October 23, 2025

Feasibility and Cost Analysis

Kirkland Synthetic Turf Infields at Crestwoods Park and 132nd Square Park

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Contents

Appendices

Tables

Introduction

The City of Kirkland Parks and Community Services (City) engaged Herrera Environmental Consultants (Herrera) and D.A. Hogan to prepare a feasibility and cost analysis to convert existing sand/silt infields into synthetic turf infields at two existing ballfields located at 132nd Square Park and Crestwoods Park. This analysis is limited to infield conversion assessment.

Herrera, D.A. Hogan, and City staff conducted a site assessment visit to review existing conditions on June 18, 2025. Herrera and D.A. Hogan had several meetings with City staff from various departments, including Parks and Community Services, Surface Water Group, Planning Department, and Capital Improvements Program, to discuss and refine potential alternatives to ensure they meet the goals of all stakeholders. The proposed synthetic turf alternatives include a variety of types of underdrains, which dictate the scale of disturbance and excavation in the infield. The proposed stormwater alternatives for the ballfield at 132nd Square Park focus on using the existing stormwater system to varying degrees. The proposed stormwater alternatives for the ballfield at Crestwoods Park are more varied and include reuse of the existing stormwater system, replacement of the existing system, and a variety of locations for required stormwater management facilities. Refer to the Alternatives Analysis memorandum (Appendix A) for a description of alternatives considered for both fields.

Two Alternatives Analysis workshops were conducted with City staff to refine and select alternatives. This report documents the feasibility and estimated costs of those preferred design alternatives. The preferred alternatives have been advanced to a 10 percent planning level design, including synthetic turf system option; permitting requirements; drainage improvements; construction and operating cost estimates; and estimated design and implementation schedules. This study finds that design, permitting, and installation of synthetic turf infields are feasible at each site. Implementation of a synthetic turf infield, at each site, will require modifications to the existing field design and stormwater management infrastructure and annual and periodic maintenance activities of the field and drainage systems different from the existing field and systems.

Stormwater Requirements

Per the 2021 King County Surface Water Design Manual (amended 2024) (KCSWDM), natural and synthetic sports fields are defined as pollution-generating pervious surface (PGPS) and if installed with an underdrain system, sports fields are considered pollution-generating impervious surface (PGIS). The KCSWDM requires a Full Drainage Review for non-single family residential projects when proposed improvements exceed the thresholds of 2,000 square feet of new plus replaced hard surface or 7,000 square feet of land disturbance. Based on the size of the turf infields (approximately 10,400 square feet each), all synthetic turf alternatives considered for this analysis will require Full Drainage Review per the KCSWDM—triggering all nine Core Requirements (CRs) and all five Special Requirements.

The two CRs most impacting the feasibility of a synthetic turf field project are CR #3 Flow Control and CR #8 Water Quality. All proposed alternatives include underdrains; therefore, stormwater from the proposed synthetic turf surfaces must meet these CRs as their installation results in the creation of new

PGIS. Flow Control and Water Quality facilities are often the largest and most expensive components of meeting stormwater requirements, which can impact project feasibility. This report assumes that all other CRs and Special Requirements can be met, regardless of chosen alternative.

Installation of a synthetic turf overlay system atop existing field surface materials with existing underdrains was explored as an alternative if it could be considered a maintenance-only activity. KCSWDM includes exemptions from CR and Special Requirements for certain maintenance activities. However, synthetic turf installation is only considered a maintenance activity if it replaces existing synthetic turf, not when converting dirt/sand infields to synthetic turf. See Table 1 for the different possible types of field retrofit projects and the surface classification that dictates which stormwater requirements apply.

Table 1. Synthetic Turf Field Retrofit Surface Classification.

Existing Field Surface Type	Existing Underdrain	Proposed Field Surface Type	Proposed Underdrain	Proposed Surface Classification per KCSWDM	Field Example
Dirt	No	Artificial Turf	No	Pervious	Taylor Fields
Dirt	No	Artificial Turf	Yes	Impervious	132nd Square Park Baseball Infield
Dirt	Yes	Artificial Turf	Yes	Impervious	Crestwoods
Grass	No	Artificial Turf	No	Pervious	
Grass	No	Artificial Turf	Yes	Impervious	132nd Square Park Multipurpose
Grass	Yes	Artificial Turf	Yes	Impervious	LWHS Baseball Outfield
Artificial Turf	No	Artificial Turf	No	Maintenance activity	
Artificial Turf	No	Artificial Turf	Yes	Impervious	
Artificial Turf	Yes	Artificial Turf	Yes	Maintenance activity	LWHS Baseball Infield

Core Requirement #3: Flow Control

For projects that propose more than 5,000 square feet of new plus replaced impervious surface or more than 0.75 acre of land disturbance, the KCSWDM requires stormwater to be managed to reduce flow rates to meet specific benchmarks depending on the downstream conditions. Typically, this results in the construction of a flow control facility that stores (detains) stormwater during storms and allows it to discharge (or infiltrate where feasible) at a rate slower than the inflow rate. Both parks are within a designated Level 2 Flow Control area, which requires regulating proposed condition runoff discharge durations to pre-development (forested) conditions for all flows greater than one-half of the 2-year peak flow rate up to the 50-year peak flow rate. This requirement can be achieved by installing a detention facility downstream of the ballfield underdrains, building storage into the aggregate base layer beneath the ballfield, or by collecting and detaining runoff from an equivalent offsite area of impervious surface as approved by City Surface Water staff.

Core Requirement #8: Water Quality

For projects that propose more than 5,000 square feet of new plus replaced PGIS or more than 0.75 acre of PGPS, the KCSWDM requires stormwater contacting pollution generating surfaces to be treated to remove potential pollutants. The ballfields included in this analysis fall within Basic Water Quality areas on King County's iMap, and do not qualify as one of the land uses that requires Enhanced (Metals) Basic Water Quality treatment; therefore, Basic Water Quality treatment is required. This requirement can be achieved by installing an approved water quality treatment device downstream of the ballfield underdrains, installing a water quality filter as a part of the turf section, or by treating runoff from an equivalent offsite area of PGIS as approved by City Surface Water staff. To date, no synthetic turf system or materials have been approved for use without water quality treatment.

Critical Areas

Herrera conducted a desktop review of existing information and a site reconnaissance at Crestwoods Park and 132nd Square Park to document the following critical areas: wetlands, frequently flooded areas, minor lakes, and fish and wildlife habitat conservation areas (FWHCAs) (which includes streams), per Kirkland Zoning Code (KZC) Chapter 90. A desktop review of City-mapped geologically hazardous areas was also conducted. Critical areas were reviewed within 300 feet of the infield at Crestwoods Park and within 300 feet of the infield at 132nd Square Park, which defines the study area at each site. A complete summary of the desktop review and site visit can be found in the technical memorandum *Synthetic Turf Infield Analysis at Crestwoods Park and 132nd Square Park – Critical Areas* (Appendix B).

Wetlands and streams were identified within the study area at Crestwoods Park. Geologically hazardous areas are mapped within the study area, including "high susceptibility landslide" areas, "moderate susceptibility landslide" areas, and "liquefaction potential" (City of Kirkland 2025). Impacts to these wetlands, streams, or their buffers would require mitigation. Additionally, any new impervious surfaces at this site would trigger a City requirement to meet the "vegetated buffer standard," per KZC 90.130, which would require enhancing existing wetland or stream buffers onsite at a minimum 1:1 ratio (square footage of buffer enhancement area to new impervious surface area).

At 132nd Square Park, the City maps a "high liquefaction potential" area within the study area (City of Kirkland 2025). No other critical areas were mapped or identified within the 132nd Square Park study area.

Additional critical areas assessment, including resource area delineation at Crestwoods, and geotechnical investigation will be required to finalize design.

Public Outreach

The City led public outreach efforts related to this project. Herrera and D.A. Hogan assisted the City with outreach for a September 3, 2025 public meeting, a presentation to the Kirkland Park Board on September 24, 2025, and a City Council presentation on October 7, 2025. The City distributed an online survey to the public, focusing on input from the Kirkland American and Kirkland National Little League organizations to better understand priorities and concerns of field users (e.g., athletes, coaches, families). The September 3, 2025 public meeting hosted by the City was attended by a member of the Herrera design team and members of Kirkland American and Kirkland National Little League. At the public meeting, the proposed design alternatives were reviewed and the public provided input on aspects of the fields that were particularly important to the Little League organizations. The public emphasized the desire for a quick project execution schedule so that athletes could use the fields as soon as possible. The City presentations to the Kirkland Park Board on September 24, 2025, and the City Council presentation on October 7, 2025 was prepared with assistance from Herrera and D.A. Hogan.

132nd Square Park

Existing Site Conditions

The existing infield at 132nd Square Park is silt/sand without underdrains. Any conversion of the existing infield to synthetic turf with a subsurface drainage system will result in the creation of new PGIS, triggering water quality and flow control requirements per the KCSWDM.

An infield conversion at the 132nd Square Park ballfield will require about 10,400 square feet of infield surface redevelopment. The total area may be greater depending on the size of the transition area from a synthetic turf infield to the natural turf outfield.

In 2021, a new synthetic turf playing field was installed as part of a larger park renovation south of this project's subject ballfield. The park renovation included installation of stormwater runoff water quality treatment and flow control facilities. Based on a review of the park renovation design report and subsequent discussion with City staff, it is understood that the installed facilities have additional flow control capacity available. The installed facilities were also assessed for additional water quality capacity. City staff relayed that the installed water quality treatment system has been frequently inundated, requiring more frequent maintenance measures than typically required. City staff stated that no additional runoff should be added to the installed water quality treatment system. Confirmation of the detailed capacity in the existing facilities is needed, potentially via hydrologic modeling or post-construction documentation, to confirm the extent of infield conversion potentially mitigated by the existing facilities. Stormwater runoff from the infield area is assumed to be routed to the flow splitter upstream of the existing water quality treatment and flow control facilities. The flow splitter routes smaller water quality flow rates to the water quality treatment system, while larger flow rates are routed to the flow control facility, bypassing the water quality facility.

See Figure 2b in Appendix B for site observations.

Synthetic Turf Infield Design

The selected turf system for 132nd Square Park is a traditional full-section conversion, which consists of synthetic turf surfacing, 10 inches of aggregate base material, and 4-inch-diameter underdrains that drain to a collector pipe and then a proposed water quality treatment facility.

See Appendices C and D for more information on synthetic turf materials, the infield design, and example underdrain details and sections.

Water Quality Treatment Facility

Based on discussions with City staff, it is preferred for the proposed water quality treatment facility to be located near the existing drainage structure with an atrium grate in the southeast corner of the ballfield (beyond right field). The existing drainage structure with the atrium grate will remain to collect runoff from the outfield during larger storm events. Runoff from the new infield underdrains is piped directly to the proposed water quality facility, which for the basis of this analysis consists of a 72-inch diameter Type II Catch Basin with one Stormfilter cartridge. The StormFilter system was chosen to match the existing water quality facility type installed on-site in 2021, which will streamline the maintenance activities needed for the two systems, but the City may consider and select an alternative product or method of water quality treatment if desired as design progresses (as allowed by the KCSWDM). Treated runoff will be routed to the existing flow splitter via subsurface pipes and an additional structure to bypass the existing water quality facility, per the City's request.

See Appendix E for stormwater design layout.

Flow Control Facility

The proposed flow control method does not require construction of a new flow control facility. Instead, this project will utilize capacity within the existing infiltration facility installed in 2021 to meet flow control requirements for the park redevelopment project constructed at that time. Based on discussions with City staff, flow control capacity beyond that included in the design was installed during construction due to unforeseen soil conditions. Confirmation of capacity in the existing facility will be required prior to permit approval for any proposed design. High infiltration soils under the infield could reduce the capacity used in the existing system. Infiltration under the infield would require a geotechnical analysis to determine if infield infiltration negatively impacts the infiltration capacity of the existing facility under the park's multiuse field.

Crestwoods Park

Existing Site Conditions

The existing infield is silt/sand with underdrains. Retrofit underdrains are also present in the outfield. Infield and outfield underdrains discharge to header pipes that convey stormwater collected beneath the ballfield surface to dispersion trenches beyond center and left fields. The center field dispersion trench receives runoff from the infield and the right and center outfield areas. Based on site observations during dry weather, it is recommended that the condition of the center field dispersion trench be evaluated; maintenance may be required. The left field dispersion trench receives runoff from a portion of the left outfield area. The left field dispersion trench was inaccessible at the time of site visit. The purpose of the dispersion trenches is to allow stormwater to discharge across a wide area, avoiding concentrated discharges that could cause erosion downstream.

The ballfield is situated atop a plateau with relatively steep slopes surrounding the field on the north, east, and south sides. The slopes and areas below the slopes are forested with the presence of wetlands. Active native growth restoration areas are present north and south of the ballfield. The surrounding topography and critical areas exclude full dispersion as a stormwater mitigation option due to required dispersion flow path parameters (e.g., maximum slope) and length.

The infield area at the Crestwoods Park ballfield is about 9,000 square feet. The area for the infield conversion is about 10,400 square feet, although the total project disturbance area in the field may be greater, depending on the size of the transition area from the infield to the natural turf outfield. The increase in infield area will require buffer vegetation enhancement plantings to mitigate for wetland buffer impacts.

See Figure 2a in Appendix B for site observations.

Synthetic Turf Infield Design

Two turf systems were chosen for further evaluation: an "overlay" synthetic turf infield using the existing underdrains and a traditional full-section replacement of the existing infield and its underdrains. The overlay design consists of synthetic turf surfacing and a panelized drainage tile system installed over the existing infield surface. The overlay design leaves the existing underdrain system in place and adds additional conveyance from the surface to the existing underdrain system.

The feasibility of an overlay synthetic turf system is dependent on the condition of the existing subsurface drainage system (permeable drainage aggregate and underdrains) below the infield. The existing infield materials include a higher percentage of fine sediments than is typical for a well-draining field. See Appendix F for pictures of material samples taken during a site visit on June 18, 2025. Further investigation of the condition of the existing drainage layer and underdrains is recommended, both to determine the extent of any fine sediment contamination and to determine the infiltration performance of the existing drainage system. Further investigation would include mechanical and hand excavation to collect material samples for laboratory analysis, as well as inspection of the pipe exterior and interior. Investigation should also include infiltration testing.

The traditional full-section conversion consists of synthetic turf surfacing, 10 inches of aggregate base material, and 4-inch-diameter underdrains which drain to a collector pipe. For this alternative, the existing underdrains are removed to accommodate the additional aggregate base storage for flow control (see below).

See Appendices E and F for more information on the infield design and example underdrain details and sections.

Water Quality Treatment Facility

The site constraints of the existing ballfield make the installation of a water quality treatment facility difficult. There is limited available site space between the outer limits of the ballfield (delineated by a fence) and the top of the steep slopes on the north and east sides of the field. In consultation with City staff, a "treatment trade" is proposed per KCSWDM Section 1.2.8.2.C. The "traded" or "swapped" area selected includes the roadway, roadside ditches, and run-on areas along 6th Street from 19th Avenue North to the turnaround area adjacent to the Crestwoods Park Playground and Outdoor Gym. For the "treatment trade", stormwater is captured from the existing ditch and culvert conveyance on both the east and west sides of 6th Street and routed to a proposed water quality facility. For the basis of this analysis, the proposed facility consists of a 4-foot by 4-foot Modular Wetland Biofiltration unit. This product was chosen for the minimal drop in elevation between the inlet and outlet pipe connections, better integrating with the existing stormwater conveyance system (ditches) along 6th Street. The City may consider and select an alternative product or method of water quality treatment if desired as design progresses (as allowed by the KCSWDM). The proposed system discharges treated stormwater back into the existing ditches along 6th Street or to the proposed flow control facility, depending on the final design.

The swap area has similar hydrologic characteristics (an equivalent area of impervious surface), is pollution-generating, and is within the same drainage basin (Forbes Creek) as the proposed infield retrofit. Runoff from the ballfield and the swap area combine in Forbes Creek about 2,800 feet downstream of the ballfield and about 1,650 feet downstream of the swap area. Existing outfalls to Forbes Creek for the ballfield and swap area runoff are within about 50 feet of each other.

See Appendix G for stormwater design layout.

Flow Control Facilities

At the direction of City staff and based on the site history as an area of fill, the soil at Crestwoods Park is assumed to be till soil with no or low infiltration potential. Therefore, the proposed flow control facility is a detention system and does not rely on infiltration to meet the CR#3. Two flow control options are considered for Crestwoods Park: a detention facility below the infield and a detention facility managing runoff from the same "swap" area as the proposed water quality treatment facility on 6th Street.

The first option, a detention facility below the infield, is feasible if the full-section replacement synthetic turf system is chosen and the existing underdrains and materials are removed. An additional 2 feet of clean aggregate would be installed below the turf system, providing void space storage for collected stormwater beneath the infield before discharging via an overflow control structure located beyond the outfield along the first base line. Runoff from the overflow control structure discharges through a new gravel dispersion trench, located beyond right field near the area of restoration plantings.

The second flow control option is a detention facility on 6th Street consisting of a 5-foot diameter perforated pipe surrounded by clean aggregate. Treated runoff from the proposed water quality facility is routed to the perforated pipes which detain the runoff before discharging it through an overflow control structure back to the existing ditches along 6th Street.

For both flow control options, additional geotechnical investigation is required to determine the underlying soil type and infiltration rate. If the subgrade soil is suitable for infiltration, the size and/or depth of the flow control facility may reduce, which may reduce construction material and labor costs.

See Appendix G for stormwater design layouts.

Permitting

Permitting to support the conversion of existing infields to synthetic turf infields at Crestwoods Park and 132nd Square Park will need to address the difference between the existing and proposed footprint of the infields; stormwater management; removal, replacement, or impact of any significant trees; temporary or permanent impacts to critical areas and buffers (at Crestwoods Park); assessment of impacts to geological hazardous areas; expansion of impervious surface area and buffer enhancement requirements (at Crestwoods Park).

At a minimum, the following permits and studies would likely be required to support improvements at the site:

- State Environmental Policy Act (SEPA) checklist for the project, utilizing the City's checklist template: The SEPA checklist includes questions regarding the proposed project and environmental elements of the site, such as earth, air, water, plants, historic and cultural resources, housing, transportation, utilities, etc.
- City of Kirkland Significant Tree Inventory, Arborist Report, and Tree Retention.
- City of Kirkland Soils Report (for geologically hazardous areas).
- City of Kirkland Land Surface Modification Permit
- City of Kirkland Critical Areas Report and Mitigation Plan (if required, at Crestwoods Park only).
- City of Kirkland Drainage Technical Information Report.
- City of Kirkland Storm Water Pollution Prevention and Spill (SWPPS) Plan.
- City of Kirkland Erosion and Sediment Control (ESC) Plan.

Cost of permitting support and fees is estimated to be $64,700 for permits, studies, applications, and procurement at Crestwoods Park. Cost of permitting support and fees at 132nd Square Park is estimated to be $32,800. The permitting schedule to complete the studies and applications is estimated to require up to 6 months, some of which can be concurrent with the design phase.

Operation and Maintenance

Daily Maintenance (in-season)

Daily maintenance during active season use is anticipated to include litter pickup and disposal, spot infill redistribution, and re-setting of bases. Assuming up to 1 hour daily labor per field (5 days per week), including tools and transport at $90 per hour, the total labor over the 6-month season is $11,700 per field, per year.

Monthly Maintenance

Monthly maintenance during active season use is anticipated to include minor top dressing and grooming synthetic turf areas. Assuming up to 2 hours labor per field, including tools and transport at $90 per hour total labor over the 6-month season, results in $1,080 per field, per year.

Buffer Enhancement Maintenance

The buffer enhancement mitigation planting at Crestwoods Park will require maintenance and monitoring. Maintenance in the spring and summer is recommended to remove invasive species and trash within planting areas. Assuming up to 8 hours of labor per field per visit, including tools and transport at $90 per hour total, results in $1,440 per field, per year.

Estimated Costs

Development Costs

Development of synthetic turf ballfields on site will require site grading, stormwater system management system modifications and improvements, and site restoration. A summary of costs associated with development (design, permitting, and construction) is presented in Table 2.

Table 2. Summary of Development Costs.

	132nd Square Park	Crestwoods Park: Overlay	Crestwoods Park: Full Section
Design and Permitting			
Permitting (including fees)	$32,800	$64,700	$64,700
Design PS&E (through Bid Award, including City PM)	$142,100	$163,400	$165,400
Design Phase Contingency (10%)	$17,500	$22,900	$23,100
Total Design and Permitting Phase Cost	$192,400	$251,000	$253,200
Construction			
Synthetic Turf Ballfield System & Related Site Improvements	$383,800	$303,300	$409,500
Stormwater Management: Water Quality	$41,500	$42,000	$43,000
Stormwater Management: Flow Control	$0	$170,000	$75,700
Mitigation Plantings	$0	$12,000	$12,000
Construction Contingency (40%)	$170,200	$211,000	$216,100
Construction Sales Tax	$44,300	$54,900	$56,200
Construction Inspections & Admin	$81,400	$96,700	$98,700
Total Construction Cost	$721,200	$889,900	$911,200
Total Development Cost	**$913,600**	**$1,140,900**	**$1,164,400**

Note: All numbers have been rounded up to the nearest $100.

Operations and Maintenance Costs

A summary of annual operations and maintenance costs for each alternative is presented in Table 3. Synthetic turf field components have varying lifespans, based on product and intensity of use. Table 4 summarizes the costs for the synthetic turf surface replacement for each field, required approximately every 10 years. The overlay option at Crestwoods Park utilizes panel drains, which require replacement approximately every 30 years. The full section underdrains at 132nd Square Park and Crestwoods Park do not require replacement within 30 years.

Table 3. Summary of Annual Operations & Maintenance Costs.

	132nd Square Park	Crestwoods Park: Overlay	Crestwoods Park: Full Section
Annual Operations, Maintenance, and Monitoring			
O&M (Annual)	$12,800	$14,300	$14,300
Mitigation Planting Monitoring (Annual for 5 years)	$0	$10,400	$10,400

Note: All numbers have been rounded up to the nearest $100.

Table 4. Summary of Repair and Replacement Costs (30 Years).

	132nd Square Park	Crestwoods Park: Overlay	Crestwoods Park: Full Section
10-Year Cycle			
Remove & Recycle Turf Surfacing & Infill	$129,000	$140,000	$140,000
Remove & Replace Pad System, Supply & Install 20% Waste	$64,500	$69,700	$69,700
Minor Base Aggregate "Tune Up"	$25,800	$27,900	$27,900
30-Year Cycle			
Panel Drain Replacement	$0	$140,000	$0
Total Repair and Replacement Costs (Years 1–30)	**$657,900**	**$852,800**	**$712,800**

Note: All numbers have been rounded up to the nearest $100.

Life Cycle Costs

Each synthetic turf retrofit alternative was evaluated across a 30-year time span to better understand total estimated project costs across an anticipated lifespan. Table 5 summarizes total 30-year life cycle costs, incorporating cost estimates from Table 2, Table 3, and Table 4. Two total 30-year life cycle costs are presented, one with a new field at the end of Year 30 and one with an exhausted field at the end of Year 30. The new field life cycle cost includes synthetic turf replacements at Years 10, 20, and 30 and panel drain replacement, if applicable, at Year 30. The exhausted field life cycle cost does not include synthetic turf replacement at Year 30 and does not include panel drain replacement, if applicable, at Year 30.

Table 5. Summary of 30-Year Life Cycle Costs.

	132nd Square Park	Crestwoods Park: Overlay	Crestwoods Park: Full Section
Design and Permitting Costs	$192,400	$251,000	$253,200
Construction Costs	$721,200	$889,900	$911,200
Operations, Maintenance, and Monitoring Costs	$384,000	$481,000	$481,000
Repair and Replacement Costs	$657,900	$852,800	$712,800
Total 30-Year Life Cycle Cost – New Field at End of Year 30[a]	$1,955,500	$2,474,700	$2,358,200
Total 30-Year Life Cycle Cost – Exhausted Field at End of Year 30[b]	$1,736,200	$2,097,100	$2,120,600

[a] The New Field at End of Year 30 total 30-year life cycle cost includes synthetic turf replacements at Years 10, 20, and 30 and panel drain replacement, if applicable, at Year 30, see Table 4.

[b] The Exhausted Field at End of Year 30 total 30-year life cycle cost includes synthetic turf replacements at Years 10 and 20. It does not include synthetic turf replacement at Year 30 or panel drain replacement, if applicable, at Year 30, see Table 4.

Note: All numbers have been rounded up to the nearest $100.

Schedule

Design and development of the infield areas, as well as necessary site improvements to support synthetic turf infield, will require a design effort that details the turf system and incorporates the proposed new pollution-generating impervious surfaces into existing and new stormwater systems. Design and permitting through the City of Kirkland, including all special studies, applications, and secured permits, are estimated to require 12 to 18 months. Procurement and contracting though the City are estimated to require 2 to 3 months. Construction is best aligned with the dry season and is anticipated to occur over a 6-month period .

1. **Design Consultant Procurement:** 2 months
2. **Design Phase:** 6 to 8 months
3. **Permitting:** 6 months, partially concurrent with design phase
4. **Procurement and Contracting:** 2 months
5. **Construction:** 6 months (dry season)
6. **Mitigation Planting Maintenance:** 2x year for 5 years
7. **Mitigation Monitoring:** 1x per year for 5 years

Design consultant procurement, permitting, design development, contract document preparation, and procurement and contracting are anticipated to take approximately 14 months, with construction occurring the next available dry construction season.

Further Investigation

This feasibility and cost analysis produced a 10 percent level conceptual design of preferred alternatives for the Crestwoods and 132nd Square Park ballfields. Before proceeding with design development, the following items are recommended for further investigation.

- A geotechnical analysis of each project site is necessary to determine subgrade conditions, design stormwater infiltration rates into subgrade, and the condition of existing subsurface underdrains at the Crestwoods site.
- Right-sizing the total area of synthetic turf retrofit at each site may allow a proposed design to qualify for exemptions to stormwater requirements per the KCSWDM. Designers should carefully consider the exact footprint of synthetic turf needed to accomplish project goals.
- In collaboration with City staff, confirm the available flow control capacity in the existing detention system at 132nd Square Park.
- In collaboration with City staff, determine mitigation planting requirements for the Crestwoods project site depending on the extent and location of a synthetic turf retrofit. Conceptual locations of any needed mitigation planting should also be discussed to confirm the feasibility of mitigating any critical areas impacts on site.

References

Kirkland, City of. 2025. Kirkland Maps. City of Kirkland, Washington. Accessed June 16, 2025. <https://maps.kirklandwa.gov/Html5Viewer/>.

Appendix A

Synthetic Turf Infields at Crestwoods Park and 132nd Square Park – Alternatives Analysis

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TECHNICAL MEMORANDUM

Date: August 18, 2025

To: Mariah Murphy, Park Planning and Development Manager, City of Kirkland Parks and Community Services

From: Eliza Hoffman, PE, and Neil Schaner, PE, Herrera Environmental Consultants, Inc.

Subject: Synthetic Turf Infields at Crestwoods Park and 132nd Square Park – Alternatives Analysis

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The City of Kirkland Parks and Community Services (City) engaged Herrera Environmental Consultants (Herrera) and D.A. Hogan to prepare a feasibility and cost analysis to convert existing sand/silt infields into synthetic turf infields at two existing ballfields: one at 132nd Square Park and one at Crestwoods Park. This analysis is limited to infield conversion assessment. This memorandum documents site assessment findings, identifies conversion alternatives, and provides high level ratings of alternatives for comparison. Information in this memorandum will inform the selection of up to two preferred alternatives for each infield site. A feasibility and cost analysis report will be subsequently developed to further detail and advance the selected preferred alternatives to 10 percent planning level design, including turf system option; permitting requirements; drainage improvements; construction and operating cost estimates; and estimated design and implementation schedule.

Design and installation of synthetic turf infields are feasible at each site; however, they will require modifications of existing field design and ongoing annual maintenance activities of synthetic turf field and drainage systems different from existing systems, if present.

Synthetic Turf Infield Options

Synthetic turf systems are comprised of several material layers above a subgrade drainage system (drainage aggregate and underdrains). The options for different turf systems and underdrain configurations are summarized below.

Turf System Options

There are two categories of turf system applicable to the project sites: full section and overlay. Full section synthetic turf systems include a surface layer, infill materials, resilient padding, if needed, and layers of permeable mineral aggregate installed above an underlying subsurface drainage system. Full section systems have a depth of about 12 inches.

Overlay synthetic turf systems are installed atop existing field surface materials. These systems include a rigid interlocking drainage panel and synthetic turf. Overlay systems add a depth of approximately 1 to 2 inches atop an existing surface. Overlay systems are only applicable to sites with an existing subsurface drainage (underdrain) system with demonstrated performance.

Several synthetic turf material types and products are available and may be implemented at the project sites. As a general rule, synthetic turf surfaces must be replaced every 10 to 12 years with underlying resilient pad systems that last longer if installed (20+ years). In addition to the visible fibers of a playing surface, there are several infill materials, each with varying characteristics. See Attachment A for descriptions of the most common turf system options used in the Puget Sound region.

Underdrain Options

Four underdrain options were considered for the project sites, as listed below. The first two options are only applicable to the Crestwoods Park site because the 132nd Square Park site does not have an existing underdrain system.

1. **Reuse existing subsurface drainage system (Crestwoods Park only)**: This option reuses the existing subsurface drainage system. The feasibility of this option requires additional assessment of the existing system to determine performance. If existing performance is poor or the extent of needed repair is too great, this option is not feasible.
2. **Rehabilitate existing subsurface drainage system (Crestwoods Park only)**: This option reuses the existing subgrade drainage system to the extent feasible but includes replacement of drainage aggregate contaminated with fine sediment that is reducing infiltration performance. This option may include cleaning or replacement of perforated underdrain pipes, depending on the extent of fine sediment contamination.
3. **Trenched Underdrains**: This is the most "traditional" option. This option includes (1) excavation of existing material to a depth appropriate to the chosen turf system to create a level surface and then (2) further excavation of trenches to accommodate drainage aggregate and underdrain piping. The circular, perforated underdrain pipes are typically 4 inches in diameter and placed in parallel rows below the turf system layers. Underdrains are connected to one or more solid-wall header pipes that convey infiltrated water to stormwater infrastructure.
4. **Flat Drains**: This option provides a similar subsurface drainage system to the trenched underdrain option but utilizes pipes that are typically less than 2 inches high and approximately 12 inches wide. The flat drain geometry allows for a shallower overall profile of the turf system and reduces the excavation needed. Excavation is limited to removal of material to a depth appropriate to the chosen turf system to create a level surface; no additional trenching is needed. Flat drains are connected to one or more solid-wall header pipes that convey infiltrated water to stormwater infrastructure.

See Attachments C and E for example underdrain details and sections.

Stormwater Requirements

Per the 2021 King County Surface Water Design Manual (amended 2024) (KCSWDM), natural and synthetic sports fields are defined as pollution-generating pervious surface (PGPS) and if installed with an underdrain system, sports fields are considered pollution-generating impervious surface (PGIS). Based on the areal size of the existing infields (about 9,000 square feet per infield), all synthetic turf alternatives considered for this analysis will require Full Drainage Review per the KCSWDM—triggering all nine Core Requirements (CRs) and all five Special Requirements. Proposed synthetic turf surfaces are targeted for mitigation of CR #3 Flow Control and CR #8 Water Quality as their installation results in the creation of new PGIS. Therefore, without sufficient capacity within existing downstream flow control and water quality facilities, additional stormwater facilities are required to meet prescribed performance standards. Maintenance activities are an exception.

Installation of a synthetic turf overlay system atop existing field surface materials with existing underdrains was explored as a potential maintenance-only activity. This option would require the repair/replacement of existing subsurface drainage systems in a manner that would not result in significant hydrologic impacts. As such, maintenance activities would not trigger a drainage review, nor are they subject to the Core and Special Requirements. However, City staff confirmed that the City does not consider any form of synthetic turf installation as a maintenance activity; therefore, this alternative is not feasible.

The infield conversion alternatives described below account for Flow Control and Water Quality requirements. Other Core and Special Requirements may be applicable but are not considered in detail for this alternatives analysis.

132nd Square Park Infield Alternatives

Existing Site Conditions

The existing infield is silt/sand without underdrains. Any conversion of the existing infield to synthetic turf with subsurface drainage system will result in the creation of new PGIS, triggering water quality and flow control requirements per the KCSWDM.

An infield conversion at the 132nd Square Park ballfield will require about 9,000 square feet of infield surface redevelopment. The total area may be greater depending on the size of the transition area from a synthetic turf infield to the natural turf outfield.

In 2021, a new synthetic turf playing field was installed as part of a larger park renovation south of this project's subject ballfield. The park renovation included installation of stormwater water quality treatment and flow control facilities. Based on review of the park renovation design report and subsequent discussion with City staff, the installed facilities have additional flow control capacity available. The existing facilities do not have additional water quality treatment capacity. Confirmation of the detailed capacity in the existing facilities is needed, potentially via hydrologic modeling or post-construction documentation, to confirm the extent of infield conversion potentially mitigated by the existing facilities. Stormwater runoff from the infield area is assumed to be routed to the existing water quality treatment and flow control facilities under existing conditions.

See Attachment B, Figure B1 and Attachment C for site observations.

Drainage Design Mitigation Alternatives

Four alternatives were identified based on stormwater and synthetic turf options detailed in Attachments B and C. All proposed alternatives are full sections and include installation of underdrains.

Alternative 1 – Full-Section with Existing Flow Control Capacity and New Water Quality Treatment Facility (Turf Option 1 + Stormwater Option 1)

Alternative 1 is a full section synthetic turf system with a traditional trenched, perforated underdrain system connected to stormwater conveyance piping. Proposed stormwater conveyance piping discharges to the existing network at the 132nd Avenue Northeast frontage that is upstream of existing water quality and flow control facilities within the park. This alternative utilizes capacity within the existing facilities to meet stormwater requirements for flow control. A new water quality treatment facility is needed to treat runoff from the infield conversion area. The maximum area of surface conversion is limited by available capacity in the existing facilities.

Alternative 2 – Full-Section with Supplemental Flow Control and New Water Quality Treatment Facilities (Turf Option 1 + Stormwater Option 2)

Alternative 2 is a full section synthetic turf system with a traditional trenched, perforated underdrain system connected to stormwater conveyance piping. Proposed stormwater conveyance piping discharges to the existing network at the 132nd Avenue Northeast frontage that is upstream of existing water quality and flow control facilities within the park. This alternative utilizes capacity within the existing facilities to partially achieve stormwater requirements. The maximum area of surface conversion is not limited by available capacity in the existing facilities because water quality and flow control capacity are supplemented by construction of new facilities located near right field.

Alternative 3 – Flat Drain Full-Section with Existing Flow Control Capacity and New Water Quality Treatment Facility (Turf Option 2 + Stormwater Option 1)

Alternative 3 is a full section synthetic turf system with flat drain perforated underdrain system connected to stormwater conveyance piping. Proposed stormwater conveyance piping discharges to the existing network at the 132nd Avenue Northeast frontage that is upstream of existing water quality and flow control facilities within the park. This alternative utilizes capacity within the existing facilities to meet stormwater requirements for flow control. A new water quality treatment facility is needed to treat runoff from the infield conversion area. The maximum area of surface conversion is limited by available capacity in the existing facilities.

Alternative 4 – Flat Drain Full-Section Supplemental Flow Control and New Water Quality Treatment Facilities (Turf Option 2 + Stormwater Option 2)

Alternative 4 is a full section synthetic turf system with flat drain perforated underdrain system connected to stormwater conveyance piping. Proposed stormwater conveyance piping discharges to the existing network at the 132nd Avenue Northeast frontage that is upstream of existing water quality and flow control facilities within the park. This alternative utilizes capacity within the existing facilities to partially achieve stormwater requirements. The maximum area of surface conversion is not limited by available capacity in the existing facilities, because water quality and flow control capacity are supplemented by construction of new facilities located near right field.

Alternatives Matrix

Table 1 rates the infield conversion alternatives for 132nd Square Park relative to each other.

Table 1. Ratings of 132nd Square Park Infield Conversion Alternatives.[a]

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Construction Cost	MEDIUM	HIGH	MEDIUM	HIGH
Construction Effort	LOW	MEDIUM	MEDIUM	HIGH
Replacement Cycle	LOW	LOW	MEDIUM	MEDIUM
Design Effort	MEDIUM	HIGH	MEDIUM	HIGH
Effort to Meet Stormwater Requirements	LOW	HIGH	LOW	HIGH
Site Disturbance	MEDIUM	HIGH	LOW	MEDIUM
Effort to Meet Permitting Requirements	LOW	MEDIUM	LOW	MEDIUM
Maintenance Effort	MEDIUM	HIGH	MEDIUM	HIGH

[a] Ratings are relative to the other alternatives and apply separately within each category.

Crestwoods Park Infield Alternatives

Existing Site Conditions

The existing infield is silt/sand with underdrains. Retrofit underdrains are also present in the outfield. Infield and outfield underdrains discharge to header pipes that convey infiltrated stormwater to dispersion trenches beyond center and left fields. The center field dispersion trench receives runoff from the infield and the right and center outfield areas. The condition of the center field dispersion trench is compromised. The left field dispersion trench receives runoff from a portion of the left outfield area. The left field dispersion trench was inaccessible at the time of site visit.

The ballfield is situated atop a plateau with relatively steep slopes surrounding the field on the north, east, and south sides. The slopes and areas below the slopes are forested with the presence of wetlands. Active native growth restoration areas are present north and south of the ballfield. The surrounding topography and critical areas exclude full dispersion as a stormwater mitigation option due to required dispersion flow path parameters and length.

The infield area at the Crestwoods Park ballfield is about 9,000 square feet. The area needed for an overlay or full section synthetic turf installation may be greater, depending on the size of the transition area from the infield to the natural turf outfield.

See Attachment D, Figure D1 and Attachment E for site observations.

Recommended Additional Site Investigation

The existing infield materials include a higher percentage of fine sediments than is typical for a well-draining field. See Attachment E for pictures of material samples taken during a site visit on June 18, 2025. Further investigation of the condition of the existing drainage layer and underdrains is recommended, both to determine the extent of any fine sediment contamination and to determine the infiltration performance of the existing drainage system. Further investigation would include mechanical and hand excavation to collect material samples for laboratory analysis, as well as inspection of the pipe exterior and interior. Investigation would also include infiltration testing.

Depending on the condition of underdrain pipes and the surrounding aggregate, use of the existing underdrains could continue with the installation of a synthetic turf overlay or full section system. City staff confirmed that an overlay synthetic turf system is not considered a maintenance activity and that it would be categorized as new pollution-generating impervious surface, triggering KCSWDM requirements.

Additional geotechnical investigation is required for any proposed stormwater flow control facilities. Kirkland GIS data maps the Crestwoods ballfield and surrounding areas as outwash soils. As a general rule, achieving the KCSWDM CR #3 Flow Control for areas with outwash soils is not possible without stormwater runoff infiltration. Soils analysis and infiltration testing must be conducted at the site of a proposed flow control facility to determine a design subgrade infiltration rate.

In addition, geotechnical investigation would be required to determine appropriate proximity of stormwater facilities to the steep slopes along the south and east sides of the field. Depending on soil conditions, the required setback from the plateau slopes may prevent the installation of new facilities outside of the outfield fence and wall.

Drainage Design Mitigation Alternatives

Four alternatives were identified based on stormwater and synthetic turf options detailed in Attachments D and E.

Alternative 1 – Overlay Infield Using Existing Underdrain System with Infield Water Quality Treatment and Flow Control (Turf Option 1 or 2 + Stormwater Option 1)

The feasibility of an overlay synthetic turf system is dependent on the condition of the existing subsurface drainage system (permeable drainage aggregate and underdrains) below the infield. If in good condition, the existing subsurface drainage system is used as-is with an overlay synthetic turf system installed atop the existing field surface materials. If in salvageable condition, the existing subsurface drainage system is rehabilitated to achieve sufficient drainage capacity with an overlay synthetic turf system installed atop. A new water quality and flow control facility is sized for the infield conversion area and located either near third base (Option 1a) or beyond center field. The center field location would require either a flow splitter to route outfield runoff around the facility (Option 1b) or a larger facility to treat runoff collected in the outfield underdrains (Option 1c). The outfield underdrain system would remain unchanged. The proposed stormwater facility discharges to the existing dispersion trench beyond center field, optionally rehabilitated to improve performance.

Alternative 2 – Full-Section or Flat Drain with Infield Water Quality Treatment and Flow Control (Turf Option 3 or 4 + Stormwater Option 2)

Alternative 2 is a full section synthetic turf system with either a traditional trenched, perforated underdrain system or a flat drain perforated underdrain system connected to existing stormwater conveyance piping. Proposed stormwater conveyance piping discharges to a new water quality and flow control facility sized for the infield conversion area. The stormwater facility discharges to a new dispersion trench beyond right field. The size of the flow control facility may be reduced if there is infiltration to subgrade below the infield, the subgrade soils meet groundwater protection standards, and orifice-control can be installed on the underdrain piping. The outfield underdrain system would remain unchanged and discharge to the existing dispersion trench beyond center field, optionally, rehabilitated to improve performance.

Alternative 3 – Full-Section or Flat Drain with Area Swapped Water Quality Treatment and Flow Control (Turf Option 2, 3, or 4 + Stormwater Option 3)

Alternative 3 is an overlay synthetic turf system with rehabilitated underdrain (see Alternative 1) or full section synthetic turf system with either a traditional trenched, perforated underdrain system or a flat drain perforated underdrain system connected to existing stormwater conveyance piping. Flow control and water quality treatment is provided for an equivalent area not already receiving treatment that meets the "mitigation trade" and "treatment trade" requirements in the KCSWDM. The area identified includes the roadway, roadside ditches, and run-on areas along 6th Street from 19th Avenue North to the street adjacent to the Crestwoods Park Playground and Outdoor Gym. Stormwater would be captured from the existing ditch and culvert conveyance on both the east and west sides of 6th Street, treated in a water quality facility, and then detained and infiltrated in a flow control facility, such as a large diameter pipe, located within the 6th Street right-of-way.

The swap area has similar hydrologic characteristics (an equivalent area of impervious surface), is pollution-generating, and is within the same drainage basin (Forbes Creek). Runoff from the ballfield and the area swap combine in Forbes Creek about 2,800 feet downstream of the ballfield and about 1,850 feet downstream of the swapped area. Existing outfalls to Forbes Creek for the ballfield and swapped area runoff are within about 50 feet of each other. The size of the flow control and water quality facility required may be reduced if there is infiltration to subgrade below the infield, the subgrade soils meet groundwater protection standards, and orifice-control can be installed on the underdrain piping.

Alternatives Matrix

Table 2 rates the infield conversion alternatives for Crestwoods Park relative to each other.

Table 2. Ratings of Crestwoods Park Infield Conversion Alternatives.[a]

	Alternative 1	Alternative 2	Alternative 3
Construction Cost	MEDIUM	HIGH	HIGH
Construction Effort	MEDIUM	MEDIUM	HIGH
Replacement Cycle	HIGH	MEDIUM	MEDIUM
Design Effort	HIGH	MEDIUM	HIGH
Effort to Meet Stormwater Requirements	HIGH	HIGH	HIGH
Site Disturbance	LOW	MEDIUM	MEDIUM
Effort to Meet Permitting Requirements	MEDIUM	MEDIUM	LOW
Maintenance Effort	MEDIUM	MEDIUM	LOW

[a] Ratings are relative to the other alternatives and apply separately within each category.

Attachment A

Infield Surface Conversions D.A. Hogan Memorandum

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MEMORANDUM

To: Neil Schaner, PE, Herrera

Cc: Eliza Hoffman, Herrera

From: Eric Gold

Date: July 10, 2025

Re: City of Kirkland Parks
Infield Surface Conversions
Narrative Summary

Having observed and studied the conditions at both 132nd Square and Crestwoods Parks Infields, we have provided narrative and graphic analysis of each, as well as 2 or 3 options for conversion to synthetic turf surfacing with representative details. Each option was selected for a variety of practical reasons including cost, durability, ease of installation, and level of site disturbance. All of the options offered have equivalent outcomes as regards safety and performance, assuming an identical synthetic turf specification and adequate installation quality controls.

Quantifying the Options

Each option, graded[1] for expected total development cost (including associated or "soft" costs), life cycle duration or durability[2], ease of installation / expected construction duration, and level of site disturbance required:

132nd Square, Option 1 "Traditional Full Section" Conversion

Total Development Cost	HIGH
Expected Life Cycle	HIGH
Ease of Installation	LOW
Site Disturbance	HIGH

132nd Square, Option 2 "Flat Drains, Full Section" Conversion

Total Development Cost	MEDIUM
Expected Life Cycle	MEDIUM
Ease of Installation	MEDIUM
Site Disturbance	MEDIUM

Crestwoods, Option 1 "Overlay" Conversion

Total Development Cost	MEDIUM
Expected Life Cycle	LOW
Ease of Installation	HIGH
Site Disturbance	LOW

Crestwoods, Option 2 "Full Section, Drainage Refresh" Conversion

Total Development Cost	HIGH
Expected Life Cycle	HIGH
Ease of Installation	LOW
Site Disturbance	HIGH

[1] Graded on a "high, medium, low" basis, relative to all options recommended for the site.
[2] Refers to the underlying infrastructure only. Synthetic Turf Surfacing itself is excluded.

Crestwoods, Option 3 "Flat Drains, Full Section" Conversion

Total Development Cost	MEDIUM
Expected Life Cycle	MEDIUM
Ease of Installation	MEDIUM
Site Disturbance	MEDIUM

Synthetic Turf Specification

The City of Kirkland has some representative experience with specific synthetic turf products and vendors. Although limited, this experience may be of some assistance in guiding the specification of future installations. As a general rule of thumb and guide for future budgeting, synthetic turf surfaces *as a whole* have a 10-12 year replacement life cycle. This excludes the underlying infrastructure and supplemental resilient pad systems (if applicable), as these elements are relatively generational (life-cycle of 20+ years). Removal and replacement, in 2025 dollars, is roughly $10/sf depending on the specification. High wear areas such as batters boxes, soccer penalty kick areas, etc. have a significantly shorter life span and require far more regular maintenance, daily during periods of high use. Note that batters boxes and pitching runout areas are normally installed as removable panels, using Velcro to secure in place. The initial installation should come with 4-6 replacement panels.

The following describes various options available on the market today.

1. **Common Products**
   The following are all typical product-type selections by the majority of our Parks, K-12, Collegiate, and Pro Clients.

   A. Slit-Film, or fibrillated tape, consists of wide, thin polyethylene fibers (somewhat analogous too scotch tape) that are then incised (slit) in a way that allows them to split or "fibrillate" during the installation of the infill materials. The fibrillation process, also often referred to as "blooming", spreads the individual strands out in a way that holds the infill in place particularly well. Slit-Film fiber is softer than most other fiber types due to its thin cross section. This makes it less abrasive but also results in it laying down or matting earlier in its service life. For many of our clients this is actually beneficial – public Parks and K-6 facilities in general like this feature as it encapsulates or traps the infill material, meaning far less migration and therefore less maintenance. In some applications, we use this product as an analogue for infield clay, as a matted surface creates faster ball roll and truer bounce.

   B. Monofilament fibers are extruded in a wide variety of cross sections, one way vendors tend to differentiate their products from the competition. Not unlike pasta: spaghetti (large, round), angel hair (small, round), linguini (thick, flat), etc., but over the years we've seen some chevrons, deltas, spined bat wings, all kinds of variations. It's debatable whether these shapes contribute much to performance, and many iterations over the years have failed spectacularly as the more complex shapes tend to break at a weak point, resulting in significant fiber loss due to breakage and shedding. The industry has largely settled on "linguini" as it's simple geometry has proved the most durable.

      Monofilaments tend to maintain their upright condition a little longer than slit-films. This favors cleat interaction with the infill as the fibers' open stance allows more cleat interface. This also creates more friction or ball "check up" which makes it among the primary soccer turf types.

   C. Dual Fiber Turf uses various proportions of both slit-film and monofilament fibers, usually somewhere between 40-60% of one and 40-60% of the other, by weight. This system offers the best of both and is gaining popularity rapidly.

   D. "Thatch Layer" Turf incorporates a dense layer of textured (curly) polyethylene, polypropylene, or nylon fibers below the top of the infill. In theory, this provides extra holding power over the infill materials, and a bit more resistance to migration under the lateral forces of cleats. This has been successful as extremely durable deep-pile surfaces, as well as thinner, faster surfaces like infields and warning tracks. While any of the top-tier vendors will supply this configuration, AstroTurf has been the leader in this development (their "RootZone" and "3D" product lines). A thatch layer can be incorporated with any fiber type or blend.

2. Specialty Products

Some sports demand specific types of synthetic turf (Field Hockey is one example, where the preferred surface is essentially the late-80's-style woven nylon over an e-layer), and some uses and applications benefit greatly from some of the more unusual configurations.

A. The "original AstroTurf" system is practically a specialty product at this point… a non-infilled, very high density, short-pile turf that can be extremely durable in many applications like batting cages, walk-off areas, conditioning spaces, and as mentioned field hockey. Because it lacks the ballasting effect of infill, this is typically glued to a solid base of concrete or asphalt, but it is supplied with an integrated closed cell pad that can act as ballast.

B. Extremely high density, thatch-zone systems with fiber heights/depths 1" or more tend to be best for landscape applications (pet areas as well).

It's worth noting that some vendors are offering "new, non-infilled turf for multi-sport applications". Our experience with products of this nature is that they tend to be highly directional, abrasive, dimensionally unstable, and generally nothing like grass. Which is what infilled synthetic turf sports surfaces strive to emulate (or should).

3. Associated Products & Materials - Infills

Infill materials are one of the main ways synthetic turf mimics grass and soil – by grabbing and releasing the cleat or sole of the shoe just as natural grass does. Probably even more than as described for monofilament turf fibers, producing unique infills has been a major way for vendors with the resources to differentiate themselves from their competitors. This has led to some significant successes, but also some abject failures. We'll only go in depth on the more common options in our region.
Inherently Resilient Options:

A. SBR Crumb Rubber is the original resilient infill introduced in the mid-late 90's. It is recycled tires supplied in a specific range of particle sizes. Only a few firms perform the process of rendering tires into this granular form – none of the turf vendors do this "in house" that I am aware of, although some do recycle it out of used turf. Two processes are used: Ambient Grind is a room-temperature process that results in a more ragged-edged particles and small pieces. This can cause the granules to "lock up" and despite the inherent resiliency of the rubber can actual get quite firm and even slow drainage considerably. Cryogenic Grind or "Cryo" uses liquid nitrogen to flash freeze the raw material to well below 0°F resulting in a brittle feed stock that essentially shatters into cleaner, more cuboidal geometry that resists consolidation or settling.

   SBR Crumb Rubber has a long history of serious claims of danger to human and environmental health, and it's hard to dispute that the negative PR has greatly diminished it's use, particularly in the PNW and more specifically west of the Cascades. Coating the granules with latex paints or polyurethane has been one means of eliminating human contact. While *most* of the claims of human health dangers have been debunked (there are current some discussions around PFAS and microplastics), the recent discovery of something called "6PPd-Q" in leachate from shredded tire material as lethal to juvenile salmonids has, or will likely, eliminate it as a viable option.

B. EPDM Crumb Rubber is another resilient material that was offered early on when the uniformity of SBR was less reliable, and later as an alternative that lacked the additives that truck tires required (and was suspected of creating health hazards). These days, as an alternative to SBR it suffers from one of its greatest attributes: it can be practically indistinguishable from SBR. For many of our clients, this potential "bad PR" excludes it from consideration. It is also quite expensive relatively (about $1.00/sf more than SBR) and must be sourced from a reliable manufacturer and rigid specification as there are some pretty bad versions of it available.

Insufficiently Resilient Options requiring a Supplemental Pad:

C. TPE, or Thermoplastic Elastomer, is a "virgin plastic" material often used in medical equipment and food-grade containers. It is only barely resilient, but extremely inert. TPE carries up to a $1.10/sf premium over SBR. Despite this, King County Parks has essentially standardized this infill, and King County does not consider it as "pollution generating" as other infills (even cork, somehow).

D. Granular Cork has become the dominant "alternative infill" in recent years. In 2016, Seattle Parks made cork their standard, and Seattle Public Schools soon followed suite, followed by Shoreline Schools, among others. As a commodity raw material of the cork industry, granular cork can be supplied by any vendor (much like SBR), making it a viable alternative under most any purchasing requirements. Cork, the bark of the cork oak (sp. Quercus suber), is of course organic, but unlike other organic infills, it does not absorb water. Used on a poorly constructed base or under some very specific environmental conditions it does float, but by its nature it does have excellent resiliency and durability. Cost for cork has come down considerable in recent years and now carries around a $0.65/sf premium over SBR.

E. Olive Pit, Walnut Shell: I put these under a common heading because they are extremely hard and can be abrasive. We typically reserve these options almost exclusively for warning tracks and walking surfaces.

F. Other Generic Organic Infills are typically based on coconut shell by-products, often mixed with other organics like rice hulls. Our experience with these materials point to two very undesirable traits: 1) they hold a LOT of excess water, and days after a rainy period can still generate "rooster tails", splashing, and general discomfort for users, and 2) during dry periods can become wind-born (i.e., blow away) and so require watering / irrigation. They also settle and migrate significantly and so require "top dressing" every other year or so.

4. Associated Products & Materials – Supplemental Resilient Pad Systems

Often referred to simply as "shock pads", these underlayments can eliminate *any* potential issues with G-Max or Head Impact Criteria regardless of the type or quality of the infill and are a necessary part of all *non-infilled* systems going back to the second generation of AstroTurf.

A. Paved-in-Place Elastic Layer, or "e-layer" is a matrix of SBR granule and pea gravel bound and encapsulated in a polyethylene binder, paved onto a permeable surface such as aggregate or porous asphalt much like asphalt. E-layers are extremely durable – we encounter installations from the 80's that are still serviceable. E-layers allow for the simplest turf replacements, being a single unit covering without seams. The only downside to e-layers is weather sensitivity during installation – cold and wet will hamper progress. Can also be somewhat problematic if settlement is a potential future issue. Definitely the preferred pad system, these run around $1.75 - $2.25/sf.

B. Most other common pad systems available fall under the "interlocking tile" category. The most common are Brock and SchmitzFoam, both of which are available at different thicknesses and resiliencies. Not at all weather dependent, these are a good option when winter installation is predicted. On the downside, these have to be removed during every subsequent turf replacement and while that may be every 10-12 years, the edges are trimmed-to-fit and generally have to be replaced. This can be an issue if the product line is no longer available and of course carries an additional cost. Installed, tile systems run $1.65 - $1.85/sf.

C. Less common with the advent of the interlocking tile system is the “rolled goods” system, which is basically a factory-fabricated e-layer, albeit much denser and less permeable, more like a flooring product – it’s most common use these days.

Attachment B

132nd Square Park Stormwater Alternatives

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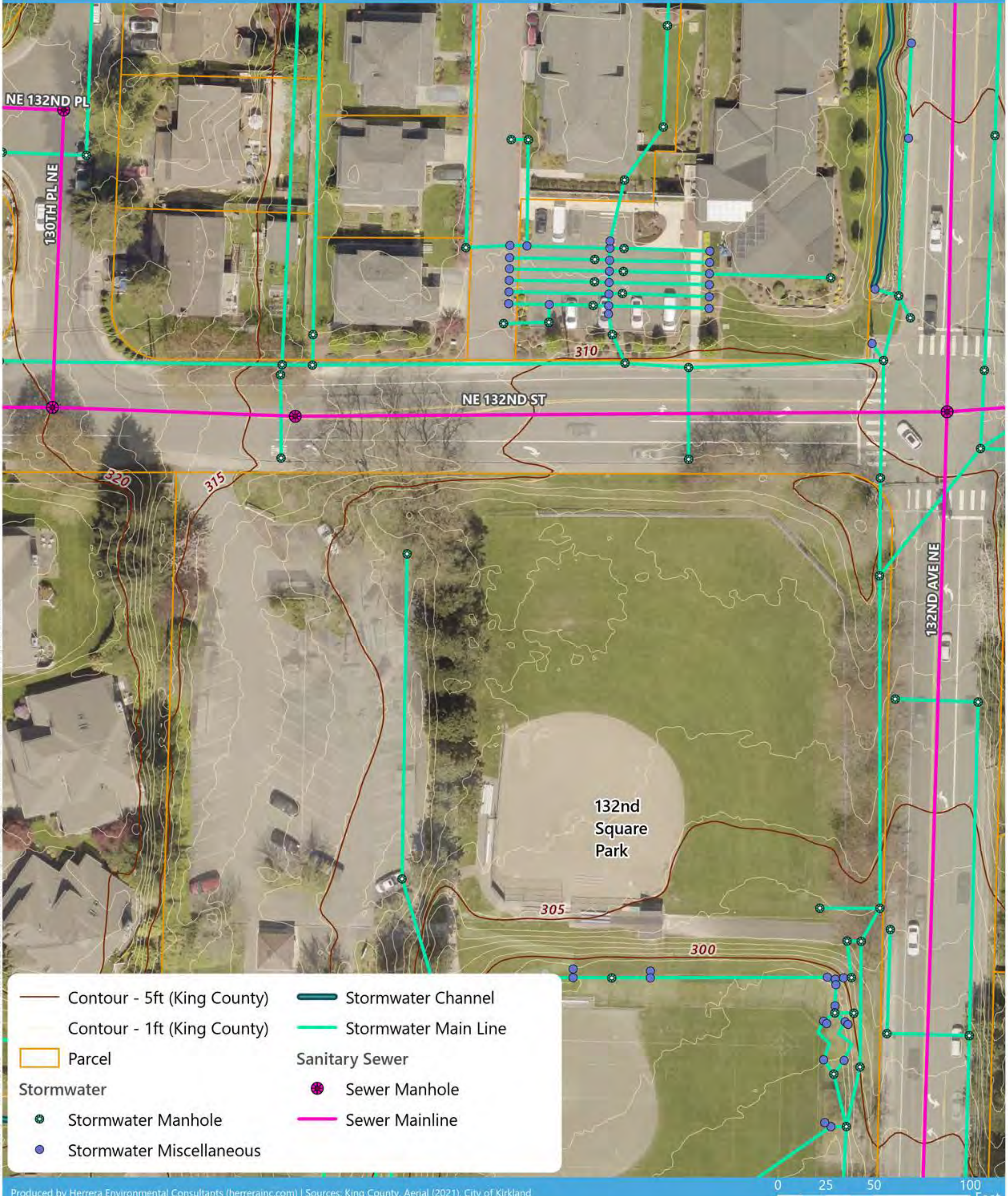
Figure 1. 132nd Square Park.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: King County, Aerial (2021), City of Kirkland

Figure 1.
132nd Square Park.

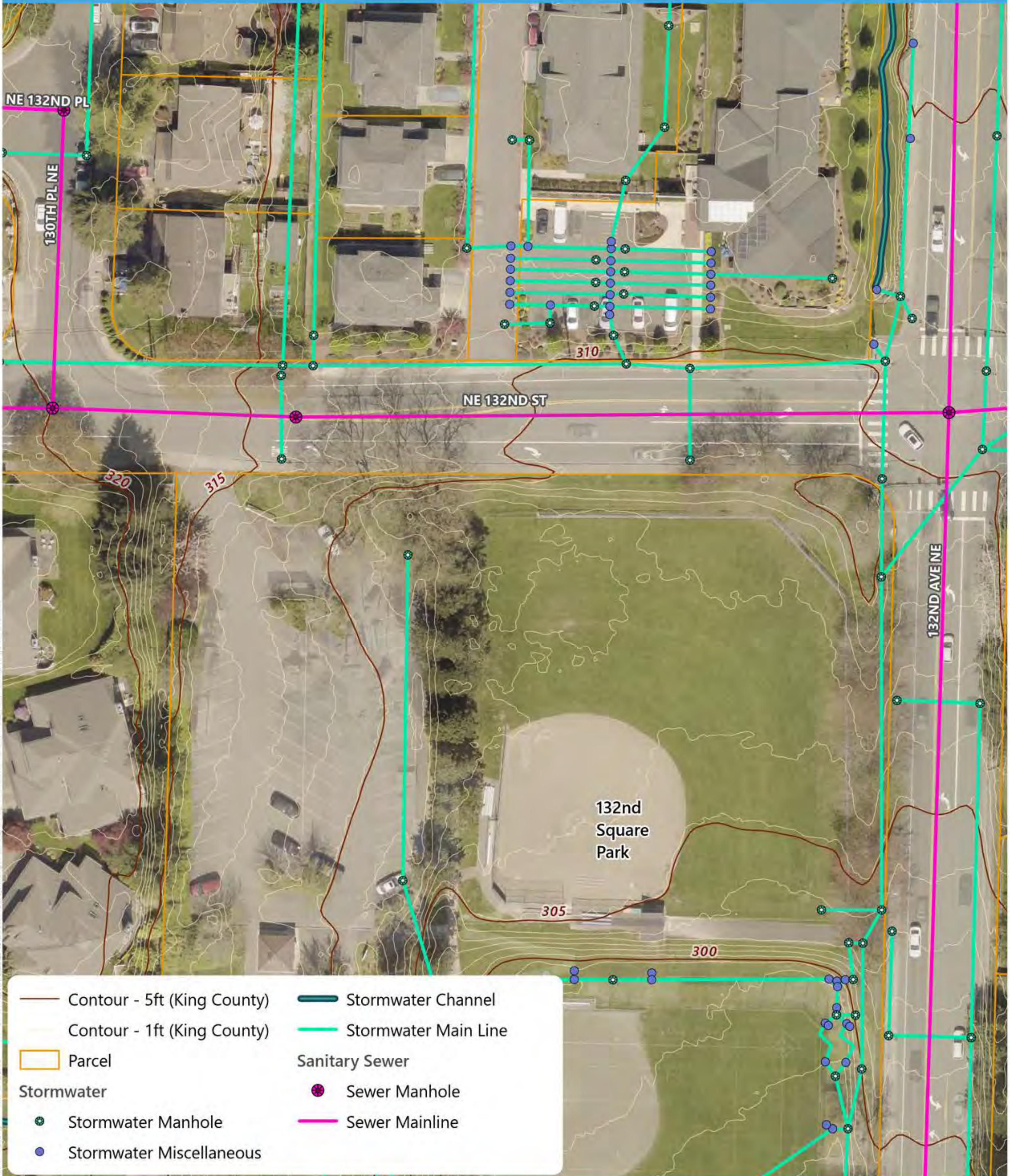


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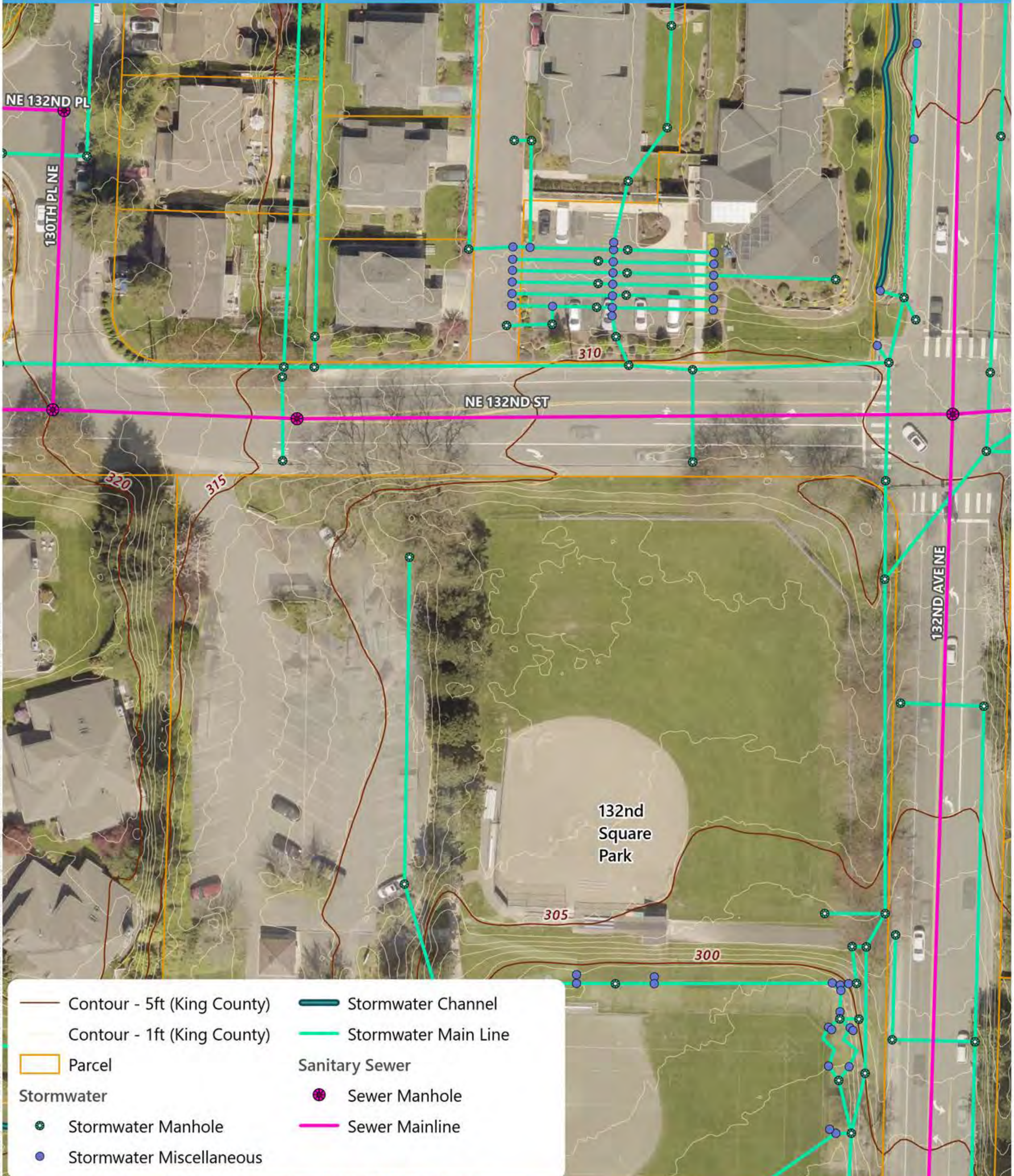
Figure 1.
132nd Square Park.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: King County, Aerial (2021), City of Kirkland

0 25 50 100 Feet

Attachment C

132nd Square Park Infield Surface Conversion
D.A. Hogan Memorandum

HERRERA
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MEMORANDUM

To: Neil Schaner, PE, Herrera

Cc: Eliza Hoffman, Herrera

From: Eric Gold

Date: July 10, 2025

Re: City of Kirkland Parks
132nd Square Park Infield Surface Conversion
Draft Feasibility Study Narrative

Existing Conditions

The following are our observations of existing conditions associated with the infield playing surface and immediately adjacent surfaces only. Fencing, Player & Spectator amenities, and outfield conditions were not assessed. Refer also to the attached "Existing Conditions" exhibit. Images follow.

- Fully "Skinned" Infield, consisting of approximately 2.5" of clay/silt/sand infield soil mix, over a thin layer of coarse sand (image 1).
- Assumed no underdrainage present.
- No fence line / containment curb (image 2).
- Grade irregularities around foul lines / foul territory and the infield "arc" (images 3, 4).
- Mostly even transitions between the foul lines (image 5).
- Surface slopes varied from 1.5% to 5% across the infield surface.
- The existing infield/outfield arc is not consistent with accepted "typical" little league baseball rules for dimension, i.e., a 60' radius drawn from the front-center of a pitching slab at 46'.

Design Assumptions / Conclusions

The following considerations apply to any Option presented.

- Lacking any existing subsurface drainage infrastructure will require a solution that employs a full-section approach using, at a minimum, a permeable aggregate foundation and formal subsurface drainage system.
- Subsurface drainage will discharge to a conveyance per Herrera.
- The lack of any perimeter containment curbs suggests two options, one using new poured-in-place concrete curbs to both contain the field foundation section and to support the synthetic turf edge anchor (see Typical Details).
- The variable surface slope and irregularities around both foul territories will require a more significant than typical transition regrade and restoration, particularly down the first base foul line and foul territory. Some of this may be remedied via the expansion of the infield/outfield arc.
- Significant adjustments / retrofit of the existing irrigation zones around the arc will be required.

Option 1, Traditional Full-Section Conversion

- Trenched 4" perforated drainage laterals, spaced 15' on center, piped to a 6" tight-line collector. Orientation of the drainage laterals as shown simplifies the collector pipe required and takes advantage the existing average surface gradient.
- A solid-piped collector will convey stormwater to Herrera for code compliance and discharge.
- Non-woven geotextile separator fabric between drainage trenches, on a prepared (planar, unyielding) subgrade.
- 8" of permeable aggregate base course (rough graded), 2" of permeable aggregate top course (fine graded) will comprise the field foundation/base. This allows for both vertical and lateral infiltration of stormwater through the surface, base, and to the subsurface drainage trenches.
- Synthetic turf surfacing of an approved specification, along with irrigation retrofit and site restoration completes this installation.

Option 2, Flat-Drains, Full-Section

- Grading design identifies a uniform and consistent slope and aspect, in this case approximately 1.5% sloping parallel to and away from the 3rd base line. The subgrade is prepared to spec tolerance planarity and density.
- Perforated collectors are installed from a central control structure, in this case a simple Type 1 CB with a solid lid. This structure should be buried as it will be "in play". Herrera will provide conveyance to code compliance and discharge.
- Non-woven geotextile separator fabric is placed across the entire subgrade.
- Flat Drains, typically 1.5" high x12" wide, are arranged diagonally across the prepared subgrade (as shown), emptying into the perforated collector trenches via gravity. This arrangement generates approximately 1% of pipe gradient running across our 1.5% sloped subgrade.
- 8" of permeable aggregate base course (rough graded), 2" of permeable aggregate top course (fine graded) will comprise the field foundation/base. This allows for both vertical and lateral infiltration of stormwater through the surface, base, and to the subsurface drainage trenches.
- Synthetic turf surfacing of an approved specification, along with irrigation retrofit and site restoration completes this installation.

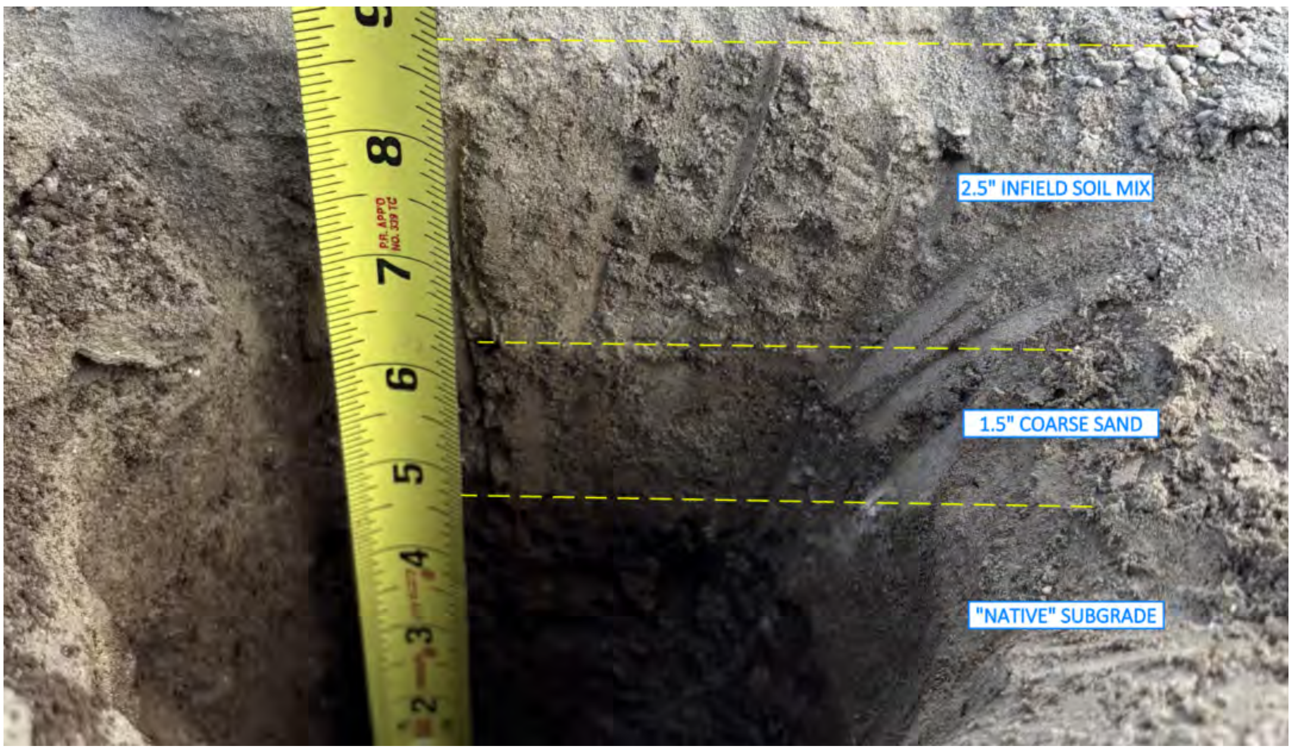


Image 1, Soil Profile

Image 2, typical fenceline condition

Image 3, Grade Irregularities

Image 4, 3rd Base Line / Foul Territory Grade Irregularities

Image 5, 1st Base Line / Foul Territory Grade Irregularities

Image 6, Relatively even transitions between the foul lines

DA HOGAN

July 9, 2025

Infield Synthetic Turf Conversion Study

Existing Conditions

"Skinned" Infield
No subsurface drainage
Soil-Based Natural Grass
Variable cross-slope

City of Kirkland, WA
Parks and Community Services

132nd Square Park
13159 132nd Ave NE
Kirkland 98034

DA HOGAN

July 9, 2025

N

0 30' 60'

SCALE: 1" = 30'

Infield Synthetic Turf Conversion Study

Option 1

Trenched 4" Drainage Tubing
Tight-Line Collector
New Fence-line Curb
Synthetic Turf Surfacing
Sodded Natural Grass Transition

City of Kirkland, WA
Parks and Community Services

132nd Square Park
13159 132nd Ave NE
Kirkland 98034

DA HOGAN

July 9, 2025

N

0 30' 60'

SCALE: 1" = 30'

Infield Synthetic Turf Conversion Study

Option 2

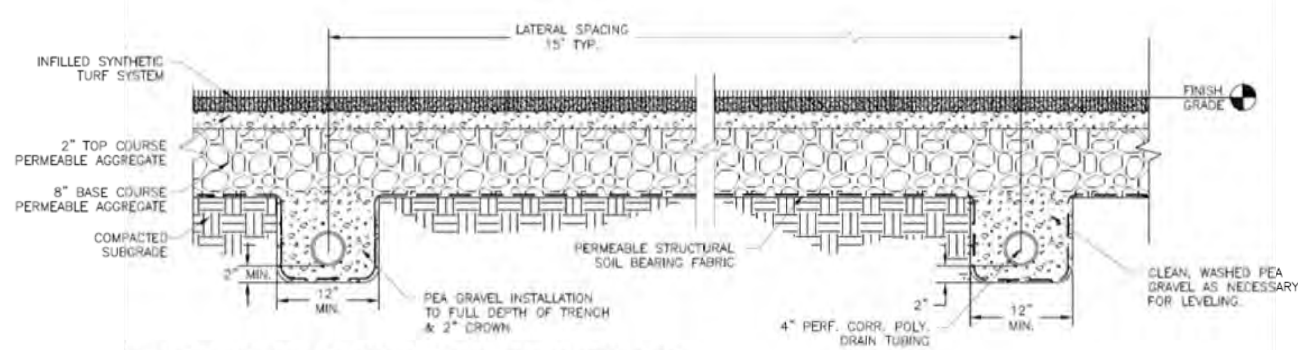
Flat Drains on subgrade
Perforated Collector
New Fence-line Curb
Synthetic Turf Surfacing
Sodded Natural Grass Transition

City of Kirkland, WA
Parks and Community Services

132nd Square Park
13159 132nd Ave NE
Kirkland 98034

DA HOGAN

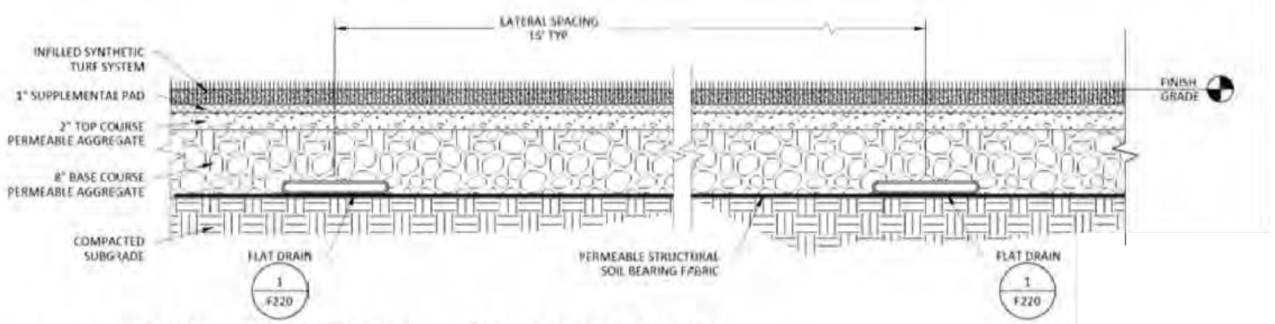
July 9, 2025



A TRADITIONAL FULL-SECTION

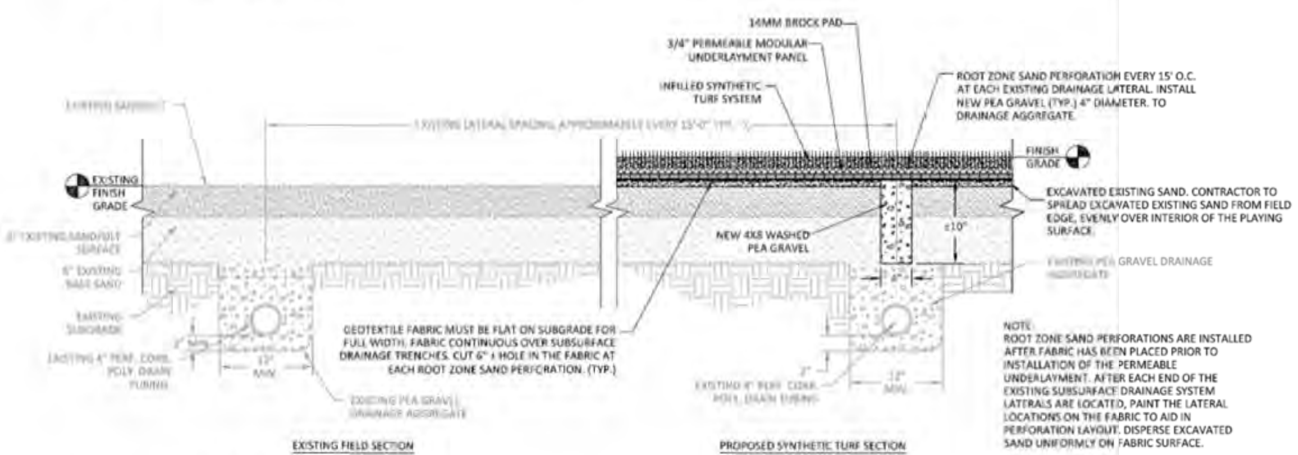
NOT TO SCALE

CRESTWOODS NOTE: REPLACE EXISTING DRAINAGE AGGREGATE



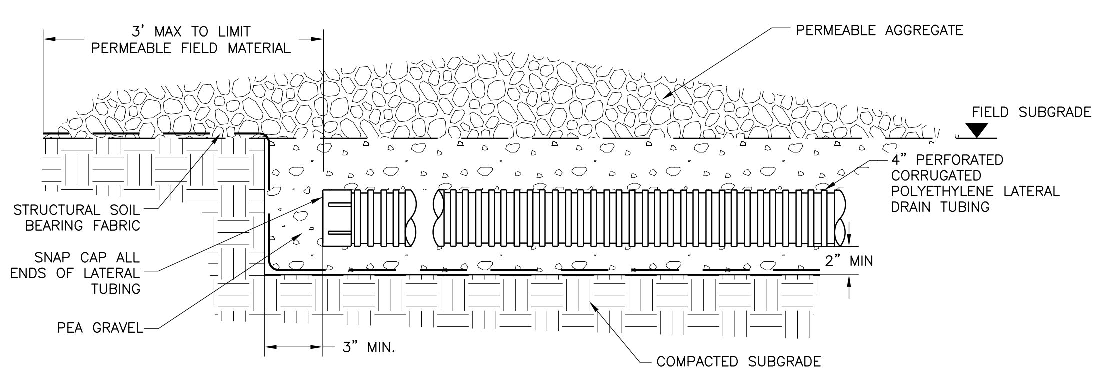
B FULL-SECTION w/FLAT DRAINS

NOT TO SCALE



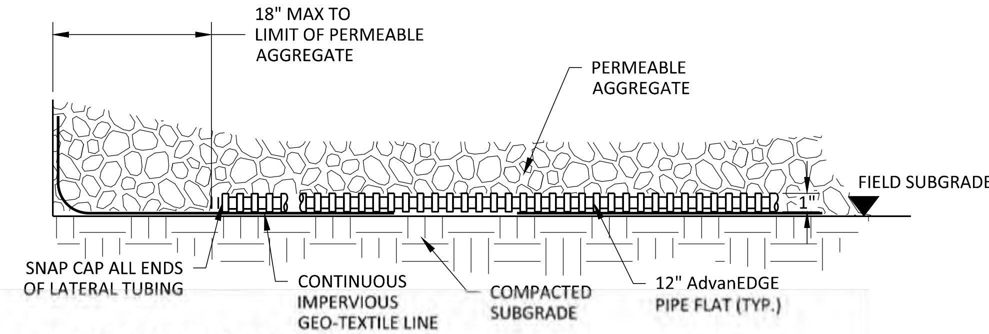
C OVERLAY

NOT TO SCALE



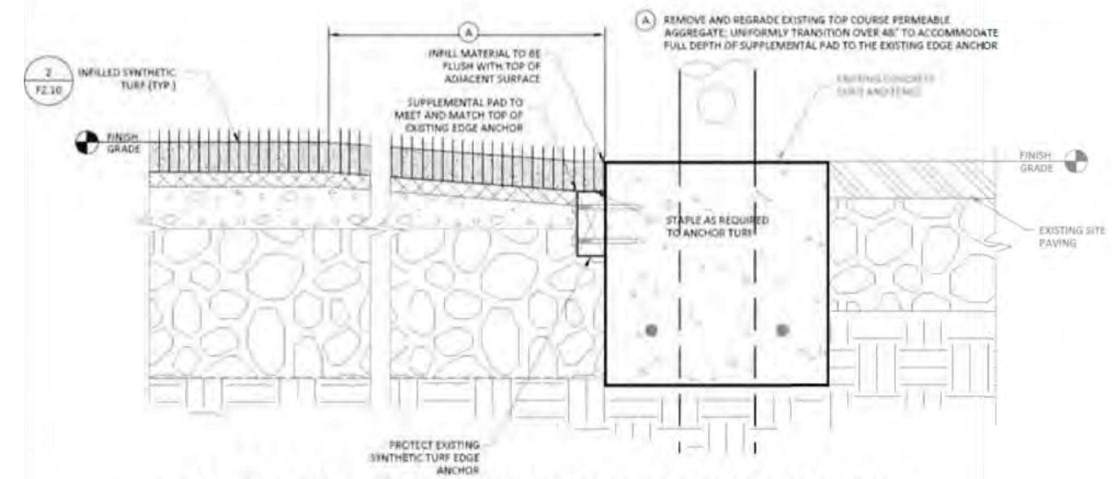
D TRENCHED SUBSURFACE DRAINAGE

NOT TO SCALE



E FLAT / PANEL DRAIN

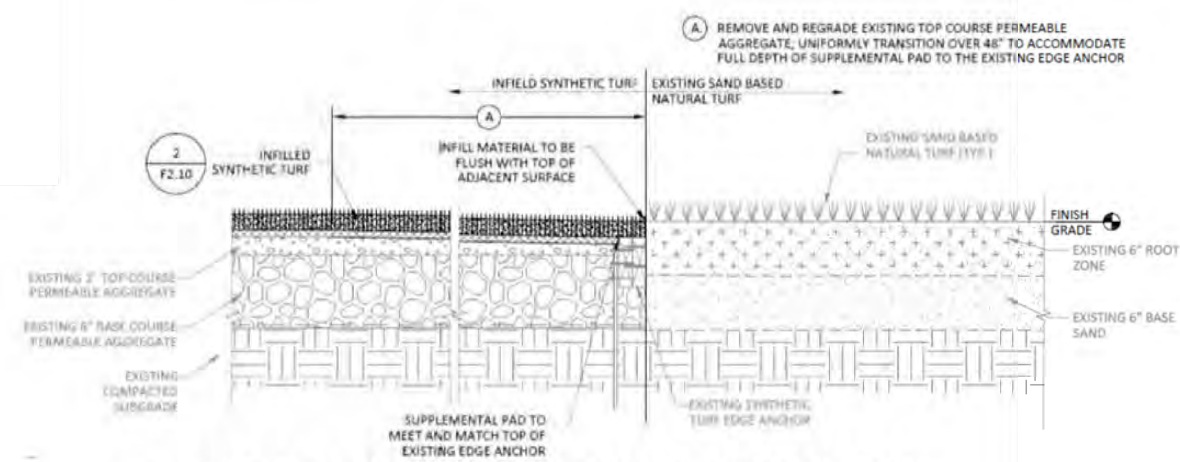
NOT TO SCALE



F CONTAINMENT CURB & EDGE ANCHOR

NOT TO SCALE

CRESTWOODS NOTE: CURB IS EXISTING



G EDGE ANCHOR @ GRASS TRANSITION

NOT TO SCALE

Infield Synthetic Turf Conversion Study

Typical Details

City of Kirkland, WA
Parks and Community Services

132nd Square Park
13159 132nd Ave NE
Kirkland 98034

Attachment D

Crestwoods Park Stormwater Alternatives

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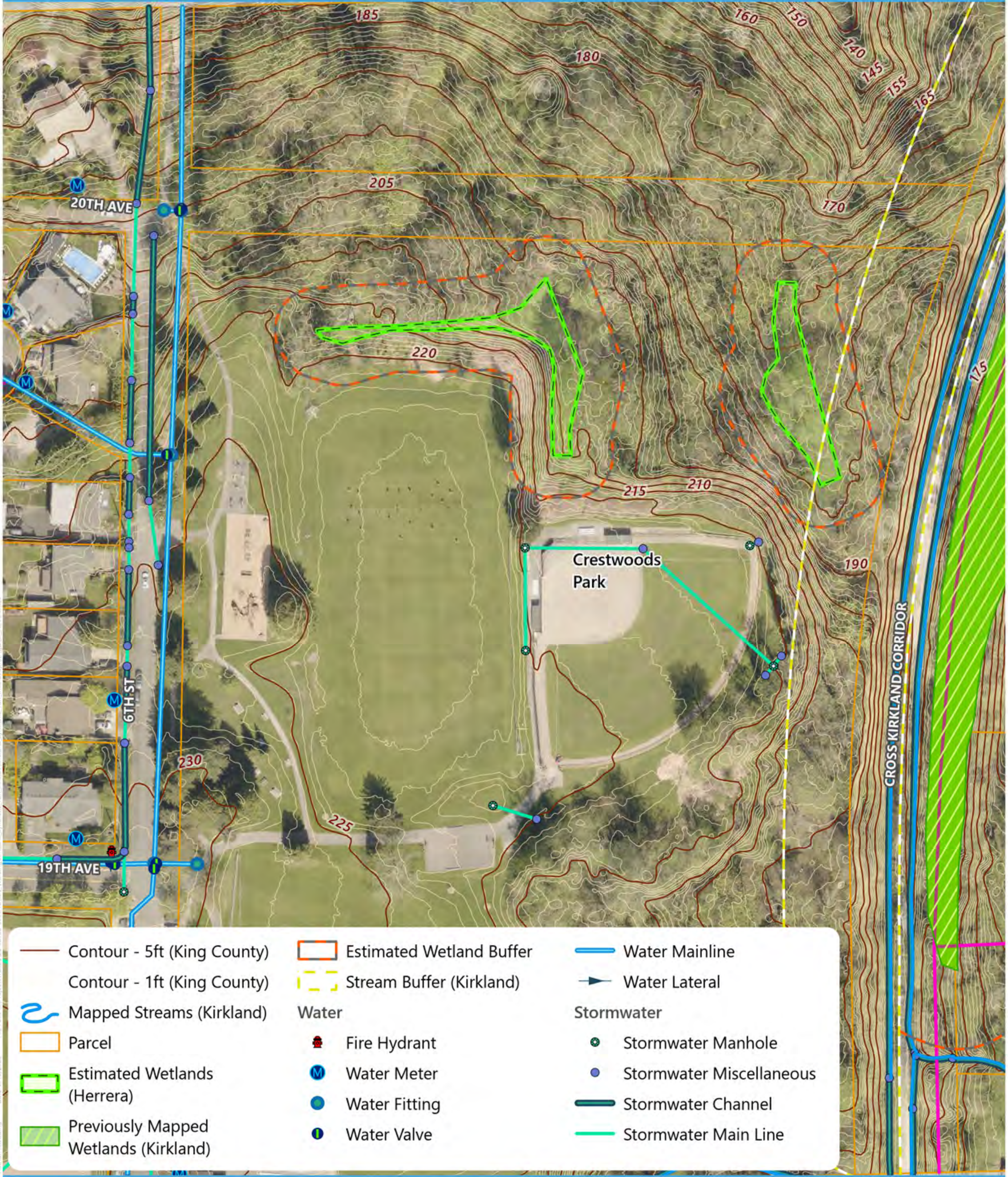
Figure 1. Crestwoods Park.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: King County, Aerial (2021), City of Kirkland

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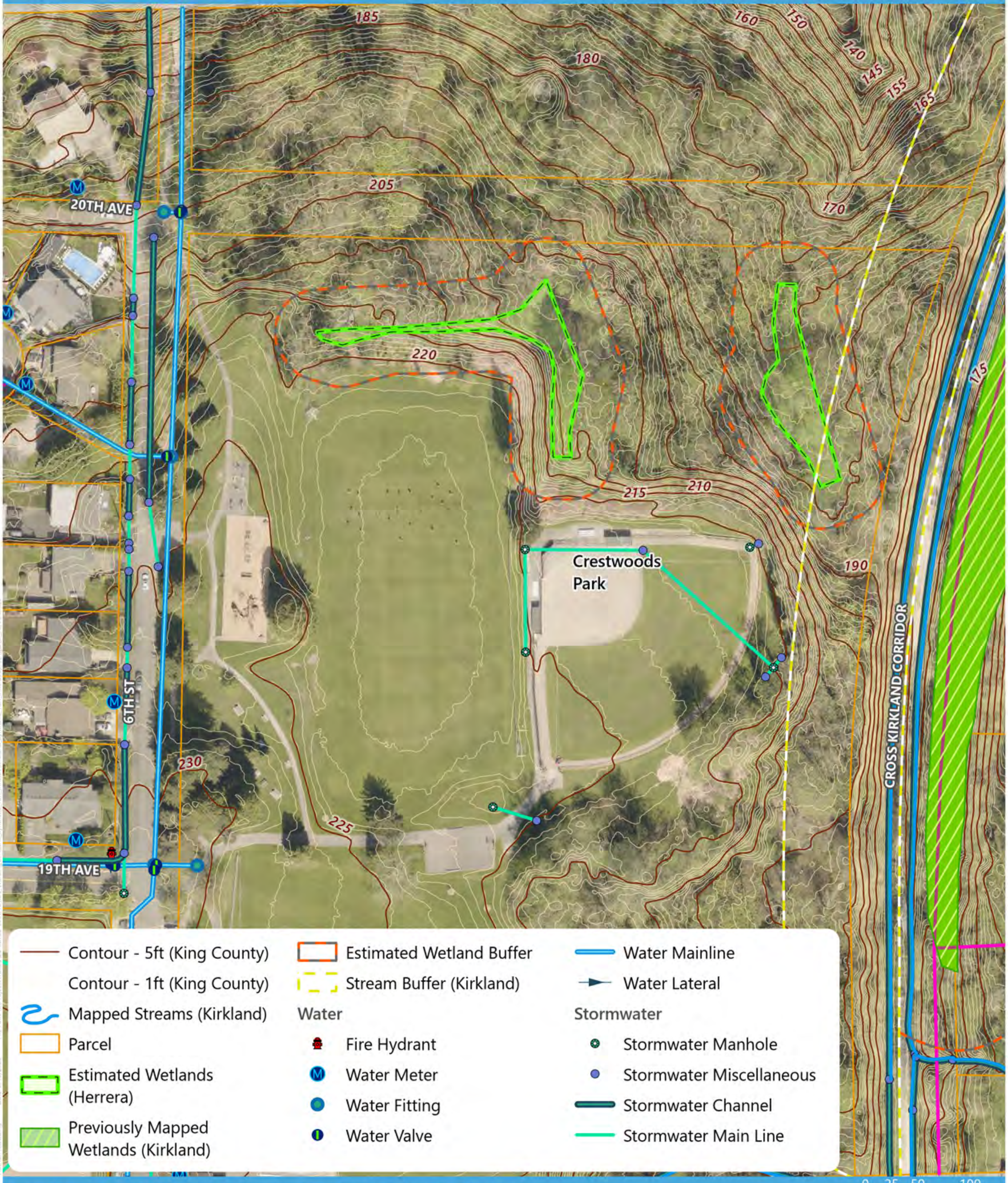
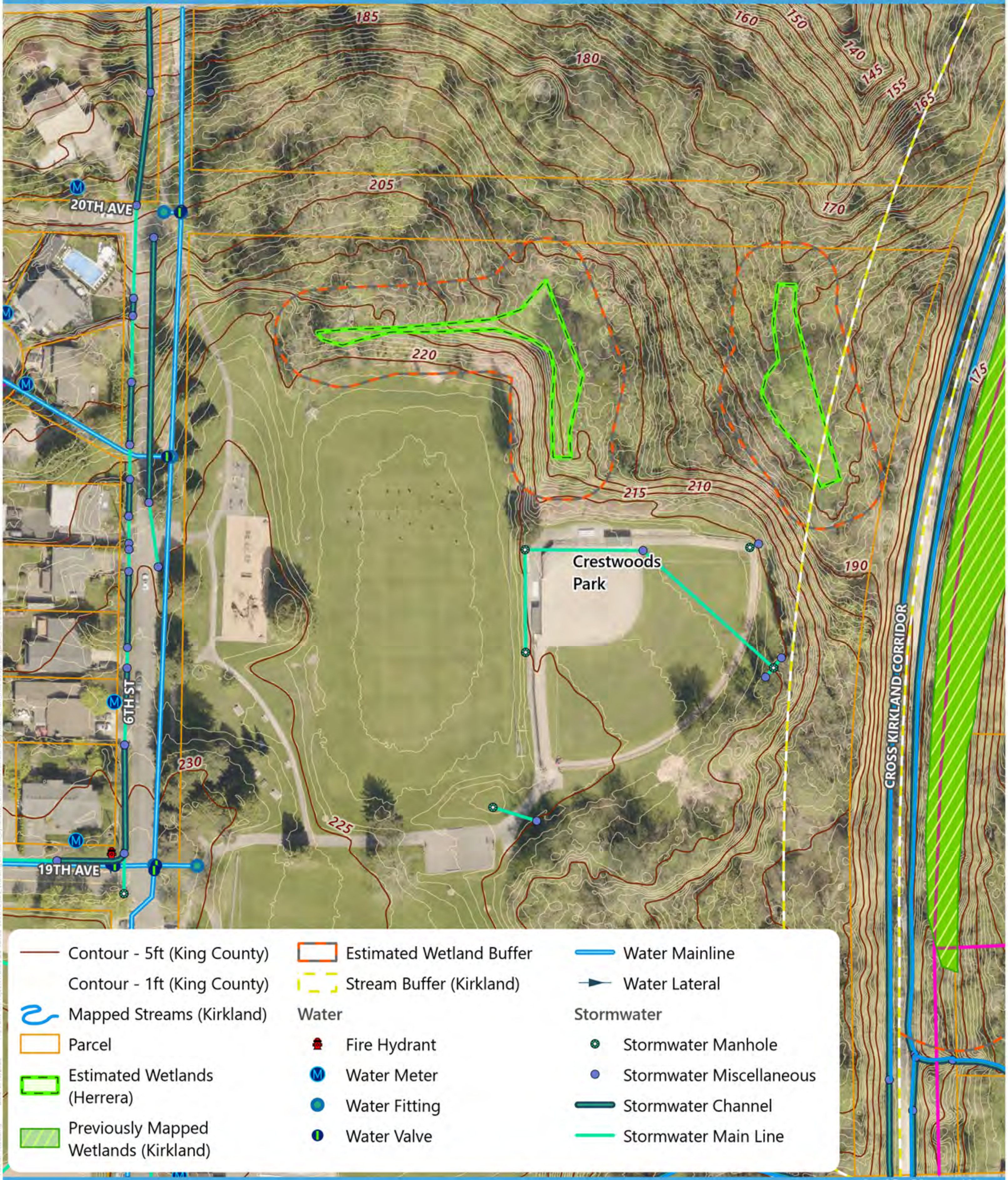
Figure 1.
Crestwoods Park.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: King County, Aerial (2021), City of Kirkland

HERRERA
Science + Planning + Design

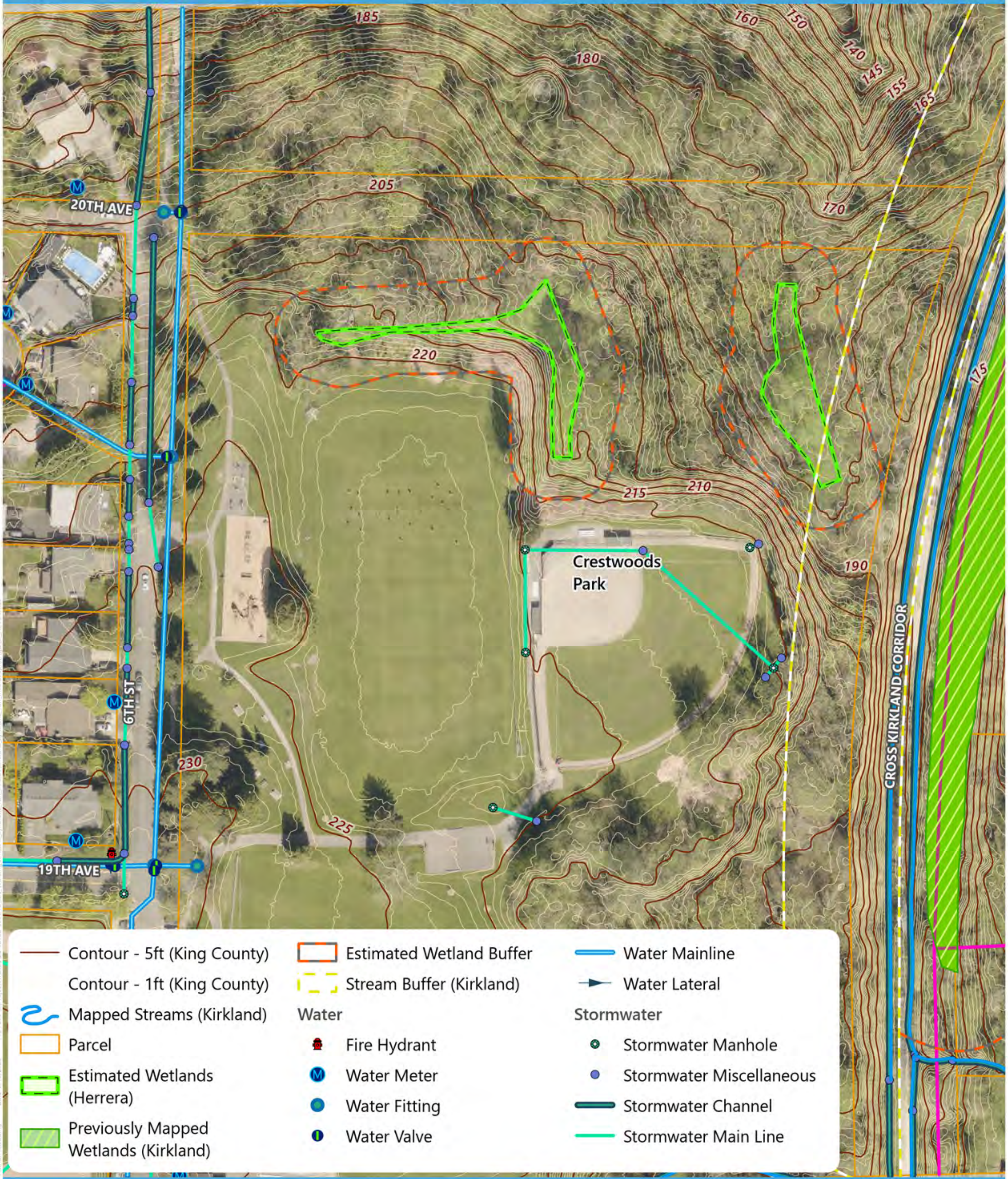
Figure 1.
Crestwoods Park.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: King County, Aerial (2021), City of Kirkland

HERRERA
Science + Planning + Design

Figure 1.
Crestwoods Park.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: King County, Aerial (2021), City of Kirkland

Attachment E

Crestwoods Park Infield Surface Conversion
D.A. Hogan Memorandum

HERRERA
Science + Planning + Design

MEMORANDUM

To: Neil Schaner, PE, Herrera

Cc: Eliza Hoffman, Herrera

From: Eric Gold

Date: July 10, 2025

Re: City of Kirkland Parks
Crestwoods Park Infield Surface Conversion
Draft Feasibility Study Narrative

Existing Conditions

The following are our observations of existing conditions associated with the infield playing surface and immediately adjacent surfaces only. Fencing, Player & Spectator amenities, and outfield conditions were not assessed. Refer also to the attached "Existing Conditions" exhibit. Images follow.

- Fully "Skinned" Infield, consisting of approximately 6" of clay/silt/sand infield soil mix, over 6" of coarse sand, consistent with the record of 2005 improvements. The constituent materials were unscientifically "tested" via a simple water-settlement process to determine approximate particle gradations (see attached "Crestwoods Park Section Sampling"), and while generally containing higher percentages of fines than might be desirable, the materials seem perfectly functional in the context of the installation.
- Subsurface drainage system was located and a sample of the drainage aggregate backfill was obtained. Visually, the aggregate was immediately observed to be far courser than desired, generally 1-½" x½" crushed washed stone. While this material has it's uses, the large void spaces do not allow "bridging" of the sand materials above, and so we found (via testing as above) roughly 20% of the expected 35% void space to be occupied by sand and fines.
- Fence line includes a consistent concrete containment curb.
- Grades are generally uniform across the site, assumed to match the 2005 record at 1.67% diagonally SW to NE.
- The existing infield/outfield arc is not consistent with accepted "typical" little league baseball rules for dimension, i.e., a 60' radius drawn from the front-center of a pitching slab at 46'.

Design Assumptions / Conclusions

The following considerations apply to any Option presented.

- The existing subsurface drainage system is suitable for re-use to varying degrees as described in the options.
- Subsurface drainage will discharge to a conveyance per Herrera.
- The amount of transition grading required will be greatly reduced by the uniform slope.
- Significant adjustments / retrofit of the existing irrigation zones around the arc will be required due only to the assumed reconfiguration of the arc to suit little league expectations.

Option 1, "Overlay" Conversion

- This unique approach usually falls under WAC 197-11-800 Categorical Exceptions SEPA Exemption for Recreational Facilities Maintenance as it a) does not disturb subgrade and b) generates little-to-no waste.
- Prior to beginning the work in earnest, the existing subsurface drainage system needs to be located. We know that the westernmost drainage lateral is located exactly 4' east of the first base dugout fenceline, so this should not be difficult. The 2005 record indicates a 15' o.c. installation.
- A transition is established around the installation perimeter to allow the finished surface of the synthetic turf to meet and match flush to surrounding surfaces as appropriate – this consists of the synthetic turf, supplemental pad (if required), and turf infill materials depths combined. This will also set the height of the turf edge anchor. For fully-skinned infields, the excavated material can be dispersed (scattered, lost) across the interior surface.

- The existing surface is then prepared by removing all unwanted vegetation, dragging to a uniform grade, and rolling to a firm and unyielding condition. The surface is then covered completely with an 8oz/sy non-woven geotextile.
- Penetrations to the existing subsurface drainage laterals, “chimney drains”, are then created by simply cutting a 12” “X” in the fabric and auguring 6” diameter holes to the drainage aggregate on a 15’ o.c. grid. The waste material from this is so incidental it too can be dispersed across the surface. The holes are filled with #4x#8 pea gravel to grade.
- A pre-molded, interlocking, panelized drainage tile is then installed, trimming neatly to all of the perimeter edges.
- Synthetic turf surfacing of an approved specification, along with irrigation retrofit and site restoration completes this installation.

Option 2 Full-Section Conversion w/Drainage “Refresh”

- This approach begins with the excavation and disposal of a 12” depth of the existing infield soils and base sand to subgrade.
- The existing 4” perforated pipe are exposed to the springline by removing all of the existing over-sided aggregate and sand/silt contaminants, which is replaced with #4x#8 pea gravel to subgrade.
- Non-woven geotextile separator fabric between drainage trenches, on a prepared (planar, unyielding) subgrade.
- 8” of permeable aggregate base course (rough graded), 2” of permeable aggregate top course (fine graded) will comprise the field foundation/base. This allows for both vertical and lateral infiltration of stormwater through the surface, base, and to the subsurface drainage trenches.
- Synthetic turf surfacing of an approved specification, along with irrigation retrofit and site restoration completes this installation.

Option 3, Flat-Drains, Full-Section

- Grading design identifies a uniform and consistent slope and aspect, in this case approximately 1.67% sloping from SW to NE. The subgrade is prepared to spec tolerance planarity and density.
- The existing collector is intercepted with a Type 1 CB / control structure, in this case a simple Type 1 CB with a solid lid. This structure should be buried as it will be “in play”.
- A perforated collector is installed from the control structure to the limit of the infield work, where it will transition to a solid pipe. Herrera will provide conveyance to code compliance and discharge.
- Non-woven geotextile separator fabric is placed across the entire subgrade.
- Flat Drains, typically 1.5” high x12” wide, are arranged diagonally across the prepared subgrade (in this case, parallel to the third base line as shown), emptying into the perforated collector trench via gravity. This arrangement generates approximately 1.2% of pipe gradient running across our 1.67% sloped subgrade.
- 8” of permeable aggregate base course (rough graded), 2” of permeable aggregate top course (fine graded) will comprise the field foundation/base. This allows for both vertical and lateral infiltration of stormwater through the surface, base, and to the subsurface drainage trenches.
- Synthetic turf surfacing of an approved specification, along with irrigation retrofit and site restoration completes this installation.

DA HOGAN

July 9, 2025

N

0 30' 60'

SCALE: 1" = 30'

Infield Synthetic Turf Conversion Study

Existing Conditions

Standard "Skinned" Infield
Existing Fence-line Curb
Standard 6"/6" Infield Section
Suspect Drainage System Backfills

City of Kirkland, WA
Parks and Community Services

Crestwoods Park
1818 6th St, Kirkland
WA 98033

DA HOGAN

July 9, 2025

N

0 30' 60'

SCALE: 1" = 30'

Infield Synthetic Turf Conversion Study

Option 1

"Chimney" Drains
Overlaid Panel Drains
Synthetic Turf

City of Kirkland, WA
Parks and Community Services

Crestwoods Park
1818 6th St, Kirkland
WA 98033

DA HOGAN
July 9, 2025

N
0
30'
60'
SCALE: 1" = 30'

Infield Synthetic Turf Conversion Study

Option 2

Full-Section Base
Replace Existing Drainage Aggregate
Limited Transition Zone Sod
Synthetic Turf

City of Kirkland, WA
Parks and Community Services

Crestwoods Park
1818 6th St, Kirkland
WA 98033

DA HOGAN

July 9, 2025

N

0 30' 60'

SCALE: 1" = 30'

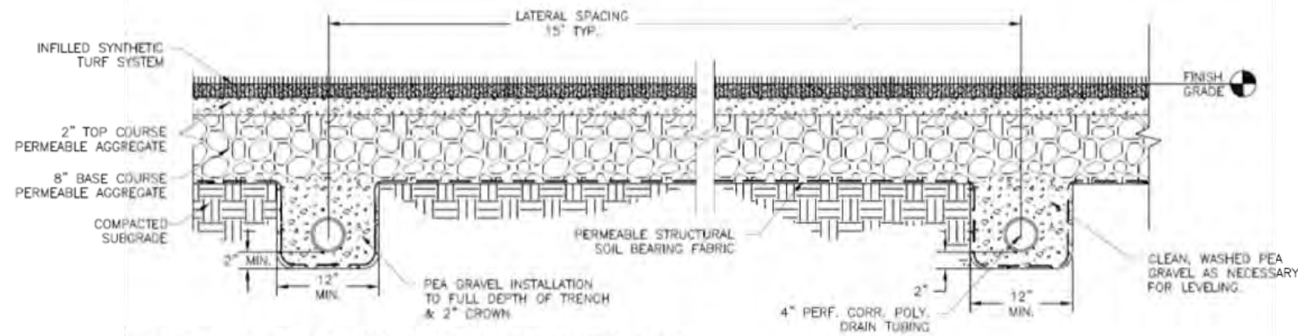
Infield Synthetic Turf Conversion Study

Option 3

Full-Section Base
Abandon Existing Drainage In-Place
New Flat Drains on Subgrade
Limited Transition Zone Sod
Synthetic Turf

City of Kirkland, WA
Parks and Community Services

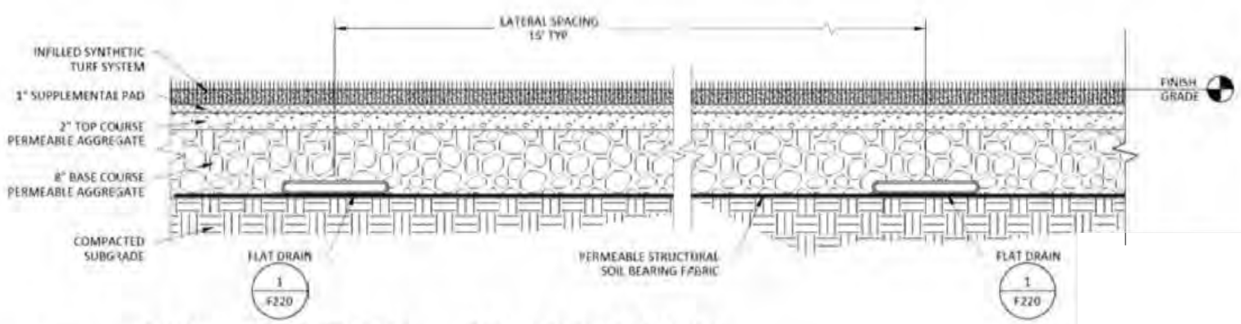
Crestwoods Park
1818 6th St, Kirkland
WA 98033



A TRADITIONAL FULL-SECTION

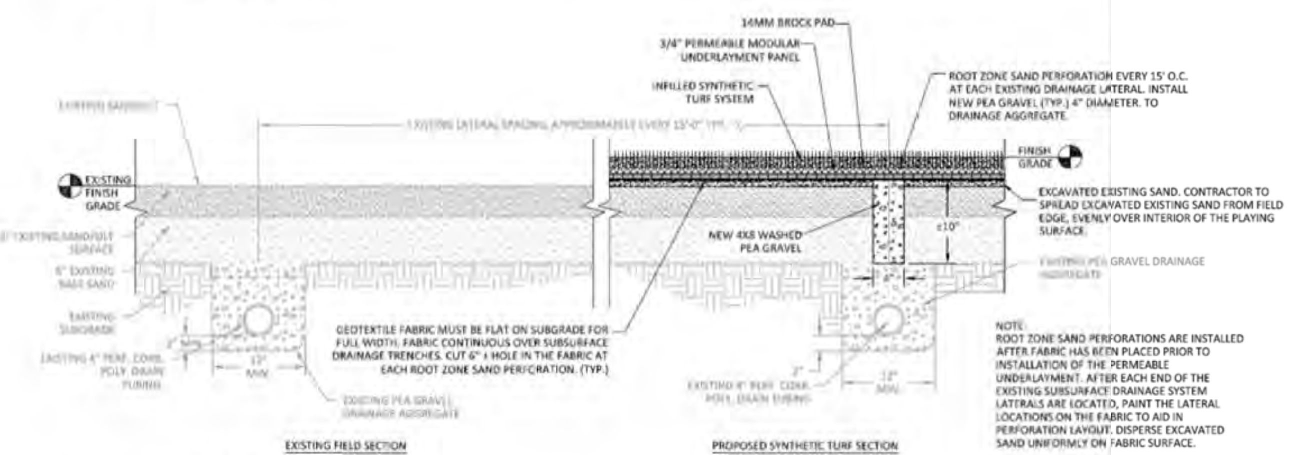
NOT TO SCALE

CRESTWOODS NOTE: REPLACE EXISTING DRAINAGE AGGREGATE



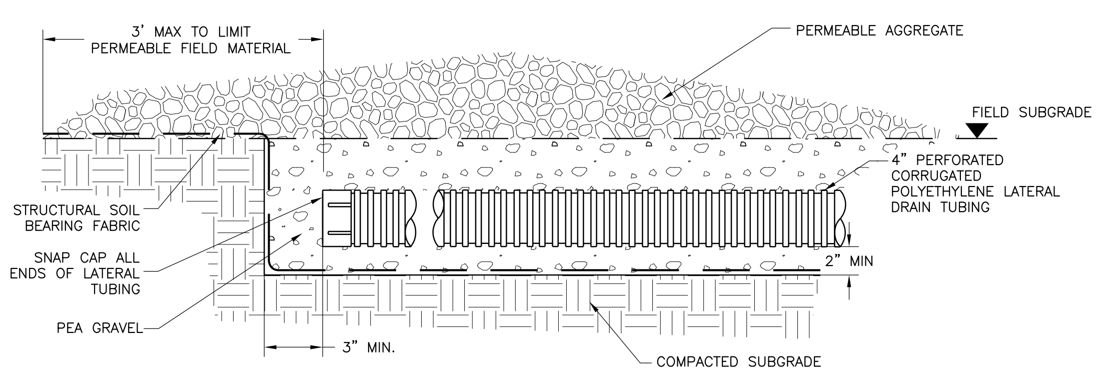
B FULL-SECTION w/FLAT DRAINS

NOT TO SCALE



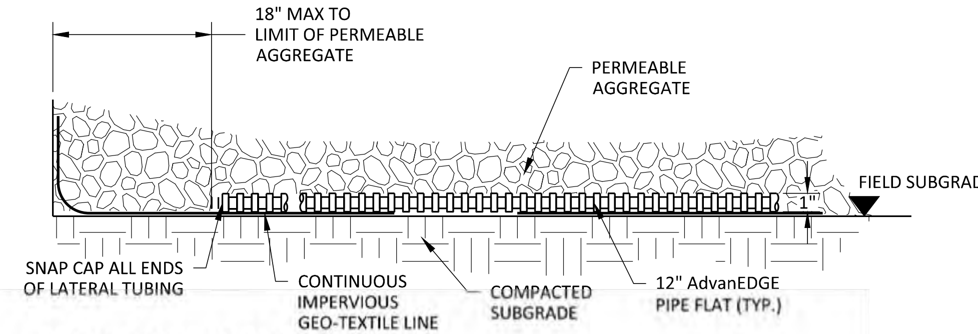
C OVERLAY

NOT TO SCALE



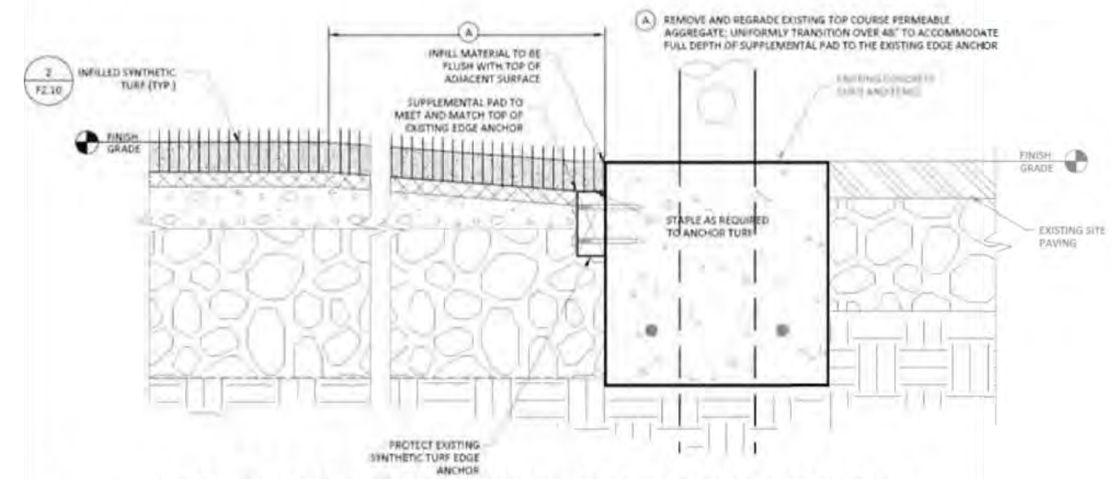
D TRENCHED SUBSURFACE DRAINAGE

NOT TO SCALE



E FLAT / PANEL DRAIN

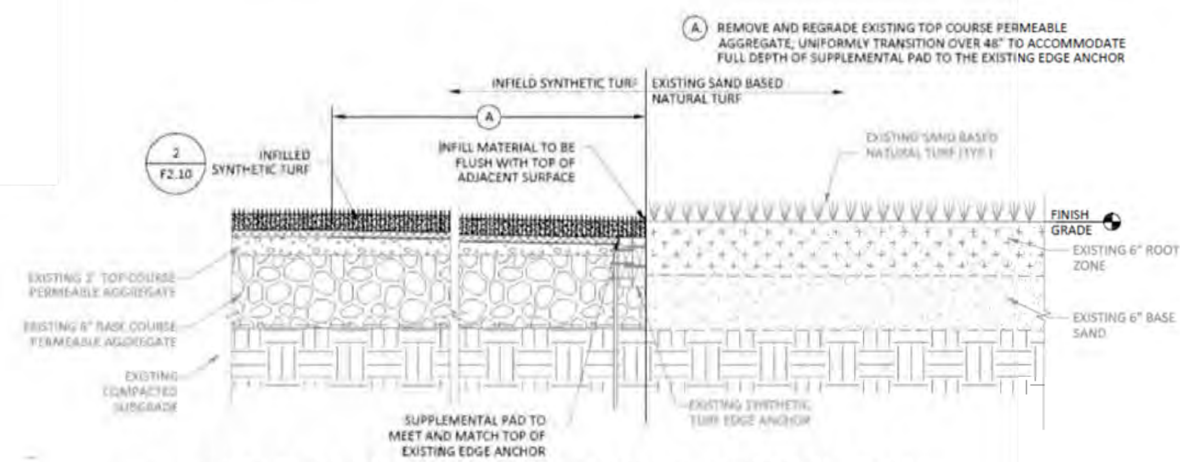
NOT TO SCALE



F CONTAINMENT CURB & EDGE ANCHOR

NOT TO SCALE

CRESTWOODS NOTE: CURB IS EXISTING



G EDGE ANCHOR @ GRASS TRANSITION

NOT TO SCALE

Infield Synthetic Turf Conversion Study

Typical Details

City of Kirkland, WA
Parks and Community Services

132nd Square Park
13159 132nd Ave NE
Kirkland 98034

Appendix B

Synthetic Turf Infield Analysis at Crestwoods Park and 132nd Square Park – Critical Areas

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Science + Planning + Design

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HERRERA
Science + Planning + Design

Date: August 26, 2025

To: Mariah Murphy, City of Kirkland Parks and Community Services

Copy to: Neil Schaner, Herrera Environmental Consultants, Inc.

From: Liliana Hansen and Shawree Zhang, Herrera Environmental Consultants, Inc.

Subject: Synthetic Turf Infield Analysis at Crestwoods Park and 132nd Square Park – Critical Areas

Contents

Appendices

Tables

Figures

Disclaimer

Note that this report only covers the following critical areas: wetlands, frequently flooded areas, minor lakes, and fish and wildlife habitat conservation areas (FWHCA) (which includes streams) (Kirkland Zoning Code [KZC] Chapter 90). This report excludes other critical areas that are geologically hazardous areas, such as erosion, landslide, and seismic hazard areas (KZM Chapter 85). This report does not include a tree inventory for the project site, which may be required if the proposed project could potentially impact significant trees.

The data documented in this report is based on a reconnaissance-level investigation and does not include official wetland delineation boundaries or stream delineations. All critical areas described and rated in this report are approximate and intended for planning purposes only. A formal wetland and stream delineation and ratings may be required by the City of Kirkland prior to any work within 300 feet of critical areas. A formal tree inventory may also be required if removing any trees within the project area.

Introduction

Herrera Environmental Consultants (Herrera) performed a wetland and stream reconnaissance for the City of Kirkland (City) on June 12, 2025, at two city parks. The City is proposing to convert two sand/silt infields to synthetic turf at two existing little league ballfields. This memorandum was produced to support the feasibility analysis effort for this project, documenting observations of potential existing critical areas based on reconnaissance-level field investigation of wetlands, streams, minor lakes, frequently flooded areas, and FWHCAs. This memorandum provides a preliminary analysis of existing conditions in the study areas.

Two sites were investigated during fieldwork. One site is located at Ballfield 4 at Crestwoods Park, west of the Cross Kirkland Corridor Trail and east of 6th Street. The other site is located at 132nd Square Park, south of Northeast 132nd Street and west of 132nd Avenue Northeast. The study areas include the ballfields and a 300-foot area around each infield (Figures 1a and 1b).

Both study areas are in Water Resource Inventory Area (WRIA) 8: the Cedar-Sammamish. Crestwoods Park is located within the Forbes Creek subbasin, while 132nd Square Park is located within the Juanita Creek subbasin.

Figure 1a.
Vicinity Map for Crestwoods Park.

HERRERA
Science + Planning + Design

Figure 1b.
Vicinity Map for 132nd Square Park.

File Path: K:\Projects\Y2025\25-08730-000\Pro\GIS_Working\Kirkland_Synthetic_Turf_Infields\Kirkland_Synthetic_Turf_Infields.aprx\Figure1_Vicinity
Date: 7/1/2025
Author: bBagniewski

Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: King County, Aerial (2023)

Methods

Preliminary Environmental Data Resources Review

The preliminary review of existing environmental data resources applicable to the subject property and its general vicinity included, but was not limited to, the following:

- National Wetlands Inventory (USFWS 2025)
- City of Kirkland online map (Kirkland 2025)
- Natural Resources Conservation Service online soil survey maps and soil descriptions (NRCS 2025b)
- Aerial photographs (Google Earth 2025)
- Washington Department of Natural Resources (WDNR) Water Typing System (WDNR 2025a)
- WDNR Natural Heritage Program database (WDNR 2025b)
- Washington State Department of Fish and Wildlife (WDFW) Priority Habitat and Species (PHS) Mapper (WDFW 2025a)
- SalmonScape Mapper (WDFW 2025b)

Wetlands Identification

Herrera performed field investigations on June 12, 2025. Herrera walked the study areas, identified locations within the study area that exhibited wetland characteristics, and used a Trimble GPS unit with sub-meter accuracy to locate approximate wetland boundaries. However, Wetland 1 was mapped based on the City of Kirkland wetlands layer (Kirkland 2025).

Herrera identified estimated wetland areas based on the presence of wetland indicators, including hydrology, soils, and vegetation. Hydrophytic vegetation is characterized by the ability to grow, effectively compete, reproduce, and persist in anaerobic soil conditions resulting from periodic or long-term saturation (Environmental Laboratory 1987). Herrera identified plant species using *Flora of the Pacific Northwest* (Hitchcock and Cronquist 1987) and *A Field Guide to the Common Wetland Plants of Western Washington and Northwestern Oregon* (Cooke 1997). Herrera biologists made notations regarding each observed plant species' estimated percentage of vegetation cover to determine the relative dominance of one plant over another within the overall vegetation community.

The indicator status of each plant species is based on the National Wetland Plant List (U.S. Army Corps of Engineers 2022) for the Western Mountains, Valleys, and Coast Region. As summarized in Table 1, five plant indicator status categories—Obligate (OBL), Facultative Wetland (FACW), Facultative (FAC), Facultative Upland (FACU) and Obligate Upland (UPL)—are regionally assigned based on a plant species' prevalence to grow in wetland or upland conditions. After reviewing the list of observed plants according to indicator status and the noted estimated percentage of vegetation cover, Herrera biologists determined if hydrophytic vegetation, typical of wetland conditions or non-hydrophytic vegetation, typical of upland conditions, was dominant within the study areas.

Table 1. Plant Indicator Status Categories.

Indicator Status	Indicator Symbol	Definition
Obligate wetland plants	OBL	Plants that occur almost always (estimated probability >99%) in wetlands under natural conditions but also occur rarely (estimated probability <1%) in upland areas
Facultative wetland plants	FACW	Plants that usually occur (estimated probability >67%) in wetlands under natural conditions but also occur (estimated probability 1% to 33%) in upland areas
Facultative plants	FAC	Plants with a similar likelihood (estimated probability 33% to 67%) of occurring in both wetlands and upland areas
Facultative upland plants	FACU	Plants that sometimes occur (estimated probability 1% to 33%) in wetlands but occur more often (estimated probability >67% to 99%) in upland areas
Obligate upland plants	UPL	Plants that rarely occur (estimated probability <1%) in wetlands under natural conditions
WET ⟵⟶ DRY *OBL – FACW – FAC – FACU – UPL*		

Source: Environmental Laboratory (1987).

A hydric soil is a soil that is saturated, flooded, or inundated long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation (Environmental Laboratory 1987, 2010). The evaluation of existing soil maps (developed by the U.S. Department of Agriculture [USDA] Natural Resources Conservation Service [NRCS] and other sources) is used to understand hydric soil distribution and to identify the likely locations of hydric soils (by verifying their inclusion on the hydric soils list). Comparison of these mapped soils to conditions found on site help verify the presence of hydric soils.

For onsite soils characterization, hydric soils data were obtained generally by digging test pits at least 16 inches deep and 4 inches wide. Hydric soil conditions were evaluated using indicators outlined in Field Indicators of Hydric Soils in the United States (NRCS 2017) and adopted by the Regional Supplement to the U.S. Army Corps of Engineers Wetlands Delineation Manual: Western Mountains, Valleys, and Coast Region (Environmental Laboratory 2010).

Hydric soil indicators applicable to the Western Mountains, Valleys, and Coast region include, but are not limited to, the presence of organic soils (i.e., histosols or histic epipedons); sulfidic material (i.e., hydrogen sulfide); depleted, gleyed, or reduced soil matrices; and/or the presence of iron or manganese concretions (Environmental Laboratory 2010). Soil color characterization (i.e., hue, value, and chroma) is a critical tool in determining depleted, gleyed, and reduced soil conditions. Soil color was evaluated by comparing soil colors at test plots to standardized color samples in Munsell Soil Color Charts (Munsell Color 2000).

Wetland hydrology is indicated by site conditions that demonstrate the periodic inundation or saturation to the soil surface for a sufficient duration during the total growing season. A sufficient duration during the growing season is defined as 14 or more consecutive days of flooding, ponding, or presence of a water table at 12 inches or less from the soil surface (Environmental Laboratory 2010). The growing season is the period of consecutive frost-free days, or the longest period during which the soil temperature stays above biological zero (41°F) when measured at 12 inches below the soil surface.

For this assessment, Herrera biologists examined onsite hydrologic indicators at the test plots during the growing season. Hydrologic indicators may include the presence of surface water, standing water in the test pit at a depth of 12 inches or less, saturation in the root zone, watermarks, drift lines, sediment deposits, drainage patterns within wetlands, oxidized rhizospheres surrounding living roots, and water-stained leaves.

Wetlands were preliminarily estimated utilizing the *Washington State Wetland Rating System for Western Washington: 2014 Update (Version 2)* (Hruby and Yahnke 2023). This methodology is used for determining the City's applicable regulated buffer widths for wetland protection, as designated in KZC 90.55. Preliminary rating forms were completed (Appendix A), based on the wetland reconnaissance boundaries. Final wetland rating forms should be completed after a full wetland delineation is completed.

Fish and Wildlife Habitat Conservation Areas

FWHCAs include habitat areas that a state or federally designated endangered, threatened, or sensitive species has a primary association with. FWHCAs also include state priority habitats and habitats with which state priority species have a primary association. These areas can be found in or near critical areas, forested areas, or Lake Washington (KZC 90.95).

Potential FWHCAs were determined based on resource map data, including WDFW PHS (WDFW 2025a), WDFW SalmonScape maps (WDFW 2025b), City of Kirkland GIS maps (City of Kirkland 2025), and personal communication with City of Kirkland staff. During the site visit, biologists also observed the existing habitat to determine if suitable habitat was available for state or federally listed species or priority species and noted any direct observations of ESA-listed species and priority species.

Streams are classified as FWHCAs. During the site visit, biologists visually assessed the presence/absence of streams within the study area but the ordinary high water mark was not located. The City of Kirkland GIS stream layers were also reviewed (City of Kirkland 2025).

Other Critical Areas

Minor Lakes

Minor lakes in Kirkland include Totem Lake and Forbes Lake. These lakes are mapped and regulated by the City due to the high quantity of wetlands along their perimeters. All activities and uses in the shallow areas of both lakes that relate to contiguous wetlands located above the ordinary high water mark are regulated by the City (KZC 90.90).

Frequently Flooded Areas

Frequently flooded areas are areas of special flood hazard. These areas are mapped by the Federal Emergency Management Agency (FEMA), and no disturbance, land surface modification, improvements, or activities may be located within them. Frequently flooded areas in the study area were reviewed on the City of Kirkland's GIS map.

Assessment Results

Background Data Review

Crestwoods Park

The City of Kirkland maps two unnamed streams on the eastern edge of the study area which parallel the Cross Kirkland Corridor trail. A wetland is mapped adjacent to the easternmost stream (Figures 2a and 2b) (Kirkland 2025). No potential FWHCAs (other than streams), lakes, or frequently flooded areas are mapped within the study area.

"High susceptibility landslide" and "moderate susceptibility landslide" areas, as well as "liquefaction potential" areas, are mapped within the study area. These are geologically hazardous areas (City of Kirkland 2025). Geologically hazardous areas are not covered by this report.

WDFW does not map any priority habitats or species in the vicinity of Crestwoods Park, and does not map any streams or fish presence within the study area (WDFW 2025a and WDFW 2025b). However, City of Kirkland staff have observed cutthroat trout (*Onchorhynchus clarkii*) in ditched tributaries to Forbes Creek with similar habitat conditions, located northeast of Streams 1 and 2. Assumedly, cutthroat trout may also be present in Streams 1 and 2 (E. Henrichsen, City of Kirkland, personal communication, July 10, 2025).

NRCS maps two types of soil within the study area: Indianola loamy sand, 5 to 15 percent slopes; and Ragnar-Indianola association, moderately steep (NRCS 2025b).

The Indianola soil series is a somewhat excessively drained soil found on terraces, kames, and eskers, with a parent material of sandy glacial outwash. A typical soil profile includes slightly decomposed plant material, loamy sand, and sand. Indianola is a non-hydric soil. Within the study area, Indianola soil includes minor components of Alderwood, Everett, and Norma soils. Of the minor components, only Norma is considered a hydric soil (NRCS 2025b).

Ragnar soil is a well-drained soil found on terraces, kames, and eskers that originates from glacial outwash as well. A typical soil profile includes ashy fine sandy loam and loamy sand. It is not rated as a hydric soil. No other soil components are mapped in the study area (NRCS 2025b).

132nd Square Park

No wetlands, minor lakes, frequently flooded areas, or FWHCAs (including streams) are mapped within the 132nd Square Park study area (City of Kirkland 2025).

The City maps a "high liquefaction potential" area within the study area. This is a geologically hazardous area (City of Kirkland 2025). Geologically hazardous areas are not covered by this report.

WDFW does not map any priority habitats or species in the vicinity of 132nd Square Park (WDFW 2025a and WDFW 2025b).

NRCS maps one soil type within the study area: Alderwood gravelly sandy loam, 8 to 15 percent slopes. Alderwood soil is a moderately well-drained soil, typically found on hills and ridges, with a parent material of glacial drift and/or glacial outwash over dense glaciomarine deposits. It has a typical profile of gravelly sandy loam and very gravelly sandy loam. Alderwood is a non-hydric soil. Within the study area, minor components of Indianola, Everett, Shalcar, and Norma soils may be present. Of the minor components, Shalcar and Norma are considered hydric soils.

Existing Environmental Conditions

Precipitation Data

Precipitation characteristics in the weeks and months preceding the site investigation are important to understand the potential for drier or wetter than normal conditions on the site. Nearby precipitation gage records were evaluated for that purpose. Precipitation data were obtained from the Natural Resources Conservation Service WETS database (NRCS 2025a). The historical average measurements were based on data collected in Seattle, Washington (WETS Station Seattle Sand Point WFO [Latitude 47°68'N, Longitude 122°25'W]) for the period of record 1995 to 2025. That station is approximately 2.5 miles west of the study area.

Precipitation was evaluated for a 3-month period prior to field investigations on June 12, 2025. In the 3 months preceding the field investigations, the conditions for March, April, and May were normal (NRCS 2025a) (Table 2). In the 10 days leading up to fieldwork, 0 inches of rain was recorded (NRCS 2025a).

Often seasonally saturated/inundated wetlands in western Washington dry out by end of May or June. Therefore, site investigations conducted in the late spring can result in lack of hydrology, even though precipitation levels may be "normal."

Table 2 Evaluation of Normal Precipitation for the 3-month Period Preceding Field Investigations.

Prior Month	WETS Rainfall Percentile (inches)		Measured Rainfall (inches)	Condition: Dry, Wet, Normal
	30th	70th		
May	1.48	2.66	2.06	Normal
April	1.95	3.26	2.22	Normal
March	2.89	4.52	3.87	Normal
Resultant Conditions for June: Normal				

Crestwoods Park

Herrera biologists identified three potential wetlands within the Crestwoods Park study area: Wetland 1, Wetland 2, and Wetland 3 (Figure 2a). The boundaries of potential wetland areas shown in Figure 2a are approximate. They are based on field observations and City of Kirkland GIS wetland layer (City of Kirkland 2025). Two unnamed streams (Stream 1 and Stream 2) are mapped by the City of Kirkland near the eastern extent of the study area (Figure 2a).

Ballfield 4

The Crestwoods Park Ballfield 4 includes a flat sand/silt infield and mowed grass outfield that is heavily managed/maintained (Photo 1). The outfield is routinely mowed, fertilized, irrigated, and overseeded two to three times a year. The infield is top-dressed with sand once a year and has an underdrain system. Pesticides are applied as needed at the beginning and end of each growing season.

Photo 1. View of the infield and outfield at Ballfield 4 (June 12, 2025).

Vegetation in the outfield was dominated by bentgrasses (*Agrostis* spp.) and bluegrasses (*Poa* spp.), and white clover, which are facultative species. All vegetation is mowed regularly to less than 2 inches tall.

Soils in the outfield displayed hydric soil indicators, including a depleted matrix with redoximorphic concentrations in the upper 12 inches. However, the soils consist of imported sand, and the soil profile is entirely artificial. Hydric sandy soils may have been imported to the site during the creation of the ballfield; therefore, the soils may be relict hydric soils. Given that the ballfield is located on a topographic high spot in the park, with steep fill slopes to the north, south, and east, the only source of hydrology to the ballfield is precipitation and irrigation; therefore, the ballfield is unlikely to support wetland hydrology. Additionally, there is an existing underdrain system in the outfield, designed to collect shallow subsurface flow and direct it to two existing dispersion trenches, one to the north and one to the east of the field. No wetland hydrology nor hydrology indicators were observed in the ballfield at the time of the site visit in June. Herrera biologists did not identify any wetlands within the Crestwoods Park Ballfield 4.

Soccer Fields

Soccer fields are located at the west end of the review area. These fields are similar to Ballfield 4 in that they are also regularly mowed and maintained; consist of imported sandy, fill soils; and are designed to drain runoff from the fields to the north. Herrera biologists did not identify any wetlands within the Crestwoods Park soccer fields.

Forested Areas Adjacent to Ballfield 4

Undeveloped forested areas are located within the study area to the north, east, and south. Although these areas include a second-growth forest, the area immediately adjacent to Ballfield 4 appears to have been a historic dump site. Large pieces of concrete, asphalt, and rebar were observed, overgrown with forested vegetation (Photo 2).

Photo 2. Upland forest with large piece of concrete overgrown with vegetation

Upland vegetation in this portion of the study area included big-leaf maple (*Acer macrophyllum*), black cottonwood (*Populus balsamifera*), western red-cedar (*Thuja plicata*), Douglas fir (*Pseudotsuga menziesii*), Himalayan blackberry (*Rubus armeniacus*), western hazelnut (*Corylus cornuta*), salal (*Gaultheria shallon*), Nootka rose (*Rosa nutkana*), trailing blackberry (*Rubus ursinus*), black twinberry (*Lonicera involucrata*), and sword fern (*Polystichum munitum*).

Wetland 1, associated with an unnamed and ditched stream (Stream 2), is mapped by the City near eastern edge of the study area (City of Kirkland 2025). Herrera biologists confirmed the presence and location of Wetland 1 during field investigations but did not map the boundaries. The approximate wetland boundary shown in Figure 2a is based on the City's wetland GIS layer.

Photo 3. Wetland 1, Stream 1, and Stream 2 located across the Cross Kirkland Corridor Trail (June 12, 2025).

Wetland 1 is a palustrine, forested, depressional wetland dominated by black cottonwood (*Populus balsamifera*), slough sedge (*Carex obnupta*), reed canarygrass (*Phalaris arundinacea*), and Himalayan blackberry (*Rubus armeniacus*). Most of the wetland extends beyond the study area to the north, south, and east. The wetland is located at the base of a slope and immediately east of the Cross Kirkland Corridor Trail. Wetland 1 is estimated to be a Category II wetland, which would have a 75-foot buffer with a low habitat score, which would be dependent on the final wetland rating (KZC 90.55.1). Preliminary wetland rating forms are included in Appendix A.

Wetland 2 is a palustrine, forested, slope wetland located in the northeast corner of the study area (Photo 4). The wetland is dominated by black cottonwood, willow (*Salix sp.*), soft rush (*Juncus effusus*), creeping buttercup (*Ranunculus repens*), lady fern (*Athyrium felix-femina*), American mannagrass

(*Glyceria grandis*), trailing blackberry, and Watson's willowherb (*Epilobium ciliatum*). Recent restoration plantings were observed within the wetland, such as red-osier dogwood (*Cornus sericea*). Wetland 2 is estimated to be a Category IV wetland (Appendix A) with a regulatory buffer of 40 feet, regardless of habitat score (KZC 90.55.1).


Photo 4. Wetland 2 (June 12, 2025).

Wetland 3 is a palustrine, forested, slope wetland located in the north half of the study area. The wetland is dominated by black cottonwood, creeping buttercup (*Ranunculus repens*), and Watson's willowherb. Wetland 3 has also been planted with a variety of native shrubs and trees, including Western redcedar (*Thuja plicata*). Wetland 3 is estimated to be a Category IV wetland (Appendix A) with a regulatory buffer of 40 feet (KZC 90.55.1).


Photo 5. West end of Wetland 3 (June 12, 2025).

Two unnamed streams are mapped by the City near the eastern edge of the study area. Stream 1 is a vegetated, ditched stream located on the west side of the Cross Kirkland Corridor Trail. Stream 1 flows northward. Stream 2 is also a vegetated, ditched stream associated with Wetland 1. Stream 2 flows northward on the east side of the Cross Kirkland Corridor Trail. The streams are mapped by the City of Kirkland; however, they are not mapped by WDFW, King County, or WDNR (WDFW 2025b, King County 2025, WDNR 2025a). Herrera biologists confirmed the presence and location of these ditched streams during field investigations but did not map the boundaries. City of Kirkland stream layers are included in Figure 2a and Figure 2b.

Based on City of Kirkland GIS stream layers, the streams appear to drain via a series of ditches, natural channels, and culverts into Forbes Creek, approximately 1,800 feet downgradient of Wetland 1. City of Kirkland staff have observed cutthroat trout in nearby ditched tributaries to Forbes Creek (E. Henrichsen, personal communication, July 10, 2025). Therefore, it is likely that Streams 1 and 2 could also be fish-bearing. Fish streams have a regulatory buffer of 100 feet (KZC 90.65.1) (Figure 2a).

The stream buffers within the study area primarily consist of forested vegetation such as black cottonwood, Douglas fir, big-leaf maple, Himalayan blackberry, and herbaceous plants.

No FWHCAs (other than streams), frequently flooded areas, or minor lakes were identified within the Crestwoods Park study area.

132nd Square Park

The study area for 132nd Square Park included developed parking lots, roads, residential lots, a turf soccer field, and the little league ballfield.

The 132nd Square Park ballfield consists of mowed lawn in the outfield and unvegetated infield, with underlying sand fill. Both the infield and the outfield are well-drained, although they do not have an underdrain system. Similarly to Crestwoods Park, 132nd Square Park is routinely mowed, fertilized, and overseeded, and is top-dressed with sand once a year. Vegetation in the outfield is dominated by bluegrasses. Soils were dry to at least 16 inches at the time of the site visit in June 2025, and no hydrology indicators were observed. No hydric soil indicators were observed. No wetlands were observed within the study area at 132nd Square Park.

No FWHCAs (including streams), minor lakes, or frequently flooded areas were identified within the 132nd Square Park study area (Figure 2b).

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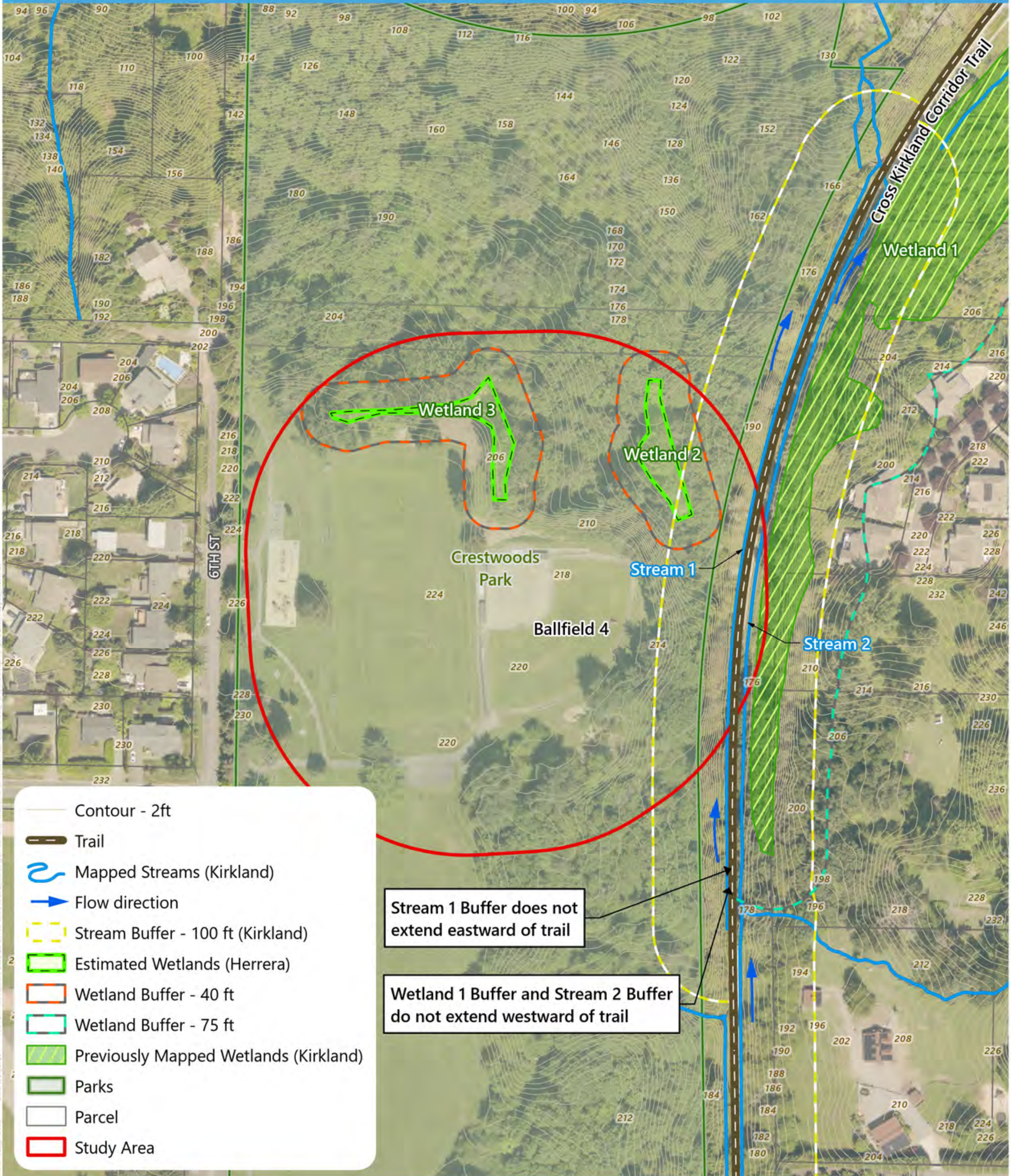
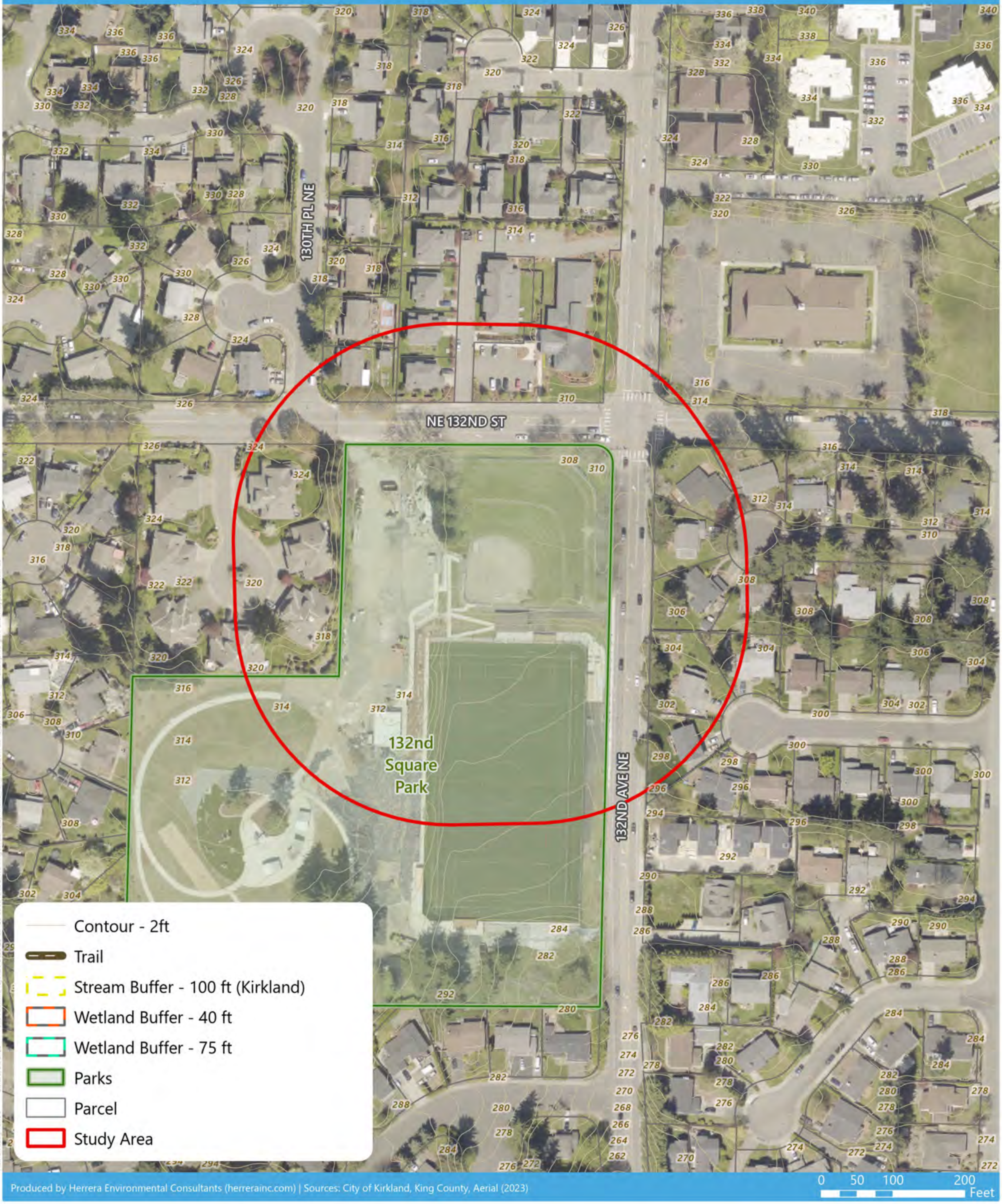
Figure 2a. Mapped and Estimated Wetlands, Streams, Minor Lakes, Frequently Flooded areas, and FWHCAs for Crestwoods Park.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: City of Kirkland, King County, Aerial (2023)

Figure 2b. Mapped and Estimated Wetlands, Streams, Minor Lakes, Frequently Flooded areas, and FWHCAs for 132nd Square Park.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: City of Kirkland, King County, Aerial (2023)

City of Kirkland Critical Areas Regulations

The City regulates critical areas including wetlands, streams, other FWHCAs, minor lakes, and frequently flooded areas, and their buffers under KZC Chapter 90. Wetland 1 is likely to require a 75-foot buffer as a Category II wetland with a low habitat score. Wetlands 2 and 3 are likely to require 40-foot buffers as Category IV wetlands, regardless of their habitat scores. Streams 1 and 2 within the study area are likely to require 100-foot buffers as potentially fish-bearing streams. The City of Kirkland is currently reviewing potential modifications to the critical areas code, which may include larger stream buffers. Final buffers will depend on the approved critical areas codes at the time of permit submission.

Per the City of Kirkland, the Cross Kirkland Corridor Trail is considered a break in wetland and stream buffers (K. Wilkinson, personal communication, June 4, 2025). Per KZC 90.120, the Planning Official may waive the required critical area buffer where the buffer is isolated from the critical area due to a legally established and improved public right-of-way, which includes the Cross Kirkland Corridor Trail. Therefore, the Wetland 1 buffer and Stream 2 buffer extend to the eastern edge of the trail only (Figure 2a).

KZC 90.130 includes vegetated buffer standards that apply to wetland and stream buffers, as included below. These standards apply to projects that result in new impervious surface area.

Vegetated Buffer Standard – The following vegetated buffer standards shall be met:

a. Native cover of at least 80 percent on average throughout the buffer area. Additionally, the first two of the following strata of native plant species each must compose at least 20 percent areal cover, and the third may compose no more than 20 percent areal cover:

> *1) Multi-age forest canopy (combination of existing and new vegetation);*
>
> *2) Shrubs; and*
>
> *3) Woody groundcover (such as kinnikinnick, salal and sword fern) or unmowed herbaceous groundcover;*

b. At least three (3) native species each making up a minimum of 10 percent coverage (for diversity);

c. Less than 10 percent noxious weeds cover using King County weed list and permanent removal of all knotweed; and

d. Removal of lawn and any illegal fill as determined by the City.

The Planning Official makes the determination if the standard buffer meets this buffer vegetation standard (KZC 90.55).

KZC 90.130.3.c applies specifically to public park projects. This section states: "For public facilities in public parks, net new impervious improvements of any amount, the buffer shall be vegetated at a minimum 1:1 ratio (i.e., net square footage of vegetated buffer area must be planted to meet the standards to match the new square footage of added impervious surfaces) meeting the vegetated buffer standard at the proportional rate of the standard, in a location and of dimensions approved by the Planning Official." This applies to park projects that involve new impervious surface, regardless of critical area or buffer impacts or not.

Impervious surface is defined under KZC as: "a hard surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions before development; or that causes water to run off the surface in greater quantities or at an increased rate of flow compared to the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roofs, walkways, patios, driveways, parking lots, or storage areas, areas that are paved, graveled or made of packed or oiled earthen materials or other surfaces that similarly impede the natural infiltration of surface water or stormwater."

The infield at Crestwoods Park is entirely artificial, with imported sand and loamy soil, and includes an existing underdrain system that prevents water from infiltrating into the soil mantle. The surface of the infield is also highly compacted and unvegetated. Therefore, the existing infield at Crestwoods Park meets the definition of an impervious surface with respect to KZC 90 (K. Wilkinson, City of Kirkland, personal communication, July 24, 2025).

Any proposed new impervious surface outside of the existing infield at Crestwoods Park would need to meet KZC 90.13.3.c and require buffer vegetation enhancement at a 1:1 ratio (new impervious area to buffer enhancement area). However, converting the existing infield to turf would not be considered a new impervious surface per KZC 90 and would not trigger buffer vegetation enhancement requirements.

KZC 90: If buffer impacts are necessary for a project, buffer averaging may be allowed if the standard or alternative buffer width is not reduced below 75 percent of the required width in any location; the total area of the buffer is no less than the area of the typical buffer; the buffer averaging provides a net improvement of the critical area's habitat, functions, and values; and the critical area would benefit from a wider buffer in one area and would not be adversely impacted by having a narrower buffer in another area.

Any impacts to wetlands or wetland buffers will require identification of these features in a full critical areas report based on a complete delineation and mitigation sequencing as required by KZC 90.145. A full critical areas report may also be required if new impervious surfaces are proposed on the property in order to meet the vegetated buffer standards required in KZC 90.130.3.c. Compensatory mitigation is required for modifications that cannot be avoided or minimized. Required wetland mitigation ratios vary greatly depending on wetland category and what form of mitigation is proposed, with wetland creation requiring the lowest ratio (1.5:1 for a Category IV wetland) and wetland enhancement requiring the highest (12:1 for a Category II wetland) (KZC 90.150.1). Wetland and stream buffer mitigation is required at a minimum ratio of 1:1 for all types of mitigation.

The City of Kirkland is currently in the process of updating KZC 90. Code sections listed above may be subject to new regulations at the time of permitting, depending on when KZC 90 modifications are approved.

City of Kirkland Tree Requirements

Both Crestwoods Park and 132nd Square Park, located within the City of Kirkland, are zoned as park/open space (Kirkland 2025). Trees within public areas are considered public trees and regulated under Kirkland Zoning Code 95.20. Significant and landmark trees are additionally regulated.

A significant tree is defined by the City of Kirkland as an existing healthy tree that is not a hazard tree (i.e., a tree that does not have a high probability of imminently falling due to a debilitating disease or structural defect) and that, when measured 4.5 feet above grade, has a minimum diameter at breast height (DBH) of 6 inches (KZC 95.10). Landmark trees are those with a 26-inch DBH or greater (KZC 95.10).

When significant trees are removed in public parks and open spaces, they must be replaced at a 1:1 ratio, including trees that are part of a hedge. The following regulations are applicable to this project:

Kirkland Zoning Code 95.20 – Public Tree – Pruning and Removal

A public tree pruning permit is required for tree removals on public lands.

Kirkland Zoning Code 92.25 – Landmark Trees – Mitigation Requirements

The removal of a landmark tree requires a tree removal permit. Key provisions from Kirkland Zoning Code 92.25 are outlined below for the removal of landmark trees:

Mitigation Ratio: For each landmark tree removed, three large species must be planted from the City of Kirkland's Approved Landmark Tree Mitigation List. Mitigation trees must meet the following size requirements at planting: a minimum of 6 feet in height for conifers, or a minimum of 2 inches in caliper for deciduous or broad-leaf evergreen trees.

Location of Mitigation Trees: Mitigation trees must be planted in a location on the property that allows for their growth to mature without significant conflicts with existing or proposed improvements on the property or adjacent properties.

Timing of Plantings and Inspection: Mitigation trees must be installed within 12 months of the associated tree removal, in accordance with Kirkland Zoning Code 95.23, or prior to the final inspection of a development permit reviewed under Kirkland Zoning Code 95.30. Following planting, an inspection by the Planning Official is required to ensure consistency with the approved mitigation plan.

Maintenance Agreement: The applicant must sign a 5-year maintenance agreement for the mitigation trees, which will be recorded with the King County Recorder's office. This agreement ensures the trees are maintained for 5 years from the final inspection.

Additional Tree Planting: Mitigation tree planting is in addition to any other tree planting required by the Kirkland Zoning Code or Municipal Code.

Dead or Dying Landmark Trees: If a landmark tree meets the definition of dead or dying, as evidenced by a photograph provided to the Planning Official, it will not be subject to mitigation requirements.

Fee in Lieu: The applicant may choose to pay a fee in lieu of planting mitigation trees on the property. The fee is $450.00 per required mitigation tree not planted on site. All fees collected will be deposited into the City Forestry Account and used for canopy restoration efforts elsewhere in the City of Kirkland. The Planning and Building Director may adjust the fee periodically to reflect current material and labor costs.

Federal and State Critical Areas Regulations

Clean Water Act

Section 404 of the federal Clean Water Act regulates the placement or removal of soil or other fill, grading, or alteration (hydrologic or vegetative) in waters of the United States, including wetlands and streams (33 USC 1344). The Seattle District of the U.S. Army Corps of Engineers (USACE) administers the permitting program under the act. The permits include nationwide (general) permits for projects involving small areas of fill, grading or alteration and individual permits for projects that require larger areas of wetland disturbance. USACE does not regulate wetland buffers.

Some wetlands are not regulated by the USACE. Isolated wetlands that lack a direct surface water connection to navigable waters of the United States are not federally regulated. Based on the recent Sackett v. EPA (598 U.S. 651), for a wetland to fall under federal jurisdiction it must have a relatively permanent, continuous surface water connection to a traditional navigable water. Wetlands 2 and 3 do not have a continuous surface water connection to a navigable water. Wetland 1 may have a continuous surface water connection to Forbes Creek, although this connection was not field verified. Therefore, Wetland 1 is likely regulated by the USACE and Wetlands 2 and 3 are likely not regulated by the USACE.

Section 401 of the Clean Water Act requires that proposed dredge (removal) and fill activities permitted under Section 404 be reviewed and certified to ensure that such activities meet state water quality standards. State 401 certification is administered by Ecology for all Section 404 permits. State 401 certification is granted without the need for a separate permit from Ecology for projects that qualify for a Section 404 nationwide permit, meet specific 401 certification conditions of the nationwide permit, and meet Ecology 401 General Conditions. If that is not the case, an Individual 401 Water Quality Certification permit is required by Ecology.

The project is unlikely to result in direct impacts to wetlands or streams; therefore, the project would not trigger Section 404 or Section 401 review.

Washington State Laws

Washington State laws and programs designed to control the loss of wetland and stream areas include SEPA and Section 401 of the Clean Water Act (a federal law that is implemented in Washington by Ecology as noted above and as mandated by the Washington State Water Pollution Control Act). The state Water Pollution Control Act also extends to non-federally regulated wetlands.

WDFW administers the Hydraulic Project Approval (HPA) program under the State Hydraulic Code (WAC 220-110), which was specifically designed to protect fish life. An HPA is required for projects that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state and may regulate any vegetation that overhangs these waters. The project is unlikely to result in impacts to streams or vegetation that overhands them; therefore, an HPA is unlikely to be required for the project.

A summary of potential local, state, and federal permits/processes are included in the permit matrix in Appendix B.

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Appendix A

Draft Ecology Rating Forms

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RATING SUMMARY - Western Washington

Name of wetland (or ID#): Wetland 1 **Date of site visit:** 06/12/2025

Rated By: Shawree Zhang **Trained by Ecology? Yes** [ ] **No** [X] **Date of Training:** N/A

HGM Class used for rating: Depressional

Wetland has multiple HGM classes? Yes [ ] **No** [X]

NOTE: Form is not complete without the figures requested *(figures can be combined).*

Source of base aerial photo/map:

OVERALL WETLAND CATEGORY: [**Category II**] (based on functions [X] or special characteristics [ ])

1. Category of wetland based on FUNCTIONS

[ ] **Category I** - Total score = 23 - 27
[X] **Category II** - Total score = 20 - 22
[ ] **Category III** - Total score = 16 - 19
[ ] **Category IV** - Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
Site Potential	**M**	**M**	**L**	
Landscape Potential	**H**	**H**	**L**	
Value	**H**	**H**	**H**	**Total**
Score Based on Ratings	**8**	**8**	**5**	**21**

Score for each function based on three ratings (order of ratings is not important)
9 = H,H,H
8 = H,H,M
7 = H,H,L
7 = H,M,M
6 = H,M,L
6 = M,M,M
5 = H,L,L
5 = M,M,L
4 = M,L,L
3 = L,L,L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	CATEGORY
Estuarine	
Wetland of High Conservation Value	
Bog	
Forested	
Coastal Lagoon	
Interdunal	
None of the above	**Not Applicable**

Wetland name or number: Wetland 1

Maps and figures required to answer questions correctly for Western Washington

Depressional Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	D 1.3, H 1.1, H 1.4	
Hydroperiods	D 1.4, H 1.2	
Location of outlet *(can be added to map of hydroperiods)*	D 1.1, D 4.1	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	D 2.2, D 5.2	
Map of the contributing basin	D 4.3, D 5.3	
1km Polygon: Area that extends 1km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	

Wetland name or number: Wetland 1

DEPRESSIONAL AND FLATS WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

D 1.0 Does the site have the potential to improve water quality?		
D 1.1 What are the characteristics of surface water outflows from the wetland?		
Wetland has no surface water outlet.	points = 3	
Wetland has an intermittently flowing, or highly constricted, outlet.	points = 2	
Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing	points = 1	
Wetland is a flat depression whose outlet is a permanently flowing ditch.	points = 1	**Score: 2**
D 1.2 Is the soil 2 in. below the surface a true clay or organic soil?		
Mapped as true clay or organic (muck or peat)	points = 4	
Soil texture identified as clay or organic in field	points = 4	
Soil texture identified as clay or organic by laboratory test	points = 4	
None of the above	points = 0	**Score: 0**
D 1.3 What are the characteristics and distribution of persistent plants?		
Wetland has persistent, ungrazed, plants > 95% of area	points = 5	
Wetland has persistent, ungrazed, plants > 50% of area	points = 3	
Wetland has persistent, ungrazed plants > 10% of area	points = 1	
Wetland has persistent, ungrazed plants < 10% of area	points = 0	**Score: 5**
D 1.4 What are the characteristics of seasonal ponding or inundation in the wetland area?		
Area seasonally ponded is > 50% total area of wetland	points = 4	
Area seasonally ponded is equal to or > 25% total area of wetland	points = 2	
Area seasonally ponded is < 25% total area of wetland	points = 0	**Score: 4**
	Total for D 1:	**11**

Rating of Site Potential [ ] **12-16 = H** [X] **6-11 = M** [ ] **0-5 = L** *Record the rating on the first page*

D 2.0 Does the landscape have the potential to support the water quality function of the site?		
D 2.1 Does the wetland unit receive stormwater discharges?		
Yes	points = 1	
No	points = 0	**Score: 1**
D 2.2 Is >10% of the area within 150ft of the wetland in land uses that generate pollutants in surface runoff?		
Yes	points = 1	
No	points = 0	**Score: 1**
D 2.3 Are there septic systems within 250ft of the wetland?		
Yes	points = 1	
No	points = 0	**Score: 0**
D 2.4 Are there other sources of pollutants coming into the wetland that are not listed in questions D 2.1-D 2.3?		
Yes	points = 1	
No	points = 0	**Score: 1**

Wetland name or number: Wetland 1

D 2.5 What are the other sources of pollutants coming into the wetland? Dogs		
	Total for D 2:	**3**

Rating of Landscape Potential [X] **3-4 = H** [ ] **1-2 = M** [ ] **0 = L** *Record the rating on the first page*

D 3.0 Is the water quality improvement provided by the site valuable to society?		
D 3.1 Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list?		
Yes	points = 1	
No	points = 0	**Score:** 1
D 3.2 Is the wetland in a basin or sub-basin where an aquatic resource is on the 303(d) list?		
Yes	points = 1	
No	points = 0	**Score:** 1
D 3.3 Has the site been identified in a watershed or local plan as important for maintaining water quality?		
Yes	points = 2	
No	points = 0	**Score:** 0
	Total for D 3:	**2**

Rating of Value [X] **2-4 = H** [ ] **1 = M** [ ] **0 = L** *Record the rating on the first page*

DEPRESSIONAL AND FLATS WETLANDS

Hydrologic Functions - Indicators that the site functions to reduce flooding and stream degradtion

D 4.0 Does the site have the potential to reduce flooding and erosion?		
D 4.1 What are the characteristics of surface water outflows from the wetland?		
Wetland has no surface water outlet.	points = 4	
Wetland has an intermittently flowing, or highly constricted, outlet.	points = 2	
Wetland is a flat depression whose outlet is a permanently flowing ditch.	points = 1	
Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing	points = 0	**Score:** 2
D 4.2 What is the depth of storage during the wet periods?		
Marks of ponding are 3ft or more above the surface or bottom of the outlet.	points = 7	
Marks of ponding are between 2ft to <3ft from the surface or bottom of the outlet.	points = 5	
Marks of ponding are at least 0.5ft to <2ft from the surface or the bottom of the outlet.	points = 3	
The wetland is a "headwater" wetland.	points = 3	
The wetland is flat but has small depressions on the surface that trap water.	points = 1	
Marks of ponding are less than 0.5ft (6in).	points = 0	**Score:** 3

Wetland name or number: Wetland 1

D 4.3 What is the contribution of the wetland to storage in the watershed?		
The area of the basin is less than 10 times the area of the unit	points = 5	
The area of the basin is 10 to 100 times the area of the unit	points = 3	
The area of the basin is more than 100 times the area of the unit	points = 0	
Entire wetland is in the Flats class	points = 5	**Score: 3**
	Total for D 4:	**8**

Rating of Site Potential [ ] **12-16 = H** [X] **6-11 = M** [ ] **0-5 = L** *Record the rating on the first page*

D 5.0 Does the landscape have the potential to support hydrologic functions of the site?		
D 5.1 Does the wetland unit receive stormwater discharges?		
Yes	points = 1	
No	points = 0	**Score: 1**
D 5.2 Is >10% of the area within 150 ft of the wetland in land uses that generate excess runoff?		
Yes	points = 1	
No	points = 0	**Score: 1**
D 5.3 Is more than 25% of the contributing basin of the wetland covered with intensive human land uses?		
Yes	points = 1	
No	points = 0	**Score: 1**
	Total for D 5:	**3**

Rating of Landscape Potential [X] **3 = H** [ ] **1-2 = M** [ ] **0 = L** *Record the rating on the first page*

D 6.0 Are the hydrologic functions provided by the site valuable to society?		
D 6.1 Is the wetland in a landscape that has flooding problems?		
Flooding occurs in a sub-basin that is immediately down-gradient of the wetland.	points = 2	
Surface flooding problems are in a sub-basin farther down-gradient.	points = 1	
Flooding from groundwater is an issue in the basin.	points = 1	
The existing or potential outflow from the wetland is so constrained that water cannot reach areas that flood.	points = 0	
There are no problems with flooding downstream of the wetland.	points = 0	**Score: 2**
D 6.2 Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan?		
Yes	points = 2	
No	points = 0	**Score: 0**
	Total for D 6:	**2**

Rating of Value [X] **2-4 = H** [ ] **1 = M** [ ] **0 = L** *Record the rating on the first page*

HABITAT FUNCTIONS

These questions apply to wetlands of all HGM classes - Indicators that the site functions to provide important habitat

H 1.0 Does the wetland have the potential to provide habitat for many species?

H 1.1 What is the structure of the plant community?

- [ ] Aquatic Bed
- [ ] Emergent
- [ ] Scrub-shrub
- [x] Forested
- [ ] Multiple strata within the Forested class (canopy, sub-canopy, shrubs, herbaceous, moss/ground cover)

4 structures or more	points = 4	
3 structures	points = 2	
2 structures	points = 1	
1 structure	points = 0	
No structures present	points = 0	**Score: 0**

H 1.2 What are the hydroperiods that meet the size thresholds in the wetland?

- [ ] Permanently flooded or inundated
- [x] Seasonally flooded or inundated
- [x] Occasionally flooded or inundated
- [ ] Saturated only
- [ ] Permanently flowing stream or river in, or adjacent to, the wetland
- [ ] Seasonally flowing stream in, or adjacent to, the wetland
- [ ] Lake Fringe wetland
- [ ] Freshwater Tidal wetland

4 or more types present	points = 3	
3 types present or Lake Fringe / Freshwater Tidal Fringe	points = 2	
2 types present	points = 1	
1 type present	points = 0	
None present	points = 0	**Score: 1**

H 1.3 What is the richness of the plant species in the wetland?

>19 species	points = 2	
5-19 species	points = 1	
<5 species	points = 0	**Score: 1**

Wetland name or number: Wetland 1

H 1.4 What is the interspersion of habitats?		
High	points = 3	
Moderate	points = 2	
Low	points = 1	
None	points = 0	**Score: 0**
H 1.5 What are the special habitat features in the wetland?		
☑ Large, downed, woody debris within the wetland (>4in diameter and 6ft long).		
☑ Standing snags (dbh >4in) within the wetland		
☑ Undercut banks are present for at least 6.6ft (2m) and/or overhanging plants extend at least 3.3ft (1m) over open water or a stream (or ditch) in, or contiguous with the wetland, for at least 33ft (10m)		
☐ Stable steep banks of fine material that might be used by beaver or muskrat for denning (>30 degree slope) OR signs of recent beaver activity are present (cut shrubs or trees that have not yet weathered where wood is exposed)		
☑ At least 0.25ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated (structures for egg-laying by amphibians)		
☐ Invasive plants cover less than 25% of the wetland area in every stratum of plants (see H 1.1 for list of strata)		
6 habitats selected	points = 6	
5 habitats selected	points = 5	
4 habitats selected	points = 4	
3 habitats selected	points = 3	
2 habitats selected	points = 2	
1 habitat selected	points = 1	
No habitats selected	points = 0	**Score: 4**
	Total for H 1:	**6**

Rating of Site Potential [ ] **15-18 = H** [ ] **7-14 = M** [X] **0-6 = L** *Record the rating on the first page*

H 2.0 Does the landscape have the potential to support habitat functions of the site?

H 2.1 What is the percentage of accessible habitat within 1km of the wetland?		
>33% of 1km Polygon	points = 3	
20-33% of 1km Polygon	points = 2	
10-19% of 1km Polygon	points = 1	
<10% of 1km Polygon	points = 0	**Score: 0**
H 2.2 What is the percentage of total habitat in a 1km polygon around the wetland?		
Total habitat is >50% of the Polygon	points = 3	
Total habitat is 10-50% of the Polygon and in 1-3 patches	points = 2	
Total habitat is 10-50% of the Polygon and in >3 patches	points = 1	
Total habitat is <10% of the Polygon	points = 0	**Score: 1**

Wetland name or number: Wetland 1

H 2.3 What is the land use intensity in the 1km polygon?		
50% of the Polygon is high intensity land use	points = -2	
<50% of the Polygon is high intensity land use	points = 0	**Score: -2**
	Total for H 2:	**-1**

Rating of Landscape Potential [ ] **4-6 = H** [ ] **1-3 = M** [X] **0 = L** *Record the rating on the first page*

H 3.0 Is the habitat provided by the site valuable to society?

H 3.1 Does the site provide habitat for species valued in laws, regulations, or policies?

- [ ] Aspen Stands
- [ ] Biodiversity Areas and Corridors
- [ ] Herbaceous Balds
- [ ] Old-growth/Mature Forests
- [ ] Oregon White Oak
- [x] Riparian
- [ ] Westside Prairie
- [ ] Fresh Deepwater
- [x] Instream
- [ ] Nearshore (Coastal, Open Coast, Puget Sound)
- [ ] Caves
- [ ] Cliffs
- [x] Snags and Logs
- [ ] Talus

The following criteria automatically score 2 points:

- [ ] The wetland provides habitat for Threatened or Endangered species
- [ ] The wetland is mapped as a location for an individual WDFW priority species
- [ ] The wetland is a Wetland of High Conservation Value
- [ ] The wetland has been categorized as an important habitat site in a local plan

The wetland has 3 or more WDFW priority habitats within 100m, or meets the criteria for societal value	points = 2	
The site has 1 or 2 WDFW priority habitats within 100m	points = 1	
The site does not meet any of the criteria for societal value	points = 0	**Score: 2**
	Total for H 3:	**2**

Rating of Value [X] **2 = H** [ ] **1 = M** [ ] **0 = L** *Record the rating on the first page*

Wetland name or number: Wetland 1

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

SC 1.0 Estuarine Wetlands

SC 1.1 Does the wetland meet all of the following criteria for Estuarine wetlands?

☐ The dominant water regime is tidal

☐ The wetland is vegetated

☐ The water salinity is greater than 0.5 ppt

Yes - Go to SC 1.2

No - Not an Estuarine Wetland — **Result: Not an Estuarine Wetland**

SC 1.2 Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151?

Yes - Category **I** Estuarine Wetland

No - Go to SC 1.3 — **Result:**

SC 1.3 Is the wetland unit at least 1ac in size and meets at least two of the following three conditions?

☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 10% cover of non-native plant species.

☐ At least 75% of the landward edge of the wetland has a 100ft buffer of shrub, forest, or un-grazed or un-mowed grassland

☐ The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands.

Yes - Category **I** Estuarine Wetland

No - Category **II** Estuarine Wetland — **Result:**

SC 2.0 Wetlands of High Conservation Value

SC 2.1 Does the wetland overlap with any known or historical rare plant or rare & high-quality ecosystem polygons on the WNHP Data Explorer?

Yes - Category **I** Wetland of High Conservation Value

No - Go to SC 2.2 — **Result: Go to SC 2.2**

SC 2.2 Does the wetland have a rare plant species, rare plant community, or high-quality common plant community that may qualify the site as a WHCV?

Yes - Category **I** Wetland of High Conservation Value

No - Not a Wetland of High Conservation Value — **Result: Not a Wetland of High Conservation Value**

Wetland name or number: Wetland 1

SC 3.0 Bogs

SC 3.1 Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16in or more of the first 32in of the soil profile? Yes - Go to SC 3.3 No - Go to SC 3.2	**Result: Go to SC 3.2**
SC 3.2 Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? Yes - Go to SC 3.3 No - Not a Bog Wetland	**Result: Not a Bog Wetland**
SC 3.3 Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least 30% cover of plant species listed in the table provided in the instructions? Yes - Category **I** Bog Wetland No - Go to SC 3.4	**Result:**
SC 3.4 Is an area with peats or mucks forested (>30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann Spruce, or western white pine AND any of the species (or combinations of species) listed in the table found in the instructions provide more than 30% of the cover under the canopy? Yes - Category **I** Bog Wetland No - Not a Bog Wetland	**Result:**

SC 4.0 Forested Wetlands

SC 4.1 Does the wetland have at least 1 contiguous acre of forest that meets one of the following criteria? ☐ Old-growth forests ☐ Mature forests Yes - Category **I** Forested Wetland No - Not a Forested Wetland	**Result: Not a Forested Wetland**

Wetland name or number: Wetland 1

SC 5.0 Wetlands in Coastal Lagoons

SC 5.1 Coastal Lagoons: Does the wetland meet all of the following criteria of a wetland in a coastal lagoon? ☐ The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or rocks ☐ The depression in which the wetland is located contains ponded water that is saline or brackish (>0.5 ppt) during most of the year in at least a portion of the open water area (measured near the bottom) ☐ The lagoon retains some of its surface water at low tide during spring tides Yes - Go to SC 5.2 No - Not a Coastal Lagoon Wetland	**Result: Not a Coastal Lagoon Wetland**
SC 5.2 Does the wetland meet all of the following three conditions? ☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species). ☐ At least 75% of the landward edge of the wetland has a 100ft buffer of shrub, forest, or un-grazed or un-mowed grassland. ☐ the wetland is larger than 0.10ac (4350 sqft) Yes - Category I Coastal Lagoon No - Category II Coastal Lagoon	**Result:**

SC 6.0 Interdunal Wetlands

SC 6.1 Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership WBUO)? Yes - Go to SC 6.2 No - Not an Interdunal Wetland	**Result: Not an Interdunal Wetland**
SC 6.2 Is the wetland 1ac or larger in size, or a mosaic that is 1ac or larger in size? Wetland is larger than 1ac in size - Go to SC 6.3 Wetland is a mosaic larger than 1ac is size - Category II Interdunal Wetland No - Go to SC 6.4	**Result:**
SC 6.3 Does the wetland score 8 or 9 points for the habitat functions? Yes - Category I Interdunal Wetland No - Category II Interdunal Wetland	**Result:**
SC 6.4 Is the wetland unit between 0.1ac and 1ac, or in a mosaic of wetlands that is between 0.1ac and 1ac in size? Yes - Category III Interdunal Wetland No - Category IV Interdunal Wetland	**Result:**

Wetland name or number: Wetland 1

Category of wetland based on Special Characteristics	
If you answered No for all types, enter "Not Applicable" on Summary Form	**Final Category: Not Applicable**

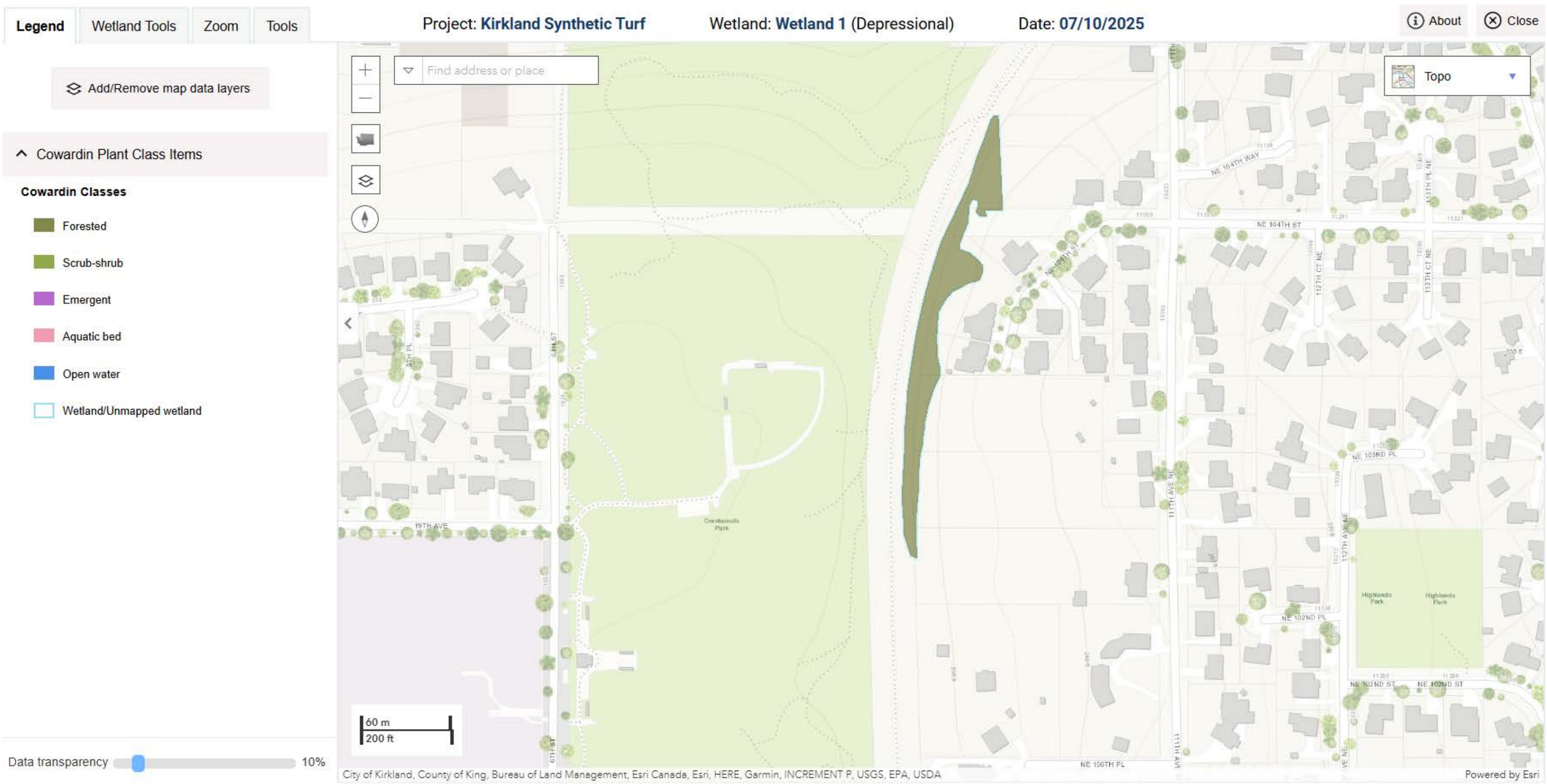

Figure A.1. Wetland 1 Cowardin Plant Classes

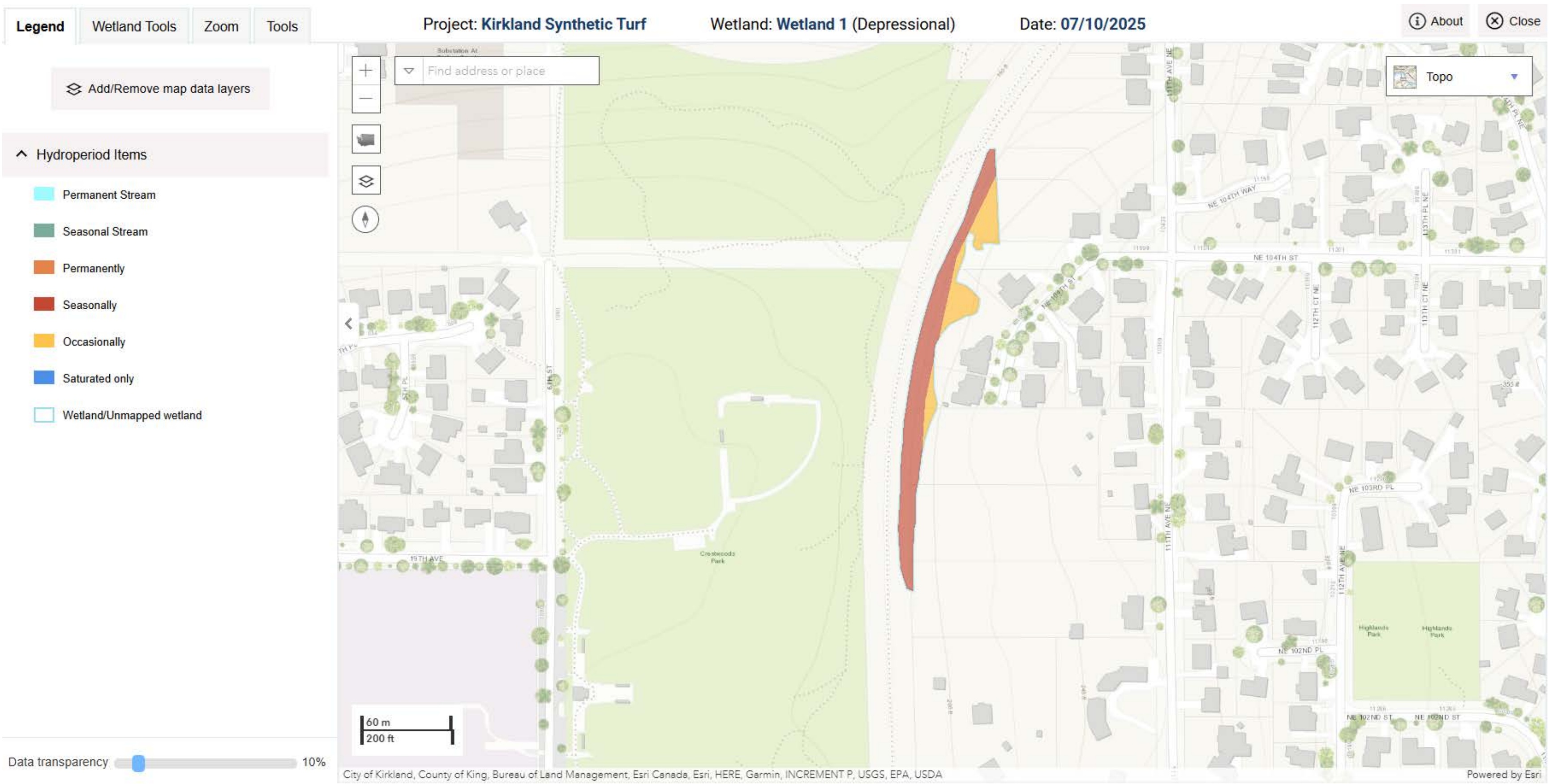

Figure A.2. Wetland 1 Hydroperiods

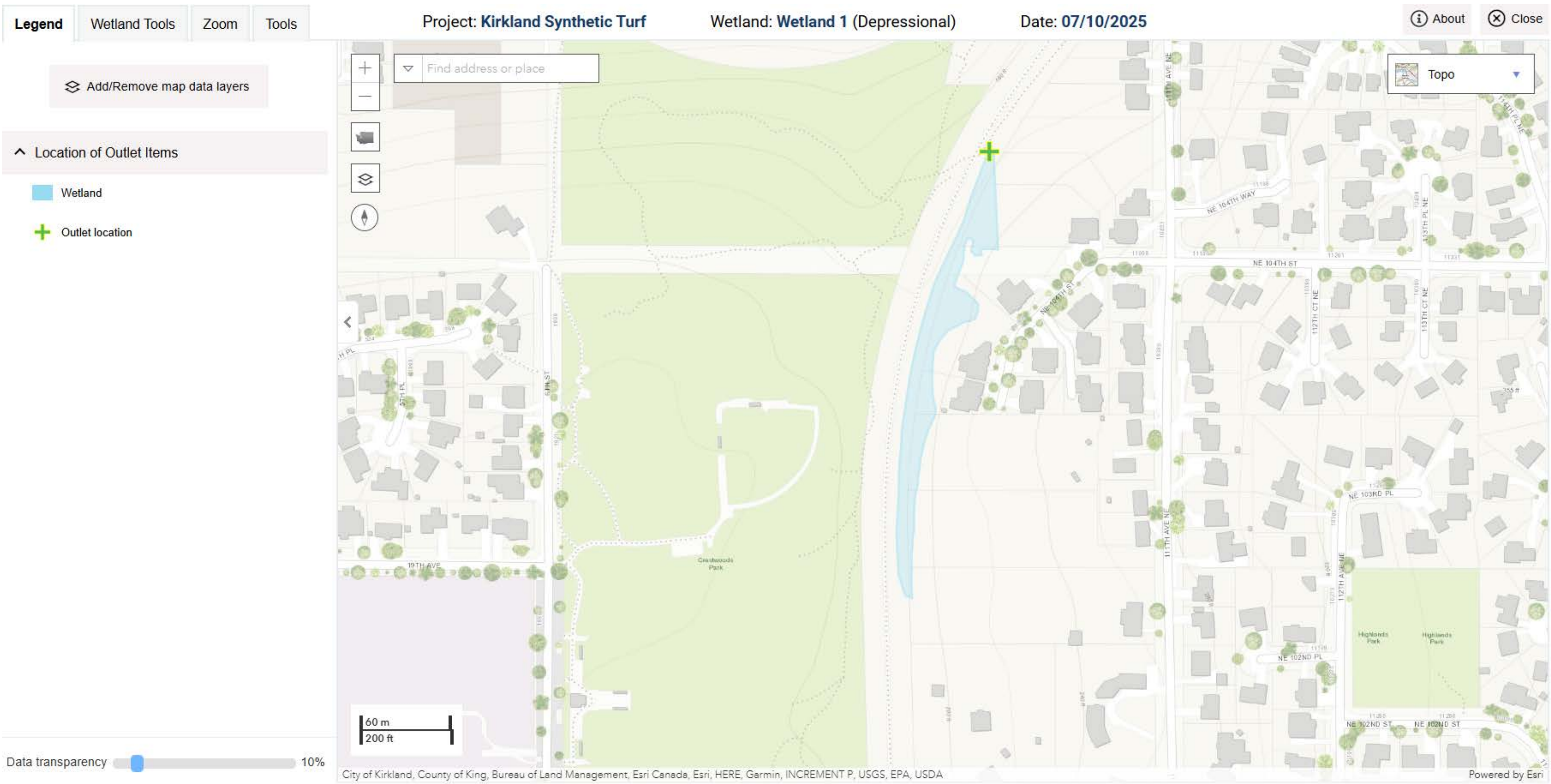

Figure A.3. Wetland 1 Outlet

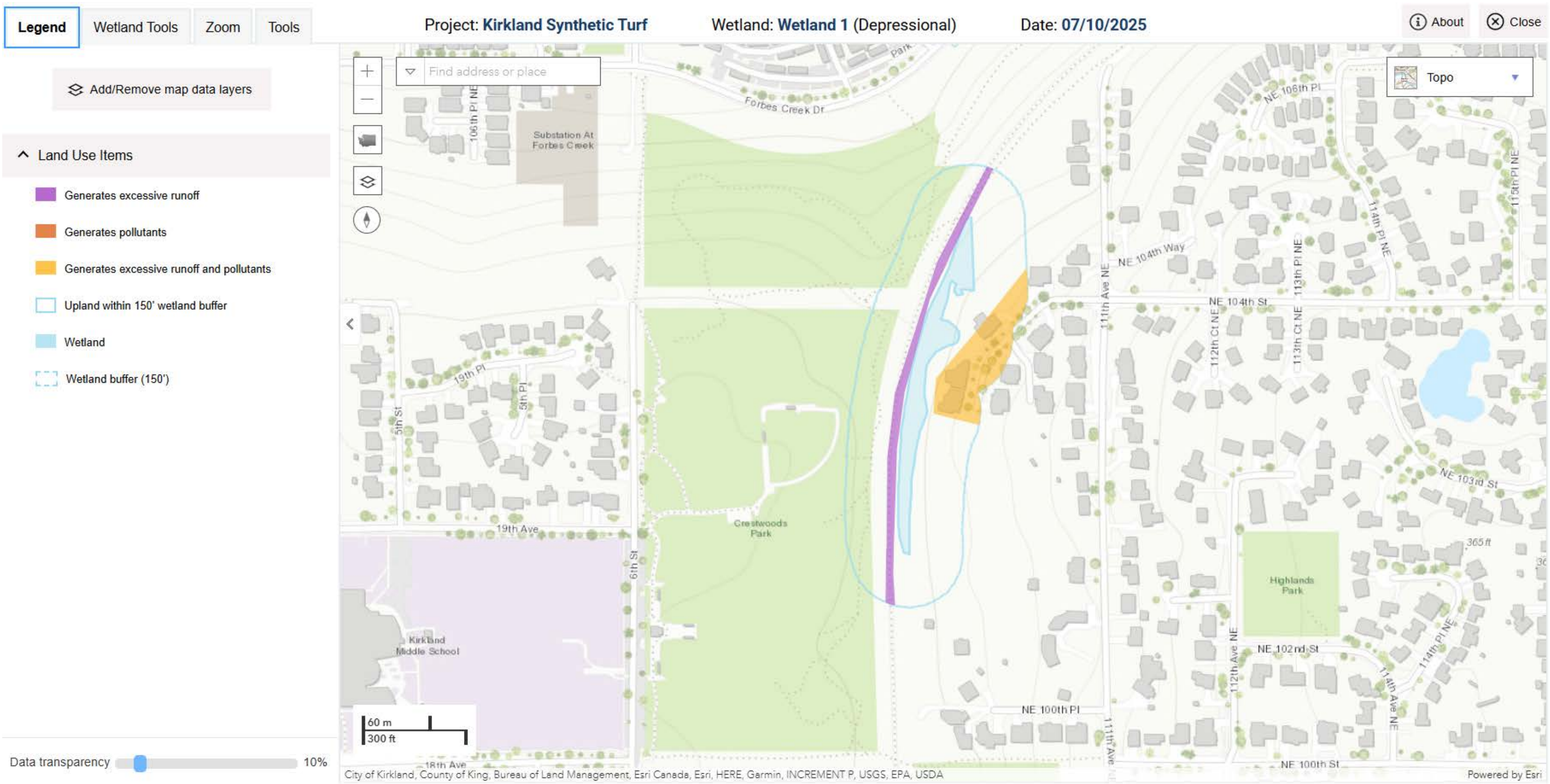

Figure A.4. Wetland 1 150-Foot Boundary

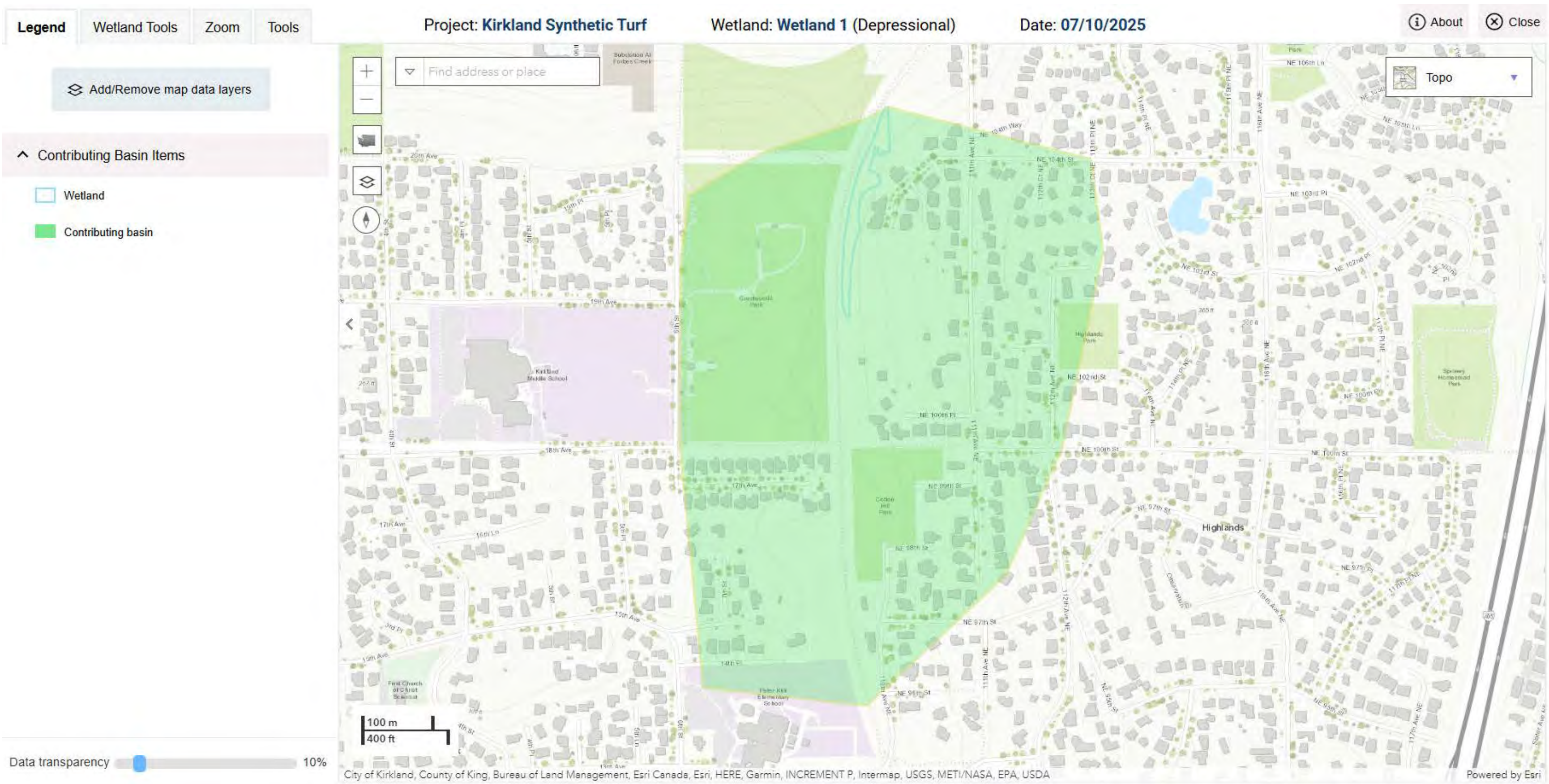

Figure A.5. Wetland 1 Contributing Basin

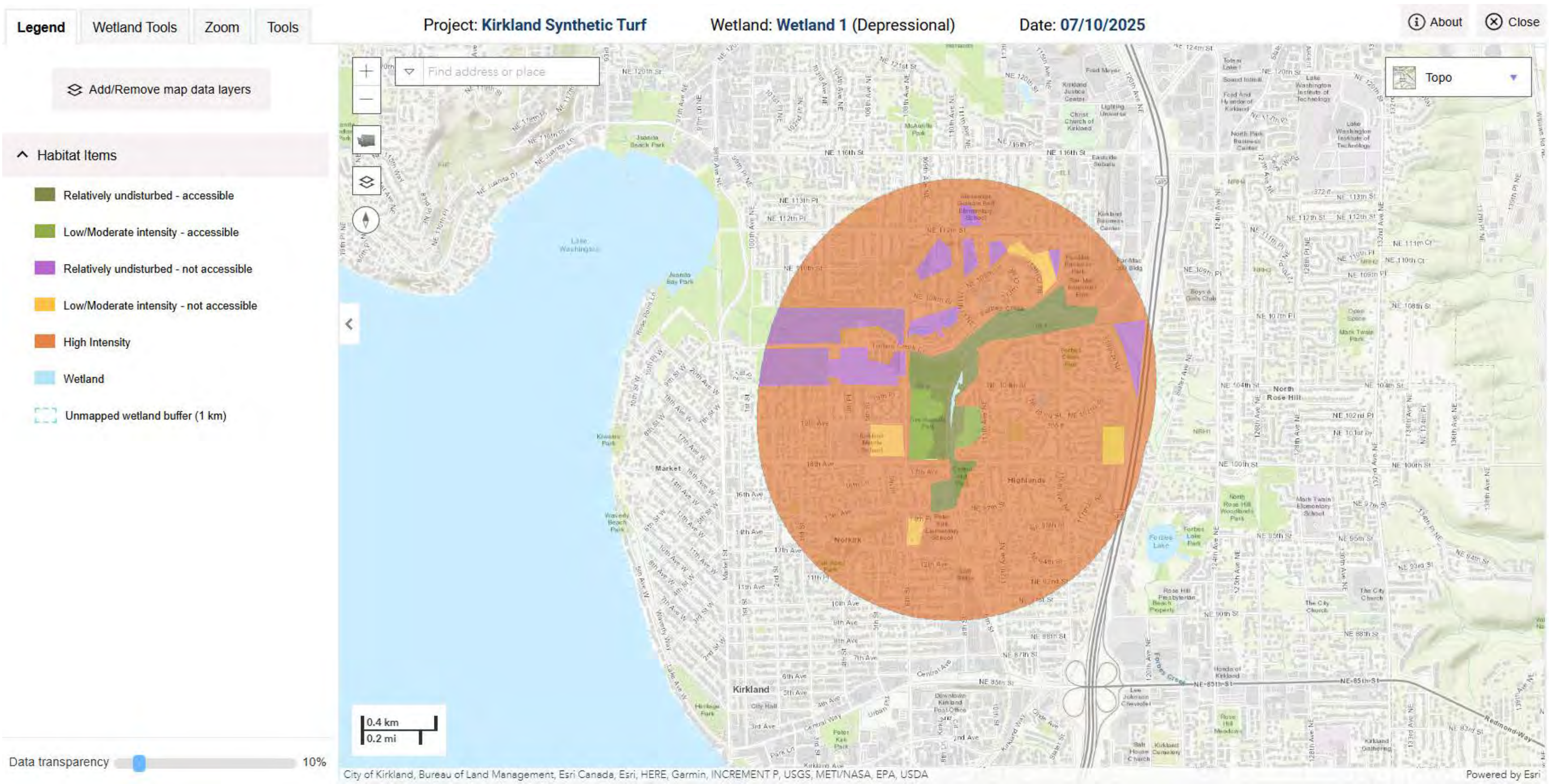

Figure A.6. Wetland 1 1 Kilometer Habitat Polygon

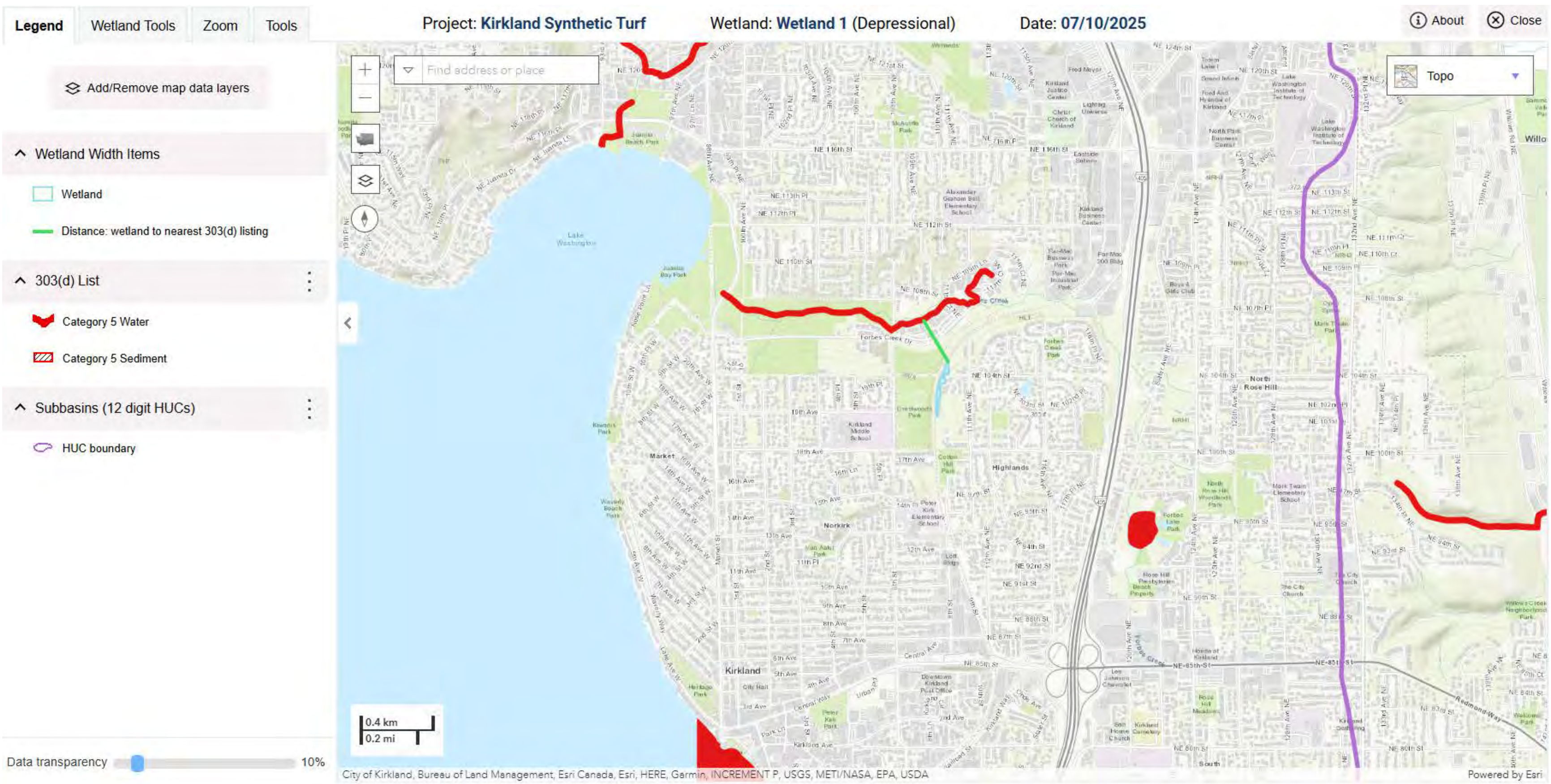

Figure A.7. Wetland 1 Distance to 303(d) Listed Waters

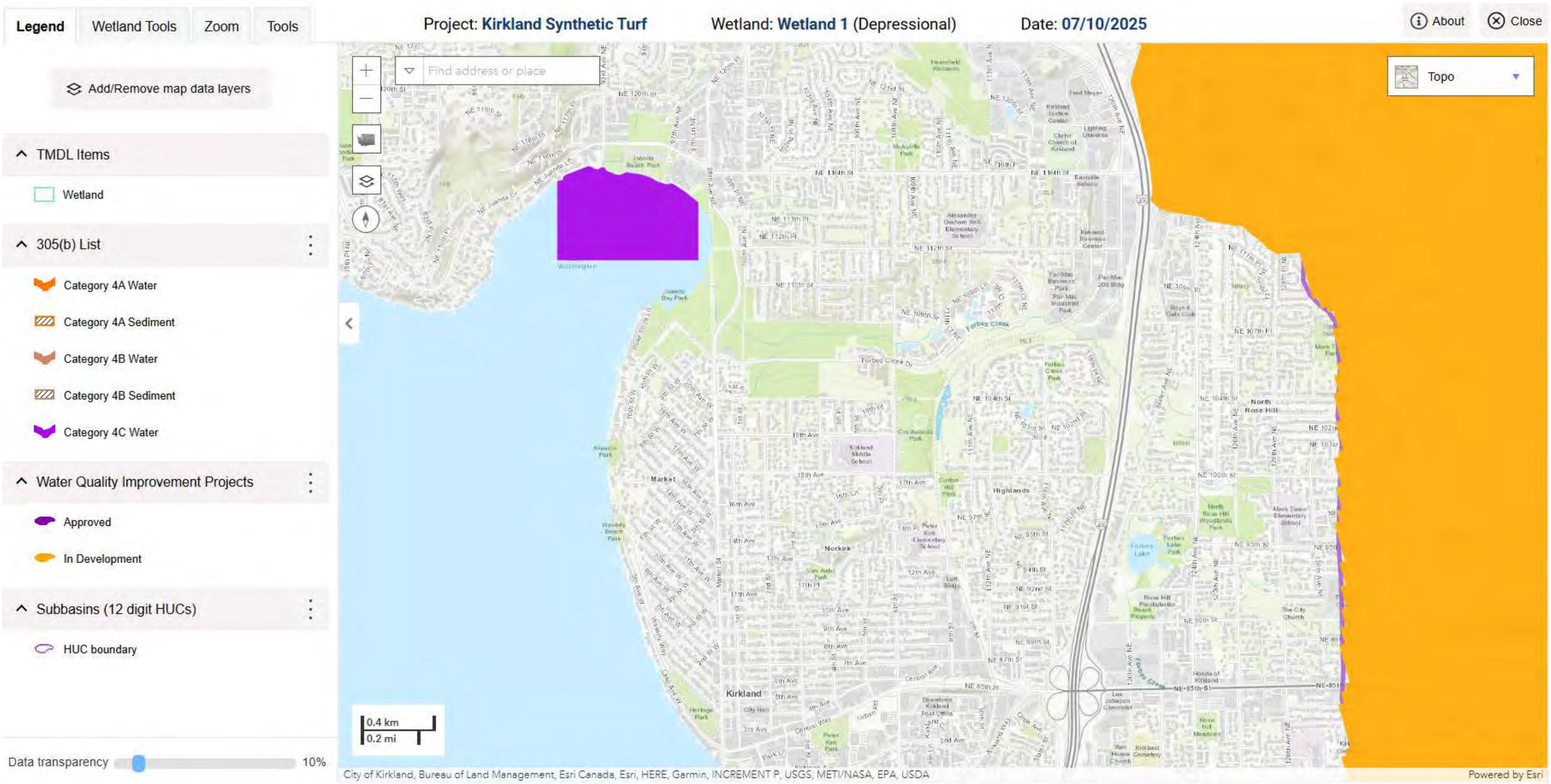

Figure A.8. Wetland 1 TMDL Map

Wetland name or number: Wetland 2

RATING SUMMARY - Western Washington

Name of wetland (or ID#): Wetland 2 **Date of site visit:** 06/12/2025

Rated By: Shawree Zhang **Trained by Ecology? Yes** [ ] **No** [X] **Date of Training:** N/A

HGM Class used for rating: Slope

Wetland has multiple HGM classes? Yes [ ] **No** [X]

NOTE: Form is not complete without the figures requested *(figures can be combined).*

Source of base aerial photo/map:

OVERALL WETLAND CATEGORY: [**Category IV**] (based on functions [X] or special characteristics [ ])

1. Category of wetland based on FUNCTIONS

[ ] **Category I** - Total score = 23 - 27

[ ] **Category II** - Total score = 20 - 22

[ ] **Category III** - Total score = 16 - 19

[X] **Category IV** - Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
Site Potential	**M**	**L**	**L**	
Landscape Potential	**L**	**L**	**L**	
Value	**M**	**H**	**H**	**Total**
Score Based on Ratings	**5**	**5**	**5**	**15**

Score for each function based on three ratings (order of ratings is not important)

9 = H,H,H
8 = H,H,M
7 = H,H,L
7 = H,M,M
6 = H,M,L
6 = M,M,M
5 = H,L,L
5 = M,M,L
4 = M,L,L
3 = L,L,L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	CATEGORY
Estuarine	
Wetland of High Conservation Value	
Bog	
Forested	
Coastal Lagoon	
Interdunal	
None of the above	**Not Applicable**

Wetland name or number: Wetland 2

Maps and figures required to answer questions correctly for Western Washington

Slope Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Plant cover of dense trees, shrubs, and herbaceous plants	S 1.3	
Plant cover of dense, rigid trees, shrubs, and herbaceous plants *(can be added to figure above)*	S 4.1	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	S 2.1, S 5.1	
1km Polygon: Area that extends 1km form entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	S 3.1, S 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	S 3.3	

Wetland name or number: Wetland 2

SLOPE WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

S 1.0 Does the site have the potential to improve water quality?		
S 1.1 What are the characteristics of the average slope of the wetland?		
Slope is 1% or less	points = 3	
Slope is >1%-2%	points = 2	
Slope is >2%-5%	points = 1	
Slope is greater than 5%	points = 0	**Score: 1**
S 1.2 What is the soil 2in below the surface or duff layer?		
Mapped as true clay or organic (muck or peat)	points = 3	
Soil texture identified as clay or organic in field	points = 3	
Soil texture identified as clay or organic by laboratory test	points = 3	
None of the above	points = 0	**Score: 0**
S 1.3 Characteristics of the plants in the wetland that trap sediments and pollutants		
Dense, uncut, herbaceous plants cover >90% of the wetland area	points = 6	
Dense, uncut, herbaceous plants cover >50% of the wetland area	points = 3	
Dense, woody, plants cover >50% of the wetland area	points = 2	
Dense, uncut, herbaceous plants cover >25% of the wetland area	points = 1	
Does not meet any of the criteria above for plants	points = 0	**Score: 6**
	Total for S 1:	**7**

Rating of Site Potential [ ] **12-16 = H** [X] **6-11 = M** [ ] **0-5 = L** *Record the rating on the first page*

S 2.0 Does the landscape have the potential to support the water quality function of the site?		
S 2.1 Is >10% of the area within 150ft on the uphill side of the wetland in land uses that generate pollutants?		
Yes	points = 1	
No	points = 0	**Score: 0**
S 2.2 Are there other sources of pollutants coming into the wetland that are not listed in question S 2.1?		
Yes	points = 1	
No	points = 0	**Score: 0**
S 2.3 What are the other sources of pollutants coming into the wetland?		
	Total for S 2:	**0**

Rating of Landscape Potential [ ] **3-4 = H** [ ] **1-2 = M** [X] **0 = L** *Record the rating on the first page*

S 3.0 Is the water quality improvement provided by the site valuable to society?		
S 3.1 Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list?		
Yes	points = 1	
No	points = 0	**Score: 0**
S 3.2 Is the wetland in a basin or sub-basin where water quality is an issue?		
Yes	points = 1	
No	points = 0	**Score: 1**
S 3.3 Has the site been identified in a watershed or local plan as important for maintaining water quality?		
Yes	points = 2	
No	points = 0	**Score: 0**
	Total for S 3:	**1**

Rating of Value [ ] **2-4 = H** [X] **1 = M** [ ] **0 = L** *Record the rating on the first page*

SLOPE WETLANDS

Hydrologic Functions - Indicators that the site functions to reduce flooding and stream degradtion

S 4.0 Does the site have the potential to reduce flooding and erosion?		
S 4.1 What are the characteristics of the plants that reduce the velocity of surface flows during storms?		
Dense, uncut, rigid plants cover >90% of the wetland area	points = 1	
All other conditions	points = 0	**Score: 0**
	Total for S 4:	**0**

Rating of Site Potential [ ] **1 = M** [X] **0 = L** *Record the rating on the first page*

S 5.0 Does the landscape have the potential to support the hydrologic functions of the site?		
S 5.1 Is more than 25% of the area within 150 ft upslope of wetland in land uses or cover that generate excess surface runoff?		
Yes	points = 1	
No	points = 0	**Score: 0**
	Total for S 5:	**0**

Rating of Landscape Potential [ ] **1 = M** [X] **0 = L** *Record the rating on the first page*

Wetland name or number: Wetland 2

S 6.0 Are the hydrologic functions provided by the site valuable to society?		
S 6.1 Is the wetland in a landscape that has flooding problems?		
Flooding occurs in a sub-basin that is immediately down-gradient of wetland.	points = 2	
Surface flooding problems are in a sub-basin farther down-gradient.	points = 1	
There are no problems with flooding downstream of the wetland	points = 0	**Score: 2**
S 6.2 Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan?		
Yes	points = 2	
No	points = 0	**Score: 0**
	Total for S 6:	**2**

Rating of Value [X] **2-4 = H** [ ] **1 = M** [ ] **0 = L** *Record the rating on the first page*

Wetland name or number: Wetland 2

HABITAT FUNCTIONS

These questions apply to wetlands of all HGM classes - Indicators that the site functions to provide important habitat

H 1.0 Does the wetland have the potential to provide habitat for many species?

H 1.1 What is the structure of the plant community?

- [ ] Aquatic Bed
- [ ] Emergent
- [ ] Scrub-shrub
- [x] Forested
- [ ] Multiple strata within the Forested class (canopy, sub-canopy, shrubs, herbaceous, moss/ground cover)

4 structures or more	points = 4	
3 structures	points = 2	
2 structures	points = 1	
1 structure	points = 0	
No structures present	points = 0	**Score: 0**

H 1.2 What are the hydroperiods that meet the size thresholds in the wetland?

- [ ] Permanently flooded or inundated
- [ ] Seasonally flooded or inundated
- [x] Occasionally flooded or inundated
- [x] Saturated only
- [ ] Permanently flowing stream or river in, or adjacent to, the wetland
- [ ] Seasonally flowing stream in, or adjacent to, the wetland
- [ ] Lake Fringe wetland
- [ ] Freshwater Tidal wetland

4 or more types present	points = 3	
3 types present or Lake Fringe / Freshwater Tidal Fringe	points = 2	
2 types present	points = 1	
1 type present	points = 0	
None present	points = 0	**Score: 1**

H 1.3 What is the richness of the plant species in the wetland?

>19 species	points = 2	
5-19 species	points = 1	
<5 species	points = 0	**Score: 1**

Wetland name or number: Wetland 2

H 1.4 What is the interspersion of habitats?		
High	points = 3	
Moderate	points = 2	
Low	points = 1	
None	points = 0	**Score: 0**
H 1.5 What are the special habitat features in the wetland?		
☑ Large, downed, woody debris within the wetland (>4in diameter and 6ft long).		
☐ Standing snags (dbh >4in) within the wetland		
☐ Undercut banks are present for at least 6.6ft (2m) and/or overhanging plants extend at least 3.3ft (1m) over open water or a stream (or ditch) in, or contiguous with the wetland, for at least 33ft (10m)		
☐ Stable steep banks of fine material that might be used by beaver or muskrat for denning (>30 degree slope) OR signs of recent beaver activity are present (cut shrubs or trees that have not yet weathered where wood is exposed)		
☐ At least 0.25ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated (structures for egg-laying by amphibians)		
☑ Invasive plants cover less than 25% of the wetland area in every stratum of plants (see H 1.1 for list of strata)		
6 habitats selected	points = 6	
5 habitats selected	points = 5	
4 habitats selected	points = 4	
3 habitats selected	points = 3	
2 habitats selected	points = 2	
1 habitat selected	points = 1	
No habitats selected	points = 0	**Score: 0**
	Total for H 1:	**4**

Rating of Site Potential [ ] **15-18 = H** [ ] **7-14 = M** [X] **0-6 = L** *Record the rating on the first page*

H 2.0 Does the landscape have the potential to support habitat functions of the site?

H 2.1 What is the percentage of accessible habitat within 1km of the wetland?		
>33% of 1km Polygon	points = 3	
20-33% of 1km Polygon	points = 2	
10-19% of 1km Polygon	points = 1	
<10% of 1km Polygon	points = 0	**Score: 0**
H 2.2 What is the percentage of total habitat in a 1km polygon around the wetland?		
Total habitat is >50% of the Polygon	points = 3	
Total habitat is 10-50% of the Polygon and in 1-3 patches	points = 2	
Total habitat is 10-50% of the Polygon and in >3 patches	points = 1	
Total habitat is <10% of the Polygon	points = 0	**Score: 1**

Wetland name or number: Wetland 2

H 2.3 What is the land use intensity in the 1km polygon?		
50% of the Polygon is high intensity land use	points = -2	
<50% of the Polygon is high intensity land use	points = 0	**Score: -2**
	Total for H 2:	**-1**

Rating of Landscape Potential [ ] **4-6 = H** [ ] **1-3 = M** [X] **0 = L** *Record the rating on the first page*

H 3.0 Is the habitat provided by the site valuable to society?

H 3.1 Does the site provide habitat for species valued in laws, regulations, or policies?

- [ ] Aspen Stands
- [ ] Biodiversity Areas and Corridors
- [ ] Herbaceous Balds
- [ ] Old-growth/Mature Forests
- [ ] Oregon White Oak
- [x] Riparian
- [ ] Westside Prairie
- [ ] Fresh Deepwater
- [x] Instream
- [ ] Nearshore (Coastal, Open Coast, Puget Sound)
- [ ] Caves
- [ ] Cliffs
- [x] Snags and Logs
- [ ] Talus

The following criteria automatically score 2 points:

- [ ] The wetland provides habitat for Threatened or Endangered species
- [ ] The wetland is mapped as a location for an individual WDFW priority species
- [ ] The wetland is a Wetland of High Conservation Value
- [ ] The wetland has been categorized as an important habitat site in a local plan

The wetland has 3 or more WDFW priority habitats within 100m, or meets the criteria for societal value	points = 2	
The site has 1 or 2 WDFW priority habitats within 100m	points = 1	
The site does not meet any of the criteria for societal value	points = 0	**Score: 2**
	Total for H 3:	**2**

Rating of Value [X] **2 = H** [ ] **1 = M** [ ] **0 = L** *Record the rating on the first page*

Wetland name or number: Wetland 2

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

SC 1.0 Estuarine Wetlands

SC 1.1 Does the wetland meet all of the following criteria for Estuarine wetlands?

☐ The dominant water regime is tidal

☐ The wetland is vegetated

☐ The water salinity is greater than 0.5 ppt

Yes - Go to SC 1.2

No - Not an Estuarine Wetland — **Result: Not an Estuarine Wetland**

SC 1.2 Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151?

Yes - Category **I** Estuarine Wetland

No - Go to SC 1.3 — **Result:**

SC 1.3 Is the wetland unit at least 1ac in size and meets at least two of the following three conditions?

☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 10% cover of non-native plant species.

☐ At least 75% of the landward edge of the wetland has a 100ft buffer of shrub, forest, or un-grazed or un-mowed grassland

☐ The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands.

Yes - Category **I** Estuarine Wetland

No - Category **II** Estuarine Wetland — **Result:**

SC 2.0 Wetlands of High Conservation Value

SC 2.1 Does the wetland overlap with any known or historical rare plant or rare & high-quality ecosystem polygons on the WNHP Data Explorer?

Yes - Category **I** Wetland of High Conservation Value

No - Go to SC 2.2 — **Result: Go to SC 2.2**

SC 2.2 Does the wetland have a rare plant species, rare plant community, or high-quality common plant community that may qualify the site as a WHCV?

Yes - Category **I** Wetland of High Conservation Value

No - Not a Wetland of High Conservation Value — **Result: Not a Wetland of High Conservation Value**

Wetland name or number: Wetland 2

SC 3.0 Bogs

SC 3.1 Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16in or more of the first 32in of the soil profile?

Yes - Go to SC 3.3
No - Go to SC 3.2 **Result: Go to SC 3.2**

SC 3.2 Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond?

Yes - Go to SC 3.3
No - Not a Bog Wetland **Result: Not a Bog Wetland**

SC 3.3 Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least 30% cover of plant species listed in the table provided in the instructions?

Yes - Category **I** Bog Wetland
No - Go to SC 3.4 **Result:**

SC 3.4 Is an area with peats or mucks forested (>30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann Spruce, or western white pine AND any of the species (or combinations of species) listed in the table found in the instructions provide more than 30% of the cover under the canopy?

Yes - Category **I** Bog Wetland
No - Not a Bog Wetland **Result:**

SC 4.0 Forested Wetlands

SC 4.1 Does the wetland have at least 1 contiguous acre of forest that meets one of the following criteria?

☐ Old-growth forests
☐ Mature forests

Yes - Category **I** Forested Wetland
No - Not a Forested Wetland **Result: Not a Forested Wetland**

Wetland name or number: Wetland 2

SC 5.0 Wetlands in Coastal Lagoons

SC 5.1 Coastal Lagoons: Does the wetland meet all of the following criteria of a wetland in a coastal lagoon? ☐ The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or rocks ☐ The depression in which the wetland is located contains ponded water that is saline or brackish (>0.5 ppt) during most of the year in at least a portion of the open water area (measured near the bottom) ☐ The lagoon retains some of its surface water at low tide during spring tides Yes - Go to SC 5.2 No - Not a Coastal Lagoon Wetland	**Result: Not a Coastal Lagoon Wetland**
SC 5.2 Does the wetland meet all of the following three conditions? ☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species). ☐ At least 75% of the landward edge of the wetland has a 100ft buffer of shrub, forest, or un-grazed or un-mowed grassland. ☐ the wetland is larger than 0.10ac (4350 sqft) Yes - Category I Coastal Lagoon No - Category II Coastal Lagoon	**Result:**

SC 6.0 Interdunal Wetlands

SC 6.1 Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership WBUO)? Yes - Go to SC 6.2 No - Not an Interdunal Wetland	**Result: Not an Interdunal Wetland**
SC 6.2 Is the wetland 1ac or larger in size, or a mosaic that is 1ac or larger in size? Wetland is larger than 1ac in size - Go to SC 6.3 Wetland is a mosaic larger than 1ac is size - Category II Interdunal Wetland No - Go to SC 6.4	**Result:**
SC 6.3 Does the wetland score 8 or 9 points for the habitat functions? Yes - Category I Interdunal Wetland No - Category II Interdunal Wetland	**Result:**
SC 6.4 Is the wetland unit between 0.1ac and 1ac, or in a mosaic of wetlands that is between 0.1ac and 1ac in size? Yes - Category III Interdunal Wetland No - Category IV Interdunal Wetland	**Result:**

Wetland name or number: Wetland 2

Category of wetland based on Special Characteristics	
If you answered No for all types, enter "Not Applicable" on Summary Form	**Final Category: Not Applicable**

Figure B.1. Wetland 2 Cowardin Plant Classes

Figure B.2. Wetland 2 Hydroperiods

Figure B.3. Wetland 2 Plant Cover of Dense Trees, Dense and Rigid Trees, Shrubs, and Herbaceous Plants

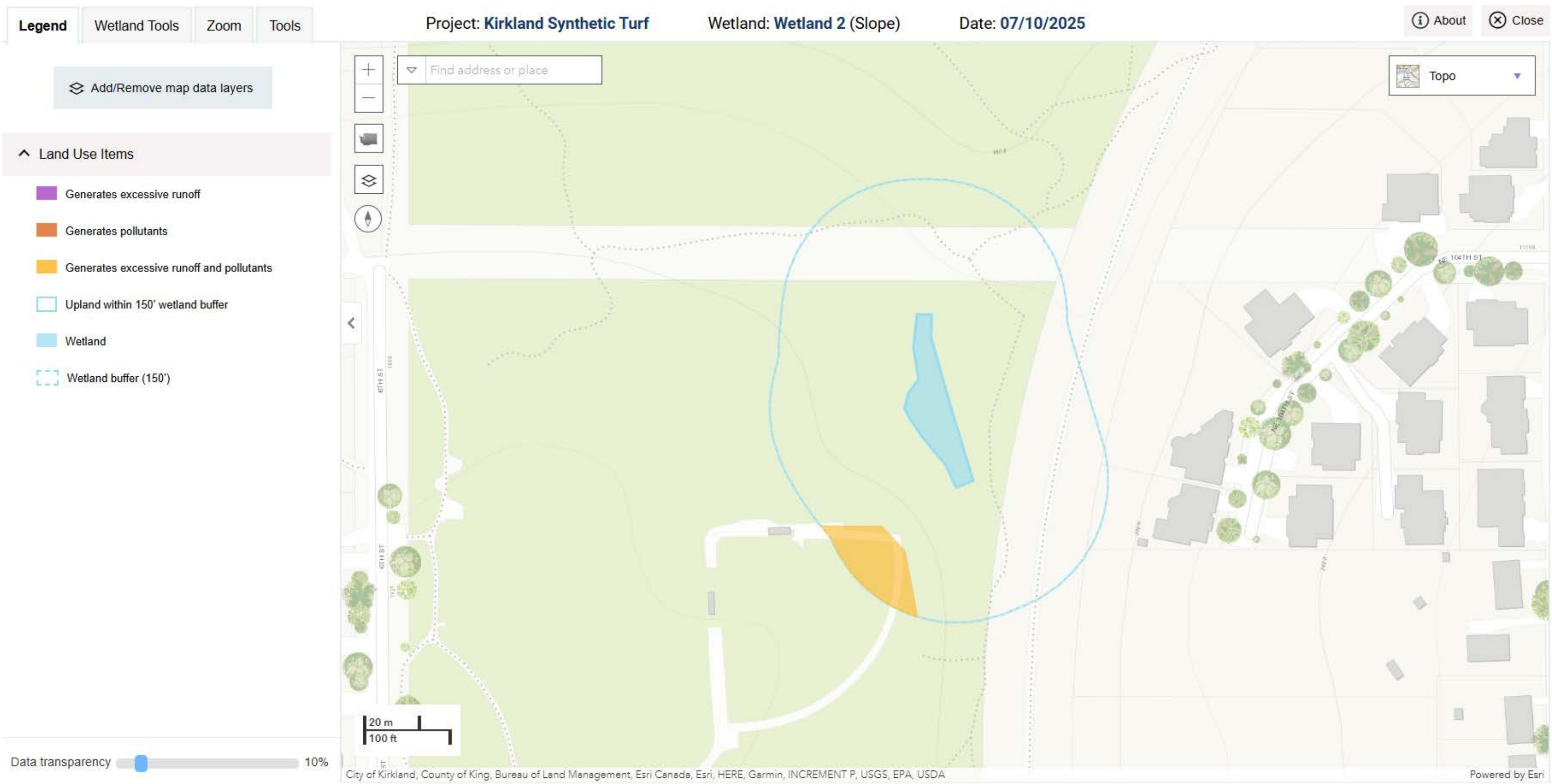

Figure B.4. Wetland 2 150-Foot Boundary

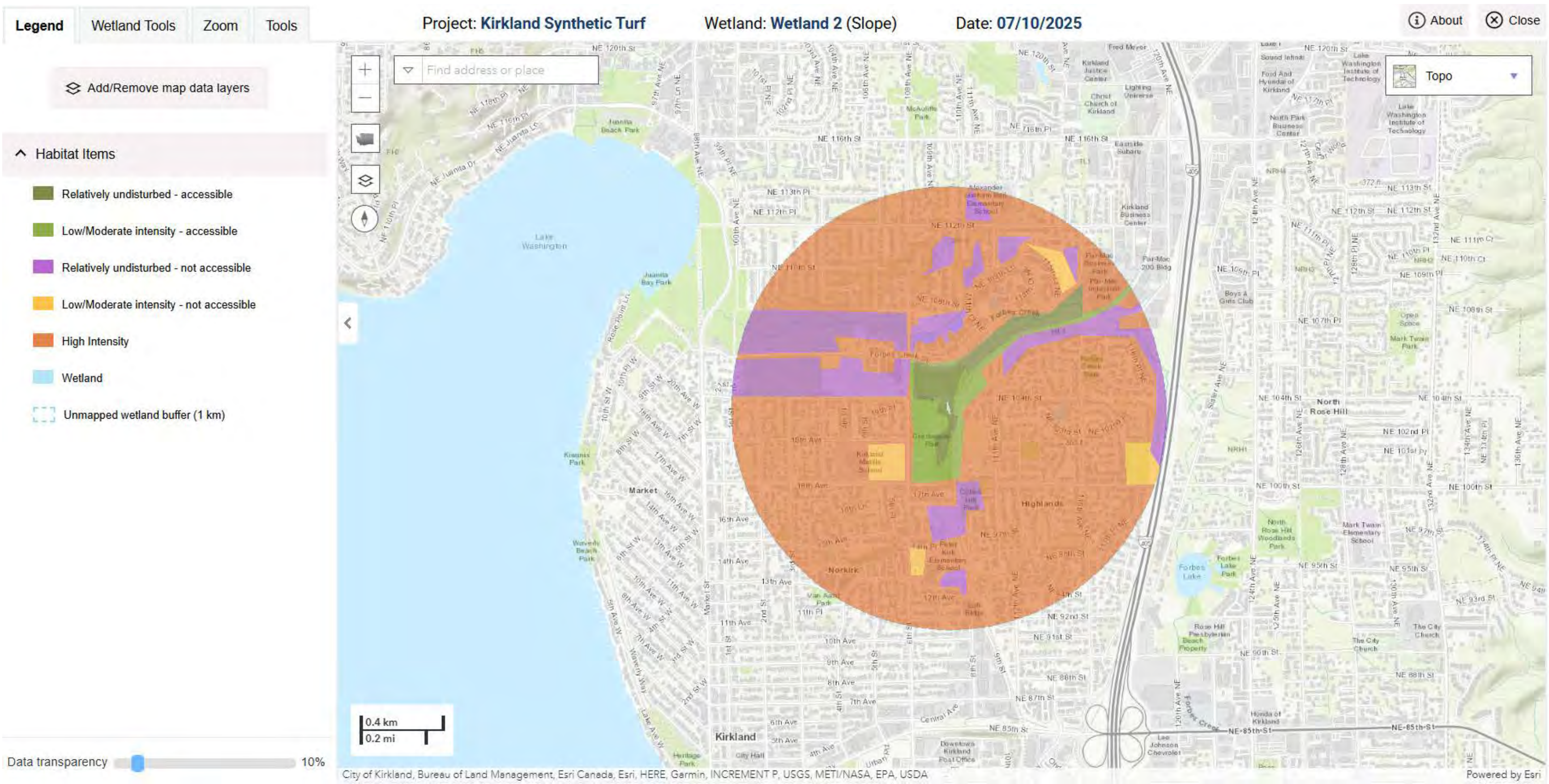

Figure B.5. Wetland 2 1 Kilometer Habitat Polygon

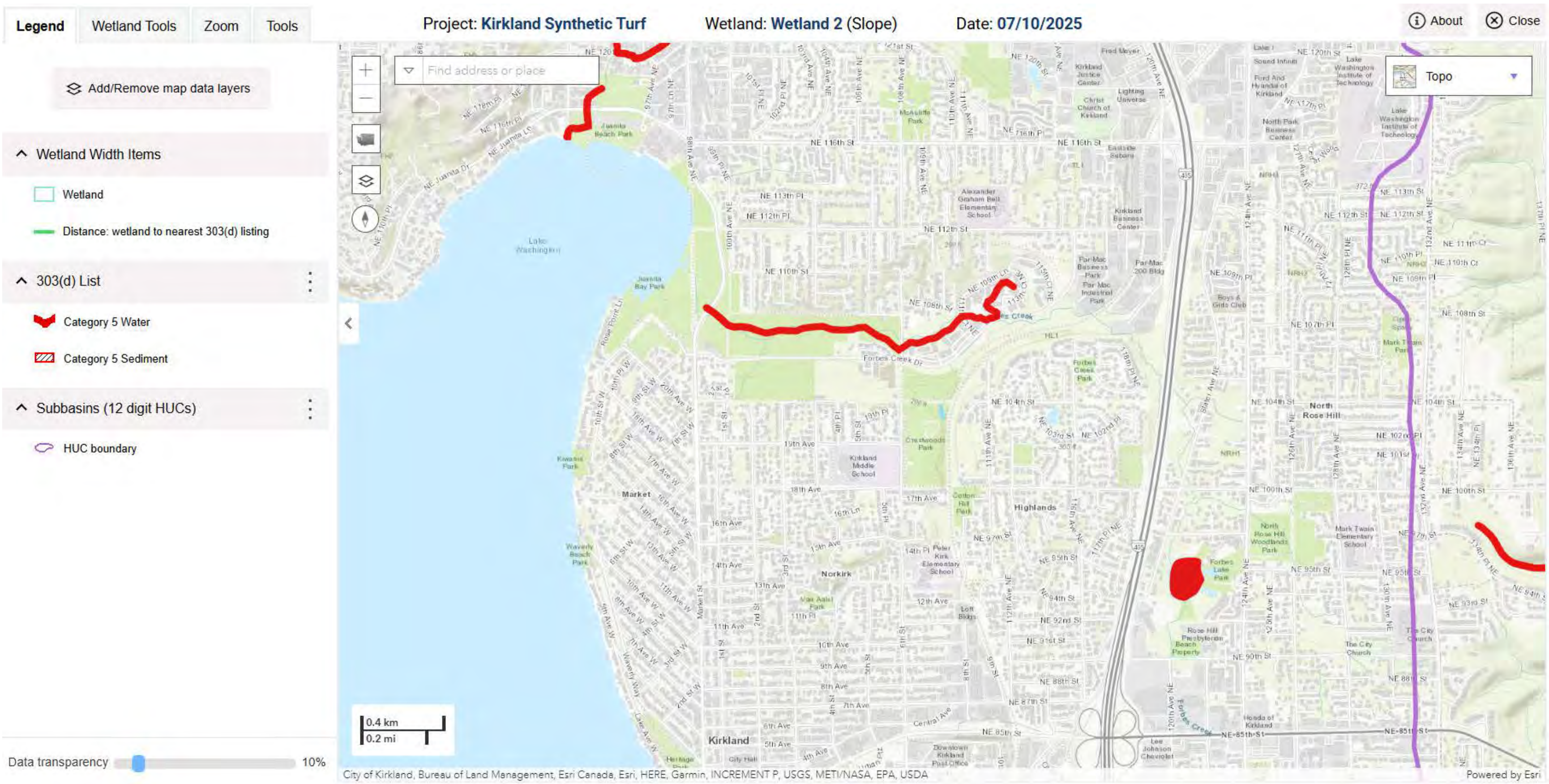

Figure B.6. Wetland 2 Distance to 303(d) Listed Waters

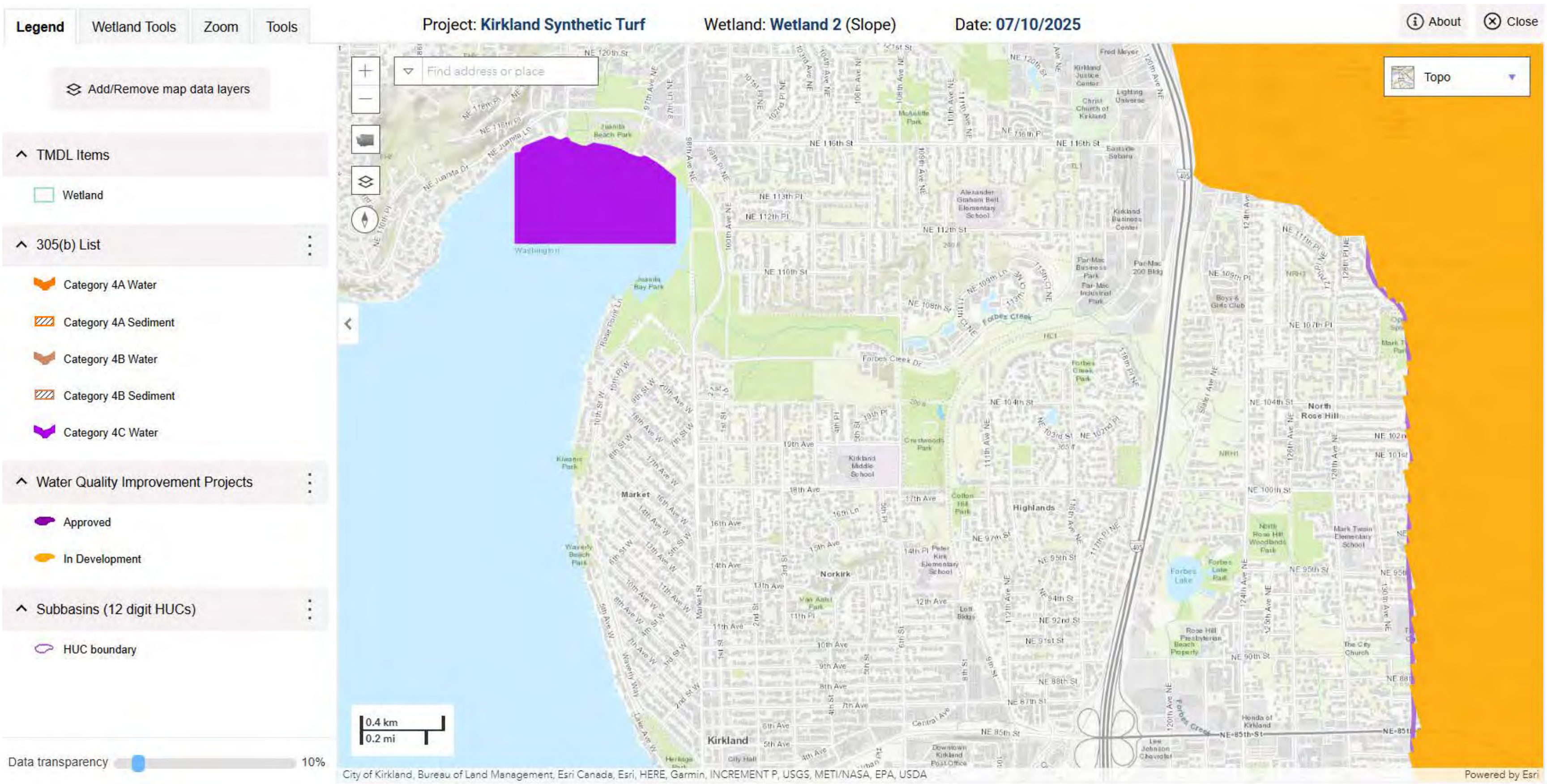

Figure B.7. Wetland 2 TMDL Map

Wetland name or number: Wetland 3

RATING SUMMARY - Western Washington

Name of wetland (or ID#): Wetland 3 **Date of site visit:** 06/12/2025

Rated By: Shawree Zhang **Trained by Ecology? Yes** [ ] **No** [X] **Date of Training:** N/A

HGM Class used for rating: Slope

Wetland has multiple HGM classes? Yes [ ] **No** [X]

NOTE: Form is not complete without the figures requested *(figures can be combined).*

Source of base aerial photo/map:

OVERALL WETLAND CATEGORY: [**Category IV**] (based on functions [X] or special characteristics [ ])

1. Category of wetland based on FUNCTIONS

[ ] **Category I** - Total score = 23 - 27
[ ] **Category II** - Total score = 20 - 22
[ ] **Category III** - Total score = 16 - 19
[X] **Category IV** - Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
Site Potential	**L**	**L**	**L**	
Landscape Potential	**M**	**M**	**L**	
Value	**M**	**H**	**M**	**Total**
Score Based on Ratings	**5**	**6**	**4**	**15**

Score for each function based on three ratings (order of ratings is not important)

9 = H,H,H
8 = H,H,M
7 = H,H,L
7 = H,M,M
6 = H,M,L
6 = M,M,M
5 = H,L,L
5 = M,M,L
4 = M,L,L
3 = L,L,L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	CATEGORY
Estuarine	
Wetland of High Conservation Value	
Bog	
Forested	
Coastal Lagoon	
Interdunal	
None of the above	**Not Applicable**

Wetland name or number: Wetland 3

Maps and figures required to answer questions correctly for Western Washington

Slope Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Plant cover of dense trees, shrubs, and herbaceous plants	S 1.3	
Plant cover of dense, rigid trees, shrubs, and herbaceous plants *(can be added to figure above)*	S 4.1	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	S 2.1, S 5.1	
1km Polygon: Area that extends 1km form entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	S 3.1, S 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	S 3.3	

Wetland name or number: Wetland 3

SLOPE WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

S 1.0 Does the site have the potential to improve water quality?

S 1.1 What are the characteristics of the average slope of the wetland?

Slope is 1% or less	points = 3	
Slope is >1%-2%	points = 2	
Slope is >2%-5%	points = 1	
Slope is greater than 5%	points = 0	**Score: 1**

S 1.2 What is the soil 2in below the surface or duff layer?

Mapped as true clay or organic (muck or peat)	points = 3	
Soil texture identified as clay or organic in field	points = 3	
Soil texture identified as clay or organic by laboratory test	points = 3	
None of the above	points = 0	**Score: 0**

S 1.3 Characteristics of the plants in the wetland that trap sediments and pollutants

Dense, uncut, herbaceous plants cover >90% of the wetland area	points = 6	
Dense, uncut, herbaceous plants cover >50% of the wetland area	points = 3	
Dense, woody, plants cover >50% of the wetland area	points = 2	
Dense, uncut, herbaceous plants cover >25% of the wetland area	points = 1	
Does not meet any of the criteria above for plants	points = 0	**Score: 2**

Total for S 1: 3

Rating of Site Potential [ ] **12-16 = H** [ ] **6-11 = M** [X] **0-5 = L** *Record the rating on the first page*

S 2.0 Does the landscape have the potential to support the water quality function of the site?

S 2.1 Is >10% of the area within 150ft on the uphill side of the wetland in land uses that generate pollutants?

Yes	points = 1	
No	points = 0	**Score: 1**

S 2.2 Are there other sources of pollutants coming into the wetland that are not listed in question S 2.1?

Yes	points = 1	
No	points = 0	**Score: 1**

S 2.3 What are the other sources of pollutants coming into the wetland?

Dogs

Total for S 2: 2

Rating of Landscape Potential [ ] **3-4 = H** [X] **1-2 = M** [ ] **0 = L** *Record the rating on the first page*

Wetland name or number: Wetland 3

S 3.0 Is the water quality improvement provided by the site valuable to society?		
S 3.1 Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list?		
Yes	points = 1	
No	points = 0	**Score: 0**
S 3.2 Is the wetland in a basin or sub-basin where water quality is an issue?		
Yes	points = 1	
No	points = 0	**Score: 1**
S 3.3 Has the site been identified in a watershed or local plan as important for maintaining water quality?		
Yes	points = 2	
No	points = 0	**Score: 0**
	Total for S 3:	**1**

Rating of Value [ ] **2-4 = H** [X] **1 = M** [ ] **0 = L** *Record the rating on the first page*

SLOPE WETLANDS

Hydrologic Functions - Indicators that the site functions to reduce flooding and stream degradtion

S 4.0 Does the site have the potential to reduce flooding and erosion?		
S 4.1 What are the characteristics of the plants that reduce the velocity of surface flows during storms?		
Dense, uncut, rigid plants cover >90% of the wetland area	points = 1	
All other conditions	points = 0	**Score: 0**
	Total for S 4:	**0**

Rating of Site Potential [ ] **1 = M** [X] **0 = L** *Record the rating on the first page*

S 5.0 Does the landscape have the potential to support the hydrologic functions of the site?		
S 5.1 Is more than 25% of the area within 150 ft upslope of wetland in land uses or cover that generate excess surface runoff?		
Yes	points = 1	
No	points = 0	**Score: 1**
	Total for S 5:	**1**

Rating of Landscape Potential [X] **1 = M** [ ] **0 = L** *Record the rating on the first page*

Wetland name or number: Wetland 3

S 6.0 Are the hydrologic functions provided by the site valuable to society?		
S 6.1 Is the wetland in a landscape that has flooding problems?		
Flooding occurs in a sub-basin that is immediately down-gradient of wetland.	points = 2	
Surface flooding problems are in a sub-basin farther down-gradient.	points = 1	
There are no problems with flooding downstream of the wetland	points = 0	**Score: 2**
S 6.2 Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan?		
Yes	points = 2	
No	points = 0	**Score: 0**
	Total for S 6:	**2**

Rating of Value [X] **2-4 = H** [ ] **1 = M** [ ] **0 = L** *Record the rating on the first page*

Wetland name or number: Wetland 3

HABITAT FUNCTIONS

These questions apply to wetlands of all HGM classes - Indicators that the site functions to provide important habitat

H 1.0 Does the wetland have the potential to provide habitat for many species?

H 1.1 What is the structure of the plant community?

- [ ] Aquatic Bed
- [ ] Emergent
- [x] Scrub-shrub
- [x] Forested
- [ ] Multiple strata within the Forested class (canopy, sub-canopy, shrubs, herbaceous, moss/ground cover)

4 structures or more	points = 4	
3 structures	points = 2	
2 structures	points = 1	
1 structure	points = 0	
No structures present	points = 0	**Score: 1**

H 1.2 What are the hydroperiods that meet the size thresholds in the wetland?

- [ ] Permanently flooded or inundated
- [ ] Seasonally flooded or inundated
- [x] Occasionally flooded or inundated
- [ ] Saturated only
- [ ] Permanently flowing stream or river in, or adjacent to, the wetland
- [ ] Seasonally flowing stream in, or adjacent to, the wetland
- [ ] Lake Fringe wetland
- [ ] Freshwater Tidal wetland

4 or more types present	points = 3	
3 types present or Lake Fringe / Freshwater Tidal Fringe	points = 2	
2 types present	points = 1	
1 type present	points = 0	
None present	points = 0	**Score: 0**

H 1.3 What is the richness of the plant species in the wetland?

>19 species	points = 2	
5-19 species	points = 1	
<5 species	points = 0	**Score: 1**

Wetland name or number: Wetland 3

H 1.4 What is the interspersion of habitats?		
High	points = 3	
Moderate	points = 2	
Low	points = 1	
None	points = 0	**Score: 1**
H 1.5 What are the special habitat features in the wetland?		
[✓] Large, downed, woody debris within the wetland (>4in diameter and 6ft long).		
[ ] Standing snags (dbh >4in) within the wetland		
[ ] Undercut banks are present for at least 6.6ft (2m) and/or overhanging plants extend at least 3.3ft (1m) over open water or a stream (or ditch) in, or contiguous with the wetland, for at least 33ft (10m)		
[ ] Stable steep banks of fine material that might be used by beaver or muskrat for denning (>30 degree slope) OR signs of recent beaver activity are present (cut shrubs or trees that have not yet weathered where wood is exposed)		
[ ] At least 0.25ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated (structures for egg-laying by amphibians)		
[ ] Invasive plants cover less than 25% of the wetland area in every stratum of plants (see H 1.1 for list of strata)		
6 habitats selected	points = 6	
5 habitats selected	points = 5	
4 habitats selected	points = 4	
3 habitats selected	points = 3	
2 habitats selected	points = 2	
1 habitat selected	points = 1	
No habitats selected	points = 0	**Score: 1**
	Total for H 1:	**4**

Rating of Site Potential [ ] **15-18 = H** [ ] **7-14 = M** [X] **0-6 = L** *Record the rating on the first page*

H 2.0 Does the landscape have the potential to support habitat functions of the site?

H 2.1 What is the percentage of accessible habitat within 1km of the wetland?		
>33% of 1km Polygon	points = 3	
20-33% of 1km Polygon	points = 2	
10-19% of 1km Polygon	points = 1	
<10% of 1km Polygon	points = 0	**Score: 0**
H 2.2 What is the percentage of total habitat in a 1km polygon around the wetland?		
Total habitat is >50% of the Polygon	points = 3	
Total habitat is 10-50% of the Polygon and in 1-3 patches	points = 2	
Total habitat is 10-50% of the Polygon and in >3 patches	points = 1	
Total habitat is <10% of the Polygon	points = 0	**Score: 1**

Wetland name or number: Wetland 3

H 2.3 What is the land use intensity in the 1km polygon?		
50% of the Polygon is high intensity land use	points = -2	
<50% of the Polygon is high intensity land use	points = 0	**Score: -2**
	Total for H 2:	**-1**

Rating of Landscape Potential [ ] **4-6 = H** [ ] **1-3 = M** [X] **0 = L** *Record the rating on the first page*

H 3.0 Is the habitat provided by the site valuable to society?

H 3.1 Does the site provide habitat for species valued in laws, regulations, or policies?

- [ ] Aspen Stands
- [ ] Biodiversity Areas and Corridors
- [ ] Herbaceous Balds
- [ ] Old-growth/Mature Forests
- [ ] Oregon White Oak
- [ ] Riparian
- [ ] Westside Prairie
- [ ] Fresh Deepwater
- [ ] Instream
- [ ] Nearshore (Coastal, Open Coast, Puget Sound)
- [ ] Caves
- [ ] Cliffs
- [x] Snags and Logs
- [ ] Talus

The following criteria automatically score 2 points:

- [ ] The wetland provides habitat for Threatened or Endangered species
- [ ] The wetland is mapped as a location for an individual WDFW priority species
- [ ] The wetland is a Wetland of High Conservation Value
- [ ] The wetland has been categorized as an important habitat site in a local plan

The wetland has 3 or more WDFW priority habitats within 100m, or meets the criteria for societal value	points = 2	
The site has 1 or 2 WDFW priority habitats within 100m	points = 1	
The site does not meet any of the criteria for societal value	points = 0	**Score: 1**
	Total for H 3:	**1**

Rating of Value [ ] **2 = H** [X] **1 = M** [ ] **0 = L** *Record the rating on the first page*

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

SC 1.0 Estuarine Wetlands

SC 1.1 Does the wetland meet all of the following criteria for Estuarine wetlands? ☐ The dominant water regime is tidal ☐ The wetland is vegetated ☐ The water salinity is greater than 0.5 ppt Yes - Go to SC 1.2 No - Not an Estuarine Wetland	**Result: Not an Estuarine Wetland**
SC 1.2 Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? Yes - Category **I** Estuarine Wetland No - Go to SC 1.3	**Result:**
SC 1.3 Is the wetland unit at least 1ac in size and meets at least two of the following three conditions? ☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 10% cover of non-native plant species. ☐ At least 75% of the landward edge of the wetland has a 100ft buffer of shrub, forest, or un-grazed or un-mowed grassland ☐ The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands. Yes - Category **I** Estuarine Wetland No - Category **II** Estuarine Wetland	**Result:**

SC 2.0 Wetlands of High Conservation Value

SC 2.1 Does the wetland overlap with any known or historical rare plant or rare & high-quality ecosystem polygons on the WNHP Data Explorer? Yes - Category **I** Wetland of High Conservation Value No - Go to SC 2.2	**Result: Go to SC 2.2**
SC 2.2 Does the wetland have a rare plant species, rare plant community, or high-quality common plant community that may qualify the site as a WHCV? Yes - Category **I** Wetland of High Conservation Value No - Not a Wetland of High Conservation Value	**Result: Not a Wetland of High Conservation Value**

Wetland name or number: Wetland 3

SC 3.0 Bogs

SC 3.1 Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16in or more of the first 32in of the soil profile? Yes - Go to SC 3.3 No - Go to SC 3.2	**Result: Go to SC 3.2**
SC 3.2 Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? Yes - Go to SC 3.3 No - Not a Bog Wetland	**Result: Not a Bog Wetland**
SC 3.3 Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least 30% cover of plant species listed in the table provided in the instructions? Yes - Category **I** Bog Wetland No - Go to SC 3.4	**Result:**
SC 3.4 Is an area with peats or mucks forested (>30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann Spruce, or western white pine AND any of the species (or combinations of species) listed in the table found in the instructions provide more than 30% of the cover under the canopy? Yes - Category **I** Bog Wetland No - Not a Bog Wetland	**Result:**

SC 4.0 Forested Wetlands

SC 4.1 Does the wetland have at least 1 contiguous acre of forest that meets one of the following criteria? ☐ Old-growth forests ☐ Mature forests Yes - Category **I** Forested Wetland No - Not a Forested Wetland	**Result: Not a Forested Wetland**

Wetland name or number: Wetland 3

SC 5.0 Wetlands in Coastal Lagoons

SC 5.1 Coastal Lagoons: Does the wetland meet all of the following criteria of a wetland in a coastal lagoon? ☐ The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or rocks ☐ The depression in which the wetland is located contains ponded water that is saline or brackish (>0.5 ppt) during most of the year in at least a portion of the open water area (measured near the bottom) ☐ The lagoon retains some of its surface water at low tide during spring tides Yes - Go to SC 5.2 No - Not a Coastal Lagoon Wetland	**Result: Not a Coastal Lagoon Wetland**
SC 5.2 Does the wetland meet all of the following three conditions? ☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species). ☐ At least 75% of the landward edge of the wetland has a 100ft buffer of shrub, forest, or un-grazed or un-mowed grassland. ☐ the wetland is larger than 0.10ac (4350 sqft) Yes - Category I Coastal Lagoon No - Category II Coastal Lagoon	**Result:**

SC 6.0 Interdunal Wetlands

SC 6.1 Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership WBUO)? Yes - Go to SC 6.2 No - Not an Interdunal Wetland	**Result: Not an Interdunal Wetland**
SC 6.2 Is the wetland 1ac or larger in size, or a mosaic that is 1ac or larger in size? Wetland is larger than 1ac in size - Go to SC 6.3 Wetland is a mosaic larger than 1ac is size - Category II Interdunal Wetland No - Go to SC 6.4	**Result:**
SC 6.3 Does the wetland score 8 or 9 points for the habitat functions? Yes - Category I Interdunal Wetland No - Category II Interdunal Wetland	**Result:**
SC 6.4 Is the wetland unit between 0.1ac and 1ac, or in a mosaic of wetlands that is between 0.1ac and 1ac in size? Yes - Category III Interdunal Wetland No - Category IV Interdunal Wetland	**Result:**

Wetland name or number: Wetland 3

Category of wetland based on Special Characteristics	
If you answered No for all types, enter "Not Applicable" on Summary Form	**Final Category: Not Applicable**

Figure C.1. Wetland 3 Cowardin Plant Classes

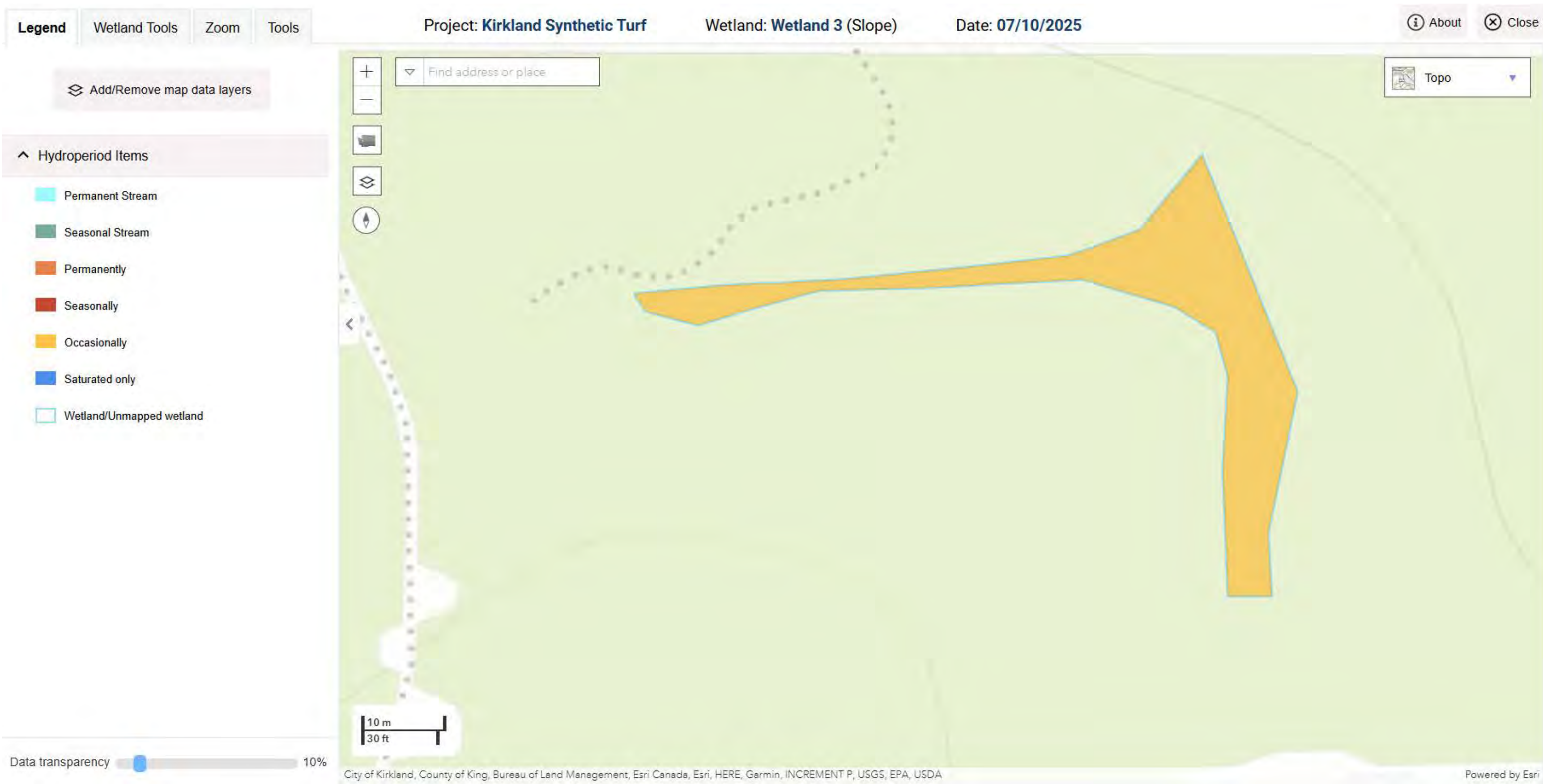

Figure C.2. Wetland 3 Hydroperiods

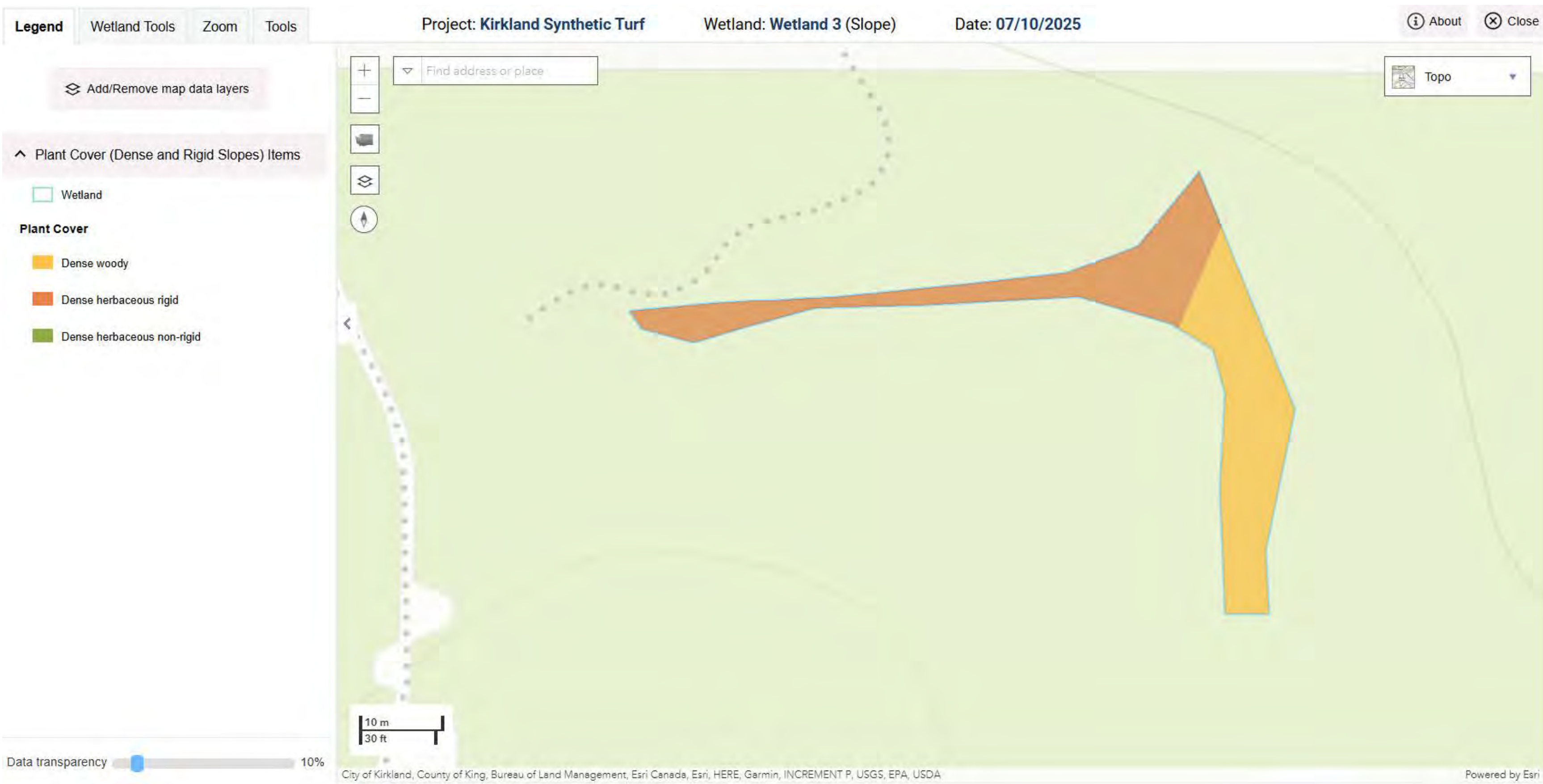

Figure C.3. Wetland 3 Plant Cover of Dense Trees, Dense and Rigid Trees, Shrubs, and Herbaceous Plants

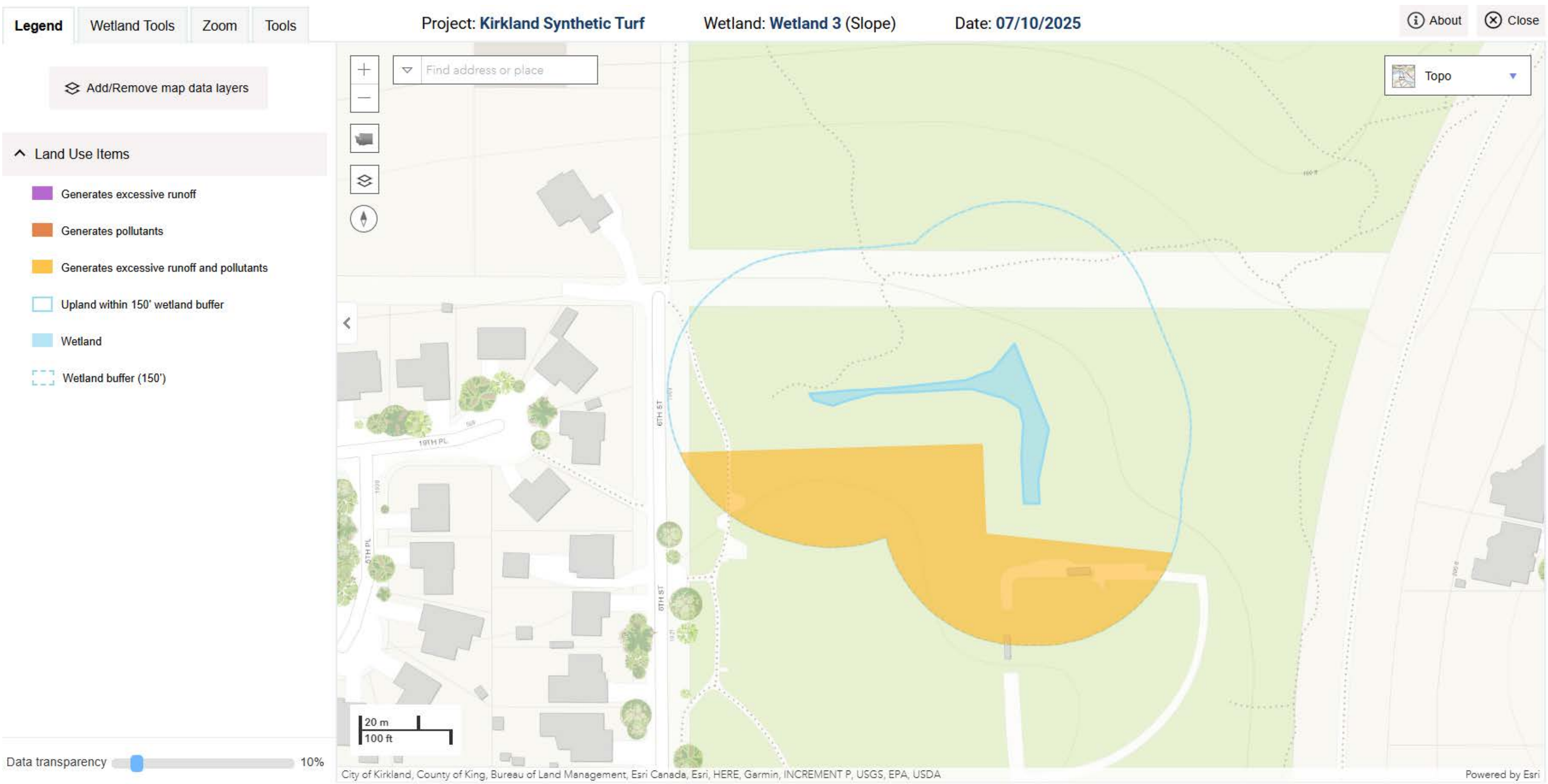

Figure C.4. Wetland 3 150-Foot Boundary

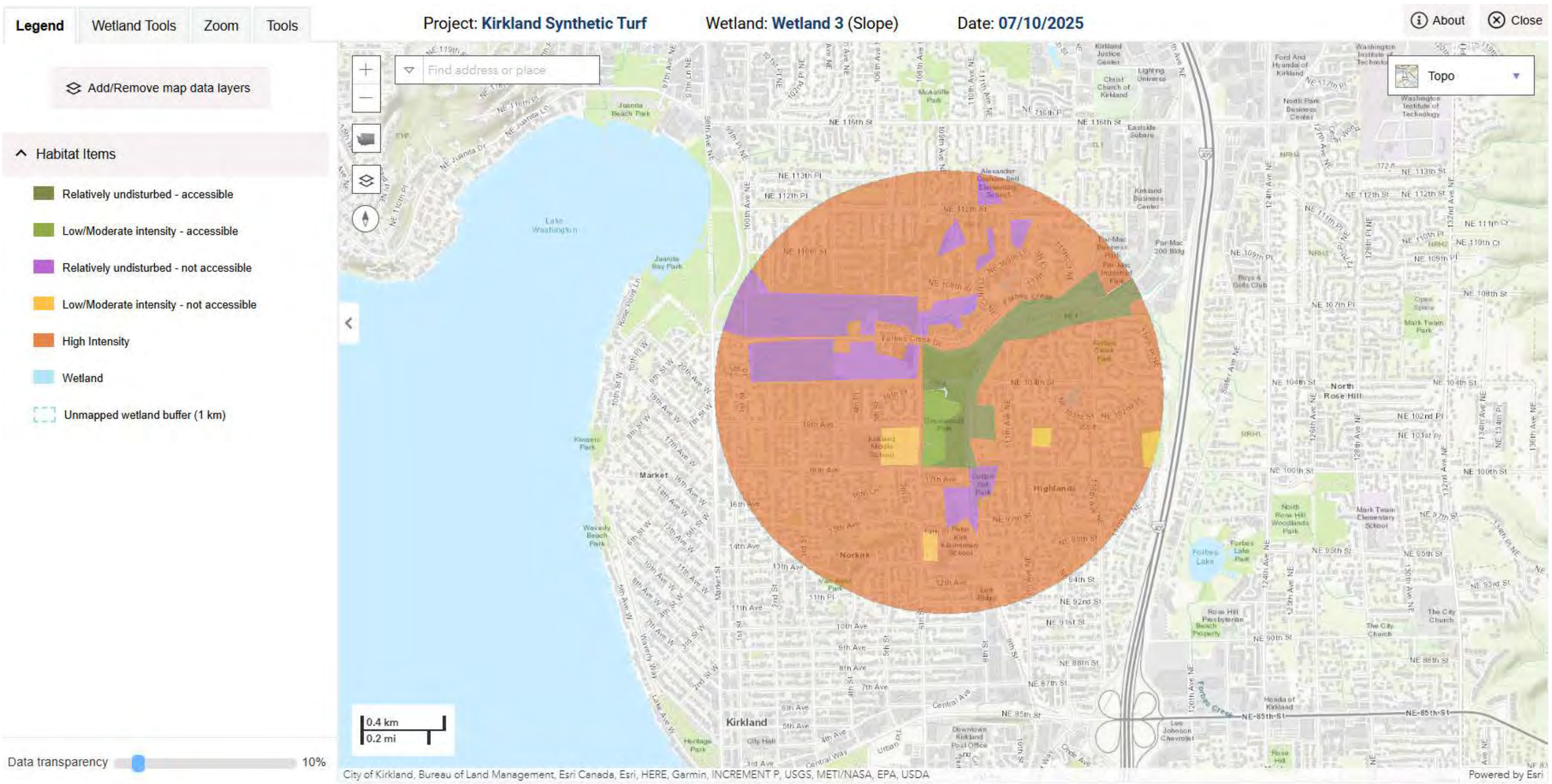

Figure C.5. Wetland 3 1 Kilometer Habitat Polygon

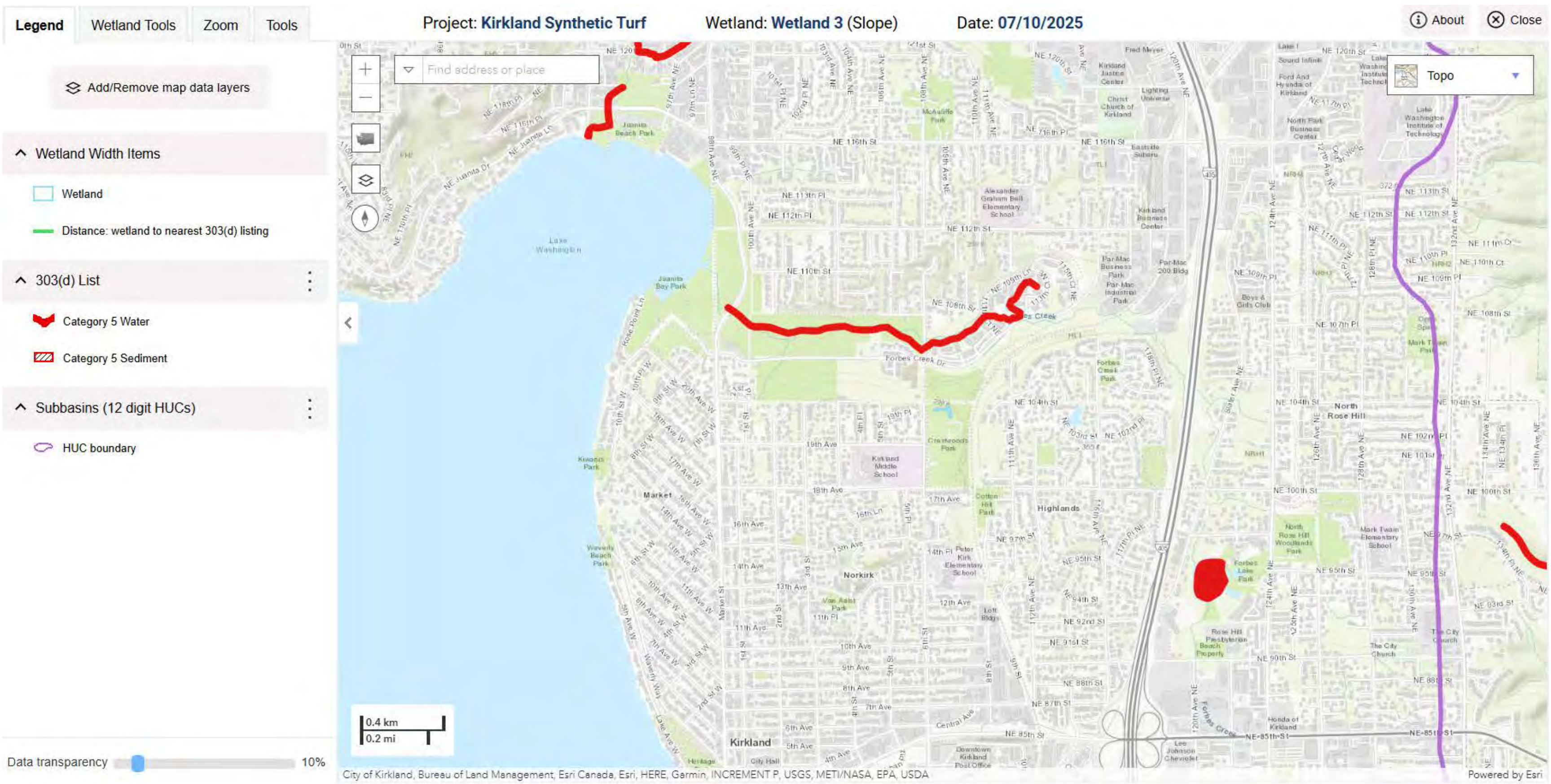

Figure C.6. Wetland 3 Distance to 303(d) Listed Waters

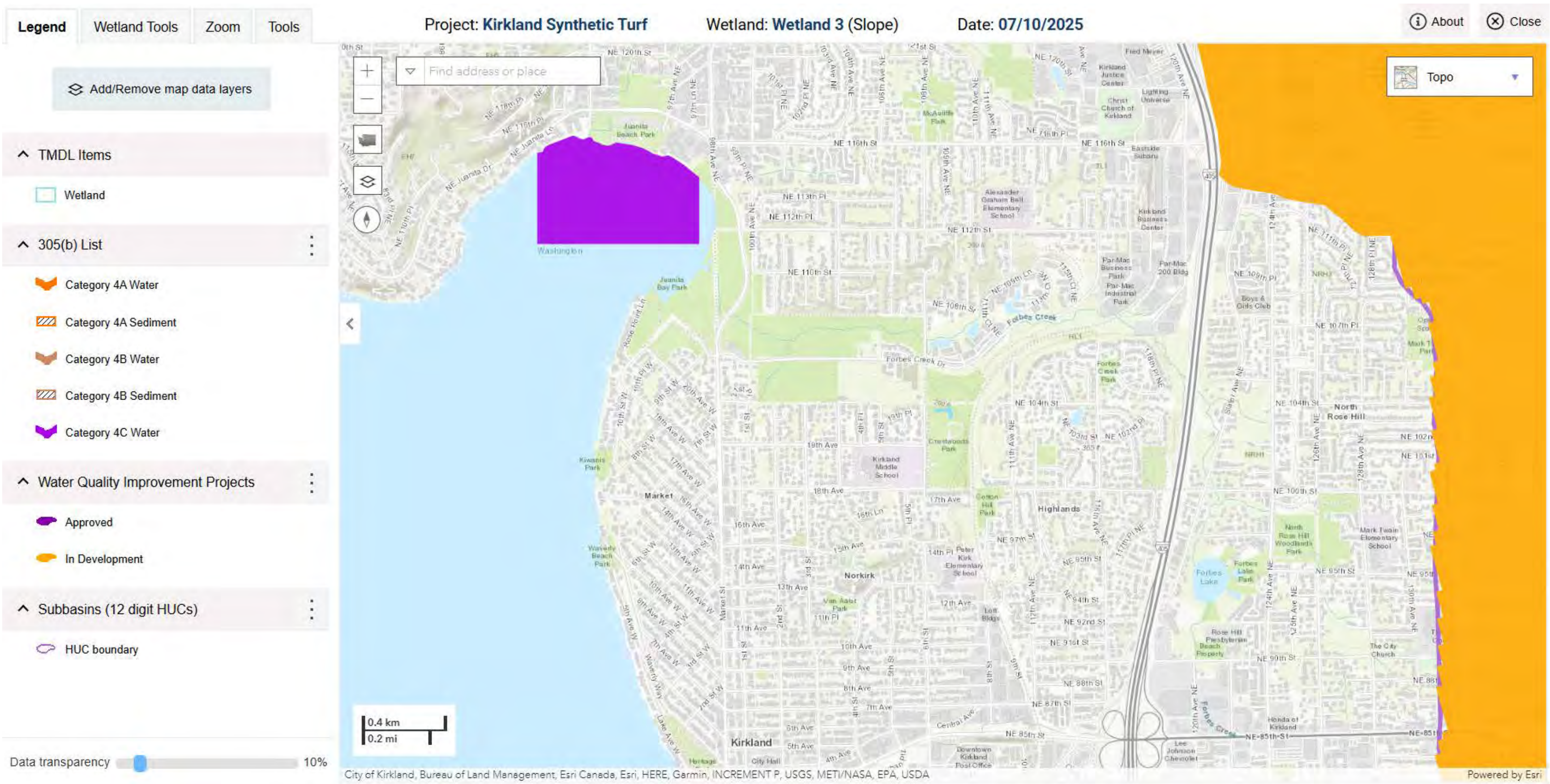

Figure C.7. Wetland 3 TMDL Map

Appendix B

Permit Matrix

Permitting Matrix For Crestwoods Park Site.

Responsible Agency	Permit/Process	Permit Triggers	Compliance Approvals/Deliverables	Estimated Agency Review Time Frame	Applicable to Infield Redevelopment
Washington State Department of Ecology	NPDES Construction Stormwater General Permit	Projects with over 1 acre of earthwork (including staging areas) or with discharges to waters of the U.S.	• Construction Stormwater General Permit NOI at least 60 days prior to construction • Two public notices and a 30-day comment period • SWPPP (can be submitted after the NOI, but prior to construction start)	2 months + 1 month comment period	No, unless project involves more than 1 acre of earthwork, including staging areas.
Lead Agency (City of Kirkland)	SEPA Checklist	Required for a proposal that requires government action and is not exempt from the threshold determination provisions.	• SEPA checklist • 60 percent site plans • Cultural Resources Review • Critical Areas Report • Geological Hazards Report	3 months	Yes
City of Kirkland (Crestwoods Park)	Critical Area Determination	Development that includes a critical area and/or its buffer within the project area	• Master Application • Critical Areas Report • Site and Construction Plans	3 months	No, unless activities extend into wetland buffers.
	Clearing and Grading/Land Surface Modification Permit	Land surface disturbance	• Master Application • Drainage Technical Information Report • Rodent Abatement Declaration and letter from rodent abatement company • Construction Plan Set • Site Plan • Construction Stormwater Pollution Prevention Plan • Landscape Plan	3 months	Yes

Permitting Matrix For 132nd Square Park Site.

Responsible Agency	Permit/Process	Permit Triggers	Compliance Approvals/Deliverables	Estimated Agency Review Time Frame	Applicable to Infield Redevelopment
Washington State Department of Ecology	NPDES Construction Stormwater General Permit	Projects with over an acre of earthwork or with discharges to waters of the U.S.	• Construction Stormwater General Permit NOI at least 60 days prior to construction • Two public notices and a 30-day comment period • SWPPP (can be submitted after the NOI, but prior to construction start)	2 months + 1 month comment period	No, unless project involves more than 1 acre of earthwork, including staging areas.
Lead Agency (City of Kirkland)	SEPA Checklist	Required for a proposal that requires government action and is not exempt from the threshold determination provisions.	• SEPA checklist • 60 percent site plans • Cultural Resources Review • Critical Areas Report • Geological Hazards Report	3 months	Yes
City of Kirkland (132nd Square Park)	Clearing and Grading/Land Surface Modification Permit	Land surface disturbance	• Master Application • Drainage Technical Information Report • Rodent Abatement Declaration and letter from rodent abatement company • Construction Plan Set • Site Plan • Construction Stormwater Pollution Prevention Plan • Landscape Plan	3 months	Yes

Appendix C

D.A. Hogan Kirkland Parks Infield Conversions

HERRERA
Science + Planning + Design

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MEMORANDUM

DA HOGAN

To: Neil Schaner, PE, Herrera

Cc: Eliza Hoffman, Herrera

From: Eric Gold

Date: August 26, 2025

Re: City of Kirkland Parks
Infield Surface Conversions
Narrative Summary

Having observed and studied the conditions at both 132nd Square and Crestwoods Parks Infields, we have provided narrative and graphic analysis of each, as well as options for conversion to synthetic turf surfacing with representative details. Each option was selected for a variety of practical reasons including cost, durability, ease of installation, and level of site disturbance. All of the options offered have equivalent outcomes as regards safety and performance, assuming an identical synthetic turf specification and adequate installation quality controls.

Preferred Options

Each option, graded[1] for expected total development cost (including associated or "soft" costs), life cycle duration or durability[2], ease of installation / expected construction duration, and level of site disturbance required:

132nd Square, Option 1 "Traditional Full Section" Conversion

Total Development Cost	HIGH
Expected Life Cycle	HIGH
Ease of Installation	LOW
Site Disturbance	HIGH

Crestwoods, Option 1 "Overlay" Conversion

Total Development Cost	MEDIUM
Expected Life Cycle	LOW
Ease of Installation	HIGH
Site Disturbance	LOW

Crestwoods, Options 2 & 3 "Full Section, Traditional Drainage" Conversion

Total Development Cost	HIGH
Expected Life Cycle	HIGH
Ease of Installation	LOW
Site Disturbance	HIGH

Synthetic Turf Specification

The City of Kirkland has some representative experience with specific synthetic turf products and vendors. Although limited, this experience may be of some assistance in guiding the specification of future installations. As a general rule of thumb and guide for future budgeting, synthetic turf surfaces *as a whole* have a 10-12 year replacement life cycle.

---

[1] Graded on a "high, medium, low" basis, relative to all options recommended for the site.
[2] Refers to the underlying infrastructure only. Synthetic Turf Surfacing itself is excluded.

1450 114th Ave SE
Bellevue, WA 98004

p. 206-285-0400
www.dahogan.com

This excludes the underlying infrastructure and supplemental resilient pad systems (if applicable), as these elements are relatively generational (life-cycle of 20+ years). Removal and replacement, in 2025 dollars, is roughly $10/sf depending on the specification. High wear areas such as batters boxes, soccer penalty kick areas, etc. have a significantly shorter life span and require far more regular maintenance, daily during periods of high use. Note that batters boxes and pitching runout areas are normally installed as removable panels, using Velcro to secure in place. The initial installation should come with 4-6 replacement panels.

The following describes various options available on the market today.

1. **Common Products**

   The following are all typical product-type selections by the majority of our Parks, K-12, Collegiate, and Pro Clients.

   A. Slit-Film, or fibrillated tape, consists of wide, thin polyethylene fibers (somewhat analogous too scotch tape) that are then incised (slit) in a way that allows them to split or "fibrillate" during the installation of the infill materials. The fibrillation process, also often referred to as "blooming", spreads the individual strands out in a way that holds the infill in place particularly well. Slit-Film fiber is softer than most other fiber types due to its thin cross section. This makes it less abrasive but also results in it laying down or matting earlier in its service life. For many of our clients this is actually beneficial – public Parks and K-6 facilities in general like this feature as it encapsulates or traps the infill material, meaning far less migration and therefore less maintenance. In some applications, we use this product as an analogue for infield clay, as a matted surface creates faster ball roll and truer bounce.

   B. Monofilament fibers are extruded in a wide variety of cross sections, one way vendors tend to differentiate their products from the competition. Not unlike pasta: spaghetti (large, round), angel hair (small, round), linguini (thick, flat), etc., but over the years we've seen some chevrons, deltas, spined bat wings, all kinds of variations. It's debatable whether these shapes contribute much to performance, and many iterations over the years have failed spectacularly as the more complex shapes tend to break at a weak point, resulting in significant fiber loss due to breakage and shedding. The industry has largely settled on "linguini" as it's simple geometry has proved the most durable.

      Monofilaments tend to maintain their upright condition a little longer than slit-films. This favors cleat interaction with the infill as the fibers' open stance allows more cleat interface. This also creates more friction or ball "check up" which makes it among the primary soccer turf types.

   C. Dual Fiber Turf uses various proportions of both slit-film and monofilament fibers, usually somewhere between 40-60% of one and 40-60% of the other, by weight. This system offers the best of both and is gaining popularity rapidly.

   D. "Thatch Layer" Turf incorporates a dense layer of textured (curly) polyethylene, polypropylene, or nylon fibers below the top of the infill. In theory, this provides extra holding power over the infill materials, and a bit more resistance to migration under the lateral forces of cleats. This has been successful as extremely durable deep-pile surfaces, as well as thinner, faster surfaces like infields and warning tracks. While any of the top-tier vendors will supply this configuration, AstroTurf has been the leader in this development (their "RootZone" and "3D" product lines). A thatch layer can be incorporated with any fiber type or blend.

2. **Specialty Products**

   Some sports demand specific types of synthetic turf (Field Hockey is one example, where the preferred surface is essentially the late-80's-style woven nylon over an e-layer), and some uses and applications benefit greatly from some of the more unusual configurations.

   A. The "original AstroTurf" system is practically a specialty product at this point… a non-infilled, very high density, short-pile turf that can be extremely durable in many applications like batting cages, walk-off areas, conditioning spaces, and as mentioned field hockey. Because it lacks the ballasting effect of infill, this is typically glued to a solid base of concrete or asphalt, but it is supplied with an integrated closed cell pad that can act as ballast.

B. Extremely high density, thatch-zone systems with fiber heights/depths 1" or more tend to be best for landscape applications (pet areas as well).

It's worth noting that some vendors are offering "new, non-infilled turf for multi-sport applications". Our experience with products of this nature is that they tend to be highly directional, abrasive, dimensionally unstable, and generally nothing like grass. Which is what infilled synthetic turf sports surfaces strive to emulate (or should).

3. Associated Products & Materials - Infills

Infill materials are one of the main ways synthetic turf mimics grass and soil – by grabbing and releasing the cleat or sole of the shoe just as natural grass does. Probably even more than as described for monofilament turf fibers, producing unique infills has been a major way for vendors with the resources to differentiate themselves from their competitors. This has led to some significant successes, but also some abject failures. We'll only go in depth on the more common options in our region.
Inherently Resilient Options:

A. SBR Crumb Rubber is the original resilient infill introduced in the mid-late 90's. It is recycled tires supplied in a specific range of particle sizes. Only a few firms perform the process of rendering tires into this granular form – none of the turf vendors do this "in house" that I am aware of, although some do recycle it out of used turf. Two processes are used: Ambient Grind is a room-temperature process that results in a more ragged-edged particles and small pieces. This can cause the granules to "lock up" and despite the inherent resiliency of the rubber can actual get quite firm and even slow drainage considerably. Cryogenic Grind or "Cryo" uses liquid nitrogen to flash freeze the raw material to well below 0°F resulting in a brittle feed stock that essentially shatters into cleaner, more cuboidal geometry that resists consolidation or settling.

   SBR Crumb Rubber has a long history of serious claims of danger to human and environmental health, and it's hard to dispute that the negative PR has greatly diminished it's use, particularly in the PNW and more specifically west of the Cascades. Coating the granules with latex paints or polyurethane has been one means of eliminating human contact. While *most* of the claims of human health dangers have been debunked (there are current some discussions around PFAS and microplastics), the recent discovery of something called "6PPd-Q" in leachate from shredded tire material as lethal to juvenile salmonids has, or will likely, eliminate it as a viable option.

B. EPDM Crumb Rubber is another resilient material that was offered early on when the uniformity of SBR was less reliable, and later as an alternative that lacked the additives that truck tires required (and was suspected of creating health hazards). These days, as an alternative to SBR it suffers from one of its greatest attributes: it can be practically indistinguishable from SBR. For many of our clients, this potential "bad PR" excludes it from consideration. It is also quite expensive relatively (about $1.00/sf more than SBR) and must be sourced from a reliable manufacturer and rigid specification as there are some pretty bad versions of it available.

Insufficiently Resilient Options requiring a Supplemental Pad:

C. TPE, or Thermoplastic Elastomer, is a "virgin plastic" material often used in medical equipment and food-grade containers. It is only barely resilient, but extremely inert. TPE carries up to a $1.10/sf premium over SBR. Despite this, King County Parks has essentially standardized this infill, and King County does not consider it as "pollution generating" as other infills (even cork, somehow).

D. Granular Cork has become the dominant "alternative infill" in recent years. In 2016, Seattle Parks made cork their standard, and Seattle Public Schools soon followed suite, followed by Shoreline Schools, among others. As a commodity raw material of the cork industry, granular cork can be supplied by any vendor (much like SBR), making it a viable alternative under most any purchasing requirements. Cork, the bark of the cork oak (sp. Quercus suber), is of course organic, but unlike other organic infills, it does not absorb water. Used on a poorly constructed base or under some very specific environmental conditions it does float, but by its nature it does have excellent resiliency and durability. Cost for cork has come down considerable in recent years and now carries around a $0.65/sf premium over SBR.

E. Olive Pit, Walnut Shell: I put these under a common heading because they are extremely hard and can be abrasive. We typically reserve these options almost exclusively for warning tracks and walking surfaces.

F. Other Generic Organic Infills are typically based on coconut shell by-products, often mixed with other organics like rice hulls. Our experience with these materials point to two very undesirable traits: 1) they hold a LOT of excess water, and days after a rainy period can still generate "rooster tails", splashing, and general discomfort for users, and 2) during dry periods can become wind-born (i.e., blow away) and so require watering / irrigation. They also settle and migrate significantly and so require "top dressing" every other year or so.

4. Associated Products & Materials – Supplemental Resilient Pad Systems

Often referred to simply as "shock pads", these underlayments can eliminate *any* potential issues with G-Max or Head Impact Criteria regardless of the type or quality of the infill and are a necessary part of all *non-infilled* systems going back to the second generation of AstroTurf.

A. Paved-in-Place Elastic Layer, or "e-layer" is a matrix of SBR granule and pea gravel bound and encapsulated in a polyethylene binder, paved onto a permeable surface such as aggregate or porous asphalt much like asphalt. E-layers are extremely durable – we encounter installations from the 80's that are still serviceable. E-layers allow for the simplest turf replacements, being a single unit covering without seams. The only downside to e-layers is weather sensitivity during installation – cold and wet will hamper progress. Can also be somewhat problematic if settlement is a potential future issue. Definitely the preferred pad system, these run around $1.75 - $2.25/sf.

B. Most other common pad systems available fall under the "interlocking tile" category. The most common are Brock and SchmitzFoam, both of which are available at different thicknesses and resiliencies. Not at all weather dependent, these are a good option when winter installation is predicted. On the downside, these have to be removed during every subsequent turf replacement and while that may be every 10-12 years, the edges are trimmed-to-fit and generally have to be replaced. This can be an issue if the product line is no longer available and of course carries an additional cost. Installed, tile systems run $1.65 - $1.85/sf.

C. Less common with the advent of the interlocking tile system is the "rolled goods" system, which is basically a factory-fabricated e-layer, albeit much denser and less permeable, more like a flooring product – it's most common use these days.

Appendix D

D.A. Hogan 132nd Square Park Infield Conversion

HERRERA
Science + Planning + Design

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MEMORANDUM

To: Neil Schaner, PE, Herrera

Cc: Eliza Hoffman, Herrera

From: Eric Gold

Date: August 26, 2025

Re: City of Kirkland Parks
132nd Square Park Infield Surface Conversion
Feasibility Study Narrative

Existing Conditions

The following are our observations of existing conditions associated with the infield playing surface and immediately adjacent surfaces only. Fencing, Player & Spectator amenities, and outfield conditions were not assessed. Refer also to the attached "Existing Conditions" exhibit. Images follow.

- Fully "Skinned" Infield, consisting of approximately 2.5" of clay/silt/sand infield soil mix, over a thin layer of coarse sand (image 1).
- Assumed no underdrainage present.
- No fence line / containment curb (image 2).
- Grade irregularities around foul lines / foul territory and the infield "arc" (images 3, 4).
- Mostly even transitions between the foul lines (image 5).
- Surface slopes varied from 1.5% to 5% across the infield surface.
- The existing infield/outfield arc is not consistent with accepted "typical" little league baseball rules for dimension, i.e., a 60' radius drawn from the front-center of a pitching slab at 46'.

Design Assumptions / Conclusions

The following considerations apply;

- Lacking any existing subsurface drainage infrastructure will require a solution that employs a full-section approach using, at a minimum, a permeable aggregate foundation and formal subsurface drainage system.
- Subsurface drainage will discharge to a conveyance per Herrera.
- The lack of any perimeter containment curbs requires new poured-in-place concrete curbs to both contain the field foundation section and to support the synthetic turf edge anchor (see Typical Details).
- The variable surface slope and irregularities around both foul territories will require a more significant than typical transition regrade and restoration, particularly down the first base foul line and foul territory. Some of this may be remedied via the expansion of the infield/outfield arc.
- Significant adjustments / retrofit of the existing irrigation zones around the arc will be required.

Traditional Full-Section Conversion

- Trenched 4" perforated drainage laterals, spaced 15' on center, piped to a 6" tight-line collector. Orientation of the drainage laterals as shown simplifies the collector pipe required and takes advantage the existing average surface gradient.
- A solid-piped collector will convey stormwater to Herrera for code compliance and discharge.
- Non-woven geotextile separator fabric between drainage trenches, on a prepared (planar, unyielding) subgrade.
- 8" of permeable aggregate base course (rough graded), 2" of permeable aggregate top course (fine graded) will comprise the field foundation/base. This allows for both vertical and lateral infiltration of stormwater through the surface, base, and to the subsurface drainage trenches.
- Synthetic turf surfacing of an approved specification, along with irrigation retrofit and site restoration completes this installation.

Image 1, Soil Profile

Image 2, typical fenceline condition

Image 3, Grade Irregularities

Image 4, 3rd Base Line / Foul Territory Grade Irregularities

Image 5, 1st Base Line / Foul Territory Grade Irregularities

Image 6, Relatively even transitions between the foul lines

DA HOGAN

July 9, 2025

N

0 30' 60'

SCALE: 1" = 30'

Infield Synthetic Turf Conversion Study

Existing Conditions

"Skinned" Infield
No subsurface drainage
Soil-Based Natural Grass
Variable cross-slope

City of Kirkland, WA
Parks and Community Services

132nd Square Park
13159 132nd Ave NE
Kirkland 98034

DA HOGAN

July 9, 2025

N

0 30' 60'

SCALE: 1" = 30'

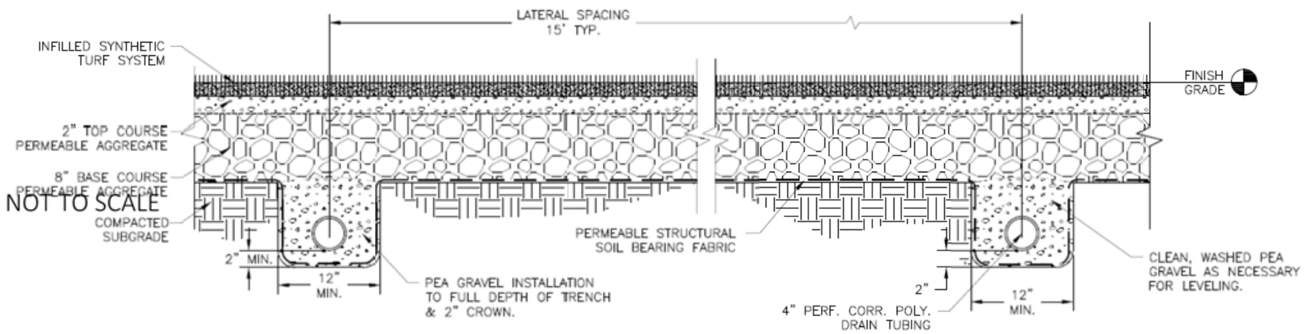
Infield Synthetic Turf Conversion Study

Option 1

Trenched 4" Drainage Tubing
Tight-Line Collector
New Fence-line Curb
Synthetic Turf Surfacing
Sodded Natural Grass Transition

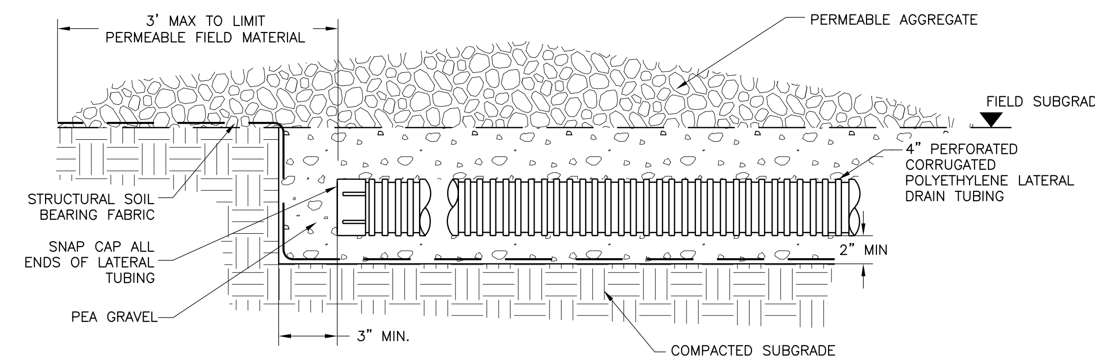
City of Kirkland, WA
Parks and Community Services

132nd Square Park
13159 132nd Ave NE
Kirkland 98034



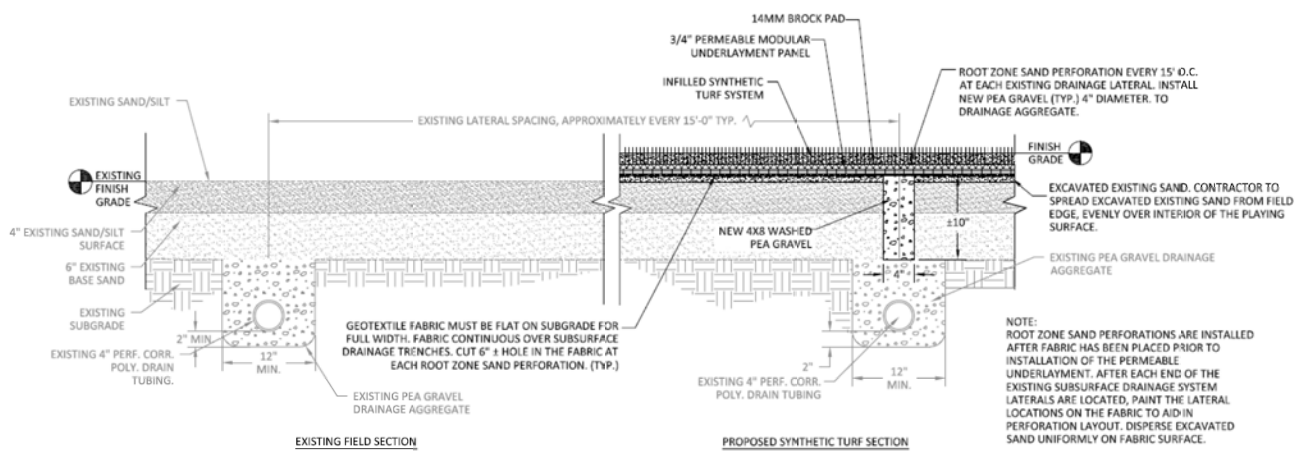
A TRADITIONAL FULL-SECTION

CRESTWOODS NOTE: REPLACE EXISTING DRAINAGE AGGREGATE



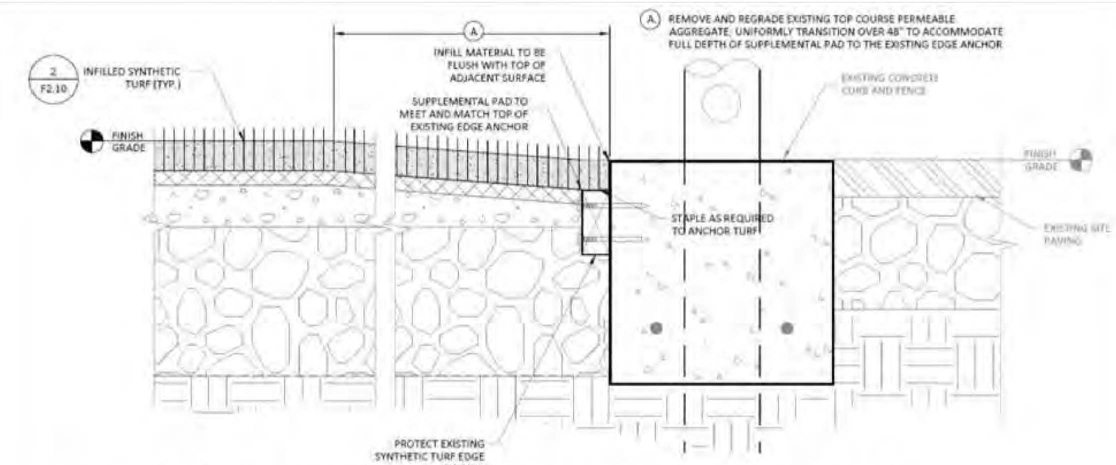
D TRENCHED SUBSURFACE DRAINAGE

NOT TO SCALE



C OVERLAY

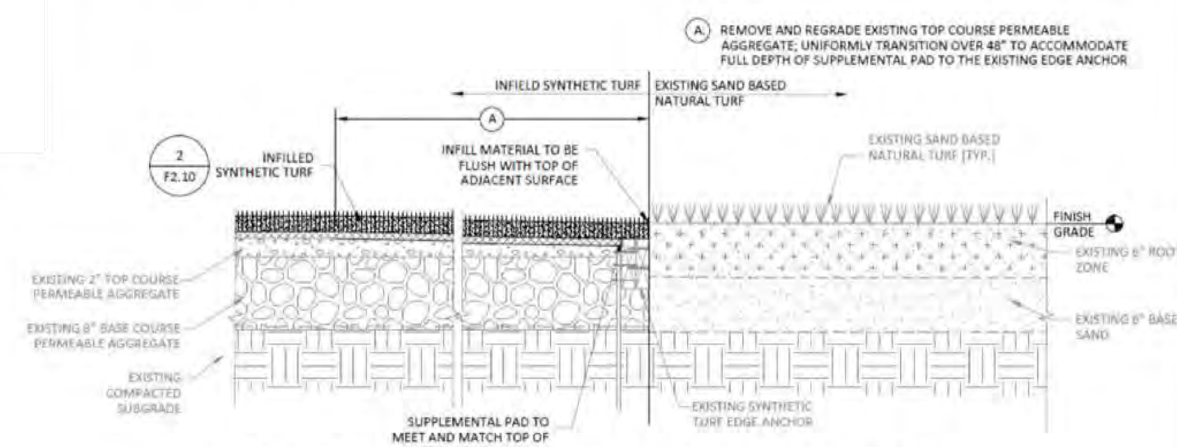
NOT TO SCALE



F CONTAINMENT CURB & EDGE ANCHOR

NOT TO SCALE

CRESTWOODS NOTE: CURB IS EXISTING



G EDGE ANCHOR @ GRASS TRANSITION

NOT TO SCALE

Infield Synthetic Turf Conversion Study

Typical Details

City of Kirkland, WA
Parks and Community Services

132nd Square Park
13159 132nd Ave NE
Kirkland 98034

Appendix E

132nd Square Park Stormwater Figure

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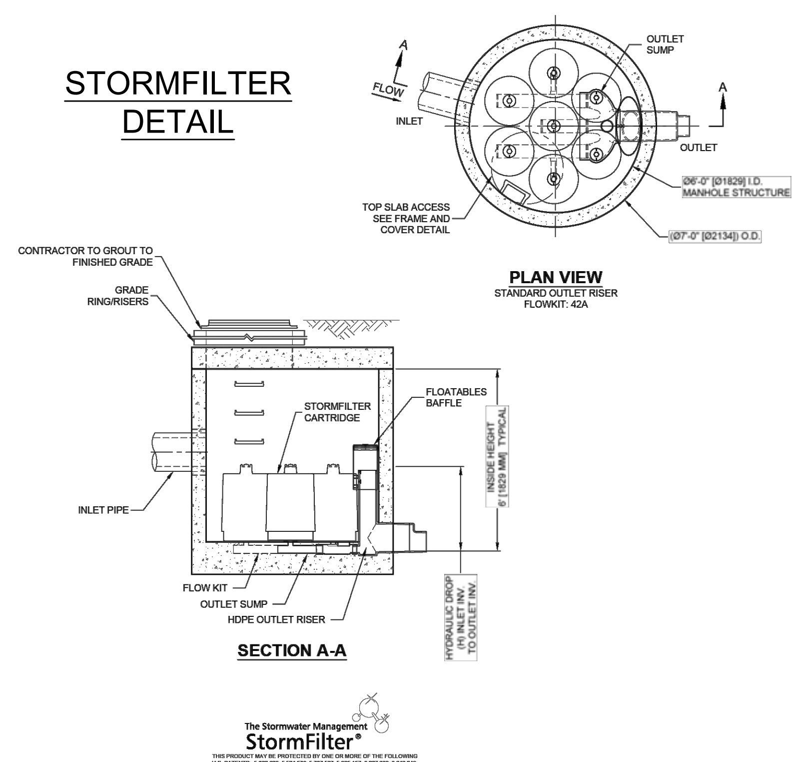
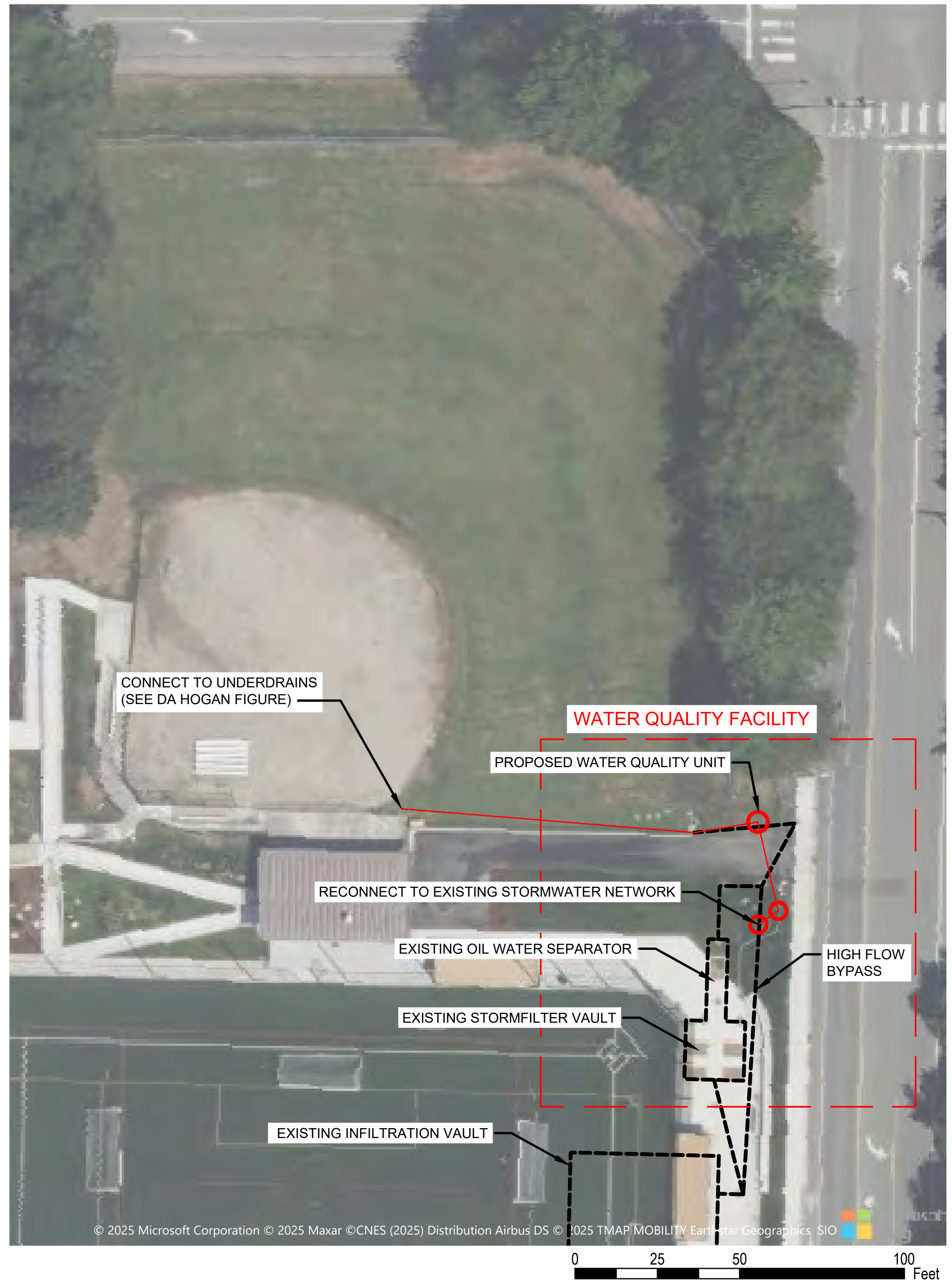
Figure X.
132nd Square Park Concept Design

132ND SQUARE PARK

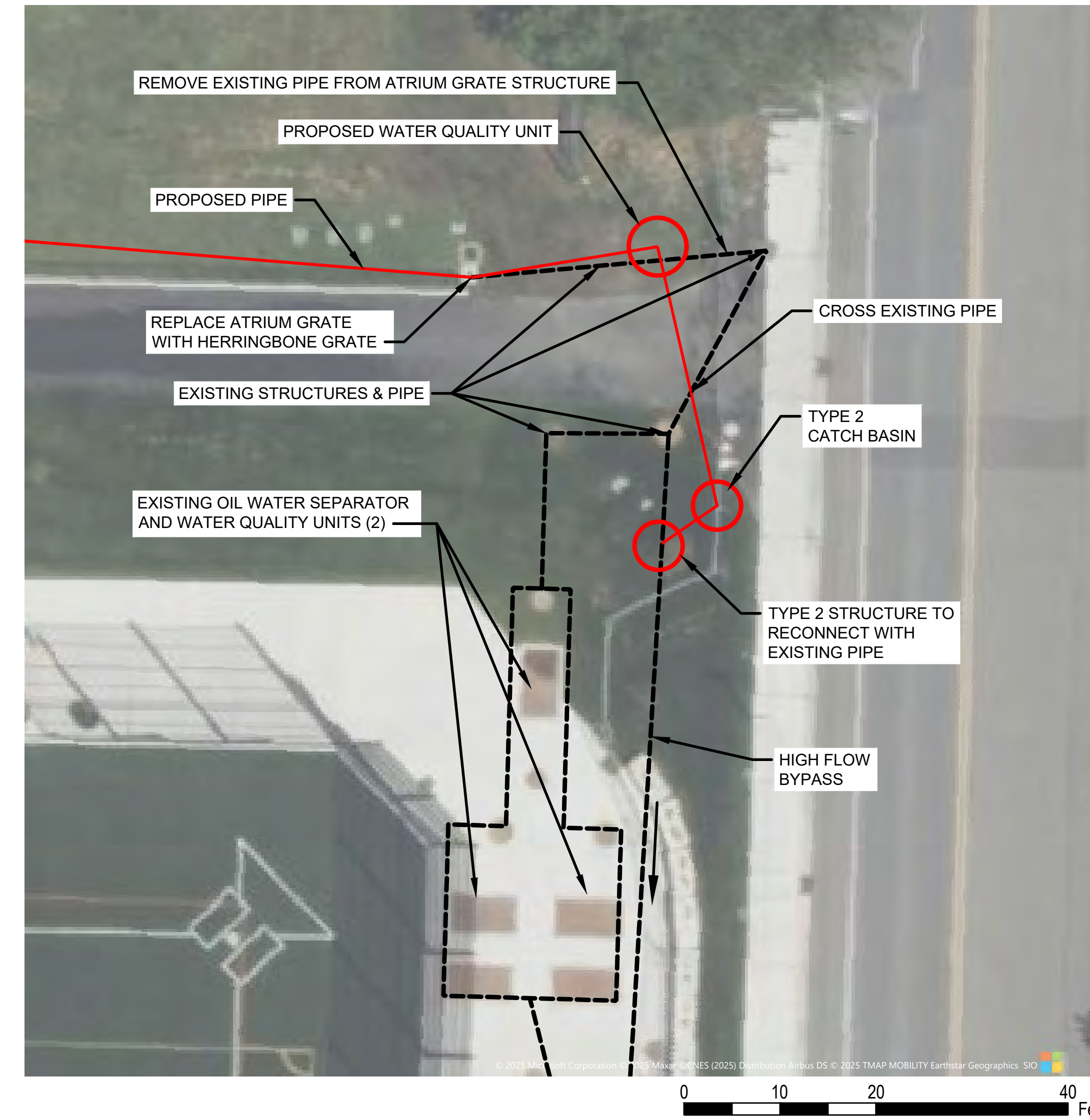
STORMFILTER DETAIL



132ND SQUARE PARK BALLFIELD



WATER QUALITY FACILITY



SITE NOTES:

1. SITE LOCATION: 132ND SQUARE PARK, KIRKLAND WA
2. THIS DESIGN ASSUMES CR #3 FLOW CONTROL CAN BE MET WITHIN EXISTING STORMWATER SYSTEM INSTALLED IN 2021.
3. THIS DESIGN ASSUMES CR #1-2, 4-7 AND 9 CAN BE MET WITHOUT ADDITIONAL FACILITIES

Appendix F

D.A. Hogan Crestwoods Park Infield Conversion

HERRERA
Science + Planning + Design

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MEMORANDUM

To: Neil Schaner, PE, Herrera

Cc: Eliza Hoffman, Herrera

From: Eric Gold

Date: August 26, 2025

Re: City of Kirkland Parks
Crestwoods Park Infield Surface Conversion
Feasibility Study Narrative

Existing Conditions

The following are our observations of existing conditions associated with the infield playing surface and immediately adjacent surfaces only. Fencing, Player & Spectator amenities, and outfield conditions were not assessed. Refer also to the attached "Existing Conditions" exhibit. Images follow.

- Fully "Skinned" Infield, consisting of approximately 6" of clay/silt/sand infield soil mix, over 6" of coarse sand, consistent with the record of 2005 improvements. The constituent materials were unscientifically "tested" via a simple water-settlement process to determine approximate particle gradations (see attached "Crestwoods Park Section Sampling"), and while generally containing higher percentages of fines than might be desirable, the materials seem perfectly functional in the context of the installation.
- Subsurface drainage system was located and a sample of the drainage aggregate backfill was obtained. Visually, the aggregate was immediately observed to be far courser than desired, generally 1-½" x½" crushed washed stone. While this material has it's uses, the large void spaces do not allow "bridging" of the sand materials above, and so we found (via testing as above) roughly 20% of the expected 35% void space to be occupied by sand and fines.
- Fence line includes a consistent concrete containment curb.
- Grades are generally uniform across the site, assumed to match the 2005 record at 1.67% diagonally SW to NE.
- The existing infield/outfield arc is not consistent with accepted "typical" little league baseball rules for dimension, i.e., a 60' radius drawn from the front-center of a pitching slab at 46'.

Design Assumptions / Conclusions

The following considerations apply to any Option presented.

- The existing subsurface drainage system is suitable for re-use to varying degrees as described in the options.
- Subsurface drainage will discharge to a conveyance per Herrera.
- The amount of transition grading required will be greatly reduced by the uniform slope.
- Significant adjustments / retrofit of the existing irrigation zones around the arc will be required due only to the assumed reconfiguration of the arc to suit little league expectations.

"Overlay" Conversion

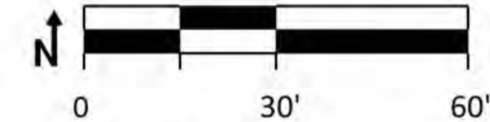
- This unique approach usually falls under WAC 197-11-800 Categorical Exceptions SEPA Exemption for Recreational Facilities Maintenance as it a) does not disturb subgrade and b) generates little-to-no waste.
- Prior to beginning the work in earnest, the existing subsurface drainage system needs to be located. We know that the westernmost drainage lateral is located exactly 4' east of the first base dugout fenceline, so this should not be difficult. The 2005 record indicates a 15' o.c. installation.
- A transition is established around the installation perimeter to allow the finished surface of the synthetic turf to meet and match flush to surrounding surfaces as appropriate – this consists of the synthetic turf, supplemental pad (if required), and turf infill materials depths combined. This will also set the height of the turf edge anchor. For fully-skinned infields, the excavated material can be dispersed (scattered, lost) across the interior surface.

- The existing surface is then prepared by removing all unwanted vegetation, dragging to a uniform grade, and rolling to a firm and unyielding condition. The surface is then covered completely with an 8oz/sy non-woven geotextile.
- Penetrations to the existing subsurface drainage laterals, “chimney drains”, are then created by simply cutting a 12” “X” in the fabric and auguring 6” diameter holes to the drainage aggregate on a 15’ o.c. grid. The waste material from this is so incidental it too can be dispersed across the surface. The holes are filled with #4x#8 pea gravel to grade.
- A pre-molded, interlocking, panelized drainage tile is then installed, trimming neatly to all of the perimeter edges.
- Synthetic turf surfacing of an approved specification, along with irrigation retrofit and site restoration completes this installation.

Traditional Full-Section

- This option can be oriented so that the subsurface drainage flows either west-to-east (option 2) or east-to-west (option 3).
- Grading design identifies a uniform and consistent slope and aspect, in this case approximately 1.67% sloping from SW to NE. The subgrade is prepared to spec tolerance planarity and density.
- The existing subsurface drainage system is abandoned in place or removed. The existing collector is maintained.
- A perforated collector is installed from a new control structure near the limit of the infield work as a solid pipe conveyance. Herrera will provide further conveyance to code compliance and discharge.
- Non-woven geotextile separator fabric is placed across the entire subgrade.
- New subsurface drainage laterals consisting of perforated 4” double walled corrugated polyethylene (CPEP) with #4x#8 pea gravel backfill are installed 15’ on center at 0.5% slope to the new collector.
- The4 subgrade is graded to a +0.05’/-0.05’ tolerance, firm and unyielding. Non-woven geotextile is placed between the subsurface drainage laterals, not covering the trenches.
- 8” of permeable aggregate base course (rough graded), 2” of permeable aggregate top course (fine graded) will comprise the field foundation/base. This allows for both vertical and lateral infiltration of stormwater through the surface, base, and to the subsurface drainage trenches.
- Synthetic turf surfacing of an approved specification, along with irrigation retrofit and site restoration completes this installation.

DA HOGAN
July 9, 2025



Infield Synthetic Turf Conversion Study

Existing Conditions

Standard "Skinned" Infield
Existing Fence-line Curb
Standard 6"/6" Infield Section
Suspect Drainage System Backfills

City of Kirkland, WA
Parks and Community Services

Crestwoods Park
1818 6th St, Kirkland
WA 98033

DA HOGAN
July 9, 2025

N
0 30' 60'
SCALE: 1" = 30'

Infield Synthetic Turf Conversion Study

Option 1

"Chimney" Drains
Overlaid Panel Drains
Limited Transition Zone Sod
Synthetic Turf

City of Kirkland, WA
Parks and Community Services

Crestwoods Park
1818 6th St, Kirkland
WA 98033

DA HOGAN
July 9, 2025

N
0 30' 60'
SCALE: 1" = 30'

Infield Synthetic Turf Conversion Study

Option 2

Full-Section Base
Abandon Existing Drainage In-Place
New Flat Drains on Subgrade
Limited Transition Zone Sod
Synthetic Turf

City of Kirkland, WA
Parks and Community Services

Crestwoods Park
1818 6th St, Kirkland
WA 98033

DA HOGAN
July 9, 2025

N

0 30' 60'

SCALE: 1" = 30'

Infield Synthetic Turf Conversion Study

Option 3

Full-Section Base
Replace Existing Drainage Aggregate
Limited Transition Zone Sod
Synthetic Turf

City of Kirkland, WA
Parks and Community Services

Crestwoods Park
1818 6th St, Kirkland
WA 98033

Appendix G

Crestwoods Park Stormwater Figures

HERRERA
Science + Planning + Design

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HERRERA
Science + Planning + Design

Figure X.
Crestwoods Park: At-Field Flow Control

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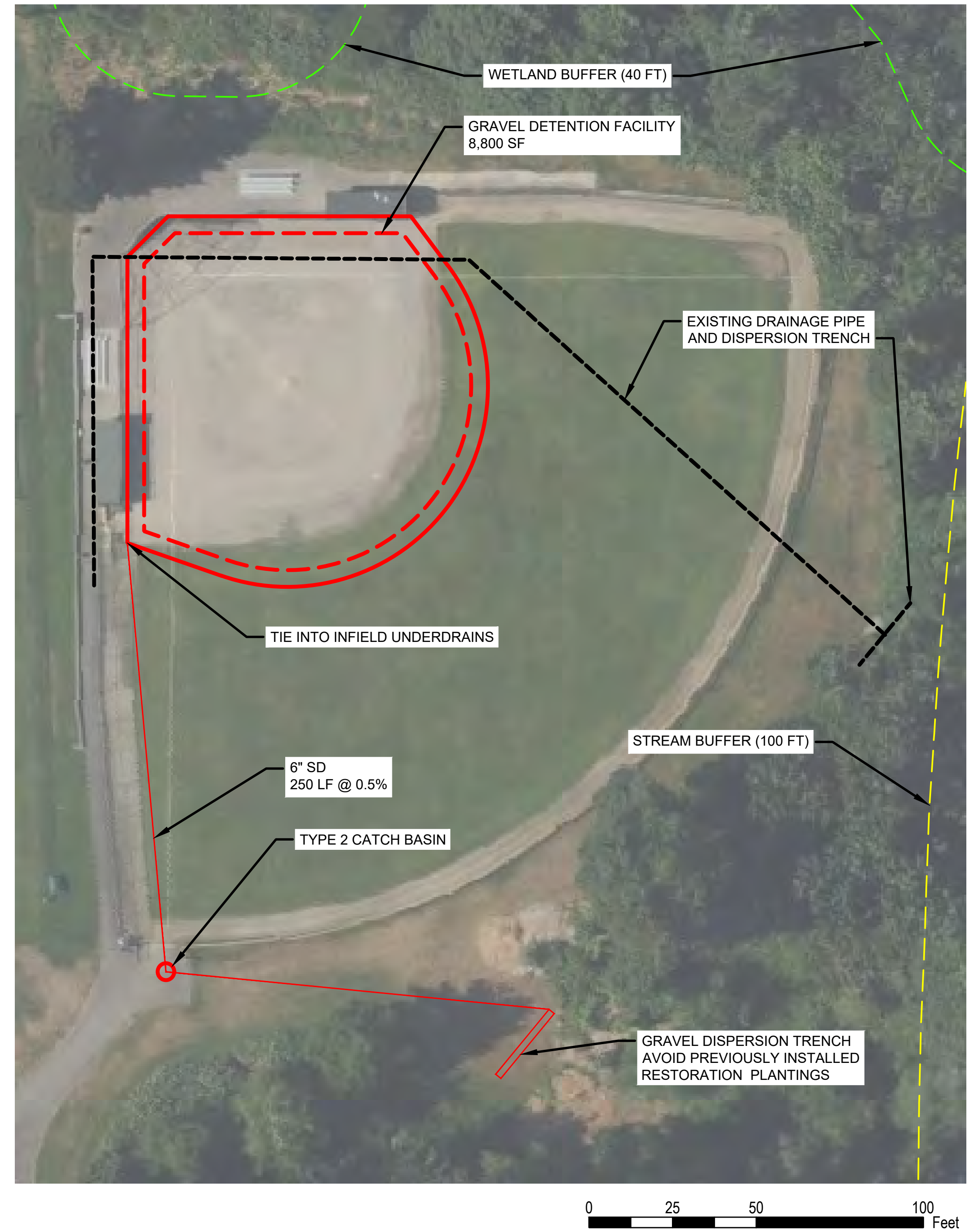
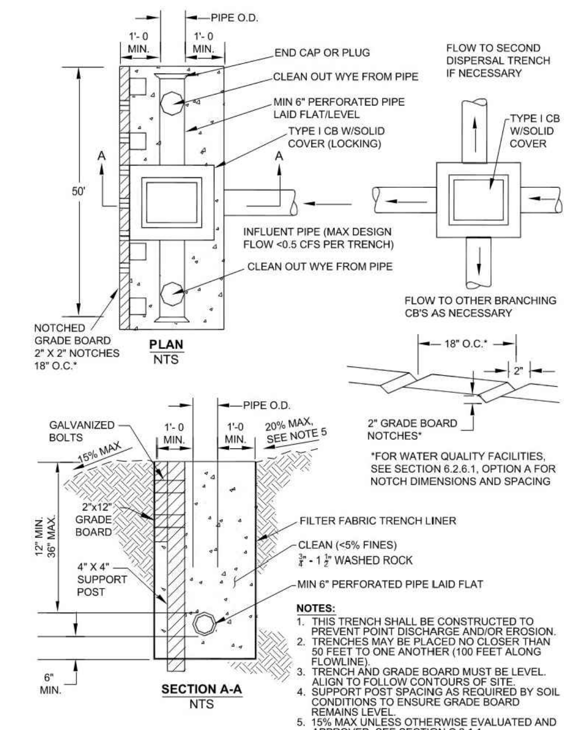
CRESTWOODS PARK LOCUS

CRESTWOODS BALLFIELD & FLOW CONTROL FACILITY

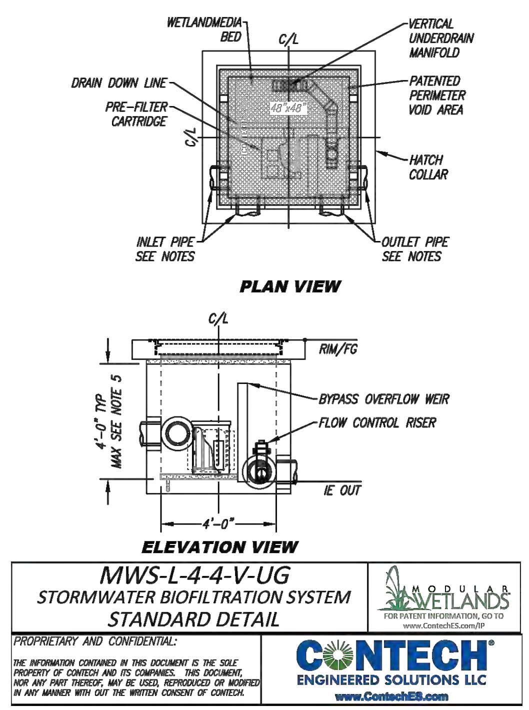


DISPERSION TRENCH DETAIL



WATER QUALITY FACILITY

MODULAR WETLAND DETAIL



SITE NOTES:

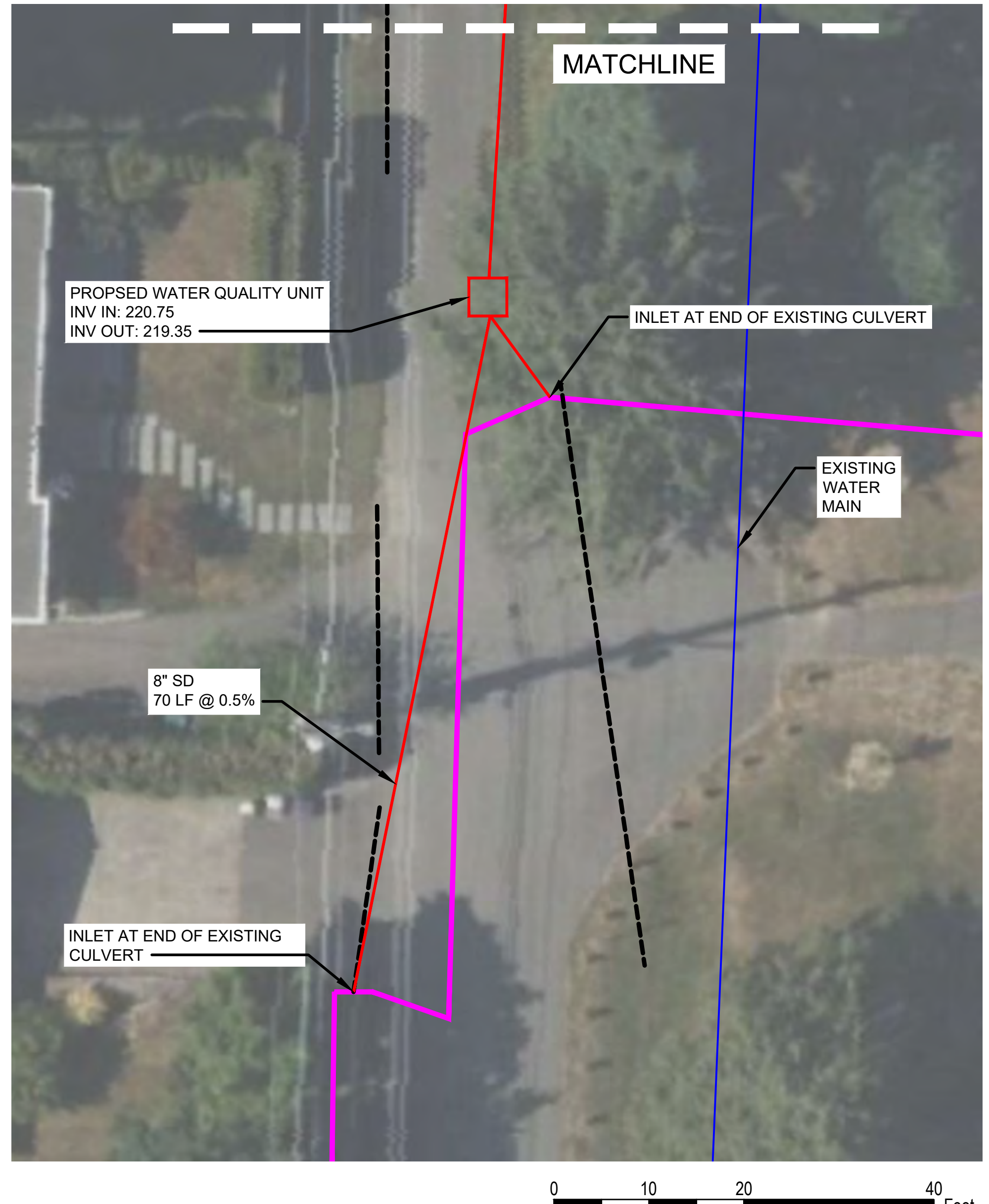
1. SITE LOCATION: CRESTWOODS PARK, KIRKLAND WA
2. THIS DESIGN ASSUMES CR #1-2, 4-7 AND 9 CAN BE MET WITHOUT ADDITIONAL FACILITIES

HERRERA
Science + Planning + Design

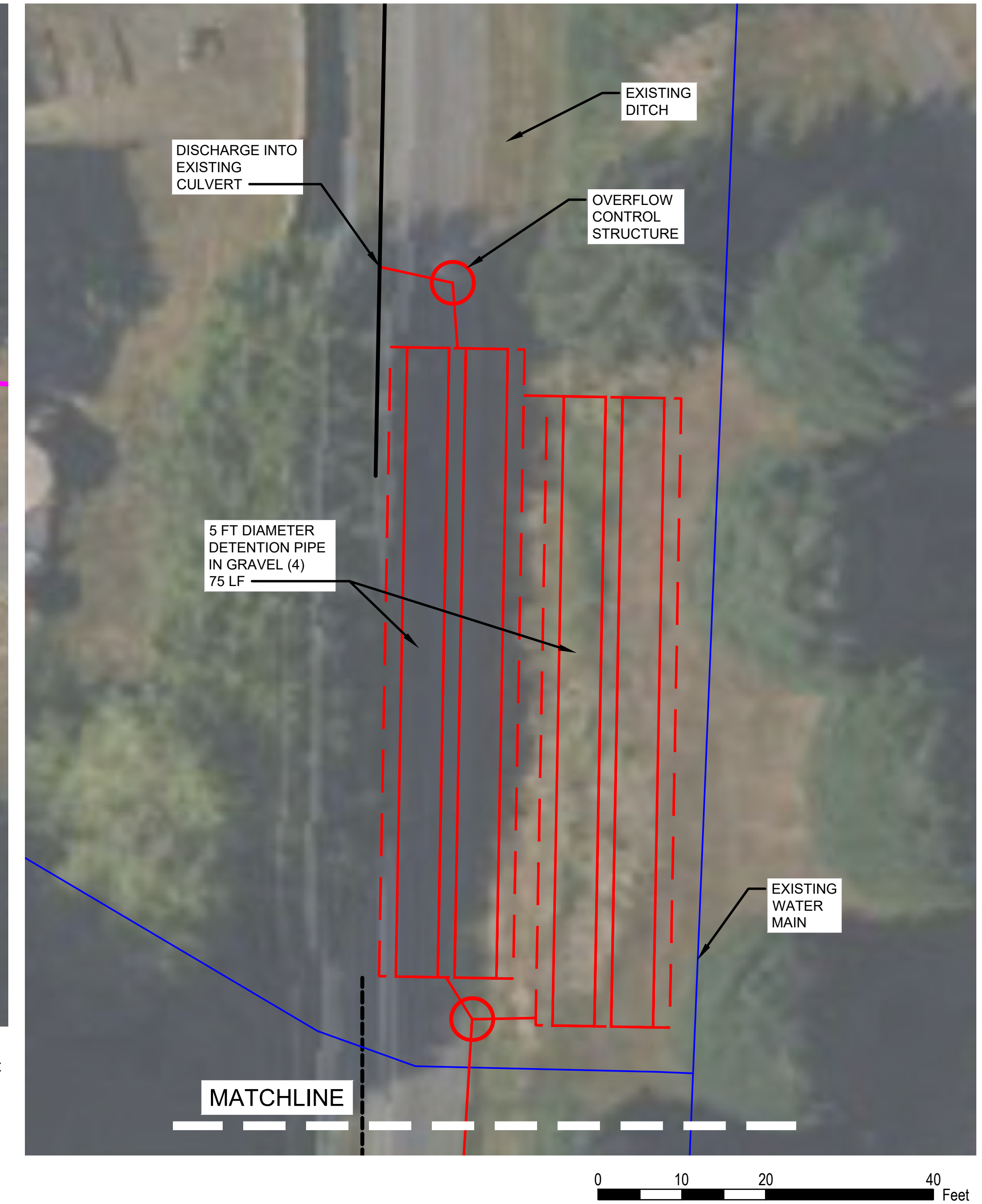
Figure X.
Crestwoods Park: Area-Swapped Flow Control

CRESTWOODS PARK LOCUS

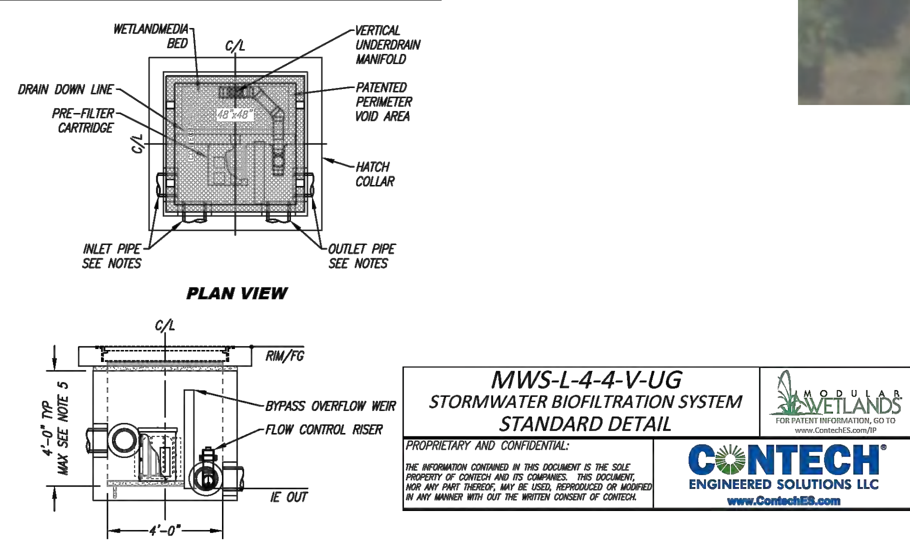
WATER QUALITY FACILITY



FLOW CONTROL FACILITY



MODULAR WETLAND DETAIL



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