be similar to those described for construction of the Proposed Action.

Operations Impacts

The operations impacts associated with Alternative 1 would be the same as those described for the Proposed Action. There might be a slight difference in total impervious surface, but it is assumed that the general approach to stormwater management and the risks would remain the same.

Alternative 2 – Reduced Intensity Alternative

Under WAC 197-11-440(4)(5), an EIS is directed to analyze reasonable alternatives, which "*shall include actions that could feasibly attain or approximate a proposal's objectives, but at a lower environmental cost or decreased level of environmental degradation*."

As such, Alternative 2 considers the potential impacts that would result if the mitigation measures that reduce the site footprint of the facility, as outlined in Section 3 Project Description, were adopted by the Applicant (Figure 4-31). Under Alterative 2, the total footprint of the facility would be reduced from about 2.6 million SF to about 1.7 million SF (about 35 percent footprint reduction). The following mitigation measures to reduce intensity would be applied:

- All warehouses would include a minimum 15-foot-wide landscape bed to be provided along the entire length of blank wall facades of buildings.
- Warehouses would not be constructed on lands designated Rural Buffer Residential (RBR) in the CPCP. The RBR designation reflects development restrictions associated with the shoreline buffer constraint area, the riparian buffer adjacent to the Puyallup River, and the erosion hazard area. This would eliminate Warehouse C and would reduce the footprint of Warehouses A and E.
- Warehouse F would be reduced in size to avoid blocking the prime view corridor from Van Lierop Park.
- Warehouse G would be reduced to avoid fill impacts to on-site portions of Wetland D and its on-site buffer, in accordance with Pierce County Code 18E.40.050.

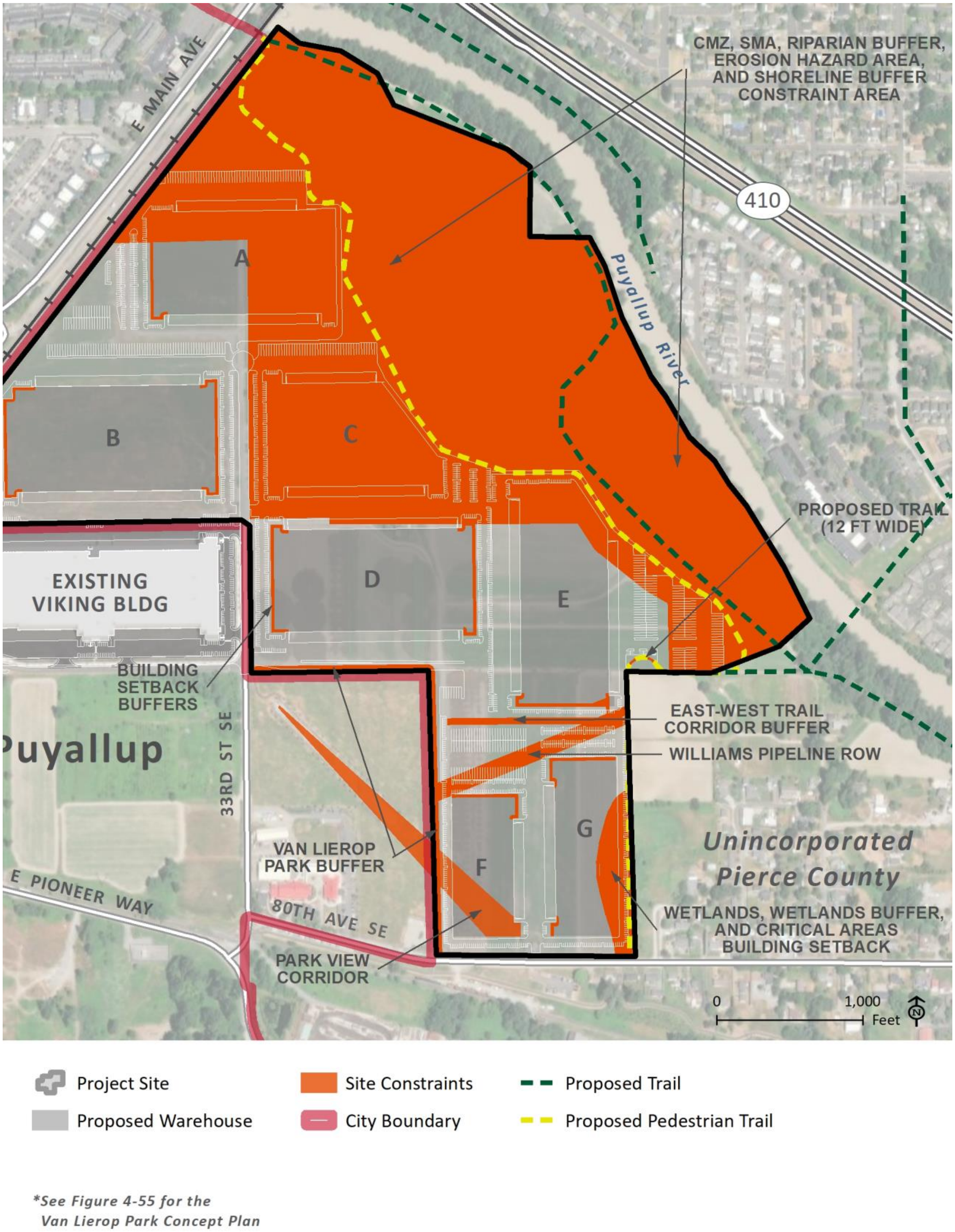

Figure 4-31. Alternative 2 – Reduced Intensity Alternative

Construction Impacts

Construction of Alternative 2 would result in similar, but slightly reduced impacts during construction as compared to the Proposed Action. During construction phases, Alternative 2 would result in fewer construction vehicle trips due to the reduced Project size and footprint of the facility. During grading and filling phases, up to 1,270 total construction vehicle trips (or up to 215 trips per day) would be expected. During utilities installation work, up to 100 total construction vehicle trips (or up to 4 trips per day) would be expected. During warehouse construction (which includes building and paving roads and parking areas), up to 1,560 construction vehicle trips (or up to 40 trips per day) would be expected.

Due to Alternative 2's reduced footprint, temporary and permanent impacts analogous to what was described above for the Proposed Action would occur, but at a smaller scale and farther from some of the environmentally sensitive areas on site. Fill impacts at Wetland D and its on-site buffer would not occur, and potential landslide hazard areas near the top of slope at the eastern edge of the high terrace would not be developed.

However, Alternative 2 does not change the current proposal to redirect most site runoff to the Puyallup River, therefore, it does not address the need to protect and maintain current groundwater-fed hydrology sources for the on-site wetlands. Neither does it propose revegetation of the undeveloped surfaces between the terrace edge and the warehouse zone, without which would be expected to revegetate naturally with a weed-dominated vegetation community.

Mitigation actions that may be applied to reduce impacts to groundwater during Construction phases are described in Mitigation Measures (Section 4.3.5).

Mitigations actions for other impacts associated with a smaller construction footprint were identified and described in other sections of this EIS (Section 4.1 Earth Resources, mitigation measures ER-1 through ER-10; Section 4.5 Land Use, mitigation measures LU-2 through LU-4; Section 4.6 Recreation, mitigation measures REC-2 through REC-3; Section 4.7 Aesthetics, mitigation measure AES-1; Section 4.10 Health and Safety, mitigation measures HS-1 through HS-5; and Section 4.13 Noise, mitigation measures N-1 and N-2).

Operations Impacts

The Operations impacts associated with Alternative 2 would be similar but slightly reduced compared to those described for the Proposed Action, due to the smaller Project area footprint. The number of daily vehicle trips generated by the KFIP warehouse complex under Operational phases for Alternative 2 would be reduced by about 21 percent, and the overall impervious surface cover on the high terrace would be decreased by about 33 percent, as compared to the Proposed Action.

Under the Proposed Action, there would be a maximum of 8,724 daily net vehicle trips (KFIP Traffic Impact Analysis). In comparison, Alternative 2 would generate 998 daily heavy-duty vehicle trips and 4,846 passenger car/light-duty truck (i.e., delivery van) trips, a total of 5,844 trips per day. Alternative 2 would also require up to 1,000 employees/day during operations (i.e., 1000 trips/day from commuting employees). In sum, Alternative 2 would result in a daily traffic volume decrease of about 21 percent.

As a result of the Alternative 2 reduced impacts approach, there would be a reduction in total impervious surface and a decrease in the number of daily traffic trips, but the general approach to stormwater management would remain the same, and the impacts to wetland groundwater hydrology sources remain the same. Thus, under Alternative 2, wetlands are still expected to become smaller or disappear entirely due to a decrease in infiltration on the high terrace and associated reduction in groundwater hydrology volumes. This is considered a significant impact. Mitigation actions that may be applied to reduce these impacts to groundwater during long-term Operational phases are described in Mitigation Measures (Section 4.3.5).

4.3.5 Mitigation Measures

This section summarizes KFIP impacts and the mitigation measures that could be implemented to avoid or minimize impacts of the currently proposed KFIP Project, both during Construction Phases and during full Operational Phases after construction is complete. Prior to initiation of construction, the proponent is expected to obtain the necessary federal, state, and local permits and to prepare the appropriate plans that are required to protect groundwater functions, including but not limited to a NPDES Construction Stormwater General permit, Dewatering Permit, Grading Permit, and a SPCC Plan. In areas where it is proposed to direct some on-site runoff to infiltration facilities, the proponent is expected to carry out infiltration tests and to obtain the necessary permits that are required to verify infiltration function, to monitor and document wetland hydroperiods, and to protect groundwater during infiltration testing.

Plans and reports resulting from monitoring work are expected to show concurrence with the PCSWDM, with relevant Pierce County Development Permit approvals, and to comply with other federal and state permit conditions of approval.

Construction and Operational Impacts

Impacts during Construction Phases would be from initial clearing, grading, and filling; installation of utilities (trenching and installation or conduit and pipe); stormwater runoff; and work associated with construction and paving of parking lots, roads, and warehouses.

Impacts during Operational Phases would primarily result from methods used to manage stormwater runoff, and from traffic—both on and off site. Operational impacts specific to the not yet defined businesses that would operate out of the warehouses are not addressed in this Draft EIS.

Impacts most likely to result in significant changes to long-term groundwater functions at the KFIP site would occur during construction phases, when the currently permeable surface is slowly paved or covered with warehouses over time. The seven warehouse complex is proposed to be constructed over a period of four years. Therefore, some warehouses could be operating while others are still under construction.

Depending on construction timing, sequencing, and relative success of infiltration design (as required to support wetland hydrology functions), impacts to groundwater systems are likely to continue through early operational phases, as the surface transitions from being mostly permeable (farmland) to being mostly impermeable (pavement or buildings). Once construction is complete, the primary impacts to groundwater during full operational phases would be from stormwater infiltration facilities, as required to support on-site wetland hydrology systems. There is no clear boundary between construction and operational phases in terms of groundwater impacts. Therefore, we have combined discussion about Construction and Operation Impacts below.

Groundwater Volumes

During construction and operations, as currently proposed, direct impacts to groundwater depths and volumes could occur due to slow elimination over a period of four years of most direct infiltration across the KFIP site. The PSWDM encourages but does not require infiltration. However, it does require protection of on-site wetlands, which would be affected by changes to current on-site groundwater system functions. Implementation of mitigation measures designed to increase infiltration in key areas on site would minimize impacts to groundwater and would reduce potential for loss of wetland areas on site. Most of these initial impacts that change groundwater functions would occur during construction, and the same impacts would simply continue during operations.

Some of the suggested mitigation options below are similar to strategies suggested in other chapters, but are adapted to specifically address impacts to groundwater, and secondary related impacts to wetlands. Wetlands are surface water systems but are controlled by groundwater sources on the KFIP site.

GW-1. Re-evaluate current stormwater management strategy (also addressed in Section 4.2 Surface Water).

- The current proposal is to infiltrate runoff from four warehouse roofs (Warehouses A, C, D, and E). Runoff from all other surfaces on site would be captured and redirected to the river through pipes. If instead, LID practices were broadly applied, and more stormwater runoff were infiltrated, the potential for significant groundwater quantity impacts and related potential for loss of wetland areas on site would be diminished.
- Consider broadly applying LID practices by infiltrating more parking lot and road runoff volumes near wetland areas. This can be done below parking lots using deep gravel-filled trenches or properly designed half-pipe infiltrator systems. It may also be permittable to locate some infiltration trenches or rock-filled galleries within the floodplain, as may be allowed if the goal is to support floodplain hydrology functions. Any infiltration increase on site would increase potential for maintaining on-site wetland hydrology sources, as required by law.
- Develop a stormwater system design and construction scheduling plan designed to ensure that adequate hydrology is directed to the on-site wetlands throughout Project construction periods, prior to construction of warehouse roofs and associated proposed infiltration trenches.
    - See below for details on how to ensure that hydrology is adequate.

These actions would be consistent with Pierce County's Comprehensive Plan policies listed in Section 4.3.2, related to applying best available science and adaptive management for critical areas, using LID practices to maintain water quality for fish, and eliminating harm to water quality from stormwater discharges through use of on-site infiltration and other means (Goal ENV-1, Goal ENV-5, Goal ENV-8, Goal ENV-11, and Goal U-38).

GW-2. Consider benefits of meeting rather than exceeding EC impervious surface limits and applying LID techniques.

- The site currently exceeds the 60 percent impervious surface limit. Redesign the site to meet the 60 percent impervious surface maximum described in PCC 18E.50.040 and Table 18E.040(A), and maximize potential for construction of LID facilities and natural infiltration through permeable surfaces and bioretention and landscaping areas across the KFIP site.

Wetlands

The groundwater source for hydrology that currently supports floodplain Wetlands A, B, and C as well as Wetland D located on the high terrace would decrease as a direct result of increases in impervious surface—paving and buildings—and redirection of surface runoff to the river. The four on-site wetlands are dependent on groundwater contributions, and disruptions to the current hydroperiods are expected to result in wetland loss or reduction in wetland surface area at Wetlands A, B, C, and D. Increasing infiltration would partially mitigate these potential losses, but no detailed information has been collected to define the wetlands' hydroperiods, and little to no information is available regarding infiltration function of the currently proposed trenches. Therefore, more information must be gathered to design an effective, long-term wetland hydrology support system.

GW-3. Assess steep slope stability adjacent to proposed infiltration facilities.

- Consistent with requirements described in the Pierce County Landslide Hazard Area Regulations, an appropriately qualified and experienced professional should evaluate the steep, sandy slopes below the proposed infiltration trenches to determine whether the sandy floodplain terrace slopes would withstand hydraulic loading pressures from the proposed infiltration facilities—to ensure that groundwater seeping from trenches installed in the sandy slopes would not fail and impact the floodplain below as well as stability of upland infrastructure and warehouses.
- Alternate infiltration facility locations and slope stability buffers that move the trenches farther from the top of slope may be indicated.

GW-4. Test infiltration facilities location and function.

- Consistent with requirements described in PCSWDM and Landslide Hazard Area regulations, an appropriately qualified and experienced professional should carry out infiltration testing at each of the proposed infiltration trench locations, and should evaluate whether appropriate volumes of hydrology from the trenches would reach any or all the target wetland areas at the right times and duration to ensure continued function of the current wetland hydroperiods.
- Infiltration trenches should not be constructed until after the wetland hydroperiod monitoring has been completed and appropriate volumes and timing of flow have been defined, as needed to support the wetlands in their current form.
- If the proposed trench locations are infeasible, that does not eliminate the requirement in law and in the 2018 Puyallup Tribe agreement to ensure a hydrology source to the wetlands. Other infiltration or hydrology support options must be defined.

GW-5. Monitor ground and surface water depth and duration in trenches and wetlands.

- Prior to final permitting and construction, the Applicant should monitor variations in groundwater levels at potential infiltration locations in response to daily precipitation events through at least one wet season (wet season as defined by the SMMWW (Ecology 2019) in order collect enough data to properly design KFIP infiltration facilities.
- Monitoring wetland hydroperiod at each wetland in relation to seasonal daily precipitation events through at least one wet season or water year is a standard BAS approach when the proposed mitigation involves managing or maintaining historic wetland hydrology. The hydroperiods of the on-site wetlands have not yet been monitored or defined.

GW-6. Long-term wetland groundwater monitoring plan.

- Maintain groundwater monitoring wells that were established during hydroperiod testing. Monitoring to document long-term wetland hydrology typically is carried out for 5 or more years (as conditions warrant). This work is intended to document that long term hydrology conditions and timing in Wetlands A, B, and C have been protected as required in code and permits. The same monitoring requirement would apply to Wetland D (additional discussion is provided in Section 4.2 Surface Water).
- As would be defined in the not yet developed or approved mitigation and monitoring plan for proposed fill impacts to Wetland D, the Applicant should expect to apply additional compensatory mitigation requirements if groundwater replenishment and related wetland hydrology is shown to be reduced relative to what would be described in the updated mitigation plan performance standards.

4.3.6 Significant Unavoidable Adverse Impacts

Under the current site design, impacts to groundwater recharge, and resultant changes to discharge volumes and timing in on-site wetlands would result in reduction in on-site wetland area or complete loss of wetland conditions over time. This would be a significant impact.