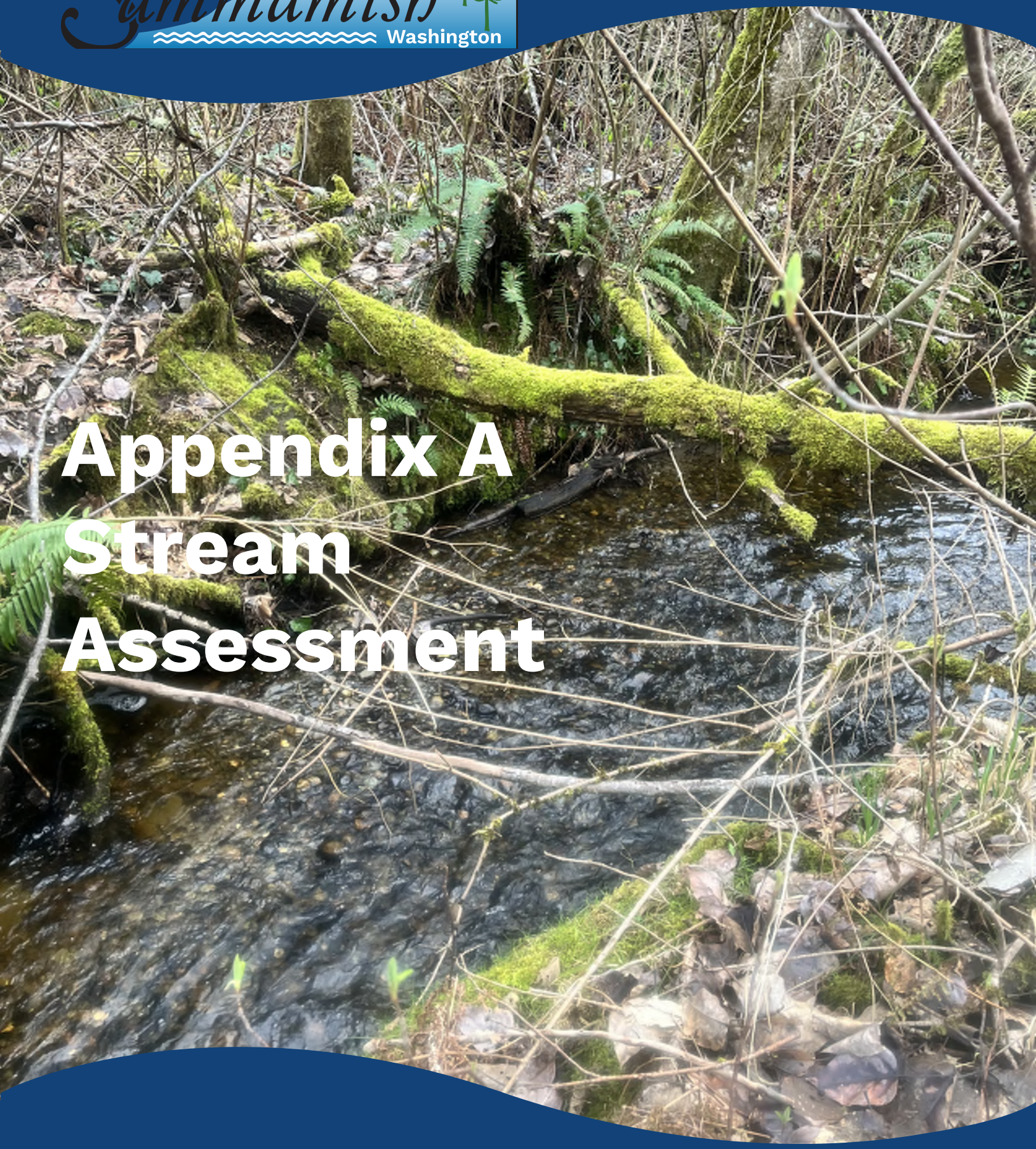
City of Sammamish Washington



Appendix A Stream Assessment

PINE LAKE CREEK BASIN PLAN

To: Toby Coenen, PE **Date:** December 16, 2024

From:

Peter Brooks, PE (NHC) Erin Nelson, PE (AltaTerra)

Re: Pine Lake Creek & Kanim Creek Stream Assessments
(NHC Reference No. 2007708)

1 STREAM ASSESSMENT

The project team conducted stream assessments of key reaches of Pine Lake Creek and Kanim Creek on March 7 and September 22, 2023. The focus of these visits was to collect data and photographs to support characterization of channel morphology, bed and bank stability, habitat conditions, and fish use. Information collected from the field assessments was used to characterize relative stability and habitat functionality and to identify areas sensitive to high flows or flow flashiness and dewatering. Observations from the stream assessments informed identification of problems and potential solutions and opportunities.

Figure 1 shows the stream alignments with reaches observed during the stream assessments highlighted. The streamlines shown in the map (and throughout this document) were updated from King County hydrography based on field observations on upper Kanim Creek, and recent LiDAR (Light Detection and Ranging) topography on lower Pine Lake and Kanim creeks and the confluence area. Figure 2 presents longitudinal profiles of both creeks extracted from the recent LiDAR and updated streamlines.

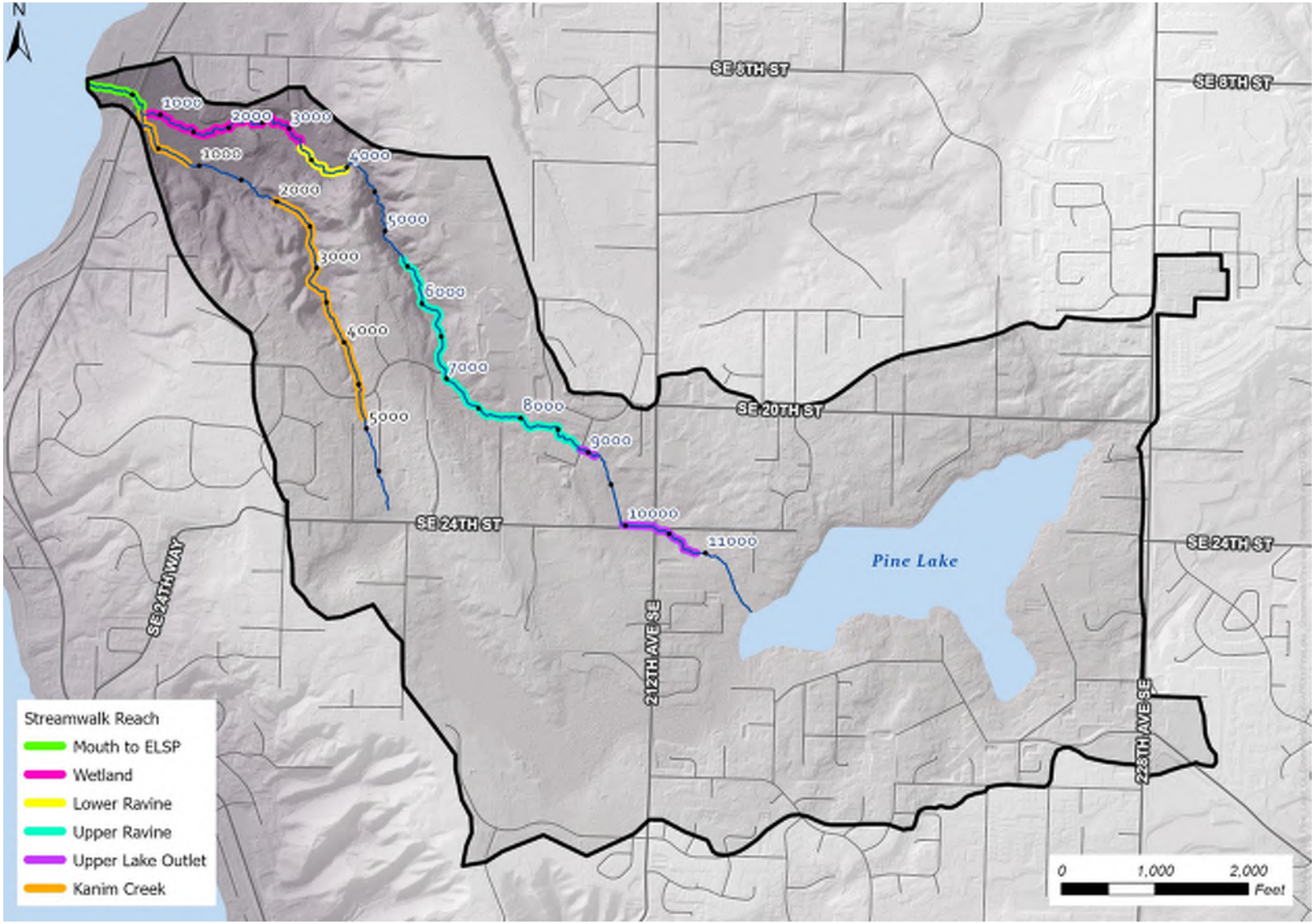


Figure 1. Stream assessment reaches. Stationing indicates distance along the stream channel from a) Lake Sammamish on Pine Lake Creek and b) Pine Lake Creek confluence on Kanim Creek.

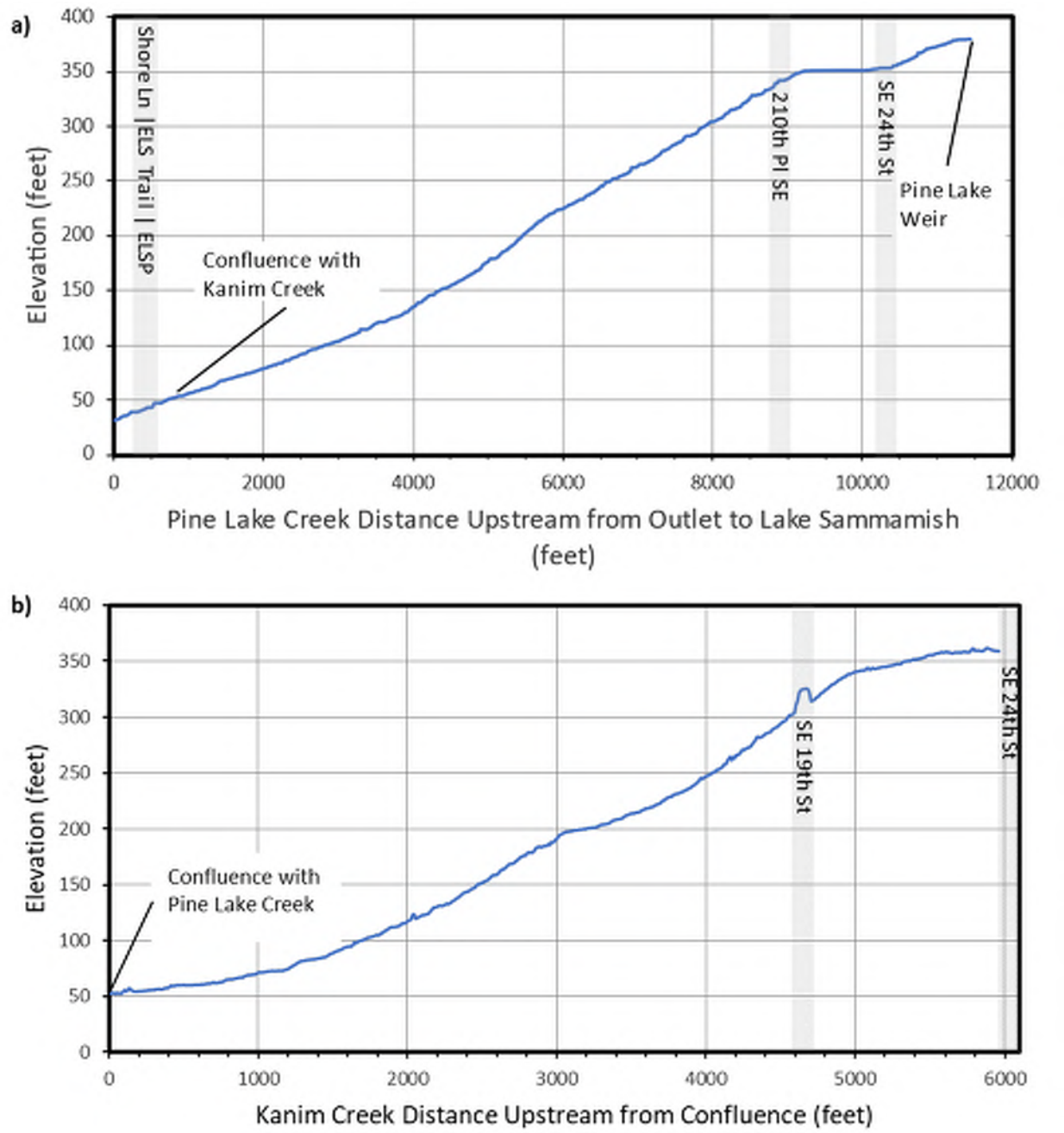


Figure 2. Stream profile plots for Pine Lake and Kanim creeks. a) Pine Lake Creek from Lake Sammamish to Pine Lake weir and b) Kanim Creek from Pine Lake Creek to headwaters. Road crossings are indicated by shaded bars. Note that the distance scale (x-axis) is different for the two plots.

The lack of road crossings is notable on the profiles for both creeks. Unlike many urban and suburban streams in western Washington, the Pine Lake Creek system (downstream of Pine Lake) has had limited direct connection with development. This is largely due to the topography

and geology of the basin downstream of Pine Lake, characterized by steep ravines and extensive wetland complexes along the creeks, making potential construction in these areas difficult and expensive, even before environmental protections.

2 REACH CHARACTERIZATION

The following sections describe observations of Pine Lake and Kanim creeks, presented in the downstream direction to better reflect the hydraulic and geomorphic interrelation between sections. Each stream reach is divided into sub-reaches defined by dominant processes and characteristics. Pine Lake Creek and Kanim Creek stream stationing (STA) referred to in the text below is referenced from Lake Sammamish for Pine Lake Creek and from the Pine Lake Creek confluence for Kanim Creek (see Figure 2a. and 2b).

2.1 Pine Lake Creek

Observations of Pine Lake Creek were made in March and September 2023. Stream walks were discontinuous due to access limitations, therefore limited observations are noted in some locations.

Lake Outlet

The lake outlet sub-reach extends from the Pine Lake weir downstream to 210th Place SE. The entire sub-reach is characterized by ditch-like channel conditions. Flow in this section of the creek is controlled by the weir at Pine Lake. Portions of this reach were observed on March 7, 2023, including the following locations:

- Pine Lake weir
- Intersection of SE 24th and 212th Ave SE
- 210th Place SE

The Pine Lake outlet weir is approximately 7.5 feet wide (Photo 1). Downstream, the channel narrows to 4.5 feet wide and is incised approximately 5 to 6 feet. The channel in this location is a straight, ditch-like feature that is mostly comprised of silt with occasional gravel and cobbles. The water depth in March 2023 was approximately 0.5 feet downstream of the weir. The weir is classified as a fish passage barrier by the Washington Department of Fish and Wildlife in their Dam Assessment Report dated 11/6/2012.

Approximately 20 feet downstream of the weir, an outfall discharges to Pine Lake Creek from the southwest (Photo 2). This is the outlet from the Pine Lake Bypass Structure, which was constructed to divert runoff from the bog area to the south around Pine Lake to reduce phosphorus loading and improve lake water quality.

Photo 1. Pine Lake outlet weir looking upstream, STA 10900 (March 2023).

Photo 2. Pine Lake Creek immediately downstream of weir, looking downstream at bypass outfall (March 2023).

At the southeast corner of the intersection of SE 24th Street and 212th Avenue SE, Pine Lake Creek and surrounding wetlands were modified in a mitigation project that restored some natural characteristics to the stream corridor by introducing native plants, floodplain connection, and meanders to the channel. This portion of the channel may be the only non-ditch-like section

between the weir and 210th Avenue SE. Our visit indicated that maintenance is needed on the mitigation site to control invasive plants, such as reed canary grass. Photos 3 and 4 show the stream and wetland before it re-enters roadside ditches along SE 24th Street and 212th Avenue SE. Photo 5 shows the channel in the ditch adjacent to SE 24th Street.

Photo 3. Mitigation site at the SE corner of SE 24th St and 212th Ave SE, looking upstream STA 10200 (March 2023).

Photo 4. Mitigation site at the SE corner of the intersection of SE 24th Street and 212th Ave SE, where channel becomes braided through wetland, STA 10100 (March 2023).

Photo 5. Pine Lake Creek in roadside ditch on south side of SE 24th Street, downstream of mitigation site. Looking downstream, STA 10000 (March 2023).

Upper Ravine

Morphology

The upper ravine sub-reach begins at the 210th Place SE crossing near STA 8900 and extends downstream to approximately STA 4000[1]. A bridge crosses 210th Place SE over Pine Lake Creek at the upper end of the ravine sub-reach (Photo 6). Our observations suggested that material at the downstream end of the bridge is not a depositional feature and may be a relic channel bank from prior to bridge construction (see Photo 6). From this location downstream, the stream steepens and enters a deep ravine.

Photo 6. Looking downstream under 210th Place SE bridge, STA 8450 (March 2023). Notice the mound of sediment next to right wall at the downstream end of the bridge.

During the September 22 streamwalk, the channel in the upper ravine was dry, though isolated wetted pools were observed. The upper ravine has a relatively uniform average slope of 4% (Figure 2a) below STA 7500. Between 210th Place SE and STA 7500, the channel has step-pool characteristics, with wood and large boulders forming channel steps (Photo 7). In addition to isolated wetted pools, water was observed in the channel between STA 7100 and STA 7300, likely from groundwater input at the interface of advanced outwash sand and underlying fine deposits (Photo 8). On the right bank near STA 7500, a narrow (about 1- to 2-foot wide), incised

[1] The downstream segment of this sub-reach, from STA 4000 to 5500, was not directly observed due to time constraints and thick vegetation making access difficult.

(2 to 3 feet deep) side channel was noted. There was no obvious outfall or source of water discharging to this location up the slope.

Photo 7. Large boulders and wood forming step pool features in steeper reach of Pine Lake Creek at STA 7500, downstream of 210th Place SE (September 2023), looking upstream direction.

Photo 8. Water in channel observed between STA 7100 and STA 7300 (September 2023).

Through the upper ravine, Pine Lake Creek is deeply incised 10 to 15 feet into the adjacent hilly terrain, forming an over-widened U-shaped stream corridor (Photos 9 and 10). Downstream of STA 7500, channel bottom width ranges from 5 to 12 feet with a plane-bed morphology. The bed composition is poorly sorted cobble, small boulders, and gravel materials. Overall, ravine banks appear relatively stable, anchored by vegetation. However, vertical faces composed of varying assemblages of till and outwash materials were also observed. A single slump was observed along the right bank near STA 5800 (Photo 11).

Photo 9. Typical channel morphology, facing upstream. Fallen trees span valley walls and provide limited hydraulic function. STA 7000 (September 2023).

Photo 10. Upper ravine channel and corridor, facing downstream, near STA 6400 (September 2023).

Photo 11. Slump on right bank of upper ravine channel, near STA 5800 (September 2023).

Although the corridor is surrounded by a second-growth mixed conifer and deciduous forest, relatively few pieces of large woody material (LWM) were observed in the channel. This may be attributed to a combination of low recruitment rates through treefall or bank erosion, larger tree size, and difficulty for larger LWM to come into contact with the incised channel (see Photos 9 and 13). Where LWM was observed, the channel appeared to be narrower, with a bankfull width more consistent with the stream size. Buried wood was also observed in the channel, as well as old tires (Photo 12). The latter are likely remnants of historic grade control features.

Photo 12. Large woody material (LWM in upper ravine facing downstream, near STA 5700. Note narrower low flow channel, remnant tire grade control (bottom center), and vertical bank composed of cemented till (bottom, right) (September 2023).

Photo 13. Example of treefall not interacting with stream channel. Looking downstream direction, near STA 5600 (September 2023).

Despite the steep gradient, sediment loading in this reach appears to be moderate owing to the already over-widened channel corridor. Accumulations of finer gravel and sand-sized materials were observed above a LWM jam near STA 5500 (Photo 14).

Photo 14. LWM debris jam, facing downstream, near STA 5500 Note, upstream sediment build-up (in foreground) (September 2023).

Stormwater and Stream Crossing Infrastructure

Several stormwater outfalls discharge to the upper ravine reach. Photos 15 and 16 show outfalls from stormwater ponds that serve The Crossings at Pine Lake development. Both outfalls appeared to be in good conditions without any signs of stream bank or bed erosion in the vicinity of the discharge points. A 12-inch corrugated metal pipe discharges from Pond D91443 on the left bank of the channel near STA 7050 (Photo 17). One private driveway road crossing (SE 19th St) spans the middle of the upper ravine reach at STA 6950. This crossing consists of a 7- to 8-foot-wide corrugated metal pipe (CMP) arch structure. Near-vertically placed logs, two to three feet high, provide grade control at the outlet of the culvert, behind which fine gravels are deposited forming a plane bed (Photo 18). According to the WDFW Level A Culvert Assessment report completed 10/31/2012, this culvert is a partial barrier and was rated 33% passable. The reason for the partial barrier rating was because of the water surface drop at the outlet of the culvert.

Photo 15. Stormwater outfall pipe and gabion dissipation structure on left side of channel looking upstream. Outfall pipe discharges stormwater from Stormwater Pond D92929 at STA 8400 near 210th Pl SE (September 2023).

Photo 16. Right bank stormwater discharge pipe from Pond D92928, STA 7800 (September 2023).

Photo 17. Left bank stormwater outfall that discharges from Stormwater Pond D91443 near STA 7050 (September 2023).

Photo 18. SE 19th Street private driveway culvert at STA 6950, looking upstream (September 2023).

Habitat

Fish use in the upper ravine reach is likely limited by lack of year-round flow. The stream is ephemeral in this reach and not likely to sustain populations of resident or anadromous salmonids.

Lower Ravine

Morphology

The lower ravine sub-reach begins at approximately STA 4000 and extends downstream to STA 3300. Flow was observed in the channel during the September 22 streamwalk. The streamflow emerges between an elevation of approximately 130 to 140 feet NAVD 88 (based on available LiDAR (King County 2021)) and generally coincides with the mapped geological contact between overlying glacial till and advance outwash (WDGER, 2016[2]).

Less confined than upstream, the lower ravine sub-reach is moderately incised into either an historic alluvial fan or mass wasting deposits. The reach averaged slope is approximately 3%. Typical stream conditions near the upstream limit of the lower ravine are shown in Photo 19. Banks generally range from 2 to 6 feet high and are heavily vegetated and relatively stable. The stream continues to show a plane-bed morphology, though small pool-riffle-type sections were also observed (Photo 20). Bed composition in the lower ravine is slightly finer than that observed upstream, consisting mostly of large gravel and cobble particle sizes.

The frequency of LWM in the lower ravine appears slightly higher than the upper ravine. The slight increase in LWM frequency may be associated with the channel being less incised and thus more accessible to fallen timber (Photo 21). LWM recruitment still appears to depend mainly on the mortality of local, relatively mature trees since the channel lacks the capacity to transport LWM any distance downstream.

[2] Washington Division of Geology and Earth Resources, 2016, Surface geology, 1:100,000--GIS data, November 2016: Washington Division of Geology and Earth Resources Digital Data Series DS-18, version 3.1, previously released June 2010.

Photo 19. Pine Lake Creek channel corridor, facing upstream, near STA 4000. Note, steeper terrain of upper ravine sub-reach in the background (September 2023).

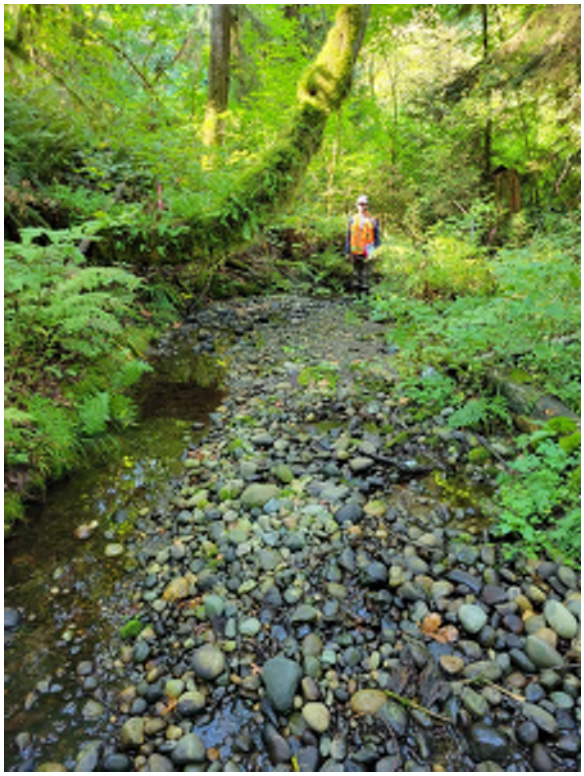


Photo 20. Plane-bed channel, with small pool, in the lower ravine sub-reach, facing downstream near STA 3600 (September 2023).

Photo 21. LWM in the lower ravine sub-reach, facing downstream near STA 3400 (September 2023).

Stormwater and Stream Crossing Infrastructure

No stormwater outfalls or stream crossings were observed in the lower ravine sub-reach.

Habitat

Small unidentified salmonids and crayfish were observed in the small pools within the lower ravine sub-reach.

Upper Wetland

Morphology

The upper wetland sub-reach of Pine Lake Creek extends from approximately STA 3300 downstream to STA 2800 and has a reach averaged slope of approximately 2.6%. This sub-reach was generally inaccessible during the September 22 stream walk due to dense blackberry vegetation. However, some information was inferred from observations around the edges of the sub-reach. Photo 22 was taken near the downstream end of the upper wetland reach, near STA 2800, and shows a channel composed mostly of sand and fine-gravelly materials. Photo 23 was taken a short distance upstream and shows a relatively open canopy surrounding the reach, with a dead fir tree standing in the center. Additional standing dead or dying trees were observed nearby. Photo 24 shows the channel, characterized by large gravel-sized bed material, near the upstream boundary of the upper wetland sub-reach (STA 3300).

Photo 22. Channel in the upper wetland reach, facing upstream, near STA 2800 (September 2023).

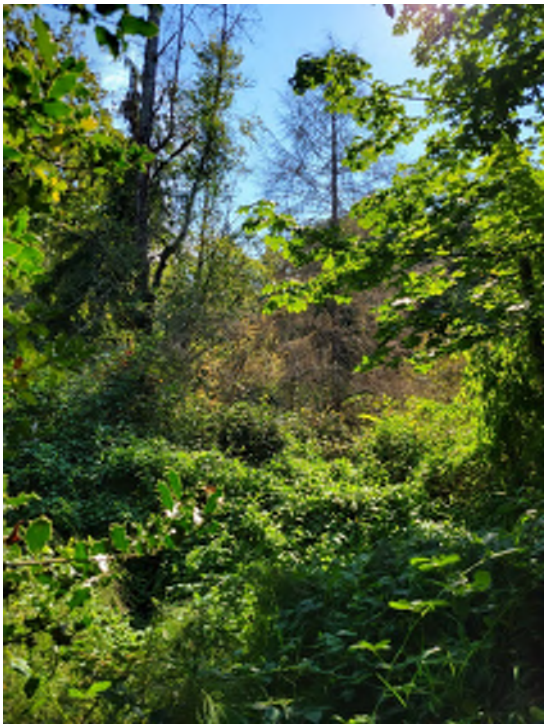


Photo 23. Canopy in the upper wetland reach, facing upstream, near STA 2900 (September 2023). Note dead fir tree standing in the center.

The dead trees suggest that this sub-reach is subject to frequent flooding. Photos taken upstream and downstream indicate abrupt fining of the streambed composition. What specifically initiated these conditions is uncertain, especially since the reach-averaged slope remains relatively steep (according to LiDAR). Localized backwater conditions originating downstream may cause flow to slow down, resulting in excess sediment deposition, flooding, and tree die-off. In turn, a positive-feedback loop could be initiated as a thick understory is allowed to grow, choke the channel, and result in more deposition. Alternatively, there could be unobserved manmade features in this sub-reach that are causing these conditions.

Regardless, it appears that the upper wetland sub-reach currently functions as storage area (sink) for coarse gravel and cobble-sized sediments transported from upstream. Further

assessment of this sub-reach by a wetland scientist could help further define the quality and function of the upper wetland.

Photo 24. Upstream limit of the upper wetland reach, facing downstream, near STA 3300 (September 2023).

Stormwater and Stream Crossing Infrastructure

No stormwater outfalls or stream crossings were observed in the upper wetland sub-reach.

Habitat

Small unidentified salmonids were observed within the upper wetland sub-reach near STA 2800.

Residential Sub-Reach

Morphology

The residential sub-reach extends from approximately STA 2800 downstream to STA 1800 and, similar to upstream, maintains a reach averaged slope of approximately 2.6%. The residential sub-reach is so named because, for the first time since the upper ravine sub-reach (Section 2.1.2), the creek meanders through landscaped residential backyards. All residences are located on 197th Avenue SW to the north. Structures are presumably outside the flood hazard area, located on an elevated terrace 12 to 20 feet above stream grade. The residential sub-reach can be further divided into upper and lower segments based on the observations made during the September 22 stream walk.

The upper segment extends from STA 2800 downstream to STA 2260 and is located within a single parcel (920 197th Avenue SE). Within this segment the channel is thickly vegetated by blackberry and wetland plants, but adjacent floodplains consist of lawn. Mature canopy cover is

generally low. The channel gradually becomes more incised in the downstream direction, with bank height on the order of two feet near the upstream end (Photo 25) and deepening to 3 to 5 feet downstream (Photo 26). A small low-lying wood pedestrian bridge spans the channel near STA 2650 (Photo 27). Bed material composition in this reach generally coarsens in the downstream direction, from sand to small gravels upstream, to gravel to small cobbles downstream. No evidence of fixed grade control, either natural LWM or manmade structures, were observed. Some active bank erosion was observed on the outside of a bend near STA 2500 and bank slumping near STA 2260 (Photo 26).

Photo 25. Channel near the upstream limit of the upper residential reach, facing upstream, near STA 2800 (September 2023).

Photo 26. Thickly vegetated and incised channel (right) near the downstream limit of the upper residential reach, facing upstream, near STA 2260. Note, NHC personnel standing adjacent to scarp at slumped bank (September 2023).

Photo 27. Small wooden pedestrian bridge over Pine Lake Creek in the upper residential reach, near STA 2650 (September 2023).

The lower segment of the residential sub-reach extends from STA 2260 downstream to STA 1800 and differs distinctively from the upper reach. The channel remains incised 3 to 5 feet below surrounding floodplains, but the corridor is relatively free of thick vegetation (Photo 28).

It is unclear if this lack of vegetation is due to landowner maintenance, a more mature canopy cover, erosive flows, or possibly all three. The channel corridor widens from approximately 10 to 25 feet in the downstream direction. Point bars were observed on the inside of meander bends. Actively eroding vertical banks were observed along much of the lower segment of the residential reach (Photo 29). In some locations, it was apparent that landowners were trying to stabilize banks with placement of small woody debris, wood or steel stakes, and erosion control fabrics (Photo 30). The channel generally maintains a pool-riffle morphology and is composed of coarse gravels and cobble-sized materials. The sub-reach is generally free of LWM. Three small pedestrian bridges cross the creek in this sub-reach reach (Photo 28).

Photo 28. Small wooden pedestrian bridge over Pine Lake Creek in the lower residential reach, facing upstream, near STA 2260. Note channel incision and lack of vegetation (September 2023).

Photo 29. Widened channel corridor with vertical banks and point bar formation in the lower residential reach, facing downstream, near STA 2150 (September 2023).

Photo 30. Bank erosion control measures placed by landowners in the lower residential reach (September 2023).

Stormwater and Stream Crossing Infrastructure

No stormwater outfalls were observed in the residential sub-reach; however, a total of four private wood pedestrian bridges were observed, as described above.

Habitat

No aquatic species were observed within the residential sub-reach.

Lower Wetland

Morphology

The lower wetland sub-reach extends from STA 1800 downstream to the confluence with Kanim Creek at STA 800. The reach averaged slope is 2.2%. The channel in the upper 450-foot segment of this sub-reach is densely vegetated and braids into two to three small shallow distributary channels. Each channel is 1 to 3 feet wide with bank heights of a foot or less. Braiding is likely a result of an ongoing cycle of sediment aggradation and vegetative recolonization. A small wooden pedestrian bridge and private "boardwalk" path cross the stream channels near the center of the braided reach at STA 1500 (Photos 31 and 32). Bed material composition is generally fine silts and sands with some small gravels. The mainstem of Pine Lake Creek appears to follow the northernmost channel braid. It is unclear if channel braids to the south and west rejoin the mainstem or Kanim Creek.

Downstream, near STA 1350, a distinct single channel is more defined and has an average bankfull width of approximately 10 feet (Photo 33); however, in some locations the channel is narrower (5 feet) and moderately incised 2 to 3 feet below the adjacent floodplain (Photo 34). Bed composition coarsens ranging from small gravel to cobble-sized material. The channel generally follows a step-pool morphology. Small gravel and sand bars are formed on the inside of bends with a fair amount of LWM observed in the channel (Photo 35).

Stormwater and Stream Crossing Infrastructure

No stormwater outfalls were observed in the lower wetland sub-reach; however, as described above, a private wood pedestrian bridge and boardwalk were observed crossing the channel and in the adjacent floodplain, respectively.

Habitat

Kokanee spawning redds have been observed in this reach in previous years (Bill Mavros, personal communication with Washington Trout).

Photo 31. Bed material composition at a small wood pedestrian bridge crossing the assumed mainstem of Pine Lake Creek in the lower wetland sub-reach near STA 1500, and view of the bridge (inset) facing south (September 2023).

Photo 32. Channel braid crossing landowner constructed boardwalk, in the lower wetland sub-reach approximately 100 feet west of STA 1500 (September 2023).

Photo 33. Pine Lake Creek near STA 900, looking upstream (March 2023).

Photo 34. Moderately incised channel in the lower wetland sub-reach, facing upstream, near STA 1200 (September 2023).

Photo 35. LWM observed in the lower wetland sub-reach near STA 1300 (September 2023).

Lower Pine Lake Creek (Kanim Confluence to Mouth)

The downstream-most reach of Pine Lake Creek extends about 800 feet from the confluence with Kanim Creek (Photo 36) to the mouth at Lake Sammamish. The stream channel is incised immediately upstream of East Lake Sammamish Parkway, and bank erosion was observed on the right bank (Photo 37).

The reach is highly modified downstream of East Lake Sammamish Parkway (ELSP) and is dominated by culvert crossings at ELSP (Photo 38), East Lake Sammamish Trail (Photo 40), and Shore Lane (Photo 42 and Photo 43). The channel sections upstream of the trail and downstream of Shore Lane are highly modified with an engineered rock-controlled step pool morphology (Photos 39 and 44); the section between the trail and Shore Lane has few large rocks or wood and is relatively straight (Photo 41). The trail culvert was recently replaced and is now fish passable, but the Shore Lane culvert remains a partial passage barrier as listed by WDFW.

The lower reach supports perennial flow, with continuous flow observed even in late September. The channel at the mouth is shown in Photo 45.

Photo 36. Confluence of Pine Lake Creek and Kanim Creek, near STA 800 (September 2023).

Photo 37. Incised channel upstream of East Lake Sammamish Parkway, looking upstream, near STA 700 (September 2023).

Photo 38. East Lake Sammamish Culvert, looking downstream, STA 600 (September 2023).

Photo 39. Boulders in channel between East Lake Sammamish Trail and East Lake Sammamish Parkway (September 2023).

Photo 40. East Lake Sammamish Trail culvert, looking north (September 2023).

Photo 41. Section between Shore Lane and East Lake Sammamish Trail, looking upstream (March 2023).

Photo 42. Shore Lane culvert (September 2023). Looking upstream.

Photo 43. Shore Lane crossing looking downstream between two redwood trees (September 2023).

Photo 44. Downstream of Shore Lane, pool downstream of wood sill, near STA 200 (September 2023).

Photo 45. Pine Lake Creek immediately upstream of mouth, STA 100 (September 2023).

2.2 Kanim Creek

Kanim Creek is the only tributary to Pine Lake Creek, flowing in from the south in the marshy area upstream of ELSP. From its headwaters near SE 24th Street and 204th Avenue SE, Kanim Creek flows through a forested corridor to SE 19th Street, where it enters a steep ravine characterized by active sediment processes, before draining out to the marshy wetland. Within the wetland, the channel was intermittently defined to the confluence with Pine Lake Creek. Channel slope through the ravine is nearly 7%, and the ravine and stream corridor show evidence of recent and ancient landslides that are a significant sediment source to the system.

Morphology

The headwaters of Kanim Creek begin in a large wetland area near the intersection of SE 24th and 204th Avenue SE (Photo 46). At the time of our March 2023 visit, this area was flooded on both sides of the road and the culvert crossing was not visible. The reach between SE 24th Street and SE 19th Street was not walked because of accessibility limitations.

Photo 46. Kanim Creek headwaters at SE 24th Street, STA 5100 (March 2023).

Kanim Creek is deeply incised downstream of the SE 19th street crossing (up to 6 or 7 feet). It remains incised until approximately STA 2500, where the channel flattens out and significant aggradation has occurred. Photo 47 shows an example of channel incision observed in Kanim Creek. Photo 48 shows an active left bank hillslope failure near a stormwater outfall. Photo 49 shows deposition in a December 2019 photo. The stream channel is not confined to a single thread in this area and is braided across the deposition zone until it re-forms a single thread incised into the thick sediment downstream at approximately STA 2200 (Photo 50).

At the time of our September 2023 visit, there was no standing water in the channel upstream of STA 1500, however, some wet zones were observed where seepage was occurring on the banks. Photo 51 shows fine sand deposited behind a log sill near STA 1500. Water was observed in the channel around STA 1500 and the channel started to have wetland-like characteristics. Kanim Creek was not walked between STA 1500 and STA 1000 due to difficult terrain and accessibility.

The lower reach of Kanim Creek upstream of the confluence with Pine Lake Creek lies entirely within a wetland complex. The channel consists of multiple threads and is very marshy.

Photo 47. Channel incision in Kanim Creek near STA 3200 (September 2023).

Photo 48. Hillslope failure near stormwater outfall on left bank near STA 3100 (September 2023).

Photo 49. Deposition of sand observed near STA 2200 (December 2019).

Photo 50. Deep incision into deposited sediment on downstream end of deposition zone, near STA 2750 (September 2023).

Photo 51. Fine sand deposited behind log sill near STA 1500 (September 2023).

Stormwater and Stream Crossing Infrastructure

A stormwater facility on the north side of SE 19th Street discharges to the roadside ditch on SE 19th before entering Kanim Creek. Photo 52 shows the incised channel that has formed downstream of the stormwater outfall. This erosion has the potential to worsen and contribute to water quality issues in Kanim Creek.

Downstream of SE 19th Street, the creek flows through a deep ravine, with active landslides, erosion, and deposition. Three culverts (two conveying Kanim Creek, and one conveying stormwater) are located at the head of the ravine and are perched several feet above the channel floor. Photo 53 shows the culverts.

Photo 52. Channel formed downstream of stormwater outfall from Stormwater Facility D92924.

Photo 53. Perched culverts conveying Kanim Creek at SE 19th Street, STA 3800 (September 2023).

Habitat

No aquatic species were observed in Kanim Creek during the streamwalk. The lower wetland reaches were not walked but would be expected to provide similar habitat conditions to the lower wetland sub-reach of Pine Lake Creek. Upstream of the wetland, the steep incised channel and ephemeral flow conditions do not provide suitable habitat for fish species and likely present a natural passage barrier. The SE 19th Street culverts are not fish passable.

CONCLUSIONS AND RECOMMENDATIONS

Pine Lake and Kanim creeks display distinct geomorphic characteristics in the assessed reaches that influence fish habitat and viability. Table 1 summarizes the general characteristics, conclusions, and recommendations for potential actions to improve quality and function for each reach. Specific project and program recommendations are addressed in the body of the Basin Plan document. Figure 3 summarizes the general character of each reach.

Table 1. Summary of reach characteristics and recommendations

Reach	Characteristics	Potential Actions
Pine Lake Outlet	Channel is controlled by lake outlet weir. There is little evidence of active sediment transport or channel instability in the ditch-like channel	Conduct flow monitoring at lake to observe and record discharge.
Pine Lake Creek Upper Ravine	Flow is ephemeral. Channel is wider, with multiple stormwater outfalls (in good condition) contributing flow. Step-pool and plane-bed morphology and very little large woody material. Likely a transport reach for accumulated smaller sediments. No significant channel instability.	No recommendation for habitat enhancements due to ephemeral flow.
Pine Lake Creek Lower Ravine	Groundwater observed in this reach, contributing to perennial flow. Lack of large woody material. Likely a transport reach for accumulated smaller sediments. Aquatic organisms were observed.	Good candidate for habitat enhancement (i.e., large woody material) to create pools and provide sediment storage.
Pine Lake Creek Upper Wetland	Provides storage for sediment transported from upstream.	Further field documentation would be helpful to understand functionality of wetland and potential enhancements.
Pine Lake Creek Residential	Incised with evidence of bank erosion, instability, and a lack of large woody material.	Good candidate for habitat enhancement.

Reach	Characteristics	Potential Actions
	Kokanee salmon redds have been observed in this sub-reach.	Coordinate with stream-side landowners for restoration and enhancement opportunities.
Pine Lake Creek Lower Wetland	Provides sediment storage that minimizes potential downstream impacts to City and private property owners.	Coordinate with property owners for restoration and enhancement opportunities.
Kanim Creek Upper Ravine	Extreme channel incision and unstable slopes with subsequent deposition.	Flow control in upland areas.
Kanim Creek Lower Wetland	Provides sediment storage that minimizes potential downstream impacts to City and private property owners.	No actions recommended.
Lower Pine Lake Creek	Engineered channel structures create step-pool features. Multiple culverts that are not full barriers to fish passage.	Coordinate with property owners for restoration and enhancement opportunities and culvert improvements when opportunities arise.

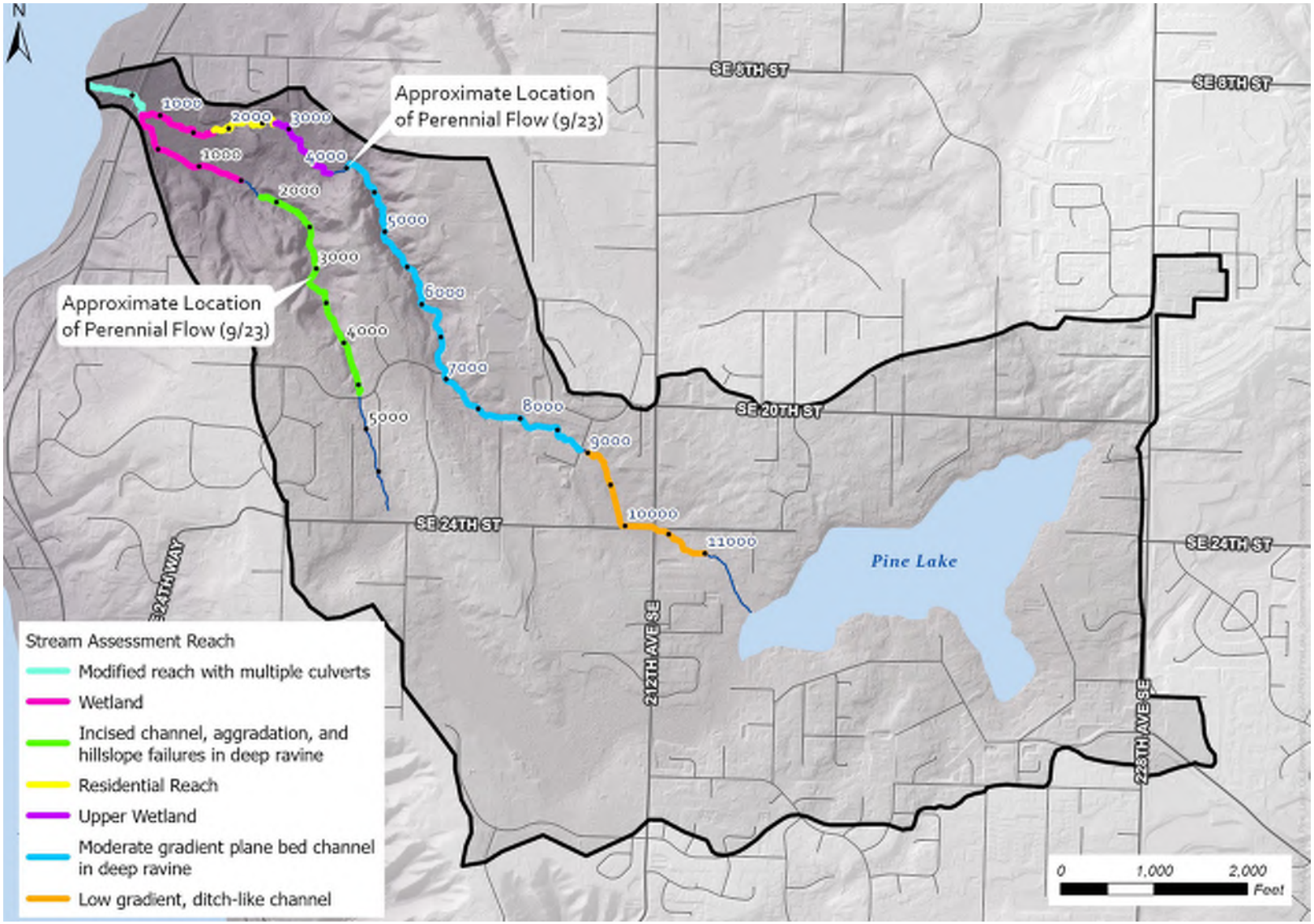


Figure 3. Sub-reach characteristics summary

City of Sammamish Washington

Appendix B Water Quality Summary

Aspect
A Geosyntec Company

MEMORANDUM

Project No. 220462

March 7, 2024

To: Toby Coenen, City of Sammamish

cc: Patty Dillon, NHC

From:

Bryan Berkompas
Principal Hydrologist
bryan.berkompas@aspectconsulting.com

Re: **Pine Lake Creek Basin Water Quality Summary**

Project Background

Pine Lake Creek drains approximately 1,200 acres near the south end of the Sammamish Plateau. It contains Pine Lake, Pine Lake Creek, Kanim Creek, and a sphagnum bog complex along with several smaller wetlands. Development (mostly residential) has increased over the past decade, especially around Pine Lake, but lower Pine Lake Creek flows through some of the largest remaining areas of contiguous forest within the city. Pine Lake Creek historically supported a substantial kokanee run and is still considered one of four primary spawning streams by the Kokanee Work Group, despite reduced spawning populations in recent years.

The City of Sammamish (City) has selected the Consultant to develop a basin plan for the Pine Lake Creek watershed, including Pine Lake. The Pine Lake Creek Basin Plan will characterize existing conditions in the basin and develop priority strategies, projects, and actions to address flooding, erosion, water quality, and ecological problems in the basin. As part of the basin plan this memorandum documents the methods and results of the water quality study in Pine Lake Creek and Kanim Creek.

Methods

Flow and water quality measurements were conducted in the spring and summer of 2023. The site locations and methods for data collection are described below.

Monitoring Sites

The sampling locations are shown on Figure 1.

Pine Lake Creek (PLC) Upper

PLC Upper is located in Pine Lake Creek just downstream of the Pine Lake outlet weir. This site measures the flow and water quality entering Pine Lake Creek from Pine Lake. Access to the creek

is via a path through the stormwater facility; and flow and water quality measurements were taken upstream of the stormwater outfall (Photograph 1). Under low flow conditions the exact position of the flow measurement varied depending on channel conditions, but the water quality samples and measurements were always collected upstream of the stormwater outfall.

Photograph 1. PLC Upper sample location between pipe and weir.

PLC Lower

PLC Lower is located in Pine Lake Creek upstream of the confluence with Kanim Creek. This site was intended to measure the flow and water quality in Pine Lake Creek before it joins with Kanim Creek and provide a point of comparison with PLC Upper. This site is on private property and access was granted by the property owner. The sample location was just downstream of the bridge near the eastern edge of the property (Photograph 2). The reach just downstream of the bridge is relatively straight and provided the best conditions for flow and water quality measurements.

Photograph 2. PLC Lower sample location looking downstream from bridge.

Kanim Upper

Kanim Upper is located in the upper region of the Kanim Creek basin. This sampling site (Photograph 3) represents the headwaters of Kanim Creek and is accessed from SE 19th Street just west of 202nd Pl SE via a faint trail on the right bank on the upstream side. Water quality and flow measurements were intended to be collected if stream conditions allowed, but due to the stream being too shallow or dry during this study, no samples were collected from this site.

Photograph 3. Kanim Upper channel upstream of SE 19th Street.

Photograph 4. Kanim Lower sampling location.

Kanim Lower

Kanim Lower is in Kanim Creek just upstream of the confluence with Pine Lake Creek. This site was intended to measure the flow and water quality from Kanim Creek and represent the overall contributions of Kanim Creek within the Pine Lake Creek Basin. This site is on private property and access was granted by the property owner. Flow and water quality measurements were collected in Kanim Creek in the northwest corner of the property, just east of the pond (Photograph 4).

PLC Outlet

PLC Outlet is in Pine Lake Creek below the confluence of Pine Lake Creek and Kanim Creek. This site was intended to measure the flow and water quality conditions of the entire basin just upstream of where the creek flows into Lake Sammamish. Access is just downstream of East Lake Sammamish Trail from East Lake Sammamish Shore Lane SE and upstream of any private property. Flow and water quality were measured in the reach just downstream of the trail bridge (Photograph 5).

Photograph 5. PLC Outlet sample location looking upstream.

Water Quality Sampling Methods

Water quality measurements were completed at each site if there was enough depth to permit sampling. Table 1 shows the parameters, sample containers, methods, holding times and preservation methods for this study.

Table 1.Summary of Water Quality Sample Methods

Analyte	Sample Containers	Method	Holding time	Preservation
Fecal coliform	250 ml sterile	SM92220	24 Hours	NaThio.EDTA
E. coli.		SM92220, SM9222G		
Total phosphorous	250 ml	EPA 200.8	28 Days	H2SO4
Nitrate + nitrite		EPA 200.8		
Total kjeldahl nitrogen		EPA 200.8		
Total Suspended Solids (TSS)	1 L HDPE (1-liter minimum volume)	SM 2540 D	7 Days	
pH	Measured in-situ with water quality sonde			
Conductivity				
Turbidity				
Temperature				

This parameter list is related to the Department of Ecology's Water Quality Index and helps provide an understanding of the overall water quality at each sampling location.

Water Quality Sonde Measurements

Upon arrival field staff deployed the water quality sonde (sonde) at least 10 feet upstream of flow measurement transect to let it equilibrate to the stream conditions while other field work was being completed. Once the discharge measurements and water quality sample collection were completed the staff returned to the sonde and confirmed that the readings stabilized. Once stable, they measured the temperature, pH, specific conductivity, and turbidity.

Water Quality Samples

If conditions allowed, water quality samples were collected in parameter specific bottles in an area downstream of the sonde and on the opposite side of the channel if possible to avoid interference between the samples and sonde. Each bottle was directly filled, and field staff were careful to not overfill or rinse out any preservatives. Each bottle was labeled and placed in a cooler on ice and transported to AmTest Laboratories under chain-of-custody for analysis.

Discharge Measurements

Discharge measurements were collected if flow conditions were suitable. Discharge measurements were collected in a transect in a relatively straight reach and far enough downstream of the sonde or sampling area to avoid affecting water quality results or having the sonde affect flow paths in the transect. All flow measurements were collected following USGS velocity-area methods (Turnipseed and Sauer, 2010) measuring at the mid-section. Per the method, field staff attempted to have no single measure represent more than 5 percent of the flow but narrow and shallow streams can make this difficult and in many cases this was not possible. If flow conditions were too low to collect a flow measurement or the channel was dry, then staff noted the conditions on the field sheet and also noted if flows appear higher or lower than previous visits.

Results

Four flow and water quality sampling events were conducted at all monitoring sites from May to August 2023. The monitoring results are presented below.

Flow Measurements

Flow measurements were collected across a range of flows and weather conditions. The upper reaches of Kanim and Pine Lake Creek both ceased flowing over the summer and it should be noted that the water was not observed flowing over the Pine Lake outlet weir during any of the visits to PLC Upper. It is assumed that the water in the channel at PLC Upper was groundwater driven either due to surrounding groundwater levels or from leakage through the soil around the outlet control structure. The lower reaches of both creeks maintained at least a trace of flow across the summer but overall the flows dropped as the basin dried out over the summer. The results of the flow measurements are shown below in Table 2.

Table 2. Flow Measurement Summary.

Date	Weather Observations	PLC Upper Flow (cfs)	PLC Lower Flow (cfs)	Kanim Upper Flow (cfs)	Kanim Lower Flow (cfs)	PLC Outlet Flow (cfs)
5/5/2023	Rain	0.059	0.233	>0*	0.119	0.750
5/18/2023	Sun	>0*	0.115	0	0.006	0.234
6/9/2023	Light rain shifting to overcast	>0*	0.080	0	0.007	0.177
8/29/2023	Scattered showers	0	0.042	0	>0*	0.140

*trickle flow, too low to measure but channel was not dry

Water Quality Results

Water quality was measured at each site when conditions permitted. Water quality samples were not collected if the creek was dry or too shallow to allow for a bottle to be filled and in-situ measurements were not taken if the creek was too shallow to cover the sensors.

Overall, the water quality results were quite variable between sites and within each site across the different events. The water quality data were compared to the flow rates at each site and across the sites with their upstream or downstream counterparts, but no trends or relationships were evident. Fecal coliform levels showed the most variability, ranging from 7 to 800 CFU/100ml, with each site experiencing both high and low values. Nitrogen, TSS, pH, and turbidity seem to be at relatively good levels across the basin. Other parameters, such as temperature were relatively high at PLC Upper but met the standard at the other sites. It is likely that the impacts of the lake and relatively stagnant flow at PLC Upper (or maybe that it was often the last site that was sampled as the day warmed up) are driving the temperature while the lower reaches benefit from shade and groundwater inputs. Field observations during the sampling events did not record any areas of concern while samples and measurements were collected. The results of the water quality monitoring are summarized in Table 3.

The water quality results were run through the Washington Department of Ecology's Water Quality Index (WQI) which helps provide an overall view of water quality at a location and also allows for some comparison between stations (Table 4). It should be noted that the WQI calculator is designed to run up to 12 sets of measurements, but for this study it was run on just 3 sets of measurements for PLC Upper and 4 sets at PLC Lower, Kanim Lower, and PLC Outlet. The relatively small number of samples can reduce the representativeness of the results as a single high or low value can have a greater effect on the WQI score. The WQI also lacks context and could lead to potential concerns that are due to local natural conditions. For example, the low dissolved oxygen scores at PLC Upper are most likely due to the majority of the water coming from groundwater and relatively stagnant pools under summer low flow conditions and would likely have far different results when flow is actively coming from the lake. Similarly, the DO and phosphorous concerns are not uncommon in reaches like Kanim Lower with slow moving flow through a densely vegetated wetland. Despite these limitations, the WQI can still help identify potential areas of good health and areas for improvement.

Table 3. Water Quality Summary

Site	Date/ Time	Fecal Coliform (CFU/ 100ml)	Escherichia coli (CUF/ 100ml)	Total Suspended Solids (mg/l)	Total Nitrogen (TKN) (mg/l)	Nitrate + Nitrite (mg/l)	Total Phosphorus (mg/l)	Temperature (°C)	Dissolved Oxygen (mg/l)	pH (S.U.)	Turbidity (NTU)
PLC_UPPER	5/5/2023 13:10	470	470	56.0	2.36	0.031	0.115	12.33	4.46	5.85	58.7
PLC_LOWER	5/5/2023 9:15	87	87	19.0	2.88	0.469	0.202	10.66	10.56	7.52	6.36
KANIM_LOWER	5/5/2023 11:50	43	43	25.0	1.46	0.384	0.118	11.01	9.2	7.03	23.7
PLC_OUTLET	5/5/2023 10:40	190	193	11.0	0.831	0.238	0.081	11.09	10.22	7.34	12.16
PLC_UPPER	5/18/2023 14:20	130	125	24.0	0.601	<0.02	0.078	21.3	2.75	6.04	7.76
PLC_LOWER	5/18/2023 10:00	7	7	5.0	0.358	0.477	0.055	13.3	9.88	7.14	4.3
KANIM_LOWER	5/18/2023 12:20	34	27	34.0	0.499	0.218	0.179	14.3	7.01	6.76	10.1
PLC_OUTLET	5/18/2023 8:30	20	18	6.0	0.366	0.218	0.074	13.4	9.39	7.22	5.07
PLC_UPPER	6/9/2023 11:30	87	87	<1	0.670	<0.02	0.045	17.84	1.63	6.46	4.95
PLC_LOWER	6/9/2023 9:45	260	250	7.0	0.479	0.388	0.070	12.86	9.83	7.46	5.58
KANIM_LOWER	6/9/2023 10:15	800	800	126	1.80	0.153	0.706	13.6	7.43	6.92	58.1
PLC_OUTLET	6/9/2023 8:10	130	100	9.0	0.474	0.188	0.101	13.56	9.44	7.33	2.01
PLC_LOWER	8/29/2023 10:30	92	92	<1	0.517	0.311	0.061	14.21	9.59	7.98	0.71
KANIM_LOWER	8/29/2023 9:15	180	176	10	0.74	0.059	0.262	15.33	7.99	7.44	9.42
PLC_OUTLET	8/29/2023 8:00	260	200	<1	0.492	0.119	0.09	14.68	9.37	7.86	6.35

Table 4. Water Quality Index Results

Monitoring Site	Fecal Coliform	Dissolved Oxygen	pH	Total Phosphorous	Total Suspended Solids	Temperature	Total Nitrogen	Turbidity	Overall
PLC Upper	73	1	57	73	85	35	82	78	4
PLC Lower	77	81	93	67	90	79	75	91	75
Kanim Lower	71	46	87	14	66	74	77	65	38
PLC Outlet	73	79	95	62	90	78	100	87	72

Low Concern = WQI score above 80
Moderate Concern = WQI score between 40 and 79
High Concern = WQI score less than 40

Summary

The flow and water quality within the Pine Lake Creek basin was monitored from May to August 2023, through a series of four discrete sampling events in Pine Lake Creek and Kanim Creek. The results show that the flow in both creeks dropped across the summer dry season. The water quality results show some areas of relatively good health (such as turbidity, nitrogen, TSS, and pH) and some areas of potential concern (such as DO and fecal coliform) within each creek. The limited number of samples combined with the variability between events and between sites did not indicate any relationships between flow and water quality or between sites within each creek.

References

Turnipseed, D.P., and Sauer, V.B., 2010. Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A8, 87 p. (also available at http://pubs.usgs.gov/tm/tm3-a8/.)

Washington Depart of Ecology WQI https://ecology.wa.gov/research-data/monitoring-assessment/river-stream-monitoring/water-quality-monitoring/river-stream-water-quality-index

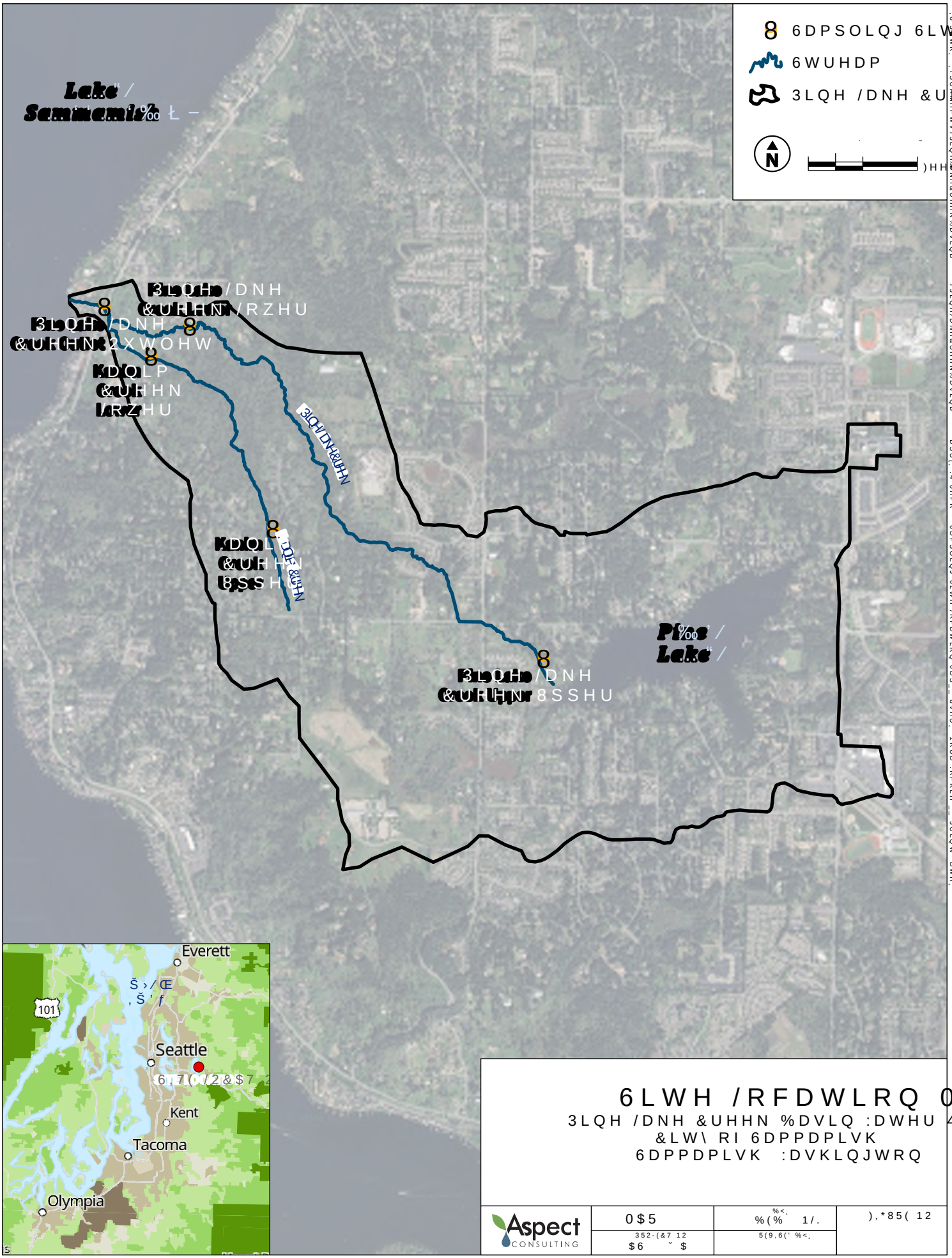
Limitations

Work for this project was performed for the City of Sammamish (Client), and this memorandum was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Attachments: Figure 1 – Site Location Map
Appendix A – Sampling Plan

FIGURE



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APPENDIX A

Pine Lake Creek Basin Flow and Water Quality Sampling Plan

PINE LAKE CREEK BASIN WATER QUALITY SAMPLING PLAN

The purpose of the monitoring is to characterize the water quality in Pine Lake Creek and Kanim Creek for the Pine Lake Creek Basin Plan. This study will collect ambient water quality samples and discharge measurements at several locations within the drainage basin. A total of up to 4 samples will be collected from each station for this study.

Sampling Locations

The addresses of the sampling locations are shown below in Table 1.

Table 1. Sampling Locations

Station	Closest Street Address	Station Measurements
PLC Upper	2606 213th Pl SE	Flow and WQ
PLC Lower	912 197th Ave SE	Flow and WQ
Kanim Upper	SE 19th St near 202nd Pl SE	Presence/absence flow
Kanim Lower	1208 E. Lake Sammamish Pkwy SE	Flow and WQ
PLC Outlet	E. Lake Sammamish Shore Lane SE	Flow and WQ

PLC Upper

PLC Upper is located in Pine Lake Creek just downstream of the Pine Lake outlet weir. This site is intended to measure the flow and water quality entering Pine Lake Creek from Pine Lake. Access to the creek is via a path through the stormwater facility and the ideal sample location for flow and water quality measurements is upstream of the stormwater outfall. Under low flow conditions the exact position of the flow measurement may vary depending on channel conditions but the water quality samples and measurements should always be upstream of the stormwater outfall.

PLC Upper sample location between stormwater outfall and weir

PLC Lower

PLC Lower is located in Pine Lake Creek upstream of the confluence with Kanim Creek. The site is intended to measure the flow and water quality in Pine Lake Creek before it joins with Kanim Creek and provide a point of comparison with PLC Upper. We have been given permission to park in the driveway near the play equipment. The homeowner has asked that we reach out the day before we want to access the site to let them know when we plan on visiting.

Ravi Soin's contact info is:
ravi.soin@bellevuecollege.edu
(206) 719-1368
Phone number is most reliable way to contact.

The sample location is just downstream of the bridge near the eastern edge of the property. The reach just downstream of the bridge is relatively straight and should provide the best conditions for flow and water quality measurements.

PLC Lower sample location looking downstream from bridge

Kanim Upper

Kanim Upper is located in the upper region of the Kanim Creek basin. This site is intended to represent the headwaters of Kanim Creek. Access Kanim Upper by parking on shoulder of SE 19th St just west of 202nd Pl SE. There is a faint trail on the right bank on the upstream side that provides access to the creek. Water quality and flow measurements can be collected if stream conditions allow but under most conditions Kanim Creek will be too shallow to collect water quality or flow measurements from. Field staff should observe whether the creek has visible flow or is dry.

Kanim Upper channel upstream of SE 19th St

Kanim Lower

Kanim Lower is in Kanim Creek just upstream of the confluence with Pine Lake Creek. This site is intended to measure the flow and water quality from Kanim Creek and represent the overall contributions of Kanim Creek within the Pine Lake Creek Basin. We have been given permission to access Kanim Creek near the pond on the northwest corner of the property. Email the homeowner at least one day in advance so they can leave the gate open.

Jim Goedhart's contact info is:
jlgoedhart@gmail.com
(we do not have Jim's phone number)

Park near the shed making sure to leave the driveway clear for access to the house and walk down the grassy hill toward the pond. The best reach for flow and water quality measurements is behind a clump of rhododendrons just east of the pond.

Kanim Lower sampling location

PLC Outlet

PLC Outlet is in Pine Lake Creek below the confluence of Pine Lake Creek and Kanim Creek. This site is intended to measure the flow and water quality conditions of the entire basin just upstream of where the creek flows into Lake Sammamish. Access is just downstream of East Lake Sammamish Trail from East Lake Sammamish Shore Lane SE. Use care to ensure you stay off of private property near the site. The best reach for flow and water quality measurements is just downstream of the trail bridge.

PLC Outlet sample location looking upstream

Analytical Parameters and Methods

Water quality samples will be analyzed for parameters of potential concern. The parameters, sample containers, methods, holding times and preservation are described below in Table 2.

Table 2. Summary of Sample Methods

Analyte	Sample Containers	Method	Holding time	Preservation
Fecal coliform	250 ml sterile	SM92220	24 Hours	NaThio.EDTA
E. coli.		SM92220, SM9222G		
Total phosphorous	250 ml	EPA 200.8	28 Days	H2SO4
Nitrate + nitrite		EPA 200.8		
Total kjeldahl nitrogen		EPA 200.8		
Total Suspended Solids (TSS)	1 L HDPE (1-liter minimum volume)	SM 2540 D	7 Days	
pH	Measured in-situ with sonde			
Conductivity				
Turbidity				
Temperature				

Sampling Procedures

This section describes field procedures that will be utilized to ensure that samples are collected in a consistent manner and the data will be comparable to data collected during this study or future monitoring programs. Procedures are described for collecting water quality samples, in-situ sonde water quality measurements and discharge measurements, and recording field measurements and conditions.

Pre-Event Setup

At least one day prior to each field sampling event, field personnel will mobilize sampling equipment and perform the following steps:

- Notify the analytical laboratory (AmTest) to ensure that laboratory staff will be available to process the samples.
    - Aaron Young aarony@amtestlab.com
- Coordinate with property owners and City staff
    - Toby Coenen TCoenen@sammamish.us
    - Jim Goedhart jlgoedhart@gmail.com, (Kanim Lower)
    - Ravi Soin ravi.soin@bellevuecollege.edu (206) 719-1368 (PLC Lower)
- Confirm inventory of lab-supplied analyte bottles in accordance with Table 2. Visit lab to obtain additional bottles if needed.
- Gather sampling equipment including:
    - Cooler with bottles
    - Tape measure or stadia rod for flow measurements
    - SonTek FlowTracker2 (with spare batteries)
    - YSI or In-Situ WQ sonde
    - Hach Turbidity meter (as backup)
    - Field sheet and COC
    - Container with tap water
    - Nitrile gloves (stored in bags to keep clean)
    - Zip ties
    - PPE

Sample Collection

On the day of the sample event. Load gear in vehicle and:

- Add ice to cooler(s).
- Calibrate sonde for:
    - Sp. Conductivity,
    - pH
    - DO
    - turbidity

Upon arrival at Kanim Lower or PLC Lower please check in with the property owner so they know we are on site.

In-Situ Water Quality Measurements

Once you arrive at each sample location, deploy the sonde at least 10 feet upstream of flow measurement transect to let it equilibrate to the stream conditions while other field work is being completed. Ensure probes are below the water surface and that the sonde is on. Then collect flow measurement if conditions allow.

Once flow measurements and water quality sample collection are complete, return to sonde and confirm that the readings have stabilized. Once stable, record the temperature, pH, Sp. Conductivity, and turbidity.

Sunlight can sometimes cause issues with in-situ turbidity meters, especially in shallow water. If such interference is suspected, please verify turbidity with Hach turbidity meter before leaving site.

Discharge Measurements

A discharge measurement should be collected if flow conditions are suitable. Find a transect in a relatively straight reach and far enough downstream of the sonde to avoid affecting water quality readings at the sonde or having the sonde affect flow paths in the transect. All flow measurements will be collected based on the USGS velocity-area methods (Turnipseed and Sauer, 2010[1]) measuring at the mid-section. Per this method, field staff will attempt to have no single measurement represent no more than 5 percent of the flow, but narrow and shallow streams can make this difficult and, in many cases, not possible. Each discharge measurement will be recorded on the field sheet to document flow conditions for the water quality measurements.

If flow conditions are too low to collect a flow measurement or the channel is dry, then describe conditions on the field sheet and note if flows appear higher or lower than previous visits.

Water Quality Sampling

- Set out sample bottles and fill out labels. Include:
    - Sample Name
      The sample name is a unique identifier used for sample tracking and data management purposes. Sample names will use the following format example if a sample was collected on April 27, 2023:

      Kanim Upper: **Kanim_Upper042723GRAB**

      Kanim Lower: **Kanim_Lower042723GRAB**

      PLC Upper: **PLC_Upper042723GRAB**

      PLC Lower: **PLC_Lower042723GRAB**

      PLC Outlet: **PLC_Outlet042723GRAB**
    - Date of collection (DD/MM/YY)
    - Local time of collection (24-hr format)
    - Analytes
    - Sampler initials
- Collect samples just downstream of the deployed water quality sonde and on the opposite side of the channel if possible to avoid interference between the samples and sonde.
- Directly fill each bottle taking care not to overfill or rinse out any preservatives.

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[1] Turnipseed, D.P., and Sauer, V.B., 2010. Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A8, 87 p. (also available at http://pubs.usgs.gov/tm/tm3-a8/.)

- Securely close each bottle and place in cooler on ice for transport to the lab.

Wrap-up at Each Site

- Fill out Field Sheet completely before leaving site. (Appendix A)
- Note any site anomalies and take pictures of anomalies along with pictures looking upstream, downstream, and perpendicular to flow transect.
- Proceed to next site and repeat sampling procedures.

Sample Transport and Custody

Fill out Chain-of-Custody (COC) at the lab in ink and ensure all samples have been collected before leaving the site. All samples will be transported in an ice-bath in a cooler to the analytical laboratory. Samples will be hand delivered to the lab on the same day they are collected or as soon as they open on the next business day if collected after lab is closed. A COC record must accompany the samples.

If needed, get sample bottles and cooler for the next event.

Post Sample Wrap-up

Upon return to Aspect shop:

- Check sonde calibration and complete sonde form.
- Scan and save all field sheets, sonde calibration sheets, COC's and photos to project folder and archive hard copies.
- Clean and maintain equipment as needed and store for next event.

City of Sammamish
Pine Lake Creek Basin Water Quality Monitoring - 220462

Station:

Sample Collection			
Personnel:	Weather:	Arrival Date/ Time:	
Discharge Measurements		**In-Situ Measurements**	
Active Flow - Y/N		Temperature (C	
Thalweg depth (ft)		Dissolved oxygen (mg/L)	
Measured flow at time of sample (cfs)		pH (S.U.)	
Flow Measurement file name		Turbidity (NTU)	
Water Quality Sampling			
Sample date/time		Photos of upstream, downstream, flow transect and sampling location?	
Sample label			
Samples iced in cooler?			
Notes:			

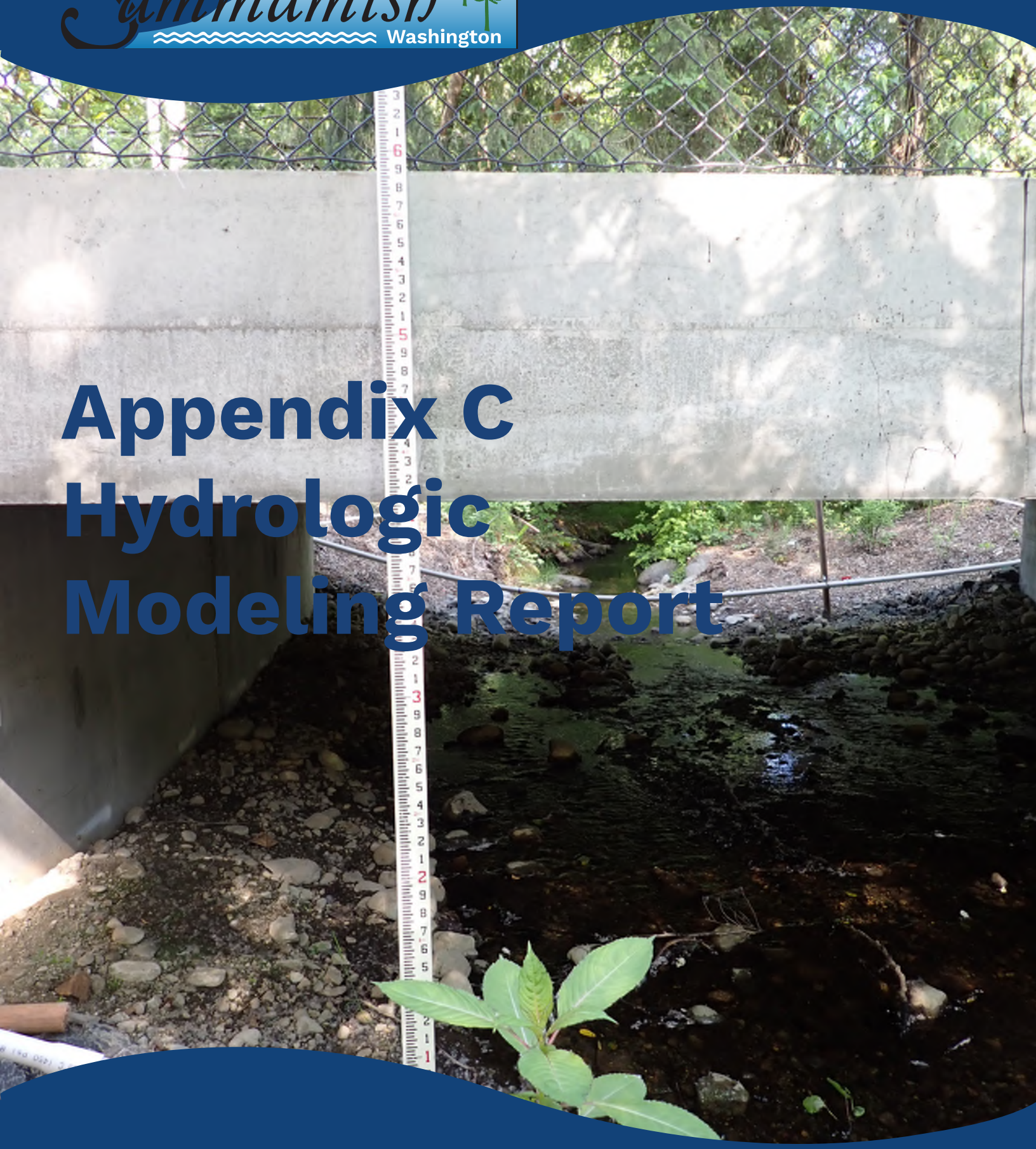
Station:

Sample Collection			
Personnel:	Weather:	Arrival Date/ Time:	
Discharge Measurements		**In-Situ Measurements**	
Active Flow - Y/N		Temperature (C	
Thalweg depth (ft)		Dissolved oxygen (mg/L)	
Measured flow at time of sample (cfs)		pH (S.U.)	
Flow Measurement file name		Turbidity (NTU)	
Water Quality Sampling			
Sample date/time		Photos of upstream, downstream, flow transect and sampling location?	
Sample label			
Samples iced in cooler?			
Notes:			

Station:

Sample Collection			
Personnel:	Weather:	Arrival Date/ Time:	
Discharge Measurements		**In-Situ Measurements**	
Active Flow - Y/N		Temperature (C	
Thalweg depth (ft)		Dissolved oxygen (mg/L)	
Measured flow at time of sample (cfs)		pH (S.U.)	
Flow Measurement file name		Turbidity (NTU)	
Water Quality Sampling			
Sample date/time		Photos of upstream, downstream, flow transect and sampling location?	
Sample label			
Samples iced in cooler?			
Notes:			

City of Sammamish Washington



Appendix C Hydrologic Modeling Report

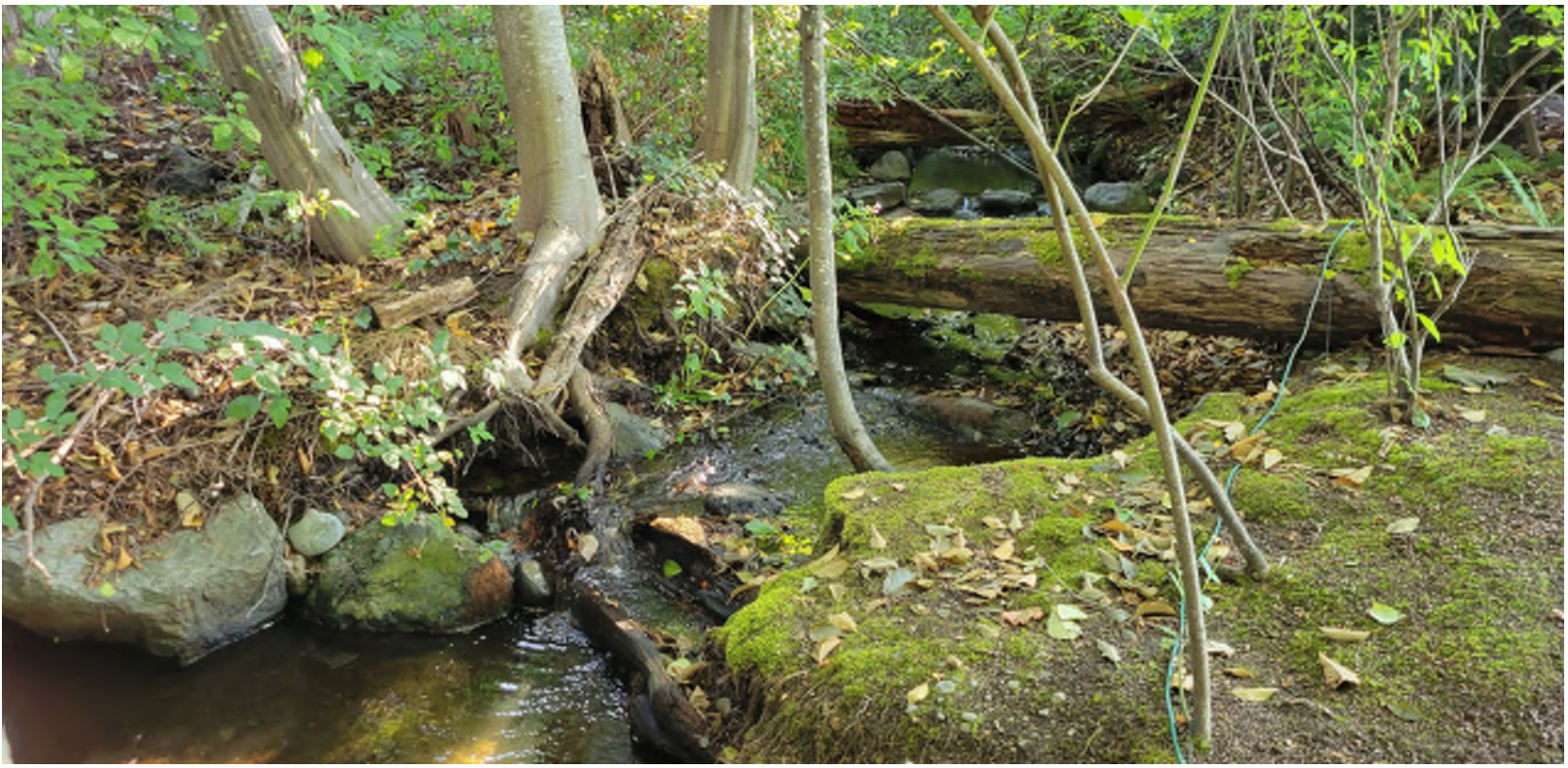


Photo source: NHC (September 2023)

Pine Lake Creek Basin Plan
Hydrologic Modeling Report

Prepared by:

Northwest Hydraulic Consultants Inc.
12787 Gateway Drive S.
Seattle, WA 98168
Tel: (206) 241-6000
www.nhcweb.com

NHC Project Contact:
Patty Dillon, P.E.
Principal

Prepared for:

City of Sammamish
801 228th Ave SE
Sammamish, WA 98075

February 21, 2024
Draft Report

NHC Reference 2007708

Report prepared by:

Unsigned draft by

Amir Golpira, EIT
Jr. Engineer
Area of Responsibility

Report reviewed by:

Unsigned draft by

Patty Dillon, P.E.
Principal
Project Manager

DISCLAIMER

1 INTRODUCTION

The City of Sammamish (City) has retained Northwest Hydraulic Consultants (NHC) to develop a basin plan for the Pine Lake Creek basin, including Pine Lake. The project includes characterizing existing conditions in the basin and developing priority strategies, projects, and actions to address flooding, erosion, water quality, and ecological problems in the basin. This report documents hydrologic modeling to support analysis of existing runoff and streamflow in the basin and potential effects of future development and climate change.

1.1 Basin Overview

The project area is located in the center of East Lake Sammamish basin, in the vicinity of Pine Lake, draining approximately 1,200 acres into Lake Sammamish. Pine Lake is located on the west side of 228th Avenue SE, south of SE 20th Street in Sammamish, Washington. Inflow to the lake is largely through adjacent storm drain systems around the lake's perimeter. Pine Lake Creek is the only outlet from the lake, flowing north-northwest from the western end of the lake. In 1982, the Washington State Department of Game, now the Washington State Department of Fish and Wildlife (WDFW), constructed a weir on Pine Lake Creek approximately 450 feet downstream of the lake to manage seasonal lake levels (City of Sammamish, 2022). The project area consists of three main subbasins as follows:

- The **Pine Lake** subbasin drains 667 acres and includes Pine Lake and adjacent areas flowing into the lake. This includes the wetland located to the southwest of the lake, which drains to Pine Lake and partly to Pine Lake Creek through a diversion.
- **Pine Lake Creek** drains 341 acres and includes Pine Lake Creek flowing from the lake for about 2.2 miles to the northwest draining into Lake Sammamish.
- **Kanim Creek** drains 185 acres and includes Kanim Creek, which originates from wetland headwaters on the plateau and flows generally northward about 1.3 miles to join Pine Lake Creek upstream of East Lake Sammamish Parkway.

Most of the watershed is located on the upland plateau, with its northwestern edge located on the steep western slope down to the shoreline of Lake Sammamish (King County, 1994). The dominant geology in the project basin is till and the primary land cover is forest. Land use is mostly residential followed by undeveloped areas in the wetland portion of the Pine Lake subbasin and downstream portions of the Kanim Creek and Pine Lake Creek subbasins.

Development (mostly residential) has increased over the past decade, especially around Pine Lake, but lower Pine Lake Creek flows through some of the largest remaining areas of contiguous forest within the city. Pine Lake Creek historically supported a substantial Kokanee run and is still considered one of four primary spawning streams by the Kokanee Work Group, despite reduced spawning populations in recent years.

Figure 1.1 shows the project area highlighting the main subbasins and creeks.

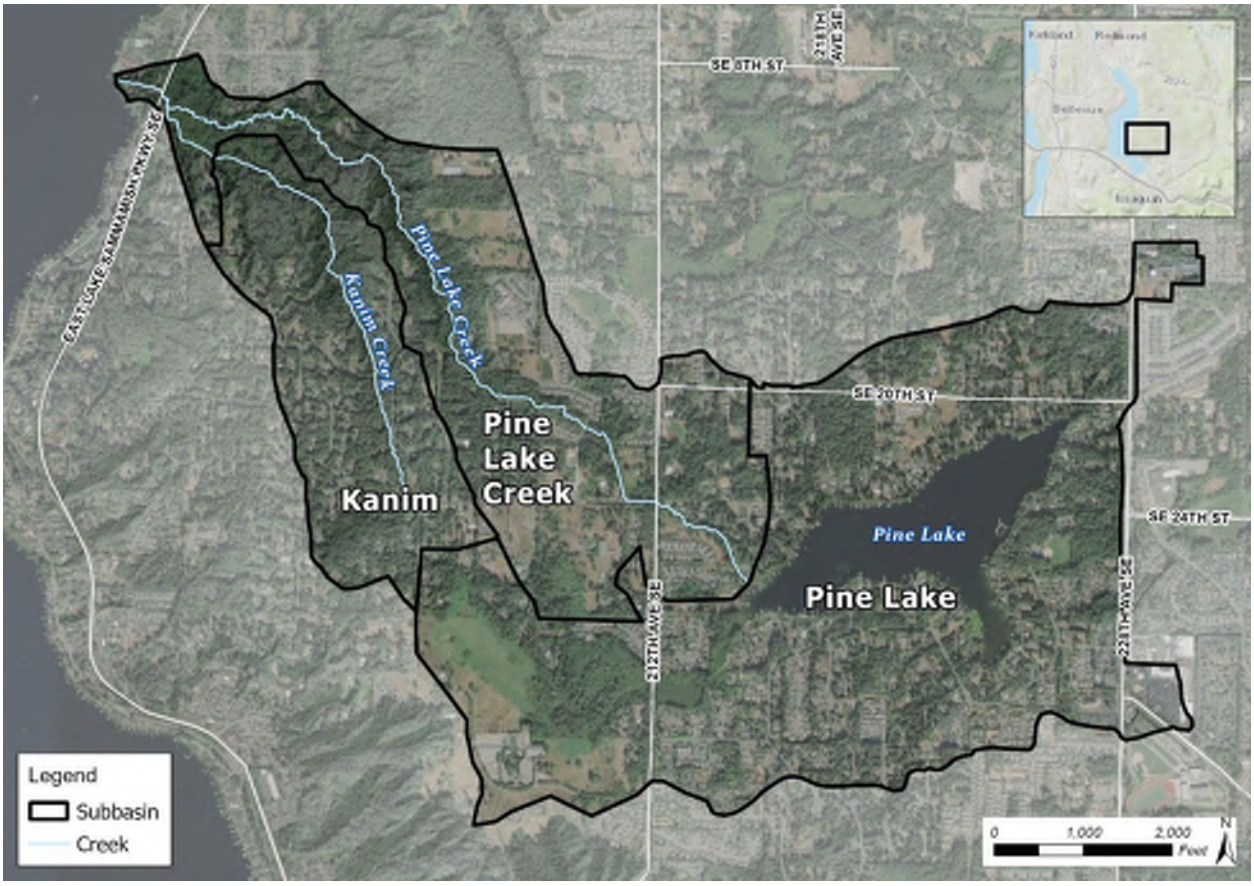


Figure 1.1 Project area main subbasins

2 MODEL DEVELOPMENT

For this study, NHC conducted hydrologic modeling using the Hydrological Simulation Program – Fortran (HSPF) software. HSPF provides flexibility in representing surface and subsurface processes and is the standard for stormwater modeling in western Washington. The model requires input time series for precipitation and evaporation and uses distinct hydrologic response units (HRUs) to represent runoff generation from different types of land surfaces. Each HRU represents a unique combination of land cover, soil/geology type, and slope that produce different runoff responses. Runoff from each subbasin is computed by adding the response from each HRU according to their area distribution within the subbasin. The combined runoff from each subbasin is routed downstream via model elements representing natural or constructed channels or storage features. The developed model in this project simulates long-term hydrologic processes from October 1949 to March 2022.

2.1 Meteorological Data

Meteorological datasets were developed in previous work by NHC, primarily for King County. NHC obtained the precipitation data from 1992 to 2022 in 15-minute intervals from the Mystic Lake station[1] through the King County Hydrologic Information Center[2], as shown in Figure 2.1. These records were extended back in time through water year 1949, based on rainfall patterns recorded at the long-term National Weather Service gage at SeaTac airport. A scaling factor of 1.167 was applied to translate the long-term data to the gage location to represent differences in annual precipitation volumes.

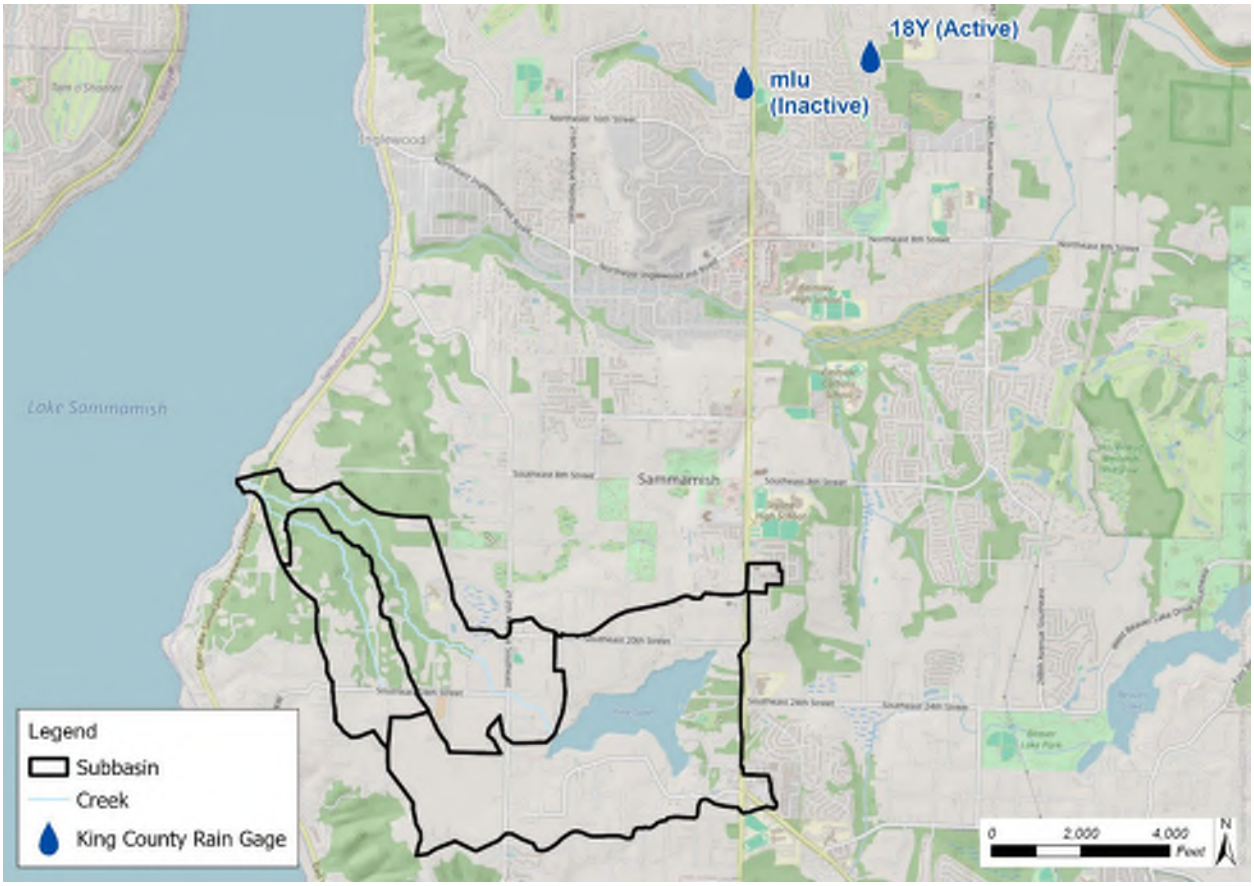


Figure 2.1 Rain gages used in the model development.

Daily pan evaporation was extended through 2022 by using the daily grass evapotranspiration (ET) estimates from Washington State University AgWeatherNet[3] Puyallup station. Further information is documented in King County (2019) and King County (2023).

[1] The data is combined from two rain gages at Mystic Lake: 18Y (2000-Present) and mlu (1992-2001). These gages are located within 0.5 miles of each other.

[2] https://green2.kingcounty.gov/hydrology/

[3] https://weather.wsu.edu/

To evaluate the basin responses under future climate, NHC used alternate precipitation developed from downscaled global climate model (GCM) projections. Detailed discussion of methodology and individual gage results are available in NHC (2023).

2.2 Spatial Data

NHC divided the watershed's three main subbasins into 32 smaller subbasins. The subbasin delineation primarily relied on a topographic map created from King County 2016 LiDAR data (Quantum Spatial, 2017) and drainage utilities maps. In areas where uncertainties were higher, NHC verified or adjusted the boundaries through communication with the City and/or field observations. Figure 2.2 shows the delineated subbasins with the corresponding number of each subbasin, where Subbasin 5 is the most downstream subbasin, in which the mouth of Pine Lake Creek is located. It should be noted that initially, from available watercourse mapping, the confluence of Pine Lake Creek and Kanim Creek was identified at the downstream end of Subbasin 10, but LiDAR analysis following the subbasin delineation and model development showed that the actual confluence is located further downstream in Subbasin 5. The boundaries of Subbasins 5 and 10 were not further adjusted because the differences in upstream drainage areas to the confluence are small and the impact on flows would be well within model uncertainties.

NHC used a six-class land cover layer, provided by the City, to characterize land cover types. The mapping includes the following classes: bare earth/miscellaneous, impervious, grass, shrub, forest, and water. NHC used an existing land use map to define effective impervious areas (EIA) for the HRUs.

Average slopes were computed from the LiDAR based on 50-foot square grid cells. To assign slopes to HRUs, the slopes were categorized into flat (< 6 percent), medium (6 – 15 percent), and steep (> 15 percent).

NHC categorized surface geologic units[4] into several broad soil types that are linked to distinct runoff response characteristics: till, outwash, saturated, and alluvial, as shown in Figure 2.2. Only an insignificant portion of Subbasin 5 was classified as an alluvial type, so this was mapped to outwash to simplify the modeling process. Water bodies were assigned a saturated soil type.

[4] From King County and the Washington Department of Natural Resources

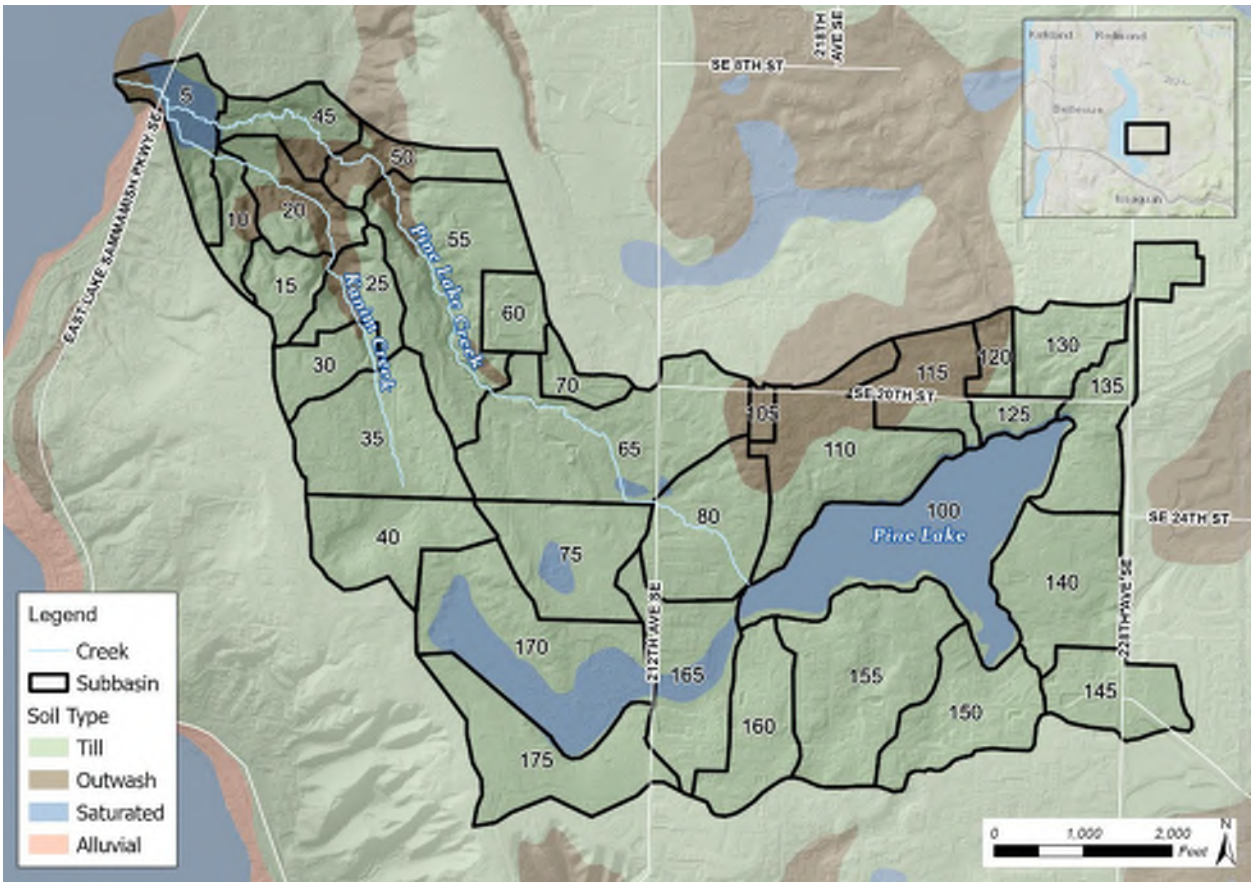


Figure 2.2 Subbasins delineation and soil types used in the HSPF model.

2.3 Routing

Routing elements representing wetlands, streams, and stormwater pipes and facilities were added to the model to capture subbasin storage and flow attenuation through the drainage network. The model incorporated significant existing stormwater facilities, which were characterized in the model based on s-built drawings from the City's engineering record drawing portal[5]. Not every pond was added, but newer and larger facilities – expected to have more impact on in-stream flows – were incorporated, resulting in the development of facility-specific hydraulic function tables (FTABLEs) for six facilities. In some subbasins including multiple ponds, NHC aggregated the storage into a single pond.

A diversion located in Subbasin 165 diverts the majority of the upstream inflow to Pine Lake Creek. This diversion was constructed in the 1980s to reduce phosphorus loading to Pine Lake. To represent this feature in the model, NHC defined an FTABLE with two outlets, the primary flow going to Pine Lake Creek, with overflow to Pine Lake. NHC verified the diversion structure and dimensions from both as-built drawings and field visits. Subbasin 170 is modeled as a wetland, where the FTABLE is defined as a stream with a wide bottom width. The Pine Lake (Subbasin 100) FTABLE is developed in reference to the outlet weir. The volume was calculated based on stage above the outlet weir crest and assuming

[5] Engineering Records Vault at https://www.sammamish.us/i-want-to/maps-gis/

constant lake surface area, and discharge was computed using standard weir equations. Elsewhere, simplified stream or pipe system routing was applied.

3 MODEL VERIFICATION

A full model calibration was beyond the scope of the project. However, as a reality check, initial model results were compared to observed data from the discontinued King County Pine Lake Creek stream gage (15b) located at the downstream end of Pine Lake Creek at East Lake Sammamish Parkway. A period of the observed data with no major gaps extending from December 1, 2007, to October 21, 2010, was selected for model verification.

The model initially used a parameter set developed for typical conditions in the Puget Sound lowlands region (Dinicola, 1990). These regional parameters produced simulated Pine Lake Creek flows that were too high for both storm events and baseflows. NHC identified several influential parameters to mitigate this overestimation. These parameters affect the relative levels of surface runoff, interflow, and groundwater in different soil types. NHC used BASINS Technical Note 6 recommendations (U.S. Environmental Protection Agency, 2000) to determine a range of applicable values for each parameter while ensuring that selected values are physically meaningful and internally consistent.

Figure 3.1 compares the modeled and observed (King County gage) flows for a specific event during the calibration period in January 2010. In general, the model tracks the observed flow patterns closely, resulting in event response times and shapes similar to the observed data. However, the model's estimated peaks and baseflows are still generally higher than observed, as highlighted in the figure.

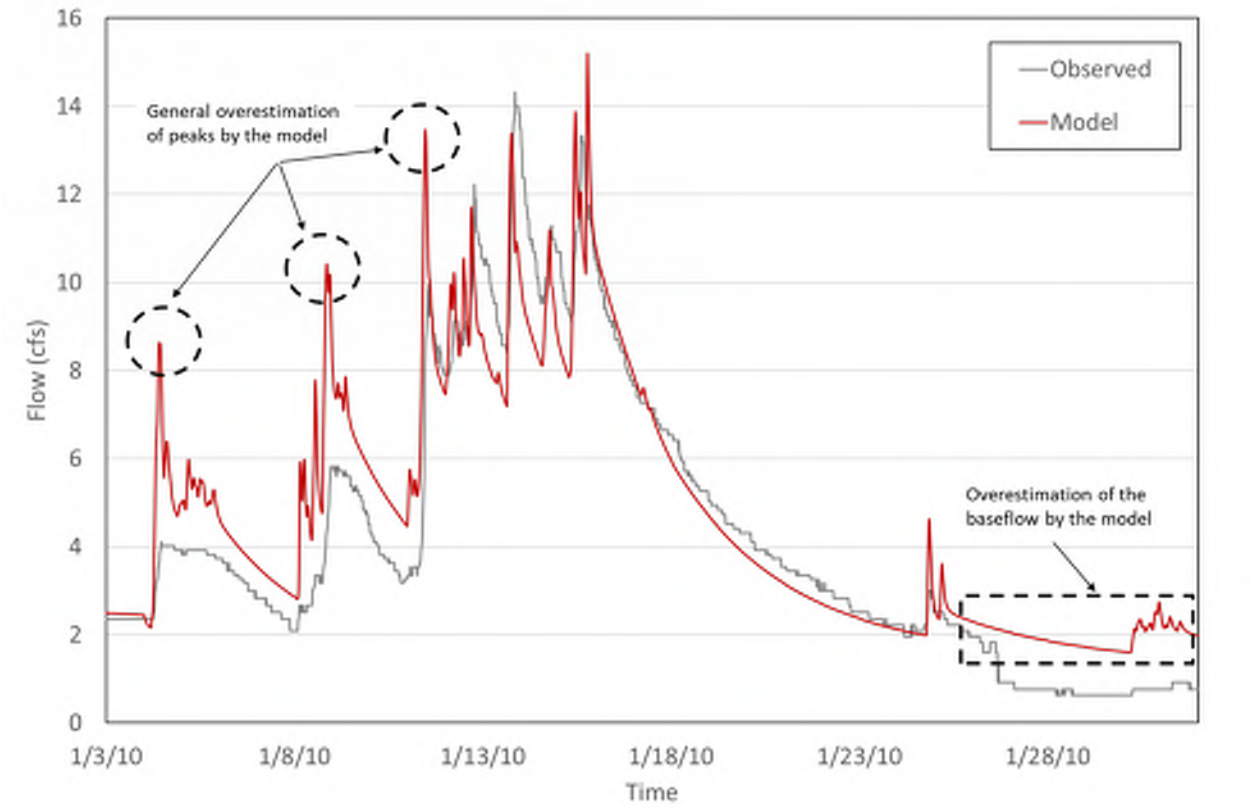


Figure 3.1 Comparison of the calibrated model and the observed flows for a specific event.

Further refinement was beyond the project scope. Since the model will primarily be used to compare different scenarios rather than providing absolute values, a partial calibration was judged to be sufficient, as the model aligns well with the flow response patterns seen in the observed data.

4 FUTURE DEVELOPMENT SCENARIO

To understand the effects of future development on the basin, NHC developed a future development (build-out) scenario, which involved defining areas within each model subbasin with projected development or redevelopment. Buildable area assumptions were based on the 2019 King County Urban Growth Capacity Study and provided as a parcel-scale analysis by the City (Sammamish, 2022). The analysis considered parcel zoning, current land use, development regulations, critical areas, and other factors to determine the allowable development area on each parcel, with percent impervious based on zoning.

For modeling purposes, developable portions of the parcels within each subbasin were consolidated into a single redevelopment subarea, with the remaining subbasin area maintained at the existing land cover. Generally, two types of developments exist in each developable portion: impervious and landscape. The impervious developable land was assigned to the impervious land cover type, and the landscape developable land was assigned to a compost-amended land cover type unique to the future development scenario. Compost-amended landscape areas were assigned runoff parameters

representative of a pasture land cover type. Figure 4.1 shows the buildable areas and new land cover assignments for the future development scenario. A hypothetical flow control facility for the developing portion of each subbasin was sized to meet existing flow control standards using methods of the Western Washington Hydrology Model (WWHM), including infiltration for areas with outwash soils.

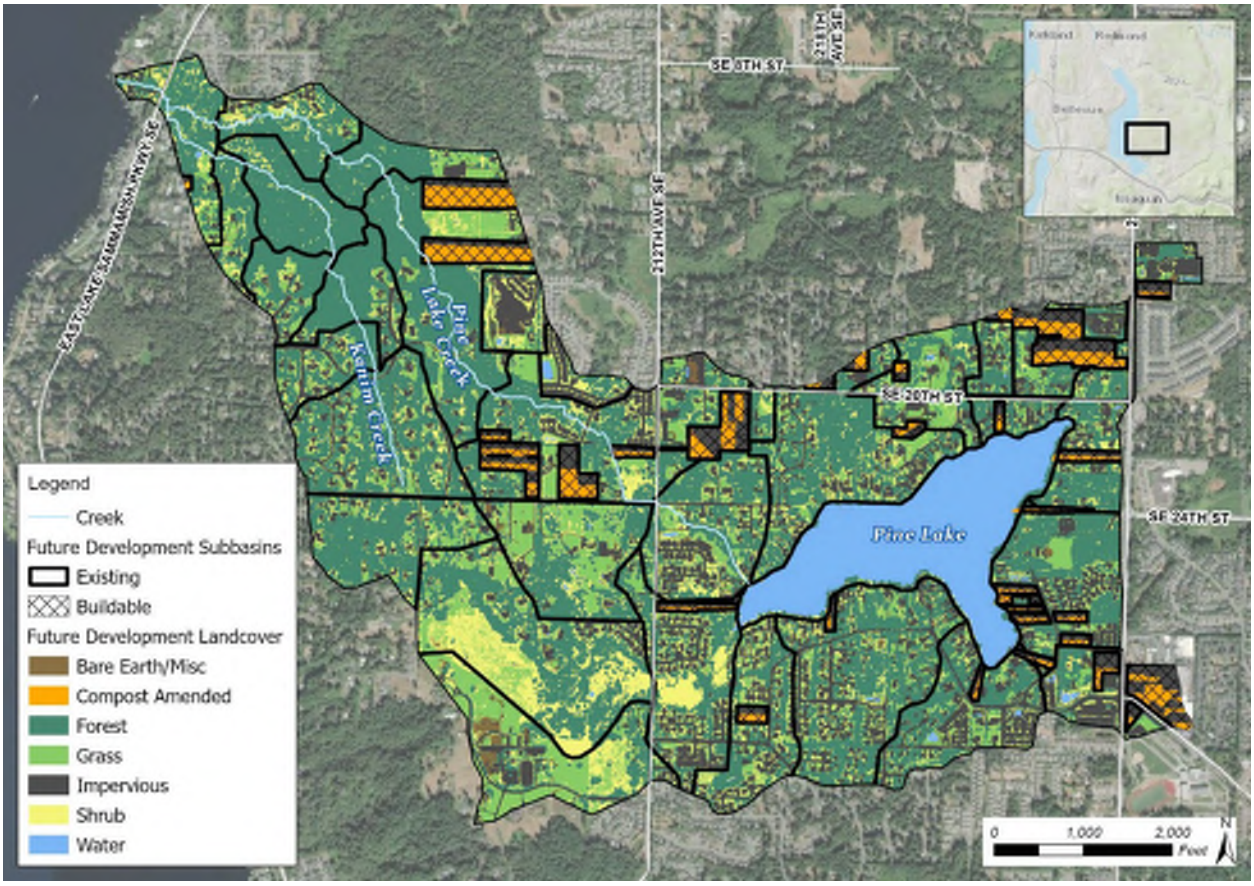


Figure 4.1 Future development scenario subbasins and land cover

5 MODEL RESULTS

NHC evaluated a total of four scenarios as listed below.

- Existing Development – Existing Climate: models existing land use with historic precipitation inputs.
- Future Development – Existing Climate: models future land use (build-out condition) with historic precipitation inputs.
- Existing Condition – Future Climate: models existing land use with projected future precipitation inputs.
- Future Development – Future Climate: models future land use (build-out condition) with projected future precipitation inputs.

Five key locations (shown in Figure 5.1) were selected to output flow: Pine Lake Creek mouth, Pine Lake Creek at confluence with Kanim Creek, Kanim Creek mouth, Pine Lake outflow, and total inflow to Pine Lake, which is the summation of flows from subbasins adjacent to the lake (hatched subbasins in the figure).

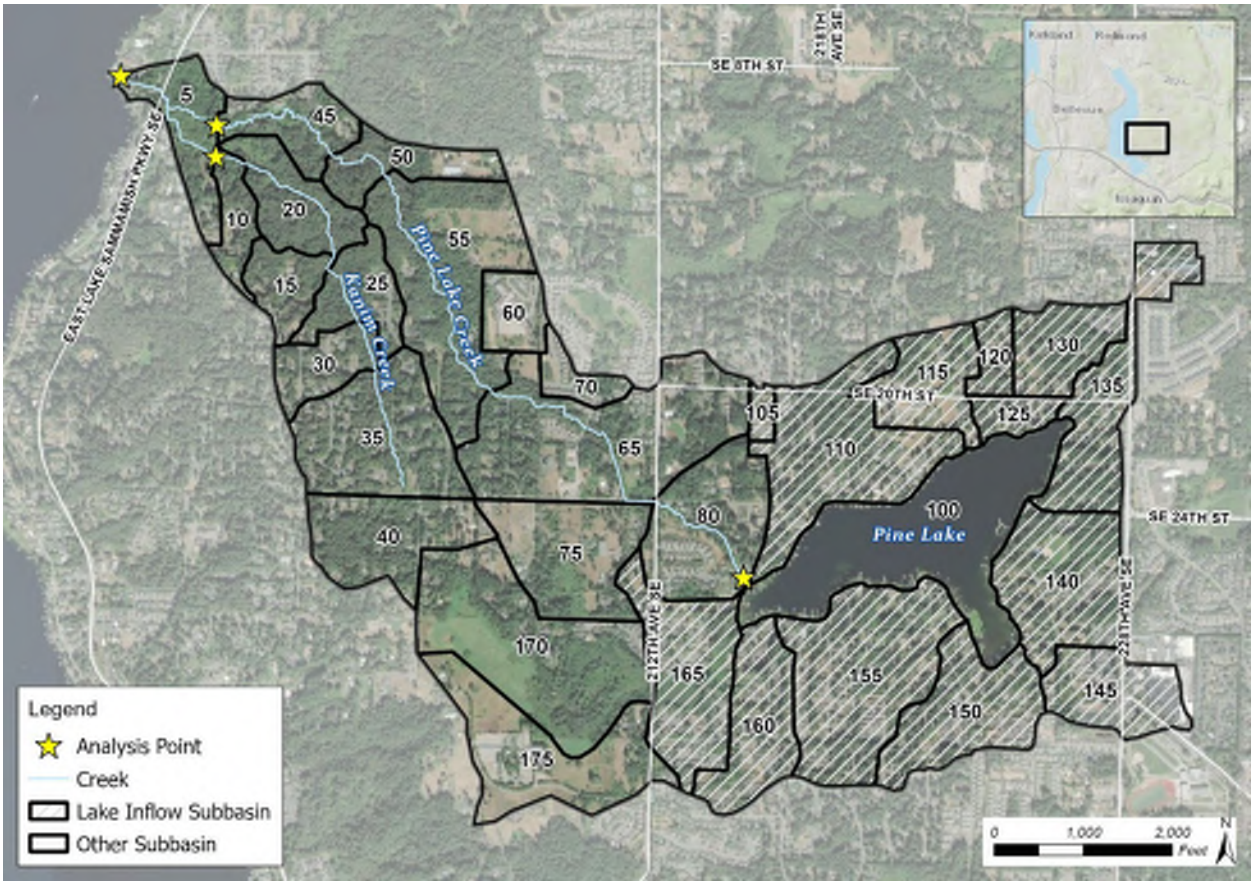


Figure 5.1 Analysis points and areas in the project subbasins

NHC computed flood frequency and flow duration curves to assess the basin's response to each scenario. Table 5.1 summarizes the results of the flood frequency analysis and Table 5.2 shows the difference in flood magnitudes relative to the existing development-existing climate scenario. At Kanim Creek mouth, there is no difference between the existing and future development scenarios because no future development is expected in the Kanim Creek subbasins. At the other locations, for any given climate, future development scenarios resulted in slightly smaller (1 to 6%) flood magnitudes, with the highest average reductions occurring for Pine Lake inflows and Pine Lake Creek flows at the Kanim Creek confluence. This suggests that the modeled flow controls associated with future development are effectively mitigating runoff increases due to land use changes.

The flood magnitudes in future climate scenarios are generally larger and notably higher at higher return intervals. The largest increases occur on Kanim Creek, where the majority till land surface generates substantial surface runoff and the steep basin provides minimal runoff storage. The smallest increases are associated with the lake outflow. The lake storage and fixed weir attenuate the increased runoff volumes and limit the increase in flood magnitudes to a maximum of about 15%.

Table 5.1 Flood frequency analysis

Location	Return period (year)[1]	1.01	2	5	10	25	50	100
	Scenario	Flow (cfs)						
Pine Lake Creek Mouth	Existing Development – Existing Climate	15.1	34.1	51.6	65.8	87.2	106.0	127.3
	Future Development – Existing Climate	15.1	33.2	49.8	63.4	83.7	101.5	121.7
	Existing Development – Future Climate	18.1	36.2	61.5	87.2	134.3	183.5	248.6
	Future Development – Future Climate	17.8	35.3	59.4	83.8	128.1	174.0	234.6
Pine Lake Creek at Confluence	Existing Development – Existing Climate	11.5	26.1	39.0	49.4	64.7	77.9	92.8
	Future Development – Existing Climate	11.5	25.1	37.2	46.8	61.0	73.2	86.8
	Existing Development – Future Climate	13.3	28.1	46.7	64.6	96.0	127.4	167.5
	Future Development – Future Climate	13.0	27.1	44.5	61.1	89.6	117.9	153.6
Kanim Creek Mouth	Existing Development – Existing Climate	4.1	8.0	12.6	16.8	23.9	30.7	39.1
	Future Development – Existing Climate	4.1	8.0	12.6	16.8	23.9	30.7	39.1
	Existing Development – Future Climate	5.1	8.4	15.1	23.1	40.4	61.4	93.2
	Future Development – Future Climate	5.1	8.4	15.1	23.1	40.4	61.4	93.2
Pine Lake Outflow	Existing Development – Existing Climate	3.4	10.2	15.0	18.2	22.3	25.4	28.5
	Future Development – Existing Climate	3.5	10.1	14.7	17.8	21.9	24.9	28.1
	Existing Development – Future Climate	3.8	11.4	16.7	20.4	25.3	29.0	32.8
	Future Development – Future Climate	3.3	11.3	16.6	20.2	24.6	27.9	31.1
Pine Lake Inflow	Existing Development – Existing Climate	17.8	32.8	47.3	59.4	77.9	94.4	113.3
	Future Development – Existing Climate	17.5	31.6	45.3	56.6	73.8	88.9	106.4
	Existing Development – Future Climate	20.5	33.5	53.7	74.7	113.8	155.3	210.9
	Future Development – Future Climate	20.0	32.3	51.2	70.7	106.6	144.5	194.9

1. Log-Pearson III using the Bulletin 17B method is used to compute flood magnitudes.

Table 5.2 Changes in flood magnitudes from existing development-existing climate scenario

Location	Return period (year)[1]	1.01	2	5	10	25	50	100
	Scenario	Difference from Existing Development – Existing Climate (%)						
Pine Lake Creek Mouth	Future Development – Existing Climate	0	-3	-3	-4	-4	-4	-4
	Existing Development – Future Climate	+20	+6	+19	+33	+54	+73	+95
	Future Development – Future Climate	+18	+4	+15	+27	+47	+64	+84
Pine Lake Creek at Confluence	Future Development – Existing Climate	0	-4	-5	-5	-6	-6	-6
	Existing Development – Future Climate	+16	+8	+20	+31	+48	+64	+80
	Future Development – Future Climate	+13	+4	+14	+24	+38	+51	+66
Kanim Creek Mouth	Future Development – Existing Climate	0	0	0	0	0	0	0
	Existing Development – Future Climate	+24	+5	+20	+38	+69	+100	+138
	Future Development – Future Climate	+24	+5	+20	+38	+69	+100	+138
Pine Lake Outflow	Future Development – Existing Climate	+3	-1	-2	-2	-2	-2	-1
	Existing Development – Future Climate	+12	+12	+11	+12	+13	+14	+15
	Future Development – Future Climate	-3	+11	+11	+11	+10	+10	+9
Pine Lake Inflow	Future Development – Existing Climate	-2	-4	-4	-5	-5	-6	-6
	Existing Development – Future Climate	+15	+2	+14	+26	+46	+65	+86
	Future Development – Future Climate	+12	-2	+8	+19	+37	+53	+72

The flow duration analysis shown in Figure 5.2 shows that future development scenario curves track very closely with existing conditions. The existing condition curve starts to deviate from the future development scenario generally at exceedance durations less than 0.001%, i.e., very high flows. However, these deviations are still relatively small. As discussed earlier, for Kanim Creek there is no difference between the existing and future development scenarios. The plots show duration curves for future climate scenarios diverging from the existing climate curves only at flows occurring less than 1% of the time, suggesting that high flows will be more significantly affected by projected precipitation changes[6].

[6] The future climate scenario accounts only for projected precipitation changes. Increases in temperature, not accounted for in the modeling, may affect evaporation and transpiration rates related to summer baseflows.

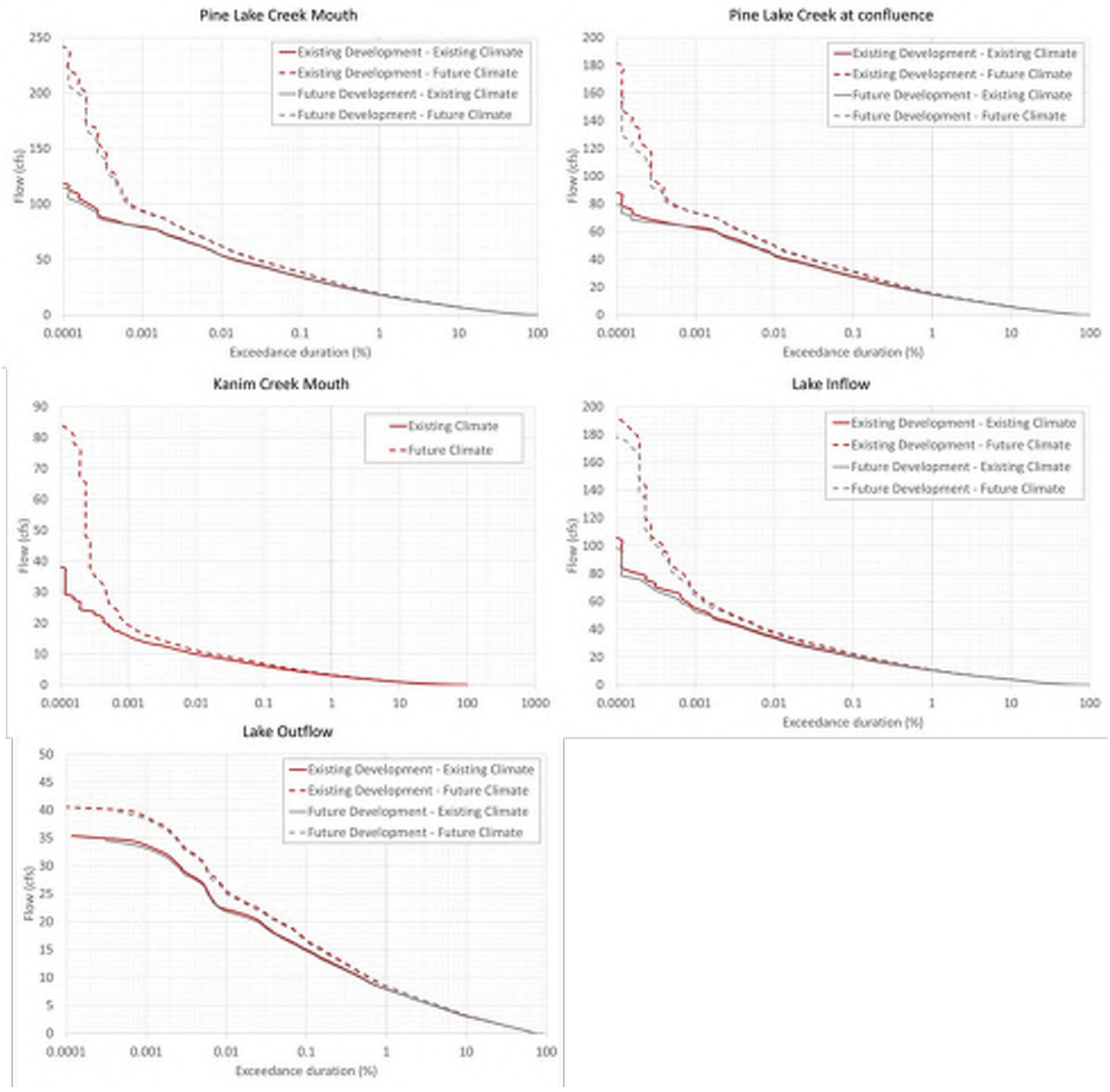


Figure 5.2 Flow duration curves. Note that no future development is expected in Kanim Creek so only existing development curves are shown.

Figure 5.3 shows the stage duration curves for lake levels for different scenarios. It should be noted that the lake levels are not tied to a regional datum, so the figure compares depth above the lake weir crest. The existing and future development scenarios are very similar, with existing levels slightly above the future development conditions. Similarly, the model indicates that lake levels under projected future climate would increase by about one tenth of a foot at most.

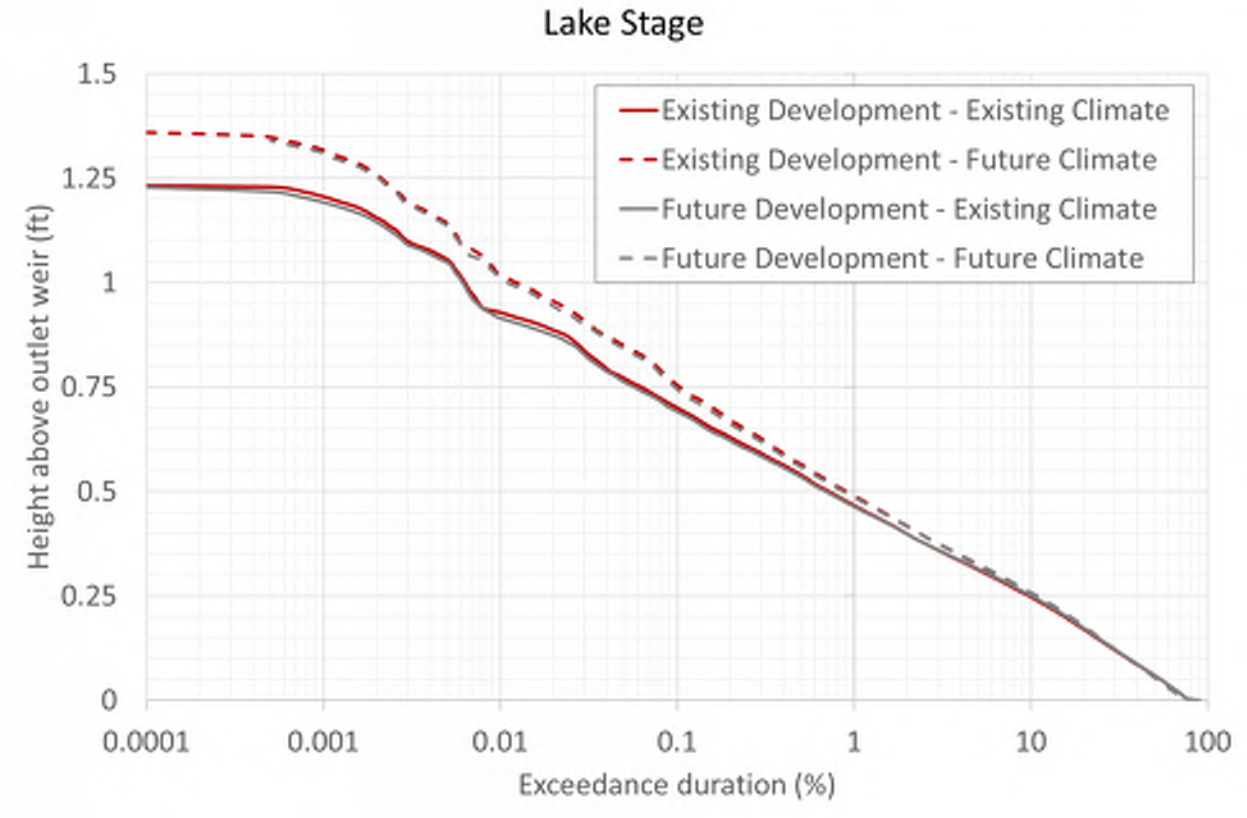


Figure 5.3 Pine Lake stage durations for different scenarios

6 SUMMARY AND CONCLUSIONS

NHC developed an HSPF model to compare how the Pine Lake Creek basin would respond to existing and future development, considering both current and future climate scenarios. The model shows that future development, under current stormwater standards, does not increase peak flow magnitudes or durations. The flow at the confluence of Pine Lake Creek with Kanim Creek and the inflow to the lake are anticipated to experience relatively higher changes as the associated areas are subject to more significant future development. In general, the impact due to future development is considered limited.

Projected future climate noticeably increases the duration of high flows and the flood magnitudes, especially at higher return intervals. The mouth of Kanim Creek and lake outlet are expected to be the most and least impacted areas due to future climate, respectively. The lake levels are not expected to fluctuate noticeably due to future development; however, future increases in storm precipitation may cause a limited increase of lake levels.

The HSPF model developed in this project adequately represents hydrologic processes in the basin and is expected to perform well for comparison purposes. Full calibration was beyond the scope of this study, however, and additional refinement is needed if consistently accurate flow values are important.

7 REFERENCES

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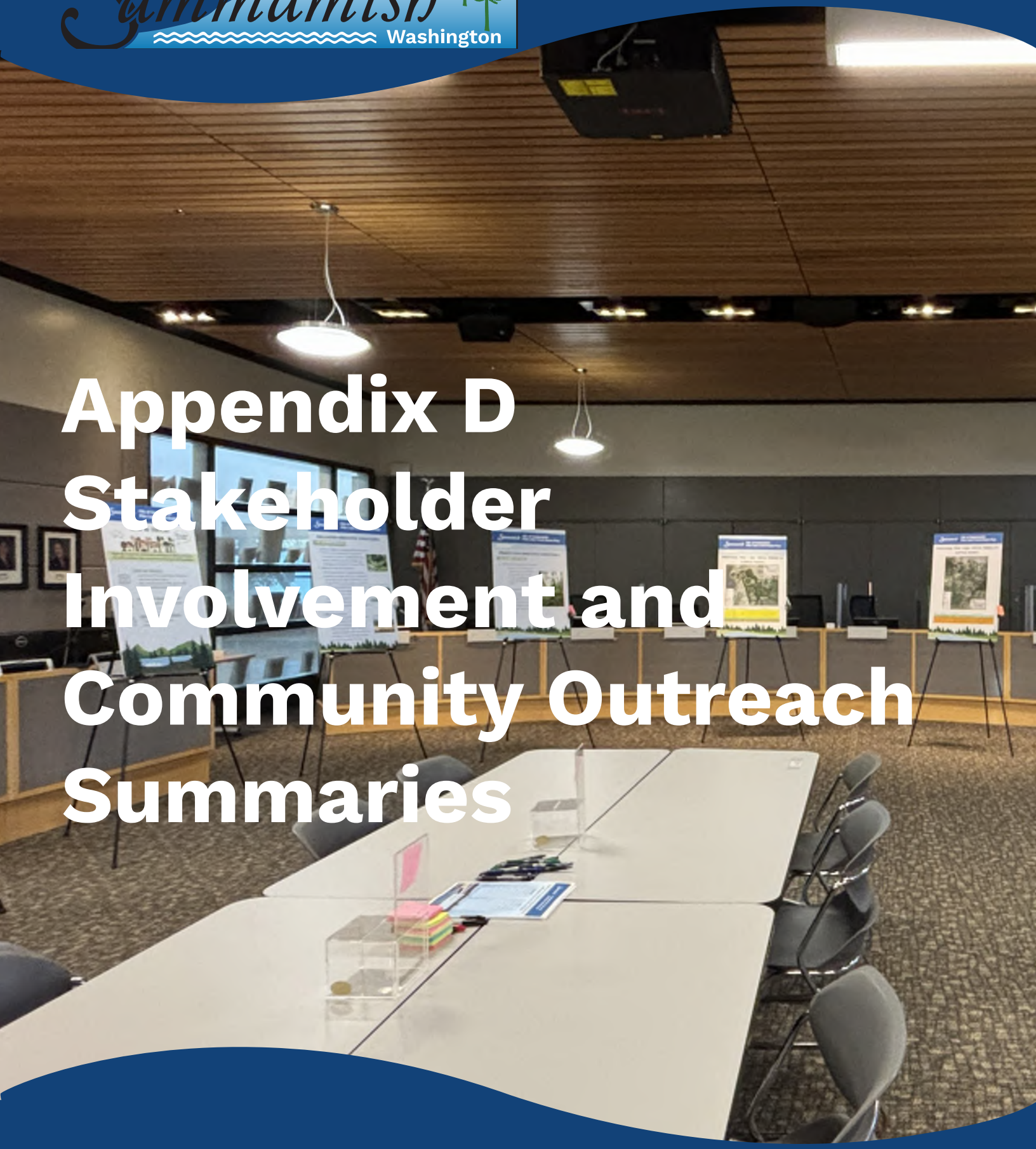
City of Sammamish Washington



Appendix D Stakeholder Involvement and Community Outreach Summaries

Stakeholder Involvement Summaries

Sammamish Pine Lake Creek Basin Plan
Stakeholder Discussions #1 Summary

August 2, 2023

Table of Contents

INTRODUCTION

The City of Sammamish is developing a basin plan for the Pine Lake Creek watershed, including Pine Lake. The Pine Lake Creek Basin Plan (Basin Plan) will characterize flooding, erosion, water quality, and ecological problems in the basin. Both future development and climate resiliency will be considered in prioritizing and designing projects and solutions.

Pine Lake Creek drains approximately 1,200 acres near the south end of the Sammamish Plateau. The basin has some of the highest resource values in the City of Sammamish (Sammamish Retrofit Strategy, 2021). It contains Pine Lake, Pine Lake and Kanim creeks, and a sphagnum bog complex along with several smaller wetlands. Development (mostly residential) has increased over the past decade, especially around Pine Lake, but lower Pine Lake Creek flows through some of the largest remaining areas of contiguous forest within the city. Pine Lake Creek historically supported a substantial kokanee run and is still considered one of four primary spawning streams by the Kokanee Work Group, despite reduced spawning populations in recent years.

The city is conducting a public involvement process to inform and engage the community in the development of the Basin Plan. As a part of that process, the city held discussions with stakeholders to better understand their priorities, and to help the city identify both issues and problems as well as potential solutions for the long-term health of the basin.

PURPOSE

On July 10, 2023, the city held two stakeholder discussions from 5:30 to 7 p.m. and from 7 to 8:30 p.m. with two different topic groups.

Basin/stream group: focus on broader basin/stream (including Kanim and Pine Lake Creeks) issues and problems and help identify potential solutions/projects to address issues and problems.

Lake Group: Focus on lake-related issues and problems and help identify potential solutions/projects to address issues and problems.

The purpose of the stakeholder discussions was to:

- Promote deeper understanding and importance of the Basin Plan.
- Provide stakeholders an opportunity to learn about the Basin Plan and to provide input.
- Maintain ongoing communications and transparency with interested stakeholders.

This summary describes the nature of the two stakeholder discussions, how they were held, and the feedback received from the stakeholders. The primary purpose of these discussions was to engage stakeholders in the identification of issues or challenges within the basin. A future round of discussions will focus on identifying solutions to the identified issues and challenges.

STAKEHOLDER IDENTIFICATION

The city and the consultant team identified potential stakeholders by brainstorming specific interests or points of view that may be interested in the plan. This resulted in a list that includes homeowners, property owners, environmental interests, non-profits, and groups working on similar issues in the area. Once this list was developed, names of individuals who fit into these categories were identified and invited to join one or both of the discussions.

DISCUSSION OVERVIEW & FORMAT

Eighteen people attended the Basin/stream group discussion and 17 people attended the Lake group discussion. A list of participants is provided in Appendix A of this summary. Participants were welcomed at the beginning of each discussion and asked to introduce themselves. Project staff presented a review of the Basin Plan, led a discussion based on a series of questions regarding the experiences, issues, and priorities related to Pien Lake Basin/Stream and Pine Lake, and wrapped up with next steps (See Appendix B for the meeting agenda and Appendix C for the presentation). The stakeholder discussion consisted of the following elements:

- Meeting and Basin Plan/Lake Plan Overview
- Discussion/Questions
- Next Steps

The meetings were held in a hybrid format, virtually via Zoom and in-person at the Sammamish City Hall.

PARTICIPANT FEEDBACK

During the discussion portion of the agenda, participants provided their responses to the discussion guide questions and offered additional feedback on a number of topics.

Below is a summary of what we heard from the two groups.

Basin/Stream group

Participants shared that they connected with the Pine Lake and Kanim Creeks by:

- Walking along the creeks to monitor the number of fish; they've been seeing fewer fish the past few years
- Tracking water quality and access issues

Participants value that the basin/stream corridor is a primary kokanee spawning stream

Participants shared some issues/problems with the stream/basin:

- Changing water flow rates, levels, and temperature
- Less biodiversity (i.e., abundance and type of insects)
- Fewer salmon fry
- Need for good sediment storage and sorting for kokanee habitat

- Chemical runoff into the watershed
- Impervious surfaces management – is there a need to focus on retrofitting older development since newer development should have less of an impact on storm water/runoff water?
- Need to consider all types of development in the basin and its impacts on water health
- Need for a natural hydrograph to support the natural habitats and incubation period of kokanee
- Maintaining access to streams and creeks to monitor and gather data

If they could fix one thing, participants shared they would:

- Have a thoughtful regional detention plan (and centralized ponds) versus lot-by-lot detention and management
- Ensure access to all parts of the stream, especially parts people have not been able to access or see well in the past

Key themes/takeaways:

- Healthy environment for kokanee
    - Water flow, levels, temperature, and physical structures for kokanee spawning
- Development in the basin
    - Management of impervious surfaces
    - Consider all types of development and their impacts in the area
    - Comprehensive plan to consider the larger picture of the basin versus individual, more localized plans
- Monitoring and access
    - Access to the stream to gather data
    - Access to data that can give a more detailed understanding of basin environment. For example, daily rain fall can show landslide risk versus just looking at the aggregate.

Lake group

Participants shared that they use and/or value the lake for:

- Recreation, including swimming
- Flood control
- Environmental benefits
- Cleanliness and water quality of the lake
- Wildlife around the lake

Issues and problems with the lake or surrounding areas include:

- Occasional poor water quality
- Invasive species (both plants and animals)
- Temperature of the water (too high)
- Variable water levels
- Impacts on the shoreline are highly variable, and thus need better lake-wide restoration and management coordination
- Septic systems around the lake
    - Smell

    - Excessive grass and plant growth around septic systems
    - Expense can be prohibitive to switch to city sewage treatment from septic tanks
- Balancing tree cover around the lake and enforcing regulations regarding trees
    - Loss of large woody habitat around the lake because of removal of large trees on the shoreline
- Fewer fish for fishing
- Concern around removing aquatic vegetation at shoreline which leads to fish habitat loss
    - Not meeting hydraulic project requirements
- Stormwater systems
    - Development of multi-family complexes will require greater stormwater management
    - Upstream stormwater systems may contribute to lowering water quality
    - Maintenance of stormwater ponds
- The weir mostly functions, but needs some repairs due to leaks
    - One participant commented that lake water levels have not fluctuated too much over the past 30 years

Participants shared they felt the top issues and problems were:

- Untreated city stormwater flows into the lake
- Septic systems around the lake
- Invasive species (iris, Nymphaea, and crayfish)
- Sediment/muck
- Algal blooms

Participants would like to improve:

- Education: on how to be a responsible lakefront property owner, covering topics such as how to effectively remove invasive species and how to maintain/improve water quality; what are the activities that decrease water quality (for example, dumping hot tub water, fertilizer use, etc.)
- Need accountability of people who live by the lake
- Enforcement of homeowners who do not follow codes and policies
- Integrative invasive species management now before it becomes a bigger problem

Participants would like to fix:

- Use and management of large water floaties on the lake
- Sediment and muck, particularly at the southern end of the lake
- More multifaceted education, particularly for newer people in the area, on healthy living at the lake

Key themes/takeaways:

- Improving and maintaining health lake conditions for all users and species that live there
    - Invasive species
    - Sediment and muck
    - Responsible living on the lake
    - Balancing urbanization and lake health

Appendix A: Attendees

Basin-Creek Group:

Name	Organization
Mary Wictor	Active in Sammamish
Ilyas Mohammed	Resident
Veronica Mohammed	Resident
Julian Olden	University of Washington, Fisheries
Alison Agness	King County, Kokanee Work Group
Jim Bower	King County, Kokanee Work Group
Gregg Johnson	Lake Resident
Paul Stickney	Active in Sammamish
Bill Way	Active in Sammamish
Sid Gupta	Friends of Lake Sammamish
Mary Cline	Resident/Blueberry Farm
Morishimo	Resident
Gene Beall	Resident
Peter Breining	resident
Doug Henderson	Resident
Becca Roberts	NHC engineer
Susan Robinson	Resident
DM	Resident

Lake Group:

Name	Organization
Ilyas Mohammed	Resident
Veronica Mohammed	Resident
Julian Olden	UW, Fisheries
Alison Agness	King County, Kokanee Work Group
Jim Bower	King County, Kokanee Work Group
Gregg Johnson	Lake Resident
Sid Gupta	Friends of Lake Sammamish
Morishimo	Resident
Jason Tamulonis	Resident
Dwayne Lamb	Resident
Peter Breining	resident
Doug Henderson	Resident
Gene Beall	Resident
Susan Robinson	Resident
Lloyd Warren	Resident, President of the board of Sammamish Plateau Water
DM	Resident

Appendix B: Stakeholder Discussion Agenda

Sammamish Pine Lake Creek Basin Plan
Lake Stakeholder Group Discussion
Monday, July 10 - 7 to 8:30 p.m.
Agenda

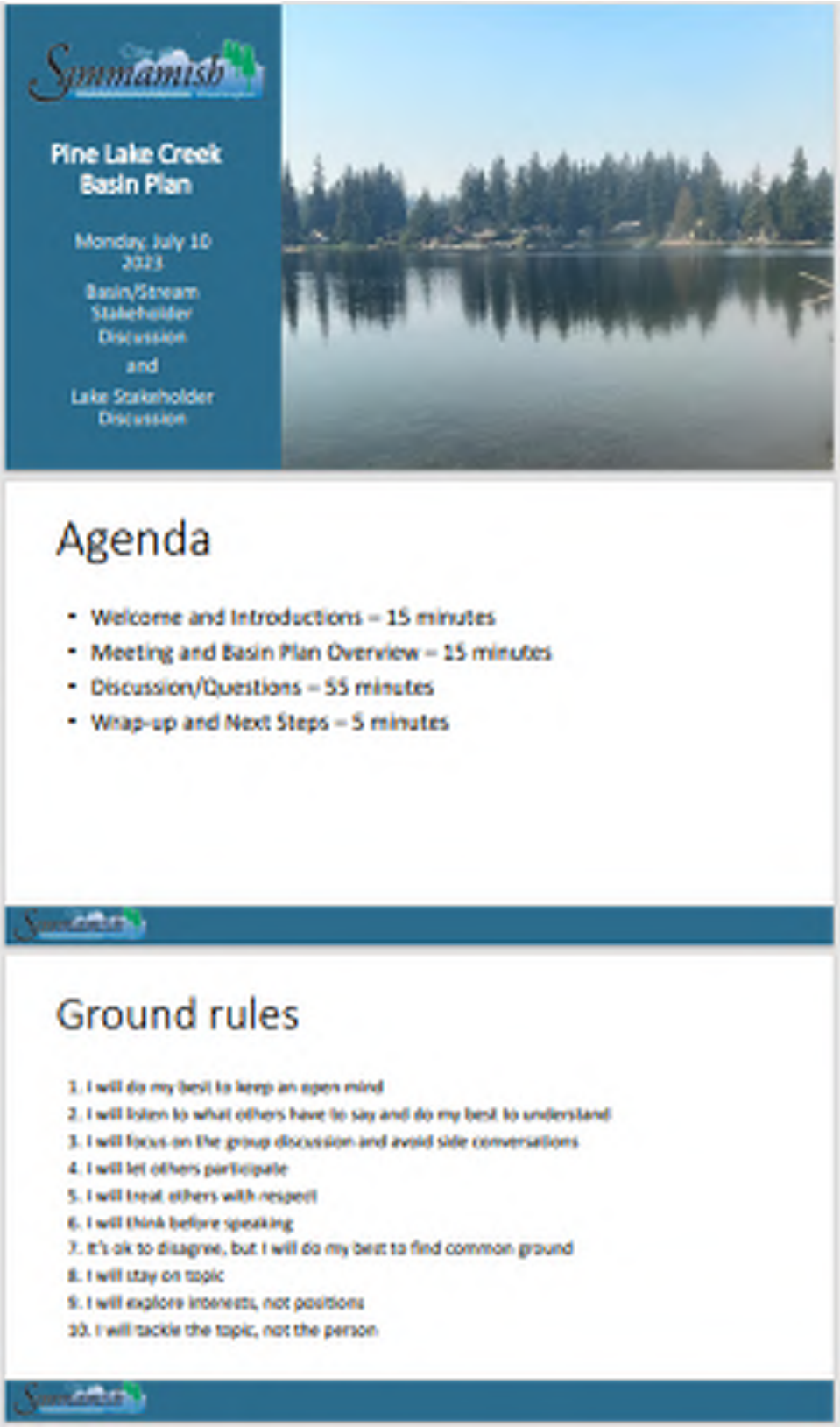
PRESENTERS:	Toby Coenen, Patty Dillon
FACILITATOR:	Chris Hoffman

TIME	TOPIC	PRESENTER
7:00 – 7:15 p.m.	**1. Welcome & Introductions**	Toby/Chris
	1.1. Welcome from the City 1.2. Team and participant introductions	
7:15 – 7:30 p.m.	**2. Meeting and Basin Plan Overview**	Chris/Patty
	2.1. Topic guide review 2.2. Ground rules 2.3. Basin Plan 2.4. Questions	
7:30 – 8:25 p.m.	**3. Discussion/Questions**	Chris
	3.1. Topic Guide	
7:25 – 8:30 p.m.	**4. Wrap-up & Next Steps**	Toby/Chris

Topic Guide

1. How do you/your group (organization, club, etc.) currently use/experience Pine Lake?
2. What do you value about the lake?
3. What is your perception of the health of the lake?
4. What is your perception of if and how the lake is managed?
5. What do you see as the city's role in managing the lake?
6. What issues/problems do you see with the lake or surrounding areas?
7. What are the top issues/problems?
8. What would you like to see improved?
9. Are there opportunities for collaboration to address issues/problems?
10. If you could fix one thing, what would it be and how would you fix it?
11. Is there anything else you'd like to share?

Appendix C: Presentation



Background

- Pine Lake Creek drains approximately 1,200 acres near the south end of the Sammamish Plateau.
- The Pine Lake Creek Basin has some of the highest resource value in the City of Sammamish. The basin includes Pine Lake, Kanim and Pine Lake creeks, and a sphagnum bog complex and several smaller wetlands.
- The basin contains some of largest remaining areas of contiguous forest within the city and Pine Lake Creek historically supported a substantial kokanee run and is still considered one of four primary spawning streams within the city.

Why is the city developing a plan?

- Pursue resource protection to ensure long-term health of the lake and basin consistent with the Stormwater Comprehensive Plan.
- Ongoing development within the basin has affected historical kokanee runs, and the basin has experienced reduced water quality, flooding, and erosion.
- Despite this, Pine Lake Creek, is one of the area's four primary kokanee spawning streams and contains some of the largest remaining areas of contiguous forests within Sammamish.

What's included in the plan?

- The City of Sammamish is developing a basin plan for the Pine Lake Creek watershed, including Pine Lake, Kanim Creek, and Pine Lake Creek.
- The Pine Lake Creek Basin Plan (Basin Plan) will characterize existing conditions in the basin and develop priority strategies, projects, and actions to address flooding, erosion, water quality, and ecological problems in the basin and that reflect the community's priorities.
- Both future development and climate resiliency will be considered in prioritizing and designing projects and solutions.

Current Management

- Very limited basin-specific management framework in place to guide development or other activities within the Pine Lake Creek basin.
- City-wide management framework through NPDES permit and King County Surface Water Design Manual and City amendments and codes.
  - Phosphorous Removal Standard
- Lake level
  - Weir built 1982
  - Owned by WDFW
- Lake Association

Basin Contributing Area

Lake Problem Areas


Lake Problem Areas


Lake & Stream Problem Areas


Stream Problem Areas


Stream Problem Areas


Stream Problem Areas


Schedule
March - December 2023
Basin Assessment & Data Collection
April - July 2023
Hydrologic Modeling
July 2023
Lake and Basin/Stream Stakeholder Group Session #1
September 2023
Open House #1
September 2023 - February 2024
Identify Projects & Strategies
November 2023
Lake and Basin/Stream Stakeholder Group Session #2
January 2024
Open House #2
March - July 2024
Prepare Basin Report

Staying Involved

- Website: https://www.sammamish.us/government/public-works/stormwater/storm-and-surface-water-projects/ (placeholder)
- StoryMap: Sammamish Pine Lake Creek Basin Plan (arcgis.com)
- Postcards
- Public Meetings
  - September 2023
  - January 2024
- Social media

Next Steps

- Summer 2023: Compile and prioritize problem areas
- September 2023: Hold first public meeting
- Fall 2023 – Early 2024: Identify projects and strategies to address problems
- Spring – Fall 2024: Develop outlines and concepts for priority projects
- Fall 2024: Draft Basin Plan
- Final adoption by end of 2024

Sammamish Pine Lake Creek Basin Plan
Stakeholder Discussions #2 Summary

December 15, 2023

Table of Contents

Introduction

The City of Sammamish is developing a basin plan for the Pine Lake Creek watershed, including Pine Lake. The Pine Lake Creek Basin Plan (Basin Plan) will characterize flooding, erosion, water quality, and ecological problems in the basin. Both future development and climate resiliency will be considered in prioritizing and designing projects and solutions.

Pine Lake Creek drains approximately 1,200 acres near the south end of the Sammamish Plateau. The basin has some of the highest resource values in the City of Sammamish (Sammamish Retrofit Strategy, 2021). It contains Pine Lake, Pine Lake and Kanim creeks, and a sphagnum bog complex along with several smaller wetlands. Development (mostly residential) has increased over the past decade, especially around Pine Lake, but lower Pine Lake Creek flows through some of the largest remaining areas of contiguous forest within the city. Pine Lake Creek historically supported a substantial kokanee run and is still considered one of four primary spawning streams by the Kokanee Work Group, despite reduced spawning populations in recent years.

The City is conducting a public involvement process to inform and engage the community in the development of the Basin Plan. As a part of that process, the city held a second round of discussions with stakeholders to provide an update on the planning process and to engage them on the potential solutions intended to address the issues and challenges identified during the first round of discussions that were held in July 2023. These follow-up discussions were held in December 2023.

Purpose

On December 7, 2023, the City held two stakeholder discussions from 5:30 to 7:00 p.m. and from 7:00 to 8:30 p.m. with two different topic groups.

Basin/stream group: Focus on broader basin/stream (including Kanim and Pine Lake creeks) issues and problems and potential solutions/projects to address issues and problems.

Lake Group: Focus on lake-related issues and problems and potential solutions/projects to address issues and problems.

The purpose of the stakeholder discussions was to:

- Promote deeper understanding and importance of the Basin Plan.
- Provide stakeholders an opportunity to learn about the Basin Plan and to provide input.
- Maintain ongoing communications and transparency with interested stakeholders.

This summary describes the nature of the two stakeholder discussions, how they were held, and the feedback received from the stakeholders. The primary purpose of these discussions was to engage stakeholders in the identification of potential solutions to the challenges previously identified.

Stakeholder Identification

The City and the consultant team identified potential stakeholders by brainstorming specific interests or points of view that may be interested in the plan. This resulted in a list that includes homeowners, property owners, environmental interests, non-profits, and groups working on similar issues in the area. Once this list was developed, names of individuals who fit into these categories were identified and invited to join one or both of the discussions.

Discussion Overview & Format

Eight people attended the Basin/stream group discussion and eight people attended the Lake group discussion. A list of participants is provided in Appendix A of this summary. Participants were welcomed at the beginning of each discussion and asked to introduce themselves. Project staff presented an overview of the Basin Plan, a review of potential solutions, led a discussion to get input from participants on the proposed solutions related to Pine Lake Basin/Stream and Pine Lake, and wrapped up with next steps (See Appendix B for the meeting agenda and Appendix C for the presentation). The stakeholder discussions consisted of the following elements:

- Meeting and Basin Plan/Lake Plan Overview
- Sharing sources of data gathering and information and what the project team has learned through their research and field observations
- Potential solutions
- Discussion/Questions
- Next Steps

The meetings were held in a hybrid format, virtually via Zoom and in-person at the Sammamish City Hall.

Participant Feedback

During the discussion portion of the agenda, participants provided their responses to the discussion guide questions and offered additional feedback on a number of topics.

Below is a summary of what we heard from the two groups.

Basin/Stream group

Participants shared several thoughts and questions related to the basin and potential solutions the project team are considering.

- Consider Native Growth Protection Areas (NGPA) easements to preserve improvements, especially for restoration or outfall projects.
- Pine Lake Creek is home to multiple species: Kokanee (which are not present during the summer), Coho, juvenile Chinook (resting habitat). Managing high flow events is important as slow flowing water is good for fish and we want to consider ways to retain more water for fish.
    - The project team's modeling effort will look at future precipitation levels and that will help provide insights on flow rates and timing throughout the year during different seasons.

- There are existing groundwater connections in the lower stream reaches – cold spring fed pools provide refuge even when streams dry up during the summer, which is a natural event.
- Stream restoration needs to include reseeding gravels and bed sediment in areas that have been impacted by high water flows.
- A participant asked questions about impacts of the Pine Lake inflow diversion on water flows and water quality in the stream and lake, and whether the diversion is the right thing for the system. Future study of water flow and water quality impacts and trade-offs could be one of the recommendations of the basin plan.
    - Related to the diversion project to reduce mid-winter algae blooms, one participant pointed out that it was well documented and could be used as a resource (the participant, P. Breining, said he could share this report).
- Participants said the basin plan should consider land use planning opportunities, with a need to balance Urban Growth Area development requirements with stream and environmental needs.
    - Options could include a property acquisition fund or development rights transfer program.
- The Sammamish Plateau Water Wastewater Comprehensive Plan includes septic system maps which could help identify areas around the lake and in the watershed that are still on septic. This could help highlight opportunities to put in sewer connections in specific areas.
- A participant shared that the Shore Lane fish passage culvert project has paused due to a property owner along the creek.
- One participant who is a member of Friends of Pine Lake Creek shared that there are some stables in the area where there could be education to the people there about not putting piles of manure next to water sources.
- A participant asked how the project team weighted the screening criteria to determine whether a subbasin had low or high opportunity or need. The project team shared they used a generalized list of screening criteria, with some quantifiable elements. The screening was an initial cut and it is currently more heavily weighted toward the level of stormwater treatment, but the team could refine with more consideration of relative weighting.
- One participant asked how the project team is prioritizing the potential solutions they shared given that resources are limited.
    - The City has it's own process of prioritizing projects and evaluates them based on quantitative and qualitative factors, how many people are impacted, the significance of the problem, etc. The project team is considering costs of projects to implement as many as possible.
    - For capital projects, the project team can identify locations for those and what facilities would be the best solutions.
    - The project team is intentionally not rating solutions right now in the process but are documenting ideas so they are not lost in case opportunities arise to implement them.

- A participant asked about how much redevelopment is potentially there since it doesn't seem like there is as much today as there was five years ago. The project team noted they are tracking this and considering impervious surfaces[1] as part of the plan.

Key themes/takeaways:

- The Basin Plan should consider solutions for multiple fish species that depend on Pine Lake Creek, not just Kokanee.
- Solutions should also consider land use planning and how to balance continual growth and development (in line with the Growth Management Act) with protecting the environment.
- The project team is continuing to gather data and refine potential solutions to consider, including how they are weighting screening criteria to determine where to target solutions.

Lake group

Participants shared several thoughts and questions related to the lake and potential solutions the project team are considering.

- One participant shared that according to the Growth Management Act (GMA), Sammamish is supposed to increase affordable housing, which is difficult in this area. There will be pressure to achieve higher density in the city and this conflicts with a lot of these project goals; stormwater management is costly. It seems like there are many competing goals (land use, population growth, affordable housing, environmental goals and protection) that this plan must take into consideration. The project team shared:
    - These are challenges faced by many other jurisdictions.
    - GMA assumes growth pays for growth and there is that tension and what reality looks like.
    - The Comprehensive Plan is wrestling with balancing growth, density, utilities, etc.
    - The City has a rate study and has one of the highest stormwater utility rates in King County that come from these impacts.
    - It's not clear what takes priority with these competing goals, environmental issues or meeting growth management goals?
- The largest land owner on the lake is the City's Parks department and they need to be engaged in this basin plan (Toby from the project team recognizes they are an important stakeholder and they were not able to attend this meeting).
    - The City has asked homeowners to be responsible for some maintenance of the lake (i.e., removing invasive plants on their property).
- A lake management district (LMD) would be a helpful tool to align and share interests between the Parks department and homeowners along the water.
    - An LMD would have to be created by the County and funded by residents while the City provides staffing support. Lake associations are another option but lack taxing power and do not seem as sustainable.

[1] The project team noted that impervious area is expected to increase by about 3-4% of the basin area for buildout conditions.

    - In order for an LMD to be successful, it must have clearly defined priorities and responsibilities upon creation.
    - Some of the participants have engaged with residents and members of Beaver Lake Management District and heard anecdotally that many members are not enthusiastic about the LMD.
    - Another participant suggested it would be helpful to know what has been accomplished by the Beaver Lake Management District to get a holistic picture of whether it's been an effective strategy or not.
    - Toby from the project team can share more information about what can and cannot be accomplished through an LMD framework.
- A participant shared their concern around the northeast corner inlet of the lake and the stormwater facility there. The project team shared they are aware of the historic and ongoing maintenance issues there and that it is a project on the Capital Improvement Project list to retrofit this stormwater facility. The City has been struggling with staffing shortfalls and has not been able to address it yet.
- One participant asked about septic conversion incentive programs and whether they would be "carrots," "sticks," or both. The project team responded they did not have an answer to this. Another participant pointed out that the City would need to consider whether they had statutory authority to require residents to switch to sewer and that converting to sewer is very costly.
- During a conversation about septic maintenance, especially for people who live on the lake, a participant shared that there are ways to enforce that septic systems are working properly (i.e., Orcas Island requires annual checks and documentation through the county).
- One participant asked whether the outreach and education actions could move forward without worrying about the larger, more complicated, expensive projects. The project team responded that they would need more staff support and that it is often times easier to get momentum around a program. They also acknowledged that there are some existing resources to support increasing education, especially around what homeowners can do on their property.
- Another participant shared an idea to have a website to educate people around Pine Lake. With code updates coming in 2024, this is a good time to get input from the public on their ideas and feedback.
- One participant recommended pulling in more information about bogs into the basin plan.

Key themes/takeaways:

- It will be challenging to balance significant growth management and development with a need to protect the environment with limited resources.
- The Basin Plan will need the collective efforts of all stakeholders and collaboration between City departments to be successful.
- It is uncertain whether a lake management district framework is a good fit for Pine Lake.
- The Basin Plan will need to consider the impacts of septic systems and costs of connecting to sewer for homeowners.
- Some ideas are to move forward with education programs for people who use the lake as more complicated, expensive projects are considered by the City.

Appendices

Appendix A: Attendees

Basin/Stream Group:

Name	Organization
Mary Wictor	Active in Sammamish
David Kyle (and daughter)	Trout Unlimited
Gregg Johnson	Lake Resident
Bill Way	Resident
Gene Beall	Resident
Peter Breining	Resident
Doug Henderson	Resident
Paul Stickney	Resident

Lake Group:

Name	Organization
Mary Wictor	Active in Sammamish
Gregg Johnson	Resident
Peter Breining	Resident
Doug Henderson	Resident
Susan Robinson	Resident
Lloyd Warren	Resident, President of the board of Sammamish Plateau Water
DM	Resident
Phone caller (206…)	Unknown

Appendix B: Stakeholder Discussion Agenda

Sammamish Pine Lake Creek Basin Plan
Basin/Stream Stakeholder Group Discussion
Thursday, December 7 - 5:30 to 7 p.m.
Agenda

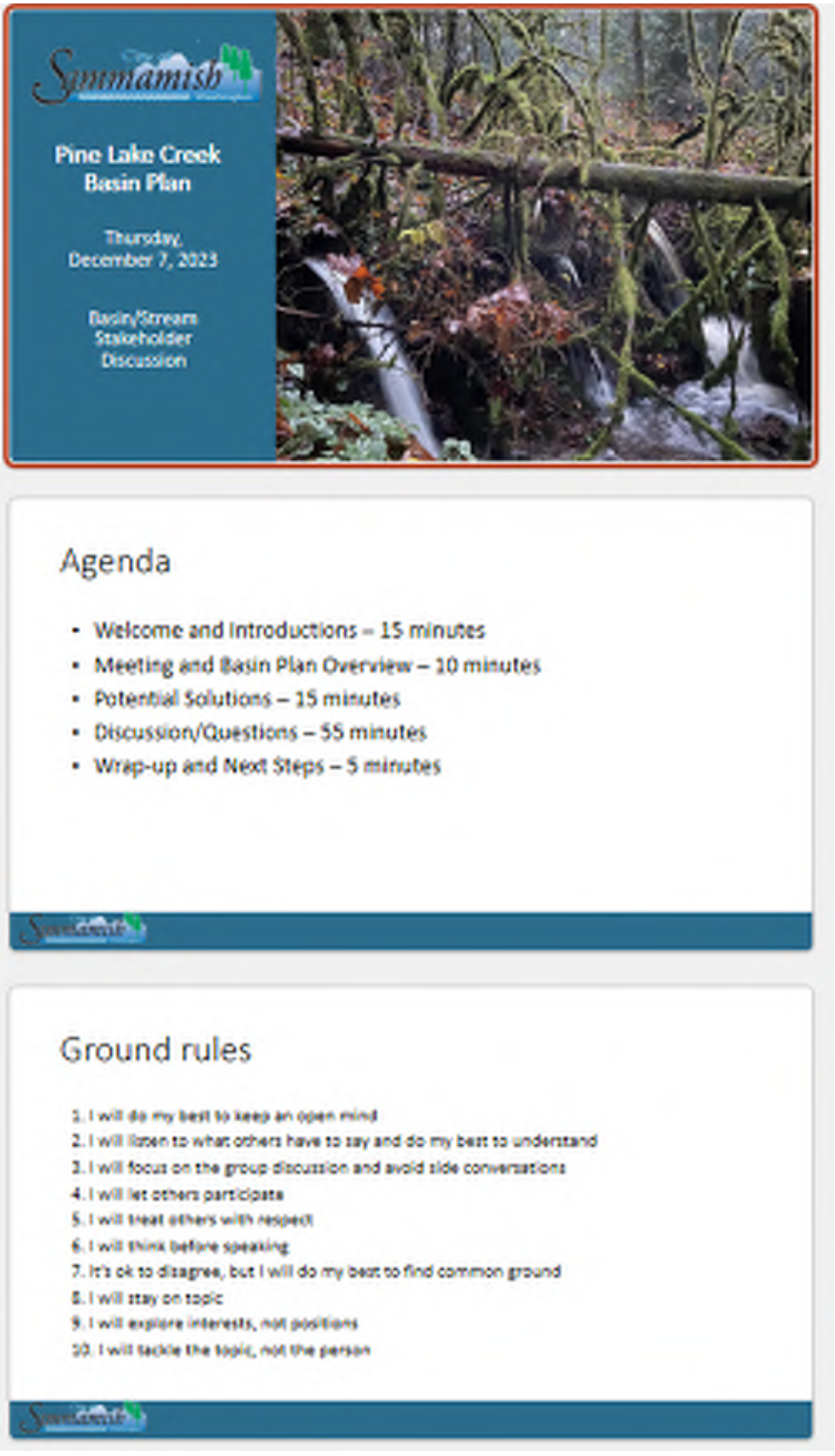
PRESENTERS:	Toby Coenen, Patty Dillon, Rebecca Roberts
FACILITATOR:	Chris Hoffman

TIME	TOPIC	PRESENTER
5:30 – 5:45 p.m.	**1. Welcome & Introductions**	Toby/Chris
	1.1. Welcome from the City 1.2. Team and participant introductions 1.3. Topic guide review 1.4. Ground rules	
5:45 – 5:55 p.m.	**2. Basin Plan Overview**	Patty
5:55 – 6:10 p.m.	**3. Potential Solutions**	Patty/Rebecca
6:10 – 6:55 p.m.	**4. Discussion/Questions**	Chris
	4.1. Topic Guide	
6:55 – 7 p.m.	**5. Wrap-up & Next Steps**	Toby

Topic Guide

1. Did we miss any issues?
2. Do the potential solutions address the issues
3. Are there other potential solutions we should consider?
4. What would you like to see improved?
5. What solutions would you prioritize?
6. Is there anything else you'd like to share?

Appendix C: Presentation



Basin Overview

Background

- Pine Lake Creek drains approximately 1,200 acres near the south end of the Sammamish Plateau.
- The Pine Lake Creek Basin has some of the highest resource value in the City of Sammamish. The basin includes Pine Lake, Kanim and Pine Lake creeks, and a sphagnum bog complex and several smaller wetlands.
- The basin contains some of largest remaining areas of contiguous forest within the city and Pine Lake Creek historically supported a substantial kokanee run and is still considered one of four primary spawning streams within the city.

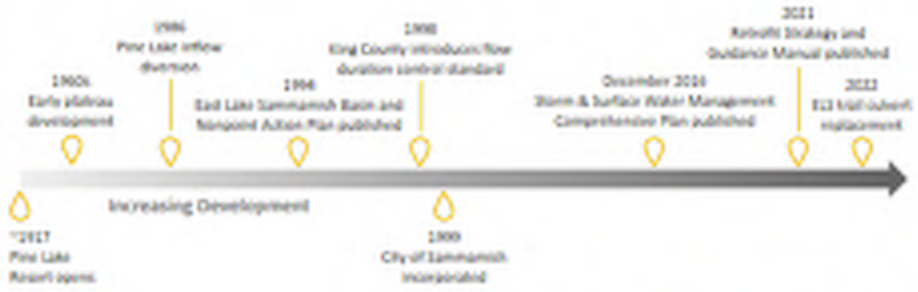
Why is the city developing a plan?

- Pursue resource protection to ensure long-term health of the lake and basin consistent with the Stormwater Comprehensive Plan.
- Ongoing development within the basin has affected historical kokanee runs, and the basin has experienced reduced water quality, flooding, and erosion.
- Despite this, Pine Lake Creek, is one of the area's four primary kokanee spawning streams and contains some of the largest remaining areas of contiguous forests within Sammamish.

Sources of Data Gathering and Information

- Review of previous plans, documentation
- Stream walks and field observations
- Interviews with City staff
- Input from Stakeholder Meetings (July 2023)
- Input from Open House (September 2023)
- Desktop modeling and analysis

Pine Lake Basin Stormwater Timeline



What's Working

- Stream corridors are largely forested
- Large wetlands attenuate flow
- Stormwater outfalls are generally in good condition

Issues we heard

- Stream concerns
  - Pollutants/water quality
  - Flow
  - Biodiversity/salmon
  - Recreational and stream monitoring access
- Lake concerns
  - Water quality/lake health
  - Invasive species/aquatic vegetation management
  - Variable water levels
  - Rowing shoreline
  - Septic systems
  - Need for education
- Development concerns
  - Stormwater management and cost of facilities
  - Impervious surfaces

Pine Lake Creek Basin Plan

Issues we observed

- Stream concerns
  - Landslides and sedimentation in Karrom Creek
  - Degraded stream channel (Pine Lake Creek) upstream of East Lake Sammamish Parkway that could potentially be Kokanee habitat
  - Fish passage barriers requiring replacement
- Basin concerns
  - Lack of modern stormwater facilities in upland locations draining to Karrom Creek that could contribute to greater landslide activity

Pine Lake Creek Basin Plan

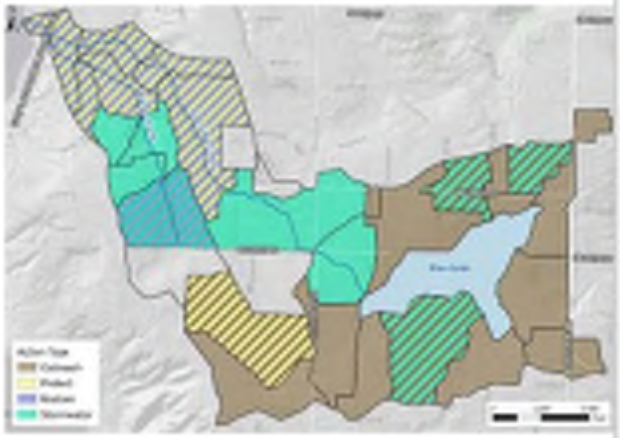
Potential Solutions

Desktop Screening

- GIS utilized to determine areas with the most opportunity and/or need
- Screening criteria
  - Stream presence
  - Wetland presence
  - Outfall locations
  - Fish barrier locations
  - Land use composition
  - Level of stormwater treatment

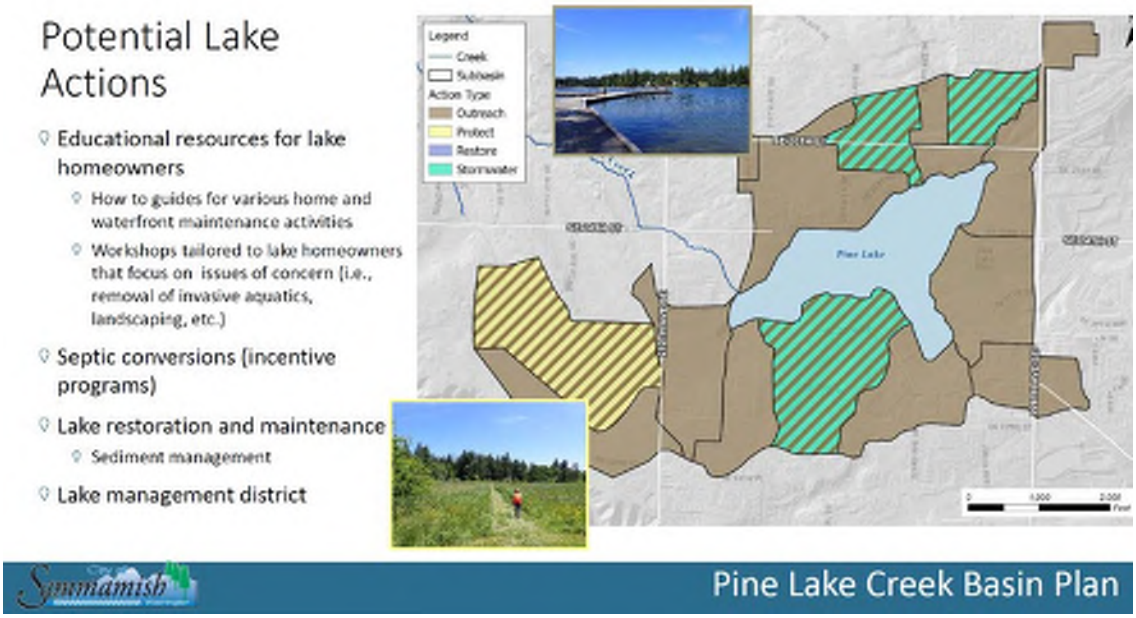
Types of Solutions

- Potential categories of projects and programs
  - Education and Outreach
  - Protection and Preservation
  - Stream Restoration
  - Stormwater Retrofits



Potential Stream Actions

- Kokanee spawning and habitat
  - Culvert upgrade (similar to trail culvert replacement near ECP)
  - Stream restoration in vicinity of East Lake Sammamish Parkway
  - Protection of upstream forested stream corridor and wetland (policies or code)
  - Stormwater management/retrofit for water quality
- Stormwater retrofits



*Note: For the Lake discussion, potential solutions were focused around the lake

Discussion/Questions

- What's your overall reaction to the potential solutions presented?
- Are there other types of actions you think should be considered?
- Other input?

Next Steps

- Early 2024: Develop outlines and concepts for specific projects and programs
- Spring 2024: Prioritize projects for Basin Plan
- Summer – Fall 2024: Draft Basin Plan
- Final adoption by end of 2024

Schedule

March - December 2023

✓ Basin Assessment & Data Collection

April - July 2023

✓ Hydrologic Modeling

July 2023

✓ Lake and Basin/Stream Stakeholder Group Session #1

September 2023

✓ Open House #1

September 2023 - February 2024

✓ Identify Projects & Strategies

December 2023

✓ Lake and Basin/Stream Stakeholder Group Session #2

Spring 2024

Open House #2

March - July 2024

Prepare Basin Report

Staying Involved

- Website: Pine Lake Creek Basin Plan | City of Sammamish
- Postcards
- Public Meetings
  - Spring 2024
- Social media

Thank you!

Open House Summaries

Pine Lake Creek Basin Plan
In-Person Open House Summary

DRAFT

October 9, 2023

Sammamish Pine Lake Creek Basin Plan Open House

DRAFT Meeting Summary

INTRODUCTION

The City of Sammamish is in the process of creating a comprehensive plan for the Pine Lake Creek watershed, which includes Pine Lake. This plan, known as the Pine Lake Creek Basin Plan (Basin Plan), aims to assess and address issues related to flooding, erosion, water quality, and ecological health within the basin. In shaping and selecting projects and solutions, the city will take into account considerations for future development and climate resilience.

The Pine Lake Creek watershed encompasses approximately 1,200 acres, primarily located at the southern end of the Sammamish Plateau. This area is notable for its significant environmental resources and values, as highlighted in the Sammamish Retrofit Strategy of 2021. It includes Pine Lake, Pine Lake and Kanim creeks, as well as a sphagnum bog complex and several smaller wetlands. Over the past decade, residential development in the vicinity, especially around Pine Lake, has been on the rise. However, lower Pine Lake Creek continues to flow through some of the largest remaining tracts of contiguous forest within the city. Historically, Pine Lake Creek has supported a thriving kokanee salmon run and remains one of the four primary spawning streams recognized by the Kokanee Work Group, despite recent declines in spawning populations.

To engage and inform the community in the development of the Basin Plan, the city is actively involving the public. This process includes meaningful discussions with stakeholders to gain a better understanding of their priorities. These discussions serve to identify both existing issues and challenges, as well as potential solutions that will contribute to the long-term health and sustainability of the basin.

PURPOSE

On September 26, 2023, the city held an in-person open house from 5:30 -7 p.m. in the Sammamish City Hall City Council Chambers. The primary objectives of the open house were to inform the residents about the project and to invite the community to actively participate in the identification of issues and prioritization of potential needs.

Sammamish Pine Lake Creek Basin Plan in-person open house on September 26, 2023.

NOTIFICATION

The project team used a variety of methods to promote the September 26 in-person Open House. These included:

- Sending a postcard to approximately 3,000 addresses within the project area
- Social media posts
- Posting event information on the City's website

OPEN HOUSE OVERVIEW & FORMAT

Approximately 40 people attended the Open House. The event featured a welcoming booth and 8 display boards in the City Hall's council chambers. The display boards: shared how the public process helps to shape the community's vision for Sammamish Pine Lake Creek Basin plan; described the current feedback and issues raised from the public up to date; and provided opportunities for participants to provide input on potential projects and improvements. Furthermore, attendees expressed their opinions and suggestions by completing comment forms, using sticky notes, and writing on flip charts, which are detailed in Appendix A of this summary.

Attendees participate in the open house through talking to the project staff, looking at the project display boards, and providing written comments.

PARTICIPANT FEEDBACK

Participants were encouraged to share their feedback through various means, including talking with the project team, providing written comments on project boards and comment forms to identify community needs and prioritize potential projects. Key themes and suggestions voiced by attendees included:

Basin-stream issues & challenges:

- Sediment capture upstream
- Pollution runoff, especially from pavement

A project team member discusses the Pine Lake issues with a group of attendees at the Open House.

Lake issues & challenges:

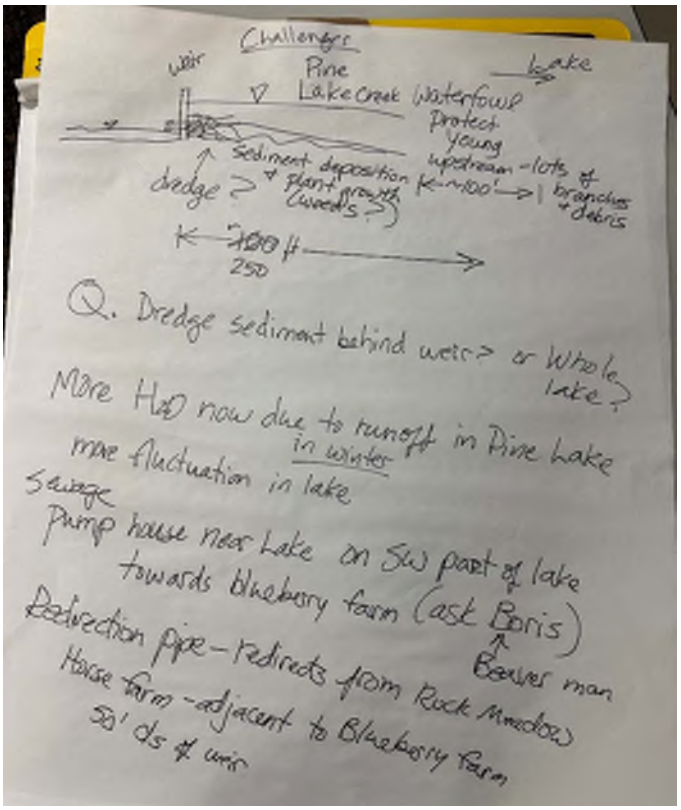
- Need effective water level management
- Overall lake health
- Address weeds issue in Pine Lake
- Combat shoreline decline
- Manage lily pads
- Removal of muck in the south cove
- Geese reduction
- Improve lake water quality
- Water level management of the weir: Pine Creek dries up in summer, affecting access.
- Increase in weed problems during summer
- The use of tarps in the lake as weed barriers
- Evaluate the use of creosote logs
- Discuss the status of sphagnum moss and its potential impact on the lake
- Address the buildup of invasive weeds and debris on the south side of Pine Lake
- Sediment buildup in the lake, which hinders fish spawning
- Address algae blooms in spring
- Identify responsible parties for water quality and code enforcement, particularly for failing septic systems and dock cleaning practices
- Raise questions about the management of the weir, with some residents volunteering for its care
- Discuss the potential transfer of weir management to the city
- Highlight the cost of beaver management ($7,000 per beaver)
- Mention the entombment study concerning four kokanee streams
- Note increased water levels in Pine Lake due to winter runoff, leading to greater lake fluctuations

A project team member points out the project area for an attendee at the Open House.

- Identify the sewage pump house near the lake's southwest section, close to the Blueberry Farm

Questions raised from the participants included:

- Whether dredged sediment accumulates behind the weir or affects the entire lake
- Strategies to reduce phosphorus levels
- The role of fertilizer uses on grass
- The notification processes for dangerous algae blooms and other issues
- The proliferation of pondweed and the changes in the lake environment
- Seek solutions that specifically address muck, weeds, and lily pads, which appear to remain unaddressed by proposed measures
- Inquiry about the activities carried out in the evaluation of Pine Lake Creek Basin and compare them to activities in other city basins
- Reiterate the involvement of volunteer residents in weir maintenance



Participants wrote comments and questions on a flip chart during the Open House.

Participants also suggested some potential solutions the challenges.

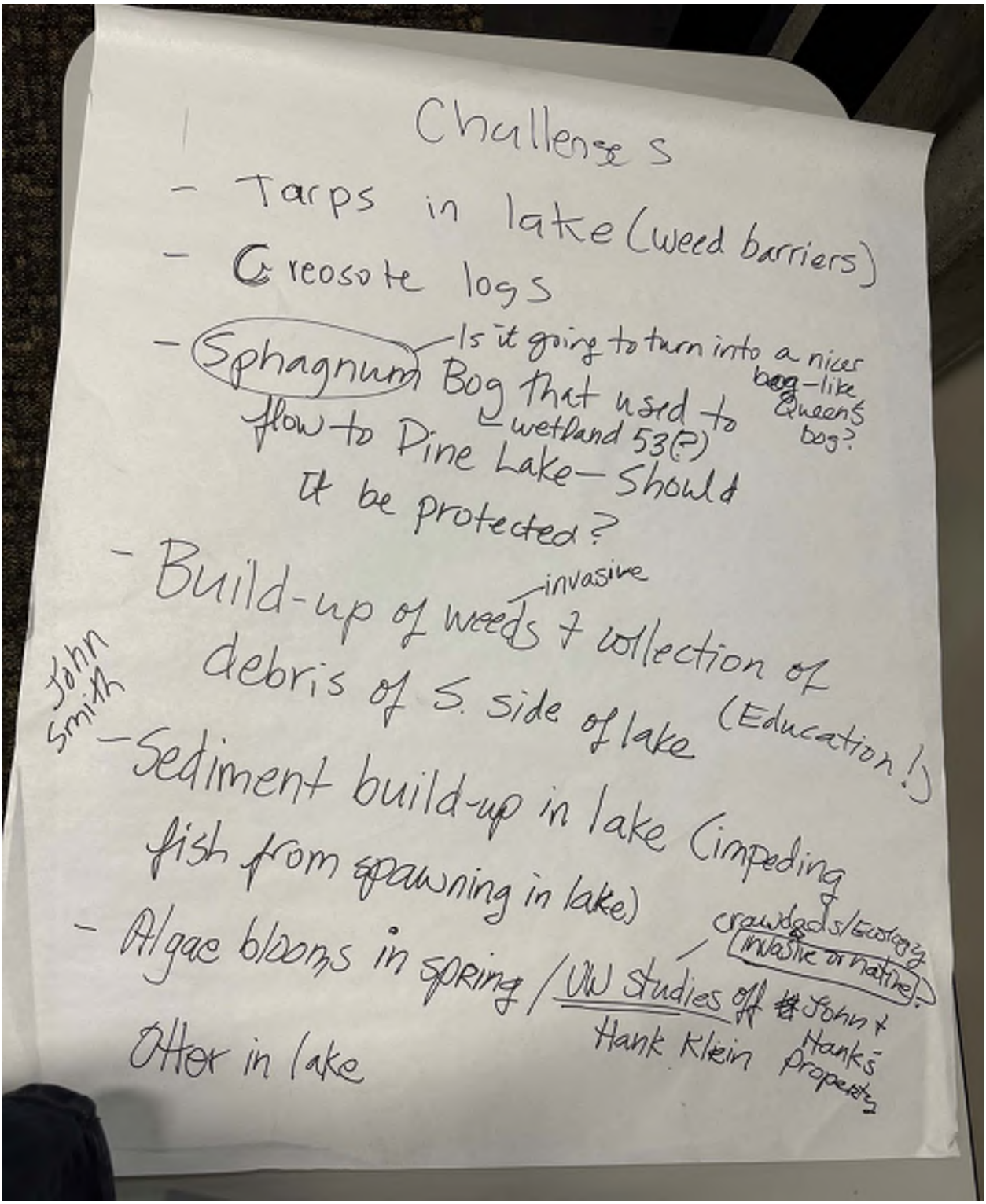
- Seek safe weed control solutions for lake property
- Advocate for lake living education on the city's website, which includes:
    - Dock maintenance
    - Weed removal
    - Construction guidelines
    - Vegetation protection
    - Waste disposal
- Redirect pipe that diverts water from Rock Meadow Horse Farm adjacent to Blueberry Farm and its impact on the weir

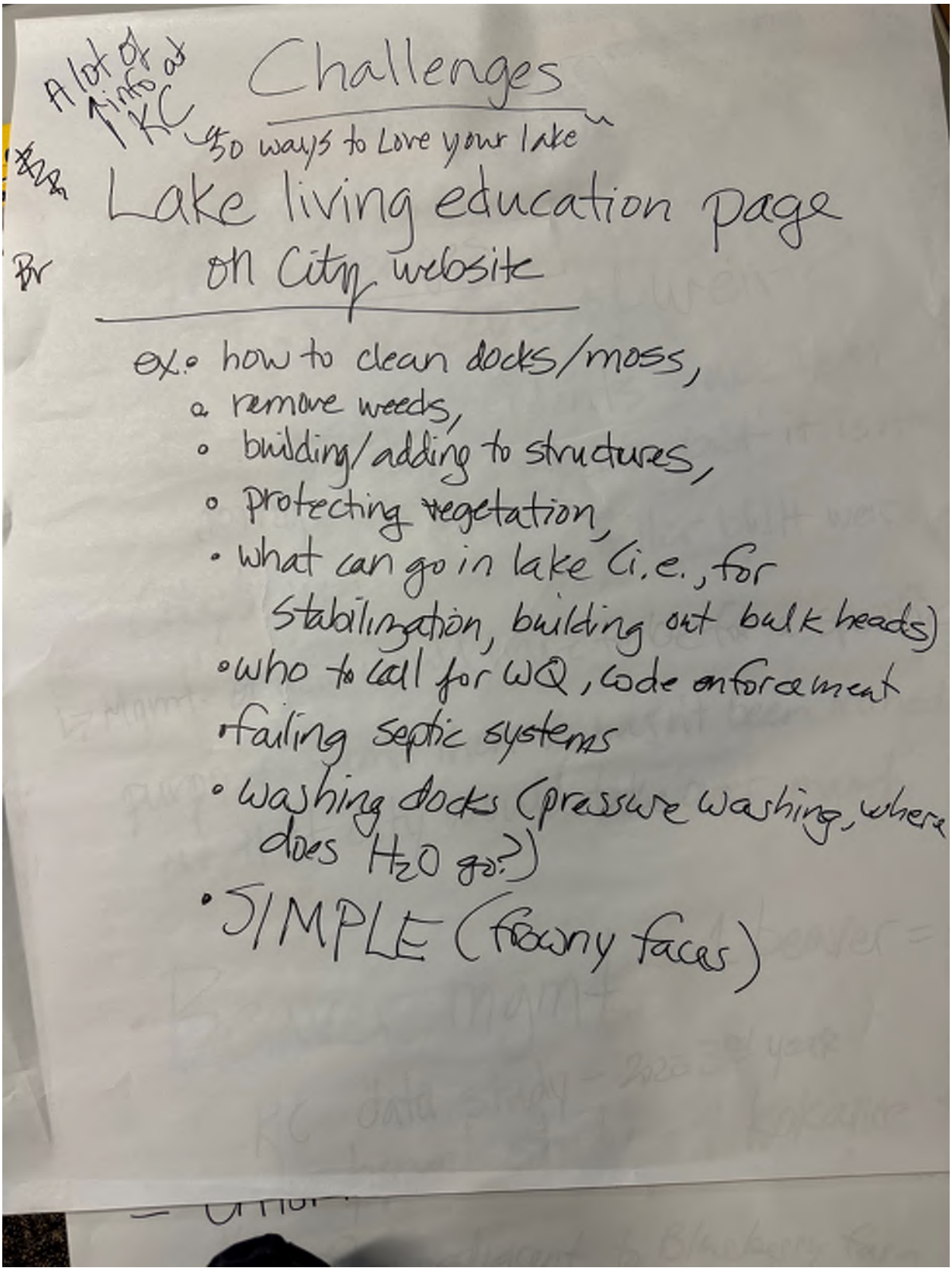
NEXT STEPS

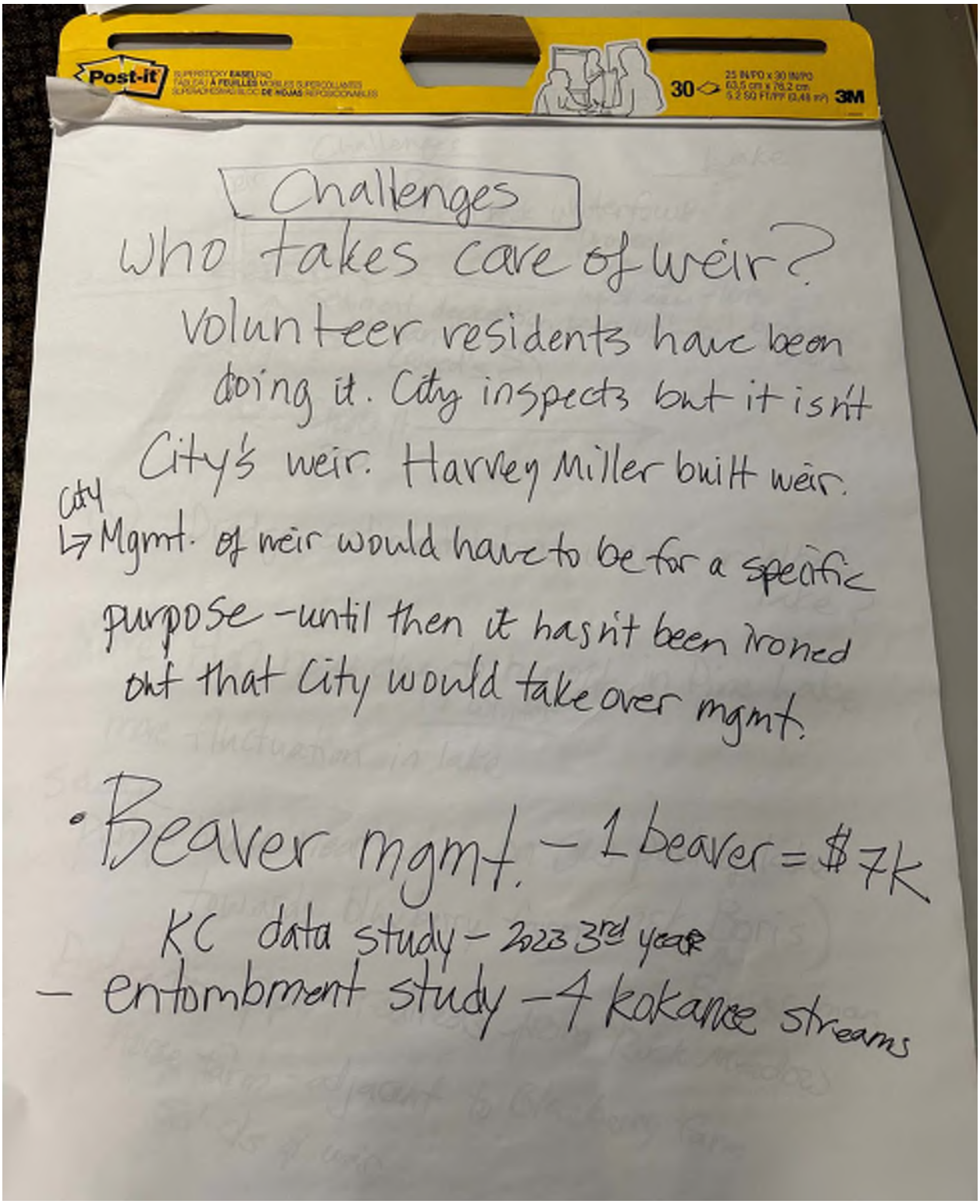
The project team will use the feedback from this Open House to inform the Pine Lake Creek Basin plan.

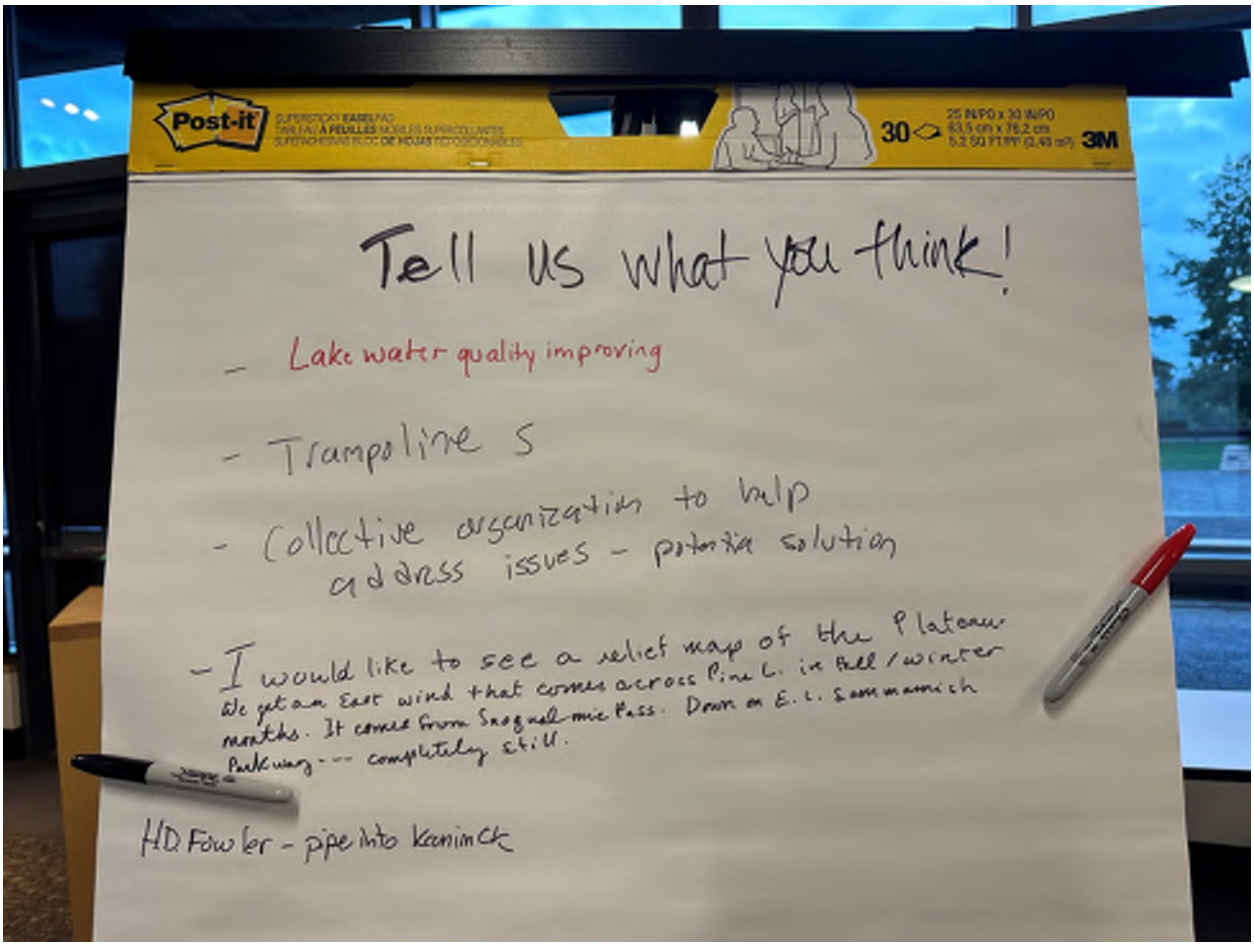
Please visit the City's website for updates and ways to stay involved: Pine Lake Creek Basin Plan | City of Sammamish.

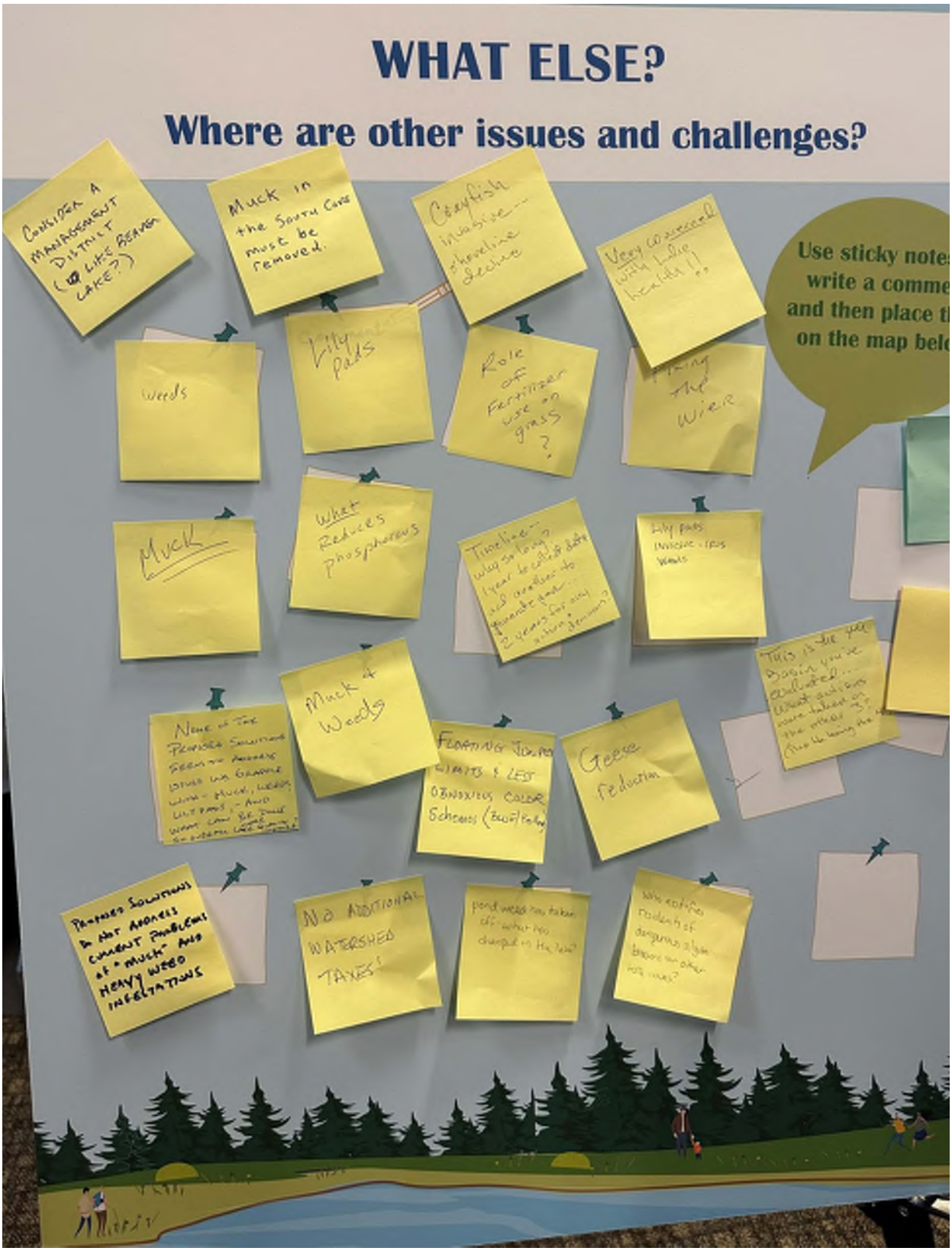
Appendix A: Comments from the Participants

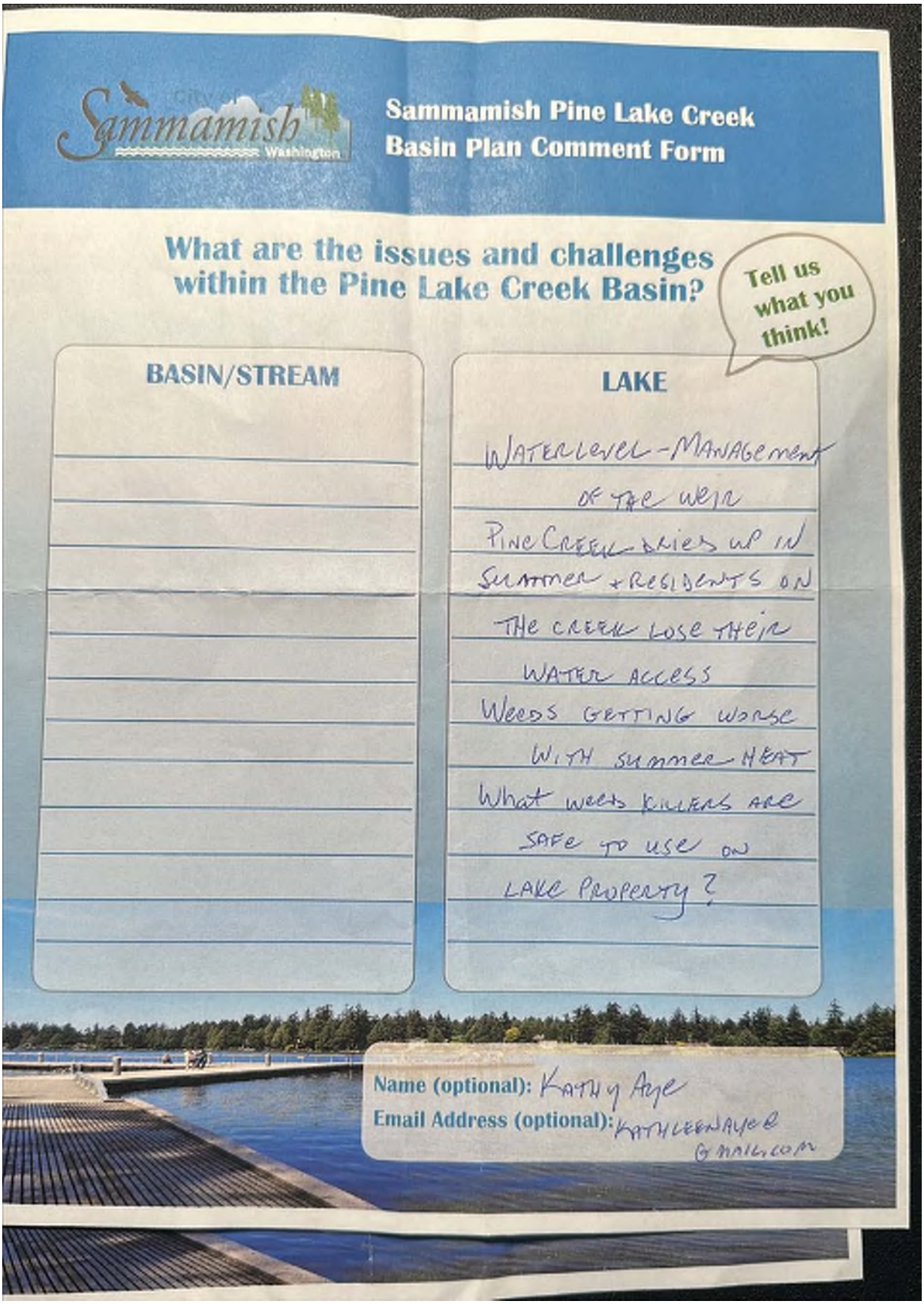

Challenges
- Tarps in lake (weed barriers)
- Creosote logs
- Sphagnum Bog that used to flow to Pine Lake – Should it be protected?
Is it going to turn into a nicer bog-like Queens bog?
wetland 53(?)
- Build-up of weeds & collection of debris of S. side of lake
invasive
(Education!)
John Smith
- Sediment build-up in lake (impeding fish from spawning in lake)
- Algae blooms in spring / UW studies off John & Hanks Hank Klein properties
crawdads/ecology invasive or native?
Otter in lake


A lot of info at KC
Challenges
50 ways to Love your lake
Lake living education page on City website
ex.
how to clean docks/moss,
remove weeds,
building/adding to structures,
protecting vegetation,
what can go in lake (i.e., for stabilization, building out bulk heads)
who to call for WQ, code enforcement
failing septic systems
washing docks (pressure washing, where does H2O go?)
SIMPLE (fewny faces)


Post-it
30
3M
Challenges
Who takes care of weir?
Volunteer residents have been doing it. City inspects but it isn't City's weir. Harvey Miller built weir.
City
↳ Mgmt. of weir would have to be for a specific purpose - until then it has not been ironed out that City would take over mgmt.
• Beaver mgmt. - 1 beaver = $7K
KC data study - 2023 3rd year
- entombment study - 4 Kokanee streams


Post-it
30
3M
Tell us what you think!
- Lake water quality improving
- Trampoline s
- Collective organization to help address issues - potential solution
- I would like to see a relief map of the Plateau We get an East wind that comes across Pine L. in Fall / winter months. It comes from Snoqualmie Pass. Down on E. L. Sammamish Parkway --- completely still.
HD Fowler - pipe into kennick


WHAT ELSE?
Where are other issues and challenges?
Use sticky notes
write a comme
and then place t
on the map belo
Muck in the South Cove must be removed.
Crayfish
Weeds
Lily pads
Role of Fertilizer use on grass ?
Muck
What Reduces Phosphorous
Muck & Weeds
Geese Reduction
Pond weeds
Lily pads



Sammamish Washington

Sammamish Pine Lake Creek Basin Plan Comment Form

What are the issues and challenges within the Pine Lake Creek Basin?

Tell us what you think!

BASIN/STREAM

LAKE

WATER LEVEL - MANAGEMENT OF THE WEIR

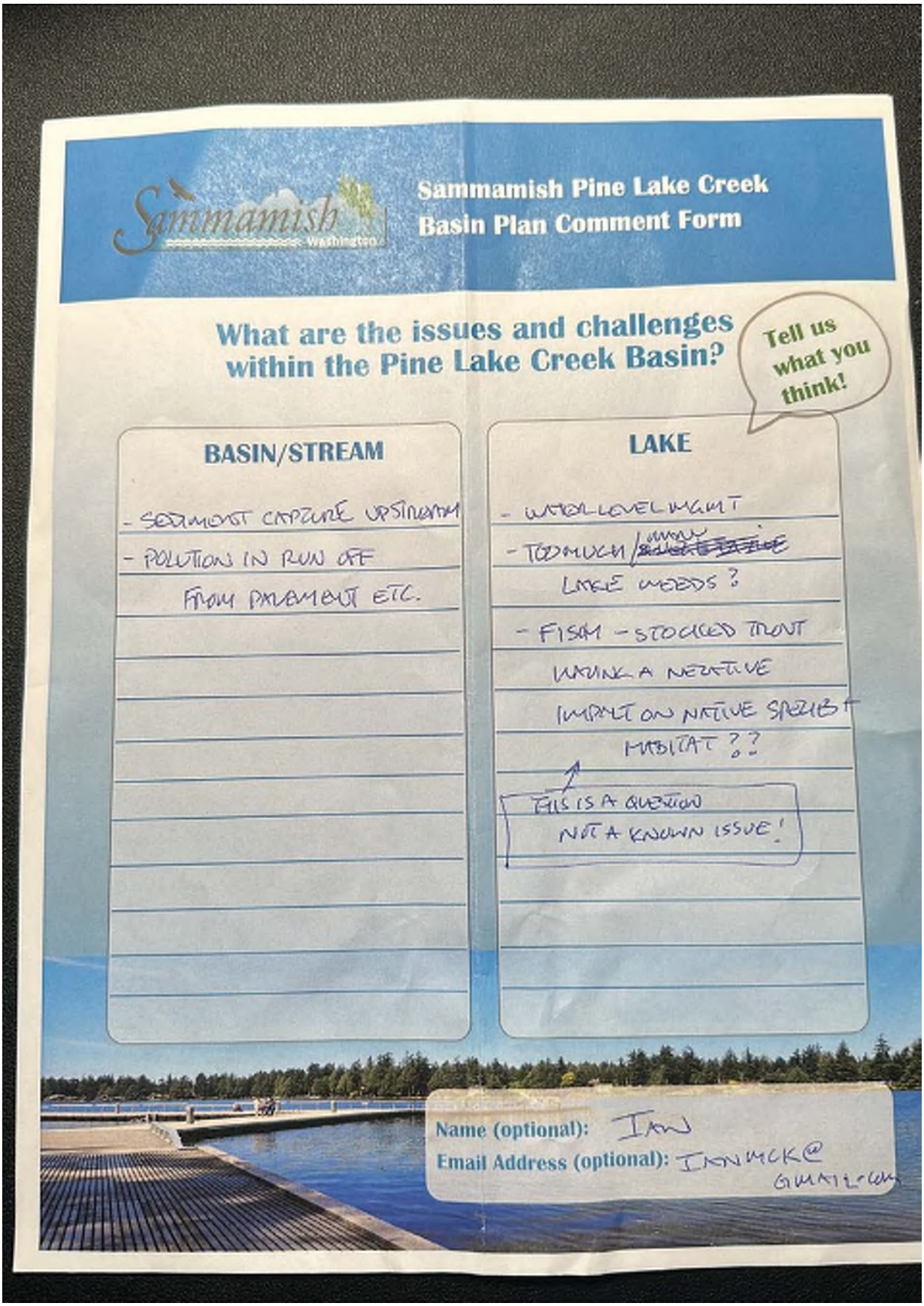
PINE CREEK DRIES UP IN SUMMER + RESIDENTS ON THE CREEK LOSE THEIR WATER ACCESS

WEEDS GETTING WORSE WITH SUMMER HEAT

What weeds killers are SAFE TO USE ON LAKE PROPERTY?

Name (optional): Kathy Aye

Email Address (optional): KATHLEENAYE @ GMAIL.COM


Sammamish Washington
Sammamish Pine Lake Creek Basin Plan Comment Form
What are the issues and challenges within the Pine Lake Creek Basin?
Tell us what you think!
BASIN/STREAM
- SEDIMENT CAPTURE UPSTREAM
- POLUTION IN RUN OFF FROM PAVEMENT ETC.
LAKE
- WATER LEVEL MGMT
- TOO MUCH / [illegible]
LAKE WEEDS?
- FISH - STOCKED TROUT HAVING A NEGATIVE IMPACT ON NATIVE SPECIES + HABITAT??
THIS IS A QUESTION NOT A KNOWN ISSUE!
Name (optional): IAN
Email Address (optional): IANMCK@ GMAIL.COM

Pine Lake Creek Basin Plan
In-Person Open House #2 Summary

April 22, 2024

Sammamish Pine Lake Creek Basin Plan Open House #2 Meeting Summary

INTRODUCTION

The City of Sammamish (City) is developing the Pine Lake Creek Basin Plan to address various environmental concerns within the Pine Lake Creek watershed, including flooding, erosion, water quality, and ecological health. Covering approximately 1,200 acres, this watershed is situated near the southern end of the Sammamish Plateau and encompasses significant environmental assets such as Pine Lake, Pine Lake and Kanim creeks, sphagnum bogs, and wetlands. Despite recent residential development, substantial forested areas remain, particularly along Pine Lake Creek, which has historically supported kokanee salmon runs. The City emphasizes the incorporation of considerations for future development and climate resilience into the Basin Plan. A key aspect of the planning process involves active community engagement, wherein stakeholders participate in meaningful discussions to articulate their priorities, identify existing challenges, and propose viable solutions. This collaborative approach underscores the commitment to ensuring the enduring health and sustainability of the watershed.

The Sammamish Pine Lake Creek Basin Plan in-person open house was attended by over 35 community members.

PURPOSE

On March 28, 2024, the city held an in-person open house from 5:30 -7 p.m. in the Sammamish City Hall City Council Chambers. The primary objectives of the open house were to share and get community feedback on potential strategies and projects identified through the project and at the September 2023 open house.

NOTIFICATION

The project team used a variety of methods to promote the March 28 in-person Open House. These included:

- Sending a postcard to approximately 3,000 addresses within the project area
- Social media posts
- Posting event information on the City's website
- Sending emails to individuals on the project contact list

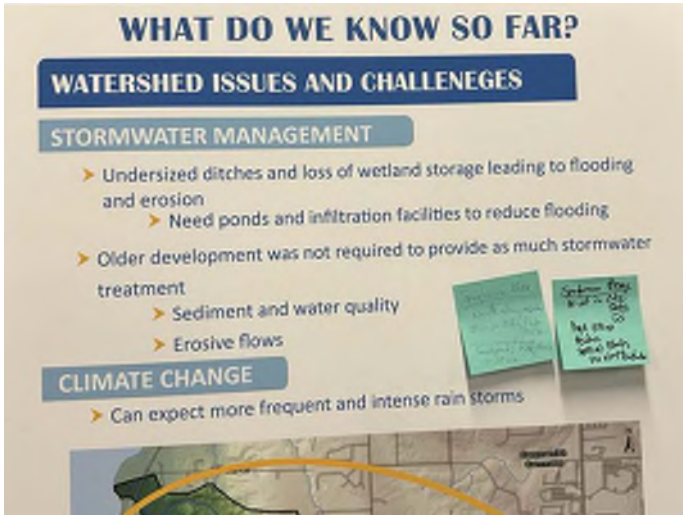
OPEN HOUSE OVERVIEW & FORMAT

Approximately 36 people attended the Open House. The event featured a welcoming booth and 15 display boards in the City Hall's council chambers. The display boards shared how the public process helps to shape the Sammamish Pine Lake Creek Basin plan; summarized the feedback and issues identified by the public to date; and summarized potential project and strategies for participants to provide input. Attendees were encouraged to ask questions and to express their opinions and suggestions by completing comment forms and using sticky notes, which are detailed in Appendix A of this summary.

Attendees participated in the open house through discussion with project staff, viewing project display boards, and providing written comments.

PARTICIPANT FEEDBACK

Attendees provided feedback in numerous ways, which included 8 comment forms and 30 sticky notes. Participants shared their thoughts and suggestions on, protection- and education-oriented strategies, stormwater, and creek improvement projects. Key themes and suggestions voiced by attendees are organized below:

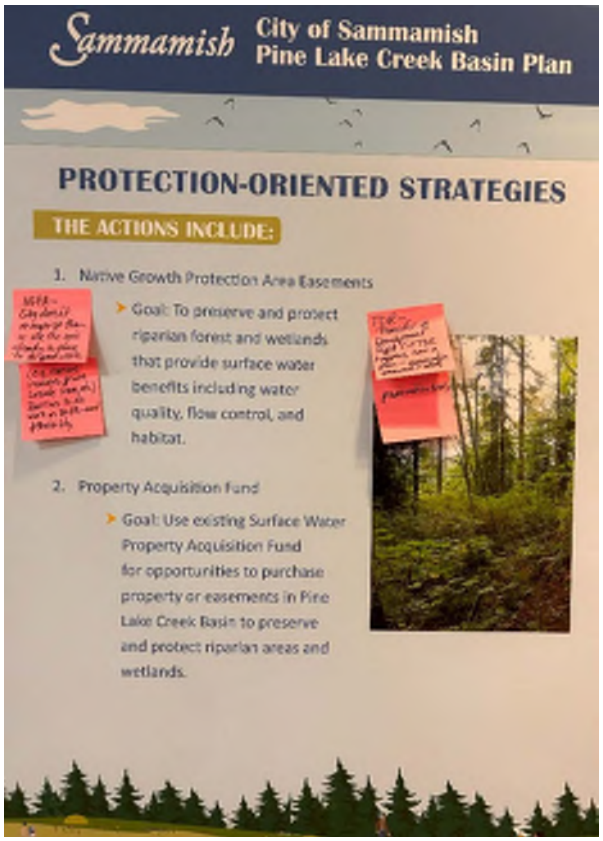


Attendees provided their thoughts and suggestions on the "what do we know so far" board.

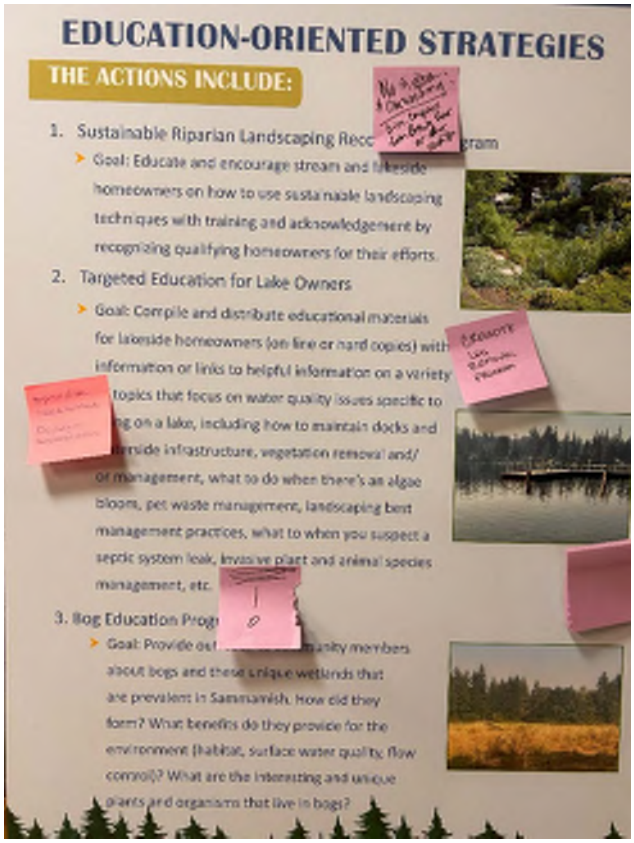
Protection-Oriented Strategies:

- The city's management and use of Native Growth Protection Area Easements was questioned in the open house, suggested they could be used for beneficial actions like invasive species removal and tree pruning. A need for flexibility, which could be limited by NGPA requirements was emphasized.
- Attendees also proposed Transfer of Development Rights (TDR) as a solution, stressing the importance of establishing a plan for conservation elements and identifying preservation tools.

- Implement measures to protect the redwood trees situated between ELSP and Lake Sammamish.



Attendees posted their notes on the Protection-Oriented Strategies display board.



Attendees posted their notes on the Education-Oriented Strategies display board.

Education-Oriented Strategies:

- Recommend educating the public to refrain from washing their cars on their properties, citing concerns about chemicals flowing into Pine Lake. They also proposed distributing coupons for use at Brown Bear Car Wash as an alternative.
- Suggested implementing an educational campaign regarding a creosote log removal program.
- Raised the issue of managing creosote-treated bulkheads.
- Education to the public about the value and importance of sphagnum bogs. Participants suggested providing background information on the prevalence and significance of sphagnum bogs, emphasizing the rarity and need for protection.
- Education to the public about the value and importance of sphagnum bogs. Participants suggested providing background information on the prevalence and significance of sphagnum bogs, emphasizing the rarity and need for protection.

Potential Stormwater Projects:

- Ensure potential projects allow water from Pine Lake Creek to expand into the wetland area on the north side of SE 24th and west side of 212th, without channelizing the creek between projects 6 and 8.
- Address runoff from city property, which is contributing to soap pollution in the lake.
- Commendations to the street crew for their response on SE 19th in January.
- Support using existing detention areas at 11 and 15 to enhance performance under various conditions.
- Explore options and funding sources for removing invasive weeds along the waterline, particularly in the southwest corner of the lake. Note that while the King Conservation District has conducted invasive removal away from the lake, they do not handle shoreline removal.
- Investigate differences in water quality parameters, especially at the lake's eastern end, and consider implementing monitoring measures. Additionally, address phosphorus (P) accumulation in the lake's mucky shoreline.

Potential Pine Lake Creek Projects (Upper Basin):

- Support for restoring the stream at the vacant property located at Upper Pine Lake NE 24th and 212th, including re-channelizing the stream where necessary.

Other Ideas for Strategies and Actions:

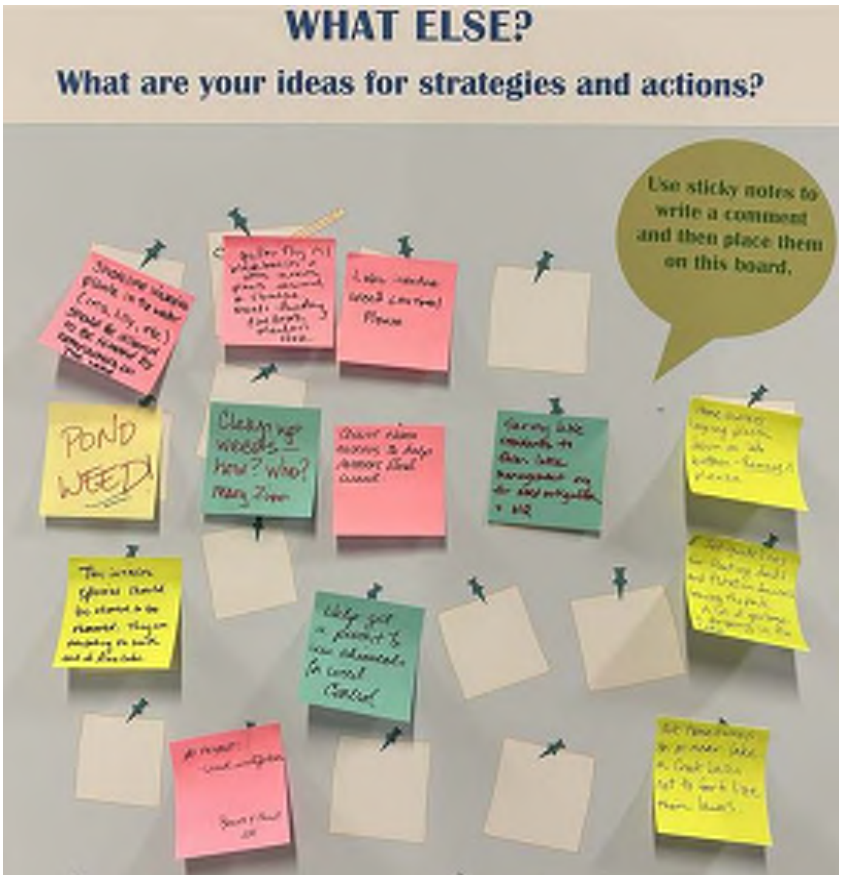
Lake

- Call for Lake Invasive Weed Control:
    - Urgent need for control measures to manage invasive weeds in the lake.
    - Request for assistance in cleaning up pond weed; clarification needed on responsible parties and methods.
    - Support homeowners in removing pond weed; specific guidance and assistance required.
- Survey for Lake Management Organizations:
    - Propose surveying lake residents to establish lake management organizations focused on weed mitigation and water quality improvement.
- Removal of Plastic on Lake Bottom:
    - Require the removal of plastic/tarps laid by homeowners on the lake bottom to prevent environmental harm.
- Guidelines for Floating Devices:
    - Establish guidelines for floating docks and devices to prevent littering and pollution of the lake.
- Permission for Invasive Species Removal:

- Advocate for permission to remove invasive species, which are rapidly spreading in the south end of Pine Lake.

Shoreline

- Shoreline Invasive Plant Removal:
  - Homeowners should be permitted to remove shoreline invasive plants such as iris and lilies in the lake.
- Pine Brook Meadows HOA seeking sources of funding for the removal of invasive plants like yellow flag iris and blackberry bushes along the shoreline.
- Permit for Chemical Weed Control:
  - Seek assistance in obtaining permits for the use of chemicals in weed control efforts.
- Request to Limit Lawn Fertilization:
  - Encourage homeowners near lakes or creek basins to refrain from fertilizing their lawns to prevent nutrient runoff.



Attendees made additional suggestions for strategies and actions.

The following is a summary of the input collected from the comment forms completed at the open house; the scanned comment forms are included in Appendix B.

Attendees listen to a brief presentation about the Pine Lake Creek Basin Plan.

Basin/Stream projects & strategies:

- Should tree cover changes in the basin be considered**?** There may be a need to review and adjust tree removal policies in affected areas.
- Request for code enforcement of grading violations in the buffer zone, particularly at SE 24th and 212th, where a long-standing violation persists along Pine Lake Creek.
- Educational initiatives for landowners could help enhance understanding and compliance with regulations.
- Attention given to Project #3 Area to ensure the preservation of the eagle's nest, which has been in existence for nearly 30 years. Displacement or disturbance of the nest should be avoided.

Lake projects & strategies:

- Concerns about maintenance of Pine Lake weir. Described as it often breaching in late spring, leading to excessive water release that results in insufficient water levels by late summer.
- **Shoreline vegetation management:** Homeowners on Pine Lake need clearer guidelines and allowances for removing invasive shoreline plants like iris, lily pads, and watercress. Additionally, addressing the issue of falling water levels on the west end of the lake is necessary.
- **Pond weed proliferation:** The problem of pond weed in Pine Lake has escalated noticeably over the past 5-6 years, especially area near QFC, causing congestion in the lake by summer. Concerns arise about its impact on the lake's health, prompting a call for action.
- **Clarity on waterfront regulations:** Lakefront property owners feel apprehensive about making any changes due to fear of unknowingly violating regulations. There's a plea for transparency, openness, and upfront communication in the education program regarding waterfront regulations.

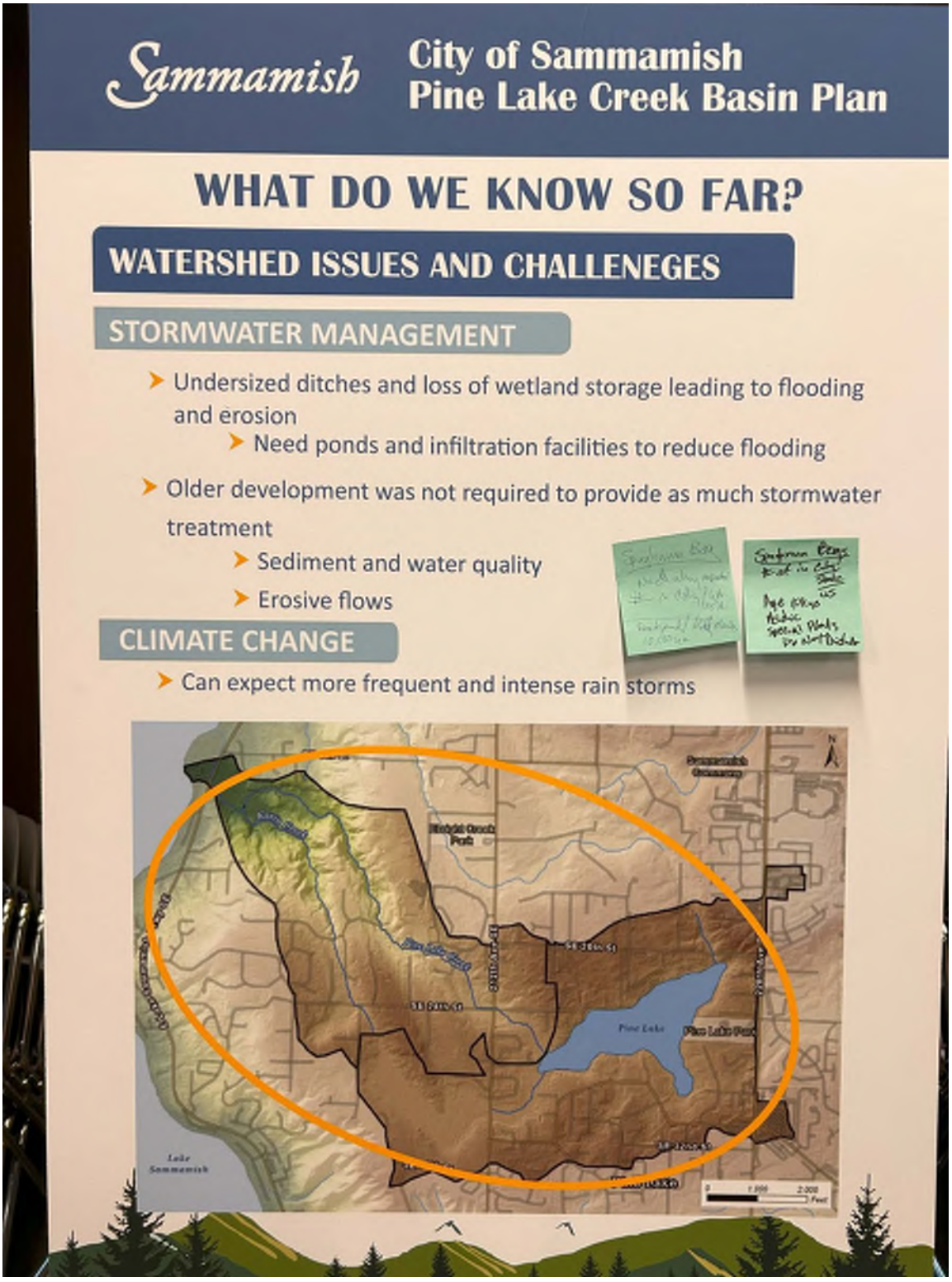
A project team member points out the project area for an attendee at the Open House.

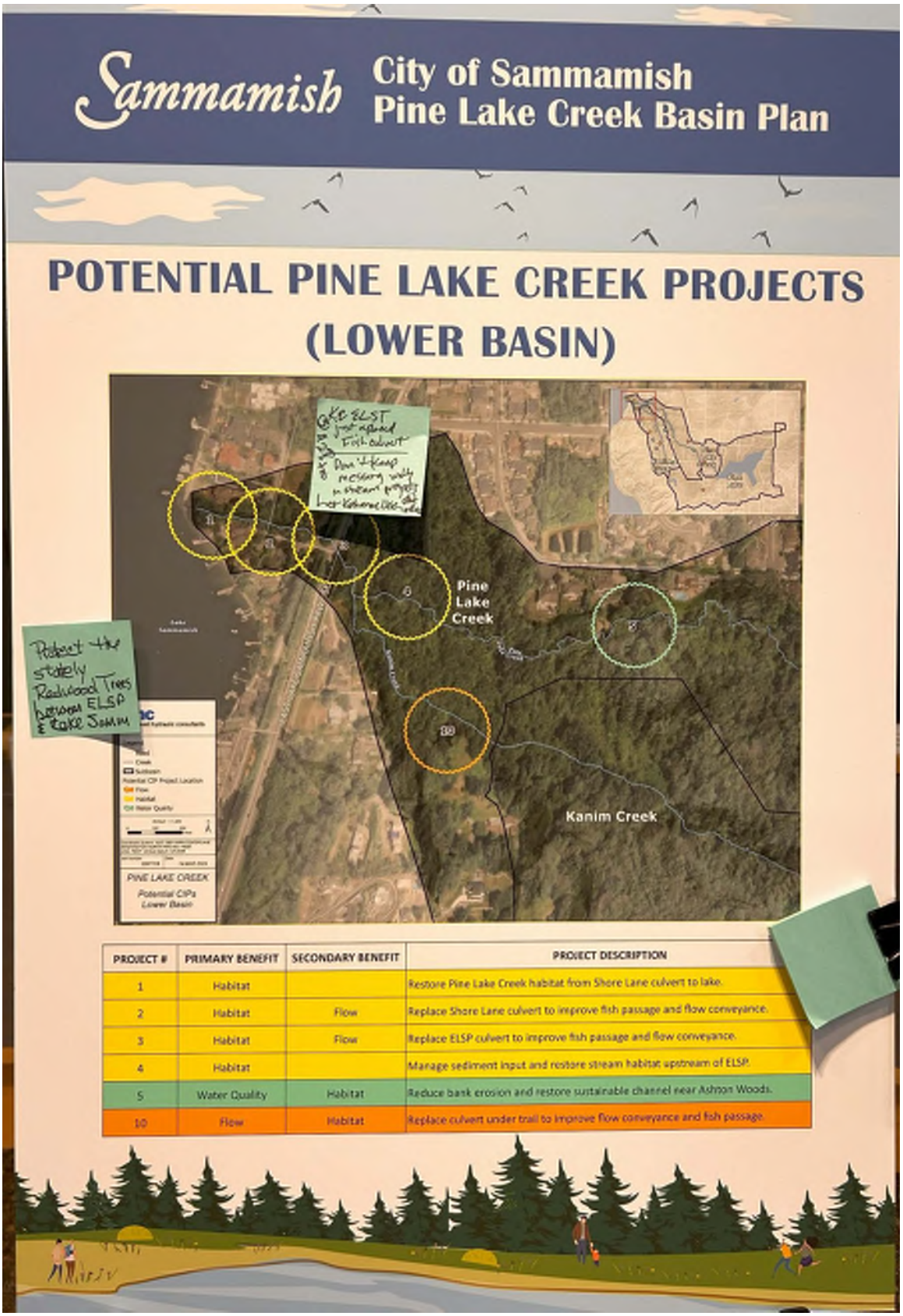
- **City responsibility for lake management:** Suggested that the City needs to take responsibility for maintaining Pine Lake's water quality and managing lake weeds, considering Pine Lake as a valuable citywide resource.
- **Invasive species management:** There's a suggestion that either the City or homeowners should be permitted to address the invasive species infestation. Over the past two decades, the south end of Pine Lake has been overtaken by invasive plants, leading to significantly reduced water levels by July/August.
- **Pine Lake Weir Repair**: An attendee provided a letter (dated 1984-85) regarding the history of the weir. The letter is included in Appendix C.

NEXT STEPS

The project team will use the feedback from this Open House to inform the Pine Lake Creek Basin plan. Please visit the City's website for updates and ways to stay involved: Pine Lake Creek Basin Plan | City of Sammamish.

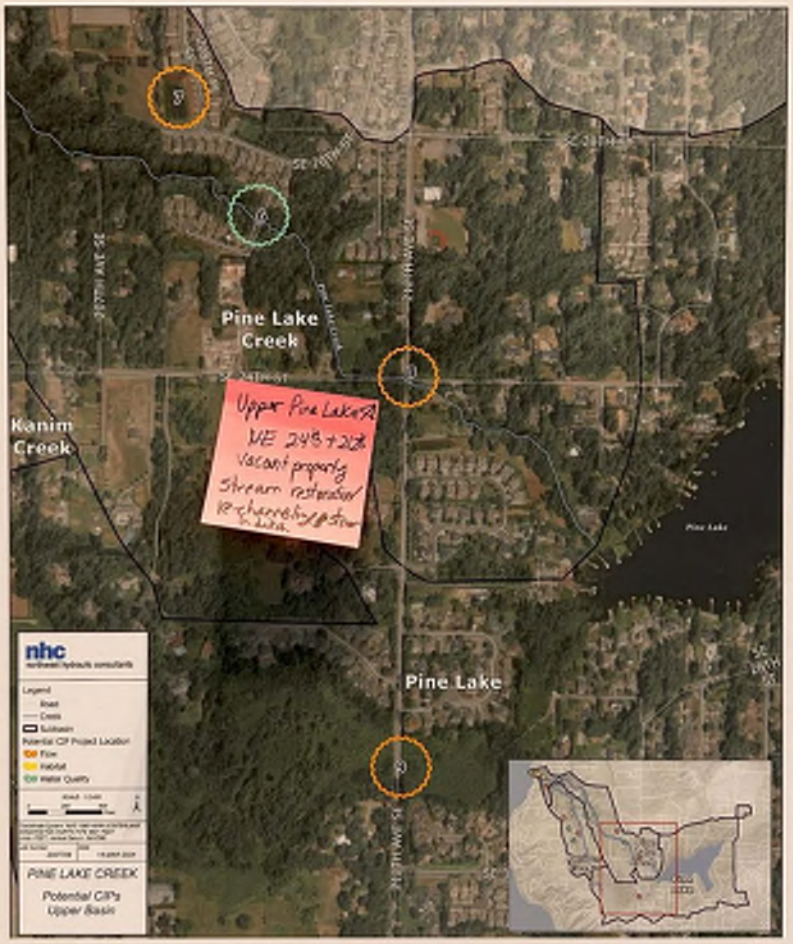
Appendix A: Comments on Display Boards



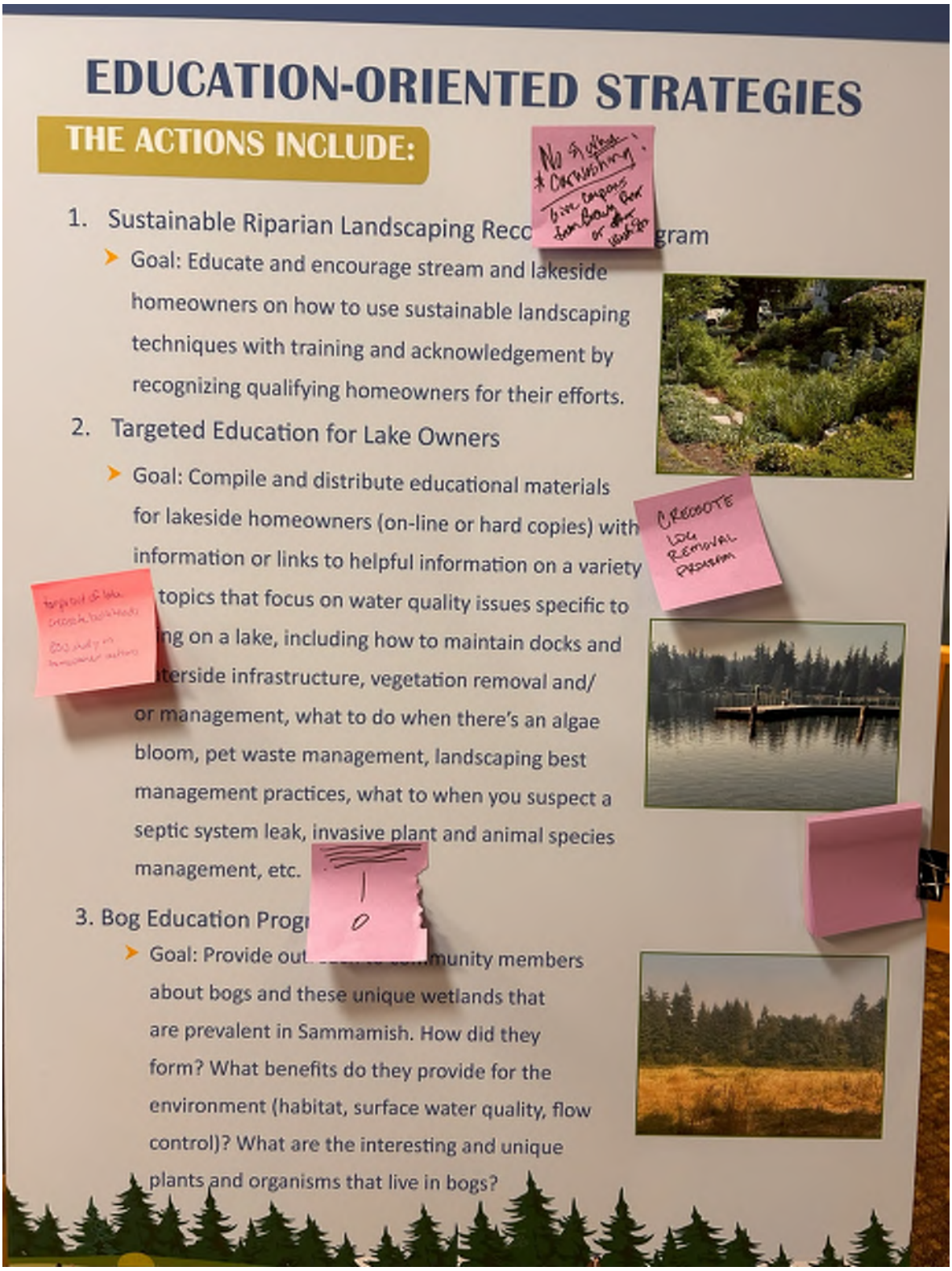

Sammamish
City of Sammamish
Pine Lake Creek Basin Plan
POTENTIAL PINE LAKE CREEK PROJECTS
(LOWER BASIN)
Pine
Lake
Creek
Kanim Creek
PINE LAKE CREEK
Potential CIPs
Lower Basin
PROJECT # | PRIMARY BENEFIT | SECONDARY BENEFIT | PROJECT DESCRIPTION
1 | Habitat | | Restore Pine Lake Creek habitat from Shore Lane culvert to lake.
2 | Habitat | Flow | Replace Shore Lane culvert to improve fish passage and flow conveyance.
3 | Habitat | Flow | Replace ELSP culvert to improve fish passage and flow conveyance.
4 | Habitat | | Manage sediment input and restore stream habitat upstream of ELSP.
5 | Water Quality | Habitat | Reduce bank erosion and restore sustainable channel near Ashton Woods.
10 | Flow | Habitat | Replace culvert under trail to improve flow conveyance and fish passage.

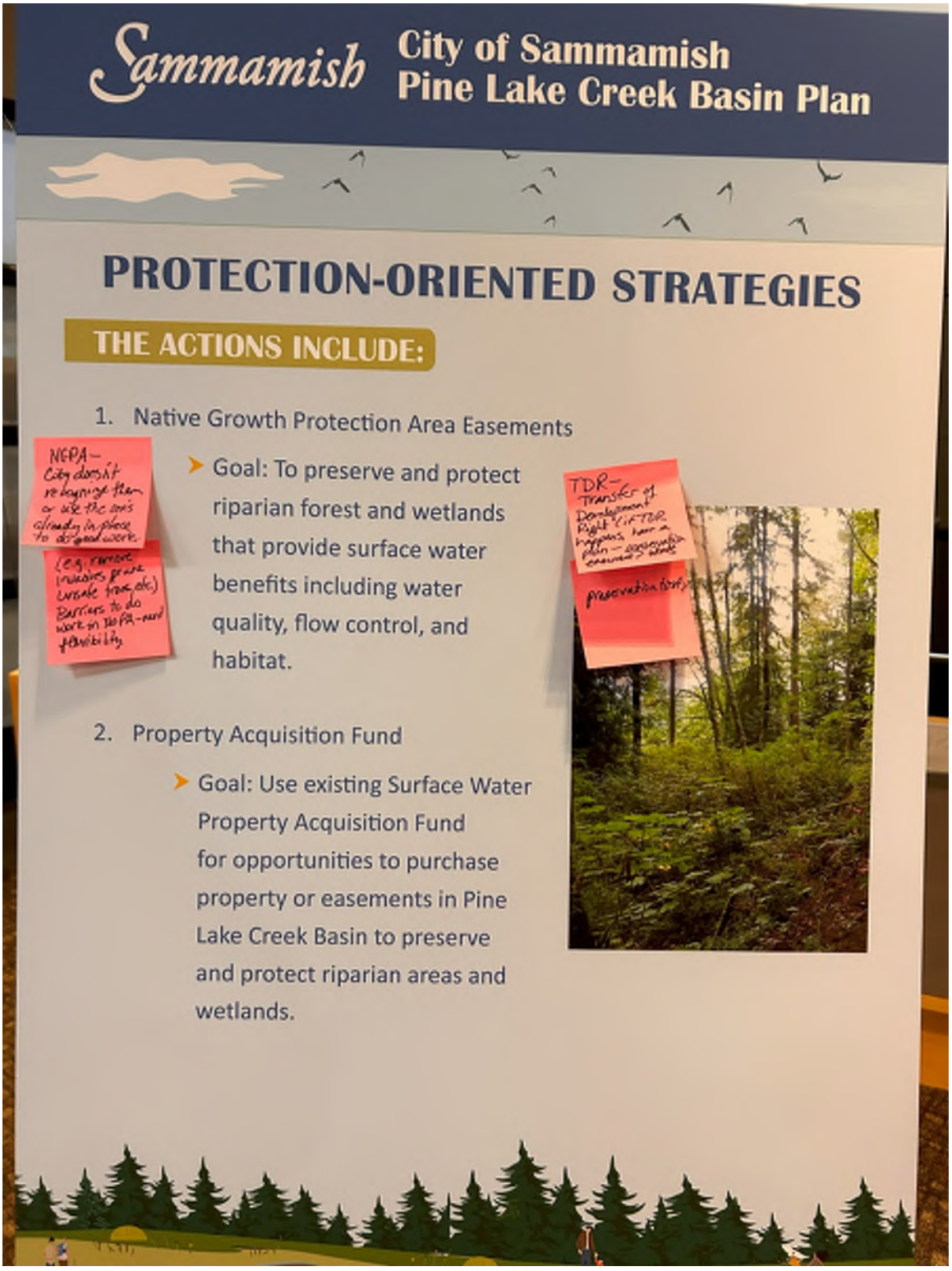
Sammamish City of Sammamish
Pine Lake Creek Basin Plan

POTENTIAL PINE LAKE CREEK PROJECTS (UPPER BASIN)

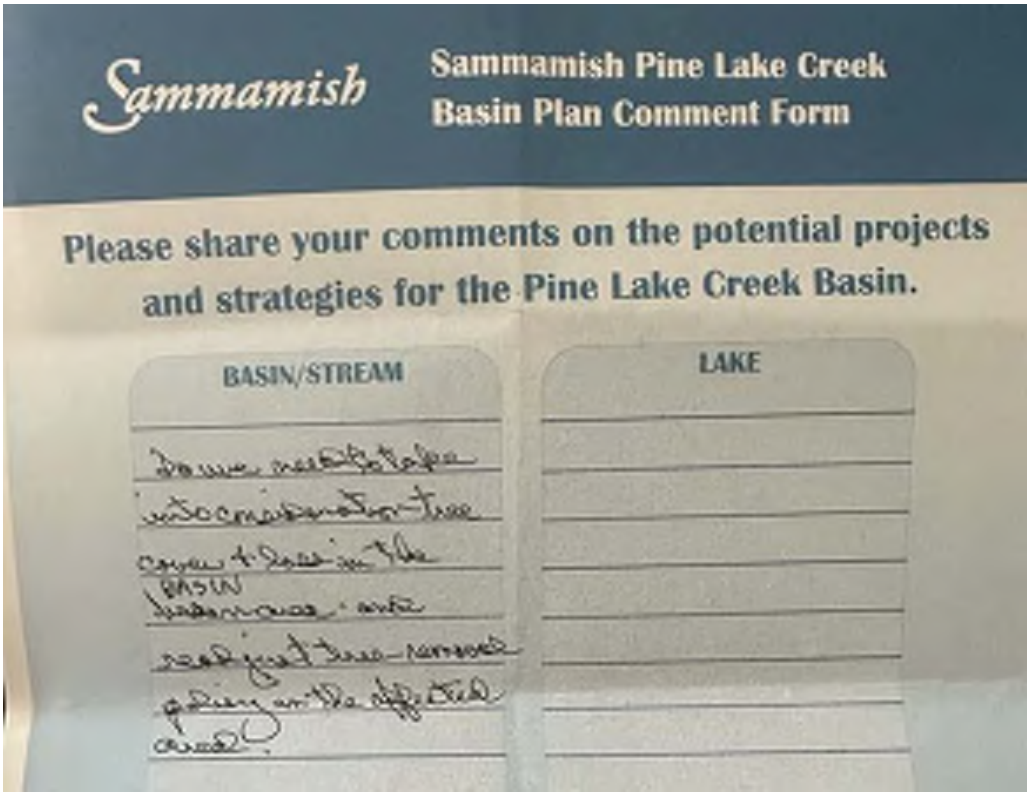


PROJECT #	PRIMARY BENEFIT	SECONDARY BENEFIT	PROJECT DESCRIPTION
6	Water Quality	Habitat	Remove sediment at bridge abutments.
7	Flow	Water Quality	Retrofit detention pond to increase flow control and accommodate future growth.
8	Flow	Habitat	Improve drainage in vicinity of 212th Ave SE and SE 24th St intersection.
9	Flow	Habitat	Expand conveyance to reduce road overtopping along 212th Ave SE.


EDUCATION-ORIENTED STRATEGIES
THE ACTIONS INCLUDE:
1. Sustainable Riparian Landscaping Reco gram
Goal: Educate and encourage stream and lakeside homeowners on how to use sustainable landscaping techniques with training and acknowledgement by recognizing qualifying homeowners for their efforts.
2. Targeted Education for Lake Owners
Goal: Compile and distribute educational materials for lakeside homeowners (on-line or hard copies) with information or links to helpful information on a variety topics that focus on water quality issues specific to ng on a lake, including how to maintain docks and terside infrastructure, vegetation removal and/ or management, what to do when there's an algae bloom, pet waste management, landscaping best management practices, what to when you suspect a septic system leak, invasive plant and animal species management, etc.
CREOSOTE LOG REMOVAL PROGRAM
3. Bog Education Prog
Goal: Provide out munity members about bogs and these unique wetlands that are prevalent in Sammamish. How did they form? What benefits do they provide for the environment (habitat, surface water quality, flow control)? What are the interesting and unique plants and organisms that live in bogs?


Sammamish
City of Sammamish
Pine Lake Creek Basin Plan
PROTECTION-ORIENTED STRATEGIES
THE ACTIONS INCLUDE:
1. Native Growth Protection Area Easements
Goal: To preserve and protect riparian forest and wetlands that provide surface water benefits including water quality, flow control, and habitat.
2. Property Acquisition Fund
Goal: Use existing Surface Water Property Acquisition Fund for opportunities to purchase property or easements in Pine Lake Creek Basin to preserve and protect riparian areas and wetlands.

Appendix B: Notes from Comment Forms



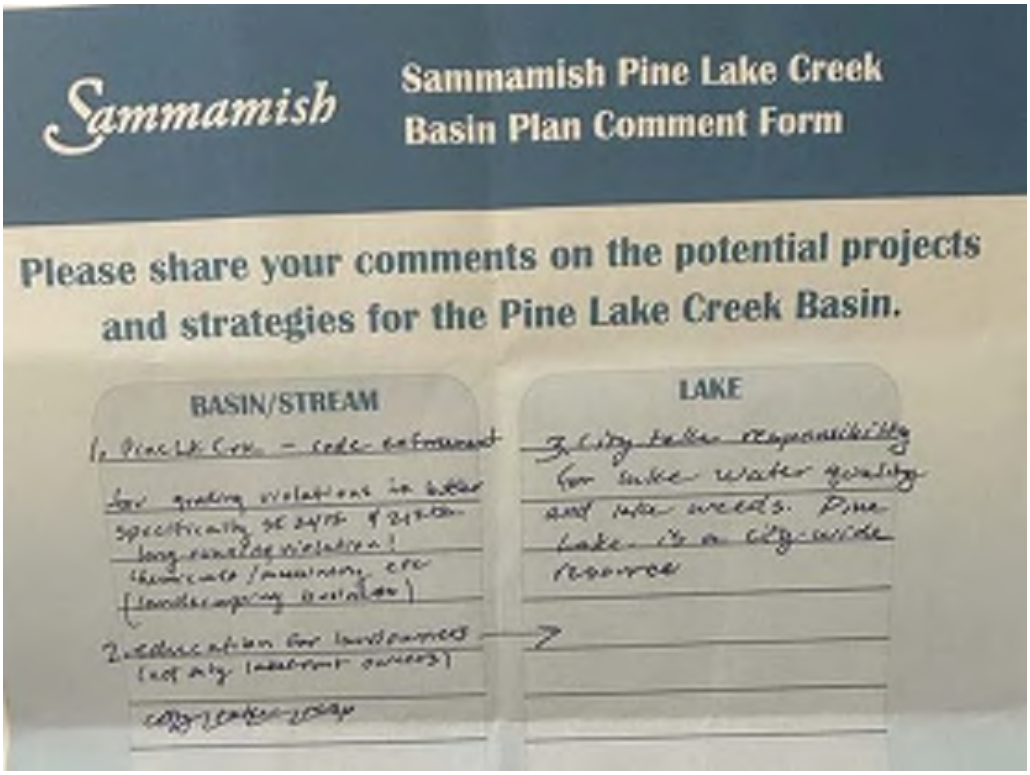
Sammamish

Sammamish Pine Lake Creek Basin Plan Comment Form

Please share your comments on the potential projects and strategies for the Pine Lake Creek Basin.

BASIN/STREAM

LAKE



Sammamish

Sammamish Pine Lake Creek Basin Plan Comment Form

Please share your comments on the potential projects and strategies for the Pine Lake Creek Basin.

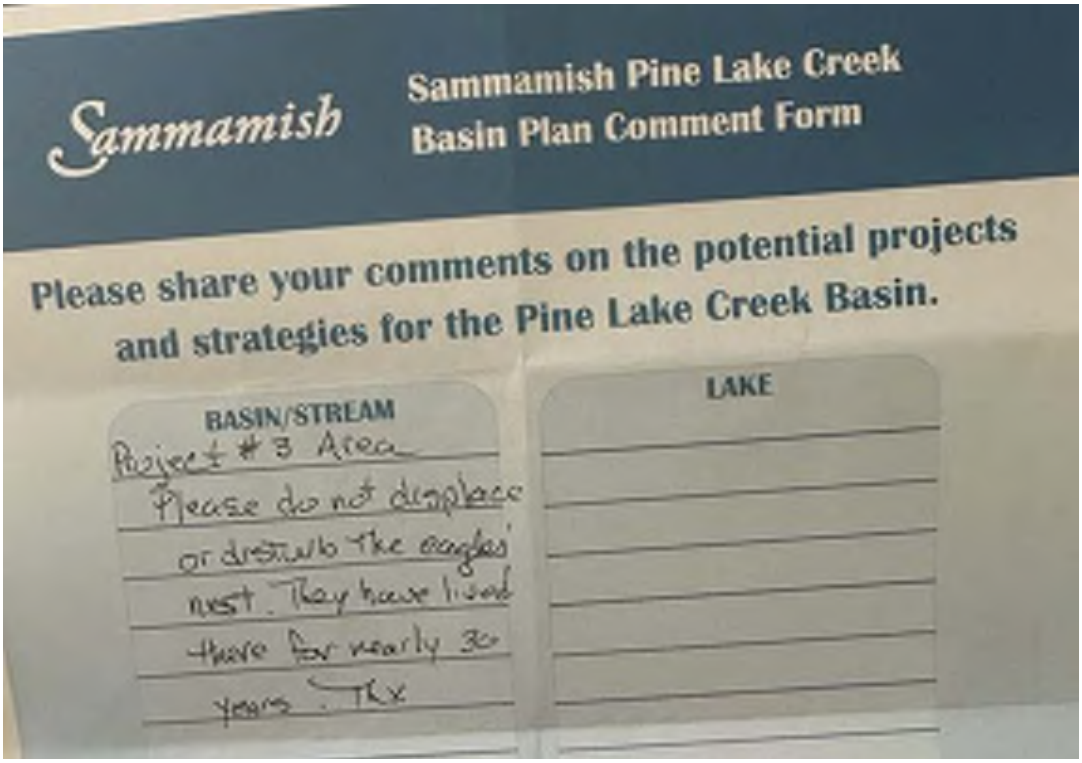
BASIN/STREAM

1. Pine Lk Crk - code enforcement for grading violations in basin specifically SE 24th & 218th long-standing violations! (hardscape/retaining, etc (landscaping outside)

2. education for landowners (not only absentee owners)

LAKE

3. City take responsibility for lake water quality and its weeds. Pine Lake is a city-wide resource



Sammamish

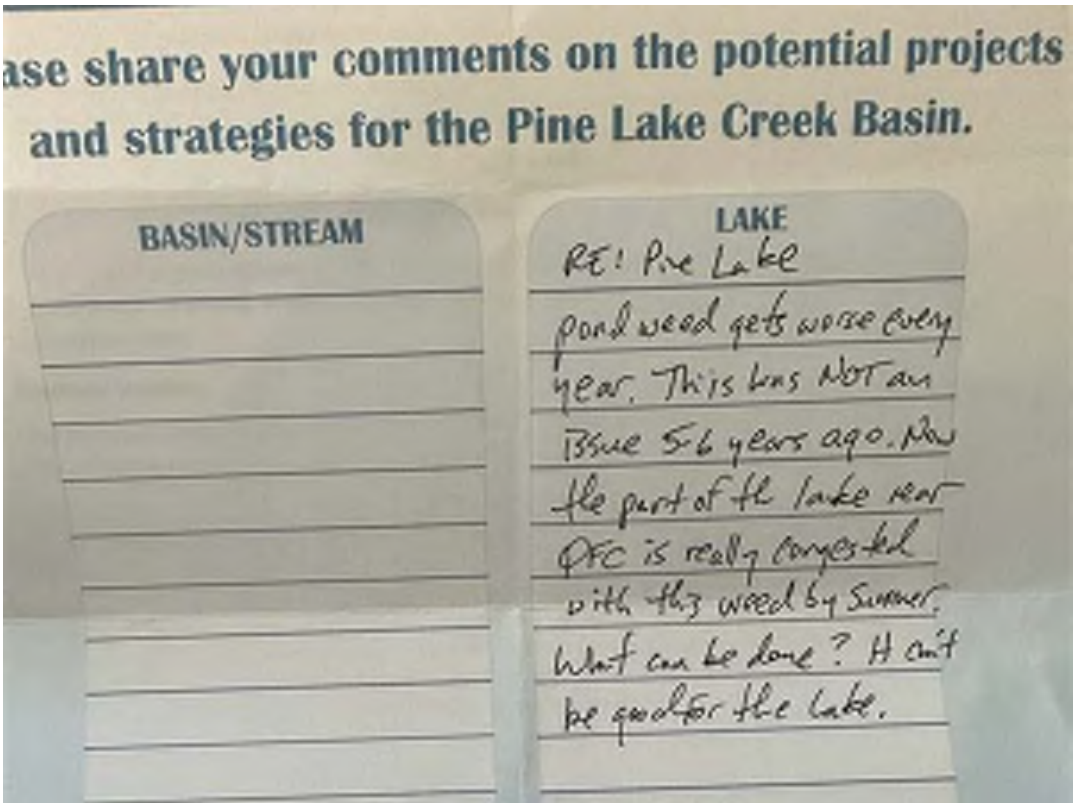
Sammamish Pine Lake Creek Basin Plan Comment Form

Please share your comments on the potential projects and strategies for the Pine Lake Creek Basin.

BASIN/STREAM

Project #3 Area
Please do not displace or disturb the eagles' nest. They have lived there for nearly 30 years. Thx

LAKE

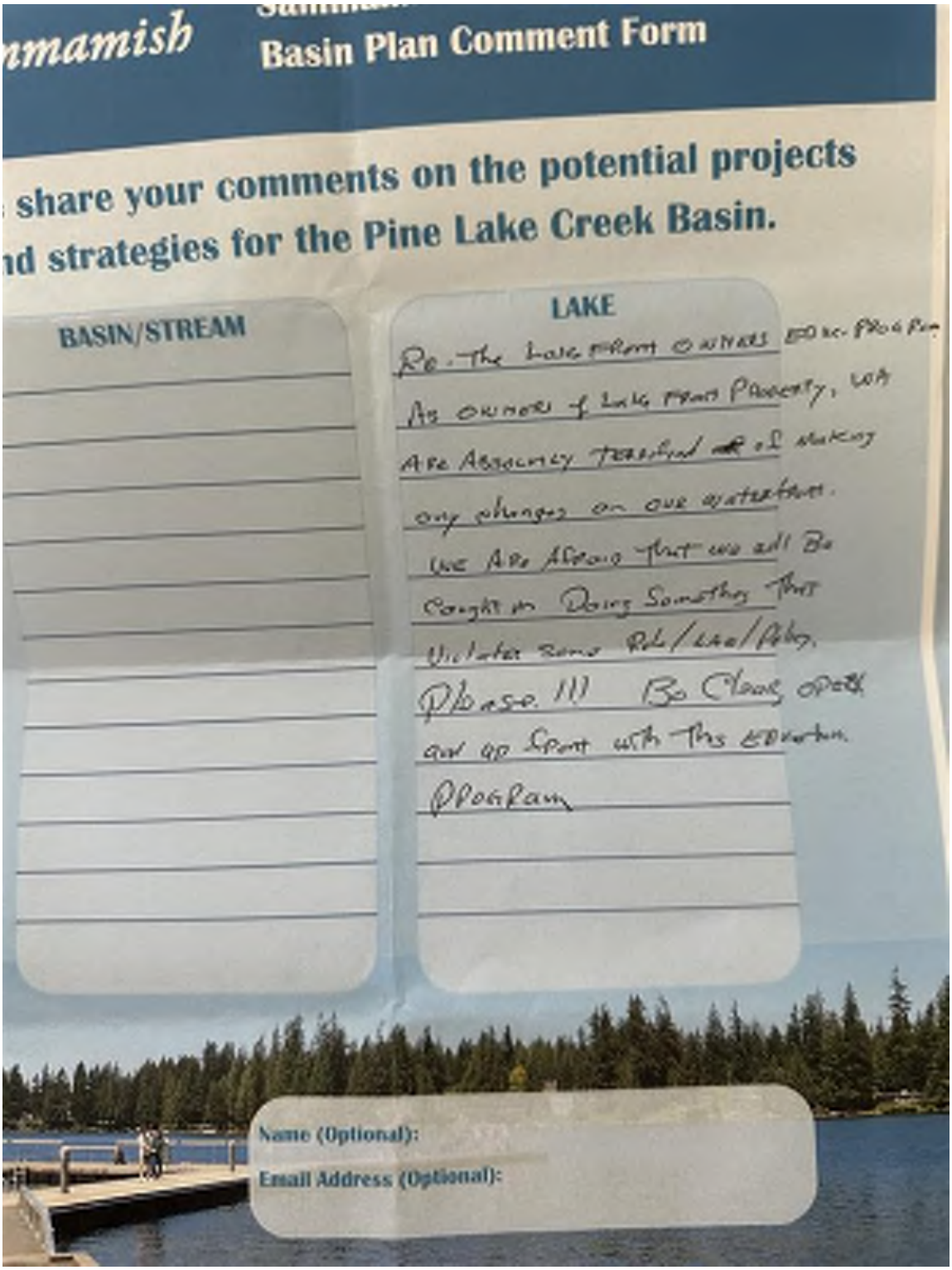


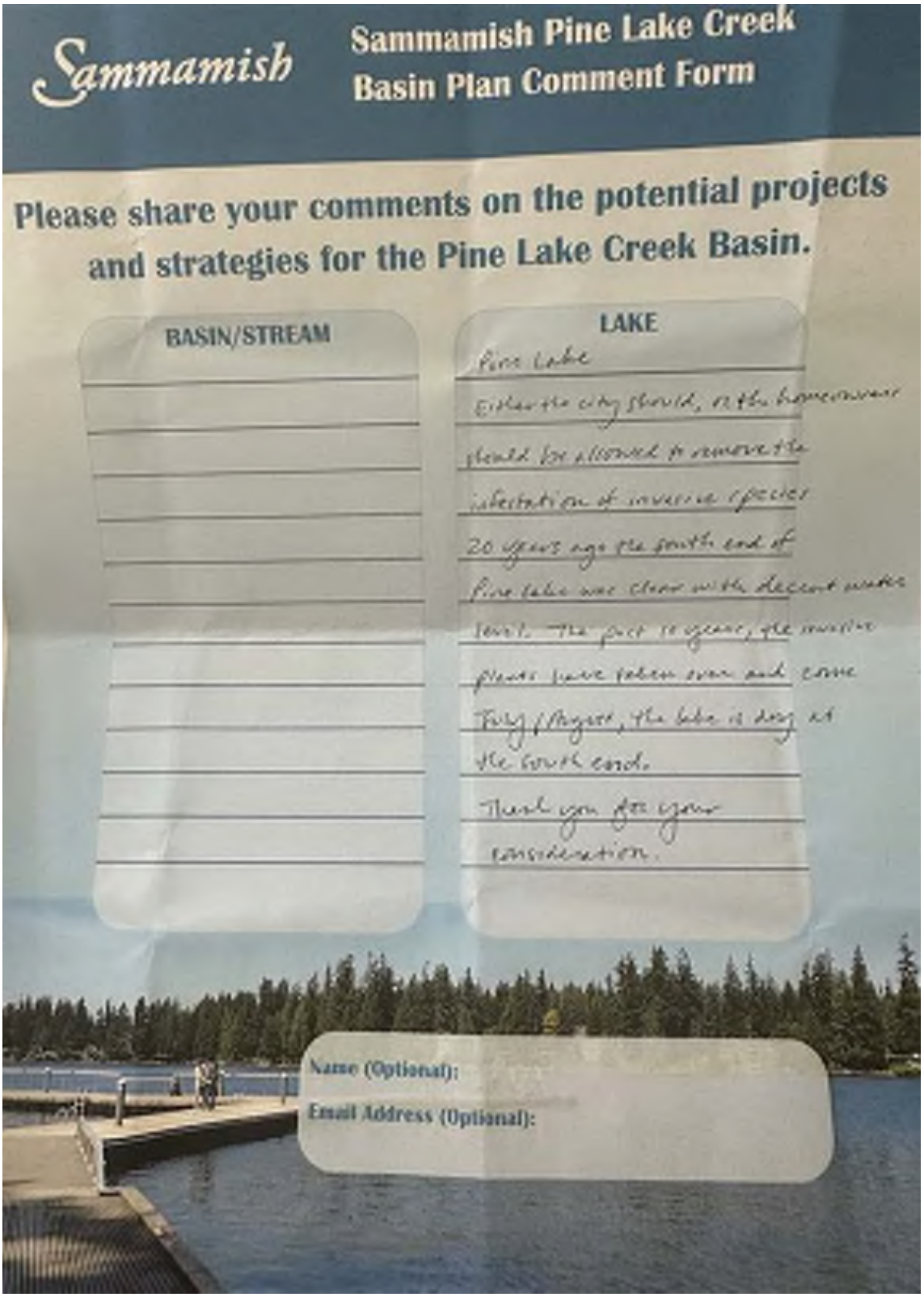
ase share your comments on the potential projects and strategies for the Pine Lake Creek Basin.

BASIN/STREAM

LAKE

RE: Pine Lake
pond weed gets worse every year. This was NOT an issue 5-6 years ago. Now the part of the lake near OFC is really congested with the weed by Summer. What can be done? It can't be good for the lake.


nmamish
Basin Plan Comment Form
share your comments on the potential projects
nd strategies for the Pine Lake Creek Basin.
BASIN/STREAM
LAKE
Re. The Lake Front Owners Education Program
As owners of Lake Front Property, WA
Are Agreeable to all making
any changes on our waterfront.
We Are Afraid that we will Be
Caught in Doing Something That
Violates Some Rule/Law/Policy.
Please. !!! Be Clear about
our Support with This Education
Program
Name (Optional):
Email Address (Optional):


Sammamish
Sammamish Pine Lake Creek Basin Plan Comment Form
Please share your comments on the potential projects and strategies for the Pine Lake Creek Basin.
BASIN/STREAM
LAKE
Pine Lake
Either the city should, or the homeowner should be allowed to remove the infestation of invasive species
20 years ago the south end of Pine Lake was clear with decent water level. The past 10 years, the invasive plants have taken over and come July/August, the lake is dirty at the south end.
Thank you for your consideration.
Name (Optional):
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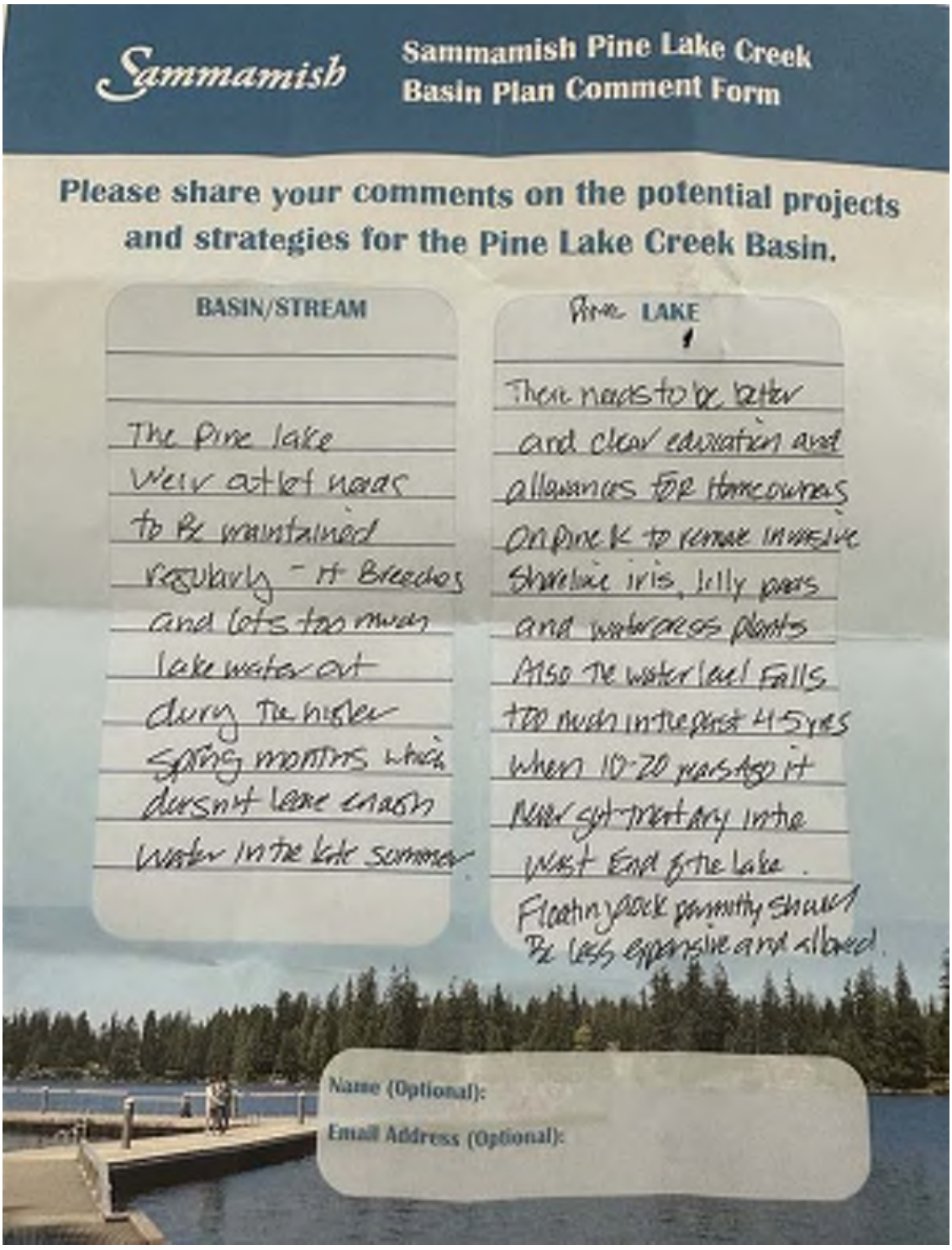


Sammamish

Sammamish Pine Lake Creek Basin Plan Comment Form

Please share your comments on the potential projects and strategies for the Pine Lake Creek Basin.

BASIN/STREAM

The Pine lake Weir outlet needs to be maintained regularly - it Breeches and lets too much lake water out during the higher spring months which doesn't leave enough water in the lake summer

Pine LAKE 1

There needs to be better and clear education and allowances for homeowners on pine lk to remove invasive Shoreline iris, lilly pads and waterweed plants Also the water level falls too much in the first 4-5 yrs when 10-20 years ago it never got that low in the west End of the Lake. Floating dock permitting should be less expensive and allowed.

Name (Optional):

Email Address (Optional):

Appendix C: Comment Letter from An Attendee

Pine Lake Weir Repair

Related by Roger Ek, Chemical Engineer

Date: 1984-85

Issue:

Pine Lake was experiencing a significant algae bloom brought on by very high phosphorus levels.

The Pine Lake homeowners' association engaged the UW and USGS to study the water quality issue. Roger said that homeowners kicked in $10 each. These funds covered the cost of contacting homeowners, and the remainder was used for the new weir.

There was an issue with the existing lake weir not holding the lake at the correct level.

The UW/USGS study concluded that the phosphorus loading was coming from the "bog" at the south end of the lake. It sounds like the UW/USGS study occurred before the development of the QFC commercial center.

Proposed Solution:

The proposed solution by Sammamish Plateau Water and Sewer District was to divert the seasonal stream that enters the south end of the lake to the Pine Lake Creek that drains into Lake Sammamish.

The District installed a 4 foot diameter diversion pipe. The diversion pipe runs from the south end stream (Blue Berry farm) to the Pine Lake outfall near the weir. The diversion pipe didn't work. Roger told me that in order to get the stream diversion to work, the District lowered the lake level by 3 feet.

Roger and Harvey Miller (civil engineer) attempted to remedy the low lake level with sandbags but the District immediately removed the sandbags. Roger and Harvey met with Ron Little, the District Manager, to impress on him that lakefront owners were materially impacted. The shallow cove south of Pine Lake Park had become a mud flat. As a result of Roger and Harvey's meeting, the District backed off its attempt make the diversion work by keeping the lake level low.

Next Steps:

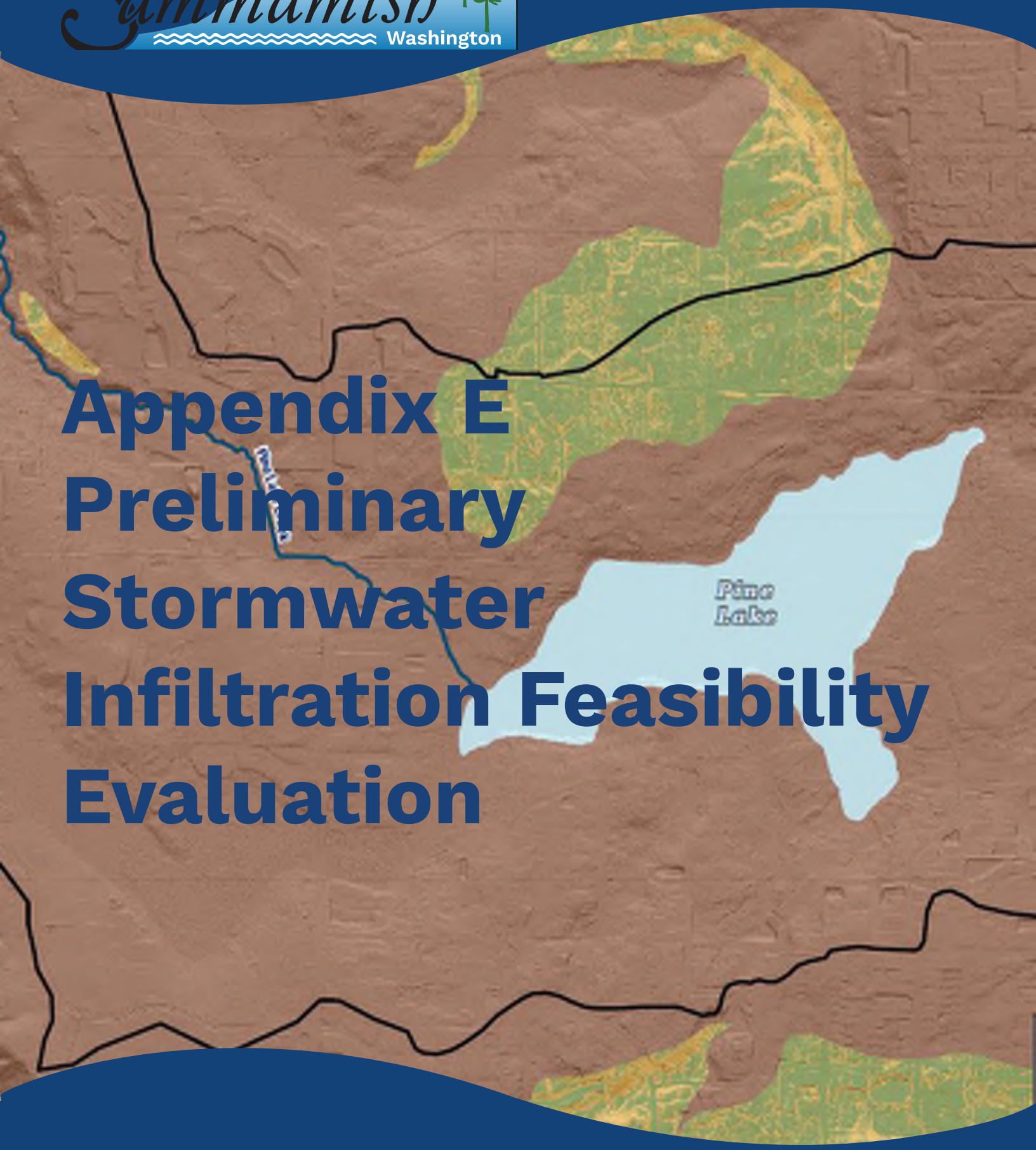
Roger and Harvey contacted WA Dept. of Ecology regarding a permit to install a new weir. DOE said that a permit would be $30,000. Alternatively, if the weir work cost less than $2,500, no permit would be required. Roger and Harvey added Bill Wright to their team. Using a scrap steel H-beam, Roger welded up a new weir structure. Construction also included 4x10 treated lumber and a removable piece at the top so the lake lever could be adjusted. Since they used salvaged materials and volunteer labor, there was little cost associated with the new weir.

Other:

For many, many years, Harvey Miller documented and managed the lake level by adjusting the weir.

In 1980 USGS installed a lake level gauge on the Pine Lake Park dock. The lake level was continually recorded by Harvey. The lake level records were vital for setting and managing the height of the weir. This work successfully mitigated pervious lake level issues.

City of Sammamish Washington



Appendix E Preliminary Stormwater Infiltration Feasibility Evaluation

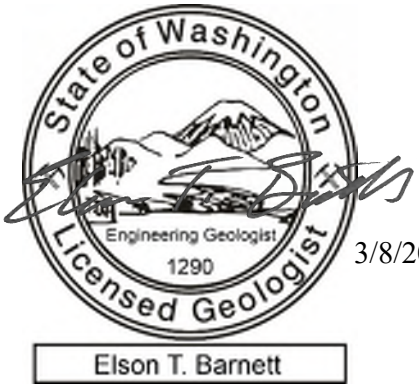
MEMORANDUM

Project No. 220462 - Task 4

March 8, 2024

To: Patty Dillon, Northwest Hydraulic Consultants

From:



3/8/2024

Elson T. "Chip" Barnett, LEG
Senior Engineering Geologist
chip.barnett@aspectconsulting.com

Bryan Berkompas
Principal Hydrologist
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J. Bodie McCosby, LG
Professional Geologist
J.Bodie.McCosby@aspectconsulting.com

Re: **City of Sammamish, Preliminary Stormwater Feasibility Evaluation, Pine Creek Basin Planning**

This memorandum, prepared by Aspect Consulting, a Geosyntec Company (Aspect), provides Northwest Hydraulic Consultants (NHC) and the City of Sammamish (City) with an evaluation of stormwater infiltration feasibility as part of the Pine Creek Basin Planning Project (Project). The Project aims to develop priority strategies, projects, and actions to address flooding, erosion, water quality, and ecological problems in the approximately 1,200-acre basin near the south end of the Sammamish Plateau in Sammamish, Washington (Figure 1).

The basin has some of the highest resource value in the City. It contains Pine Lake, Pine Lake Creek, Kanim Creek, and a sphagnum bog complex along with several smaller wetlands. Development (mostly residential) has increased over the past decade, especially around Pine Lake, but lower Pine Lake Creek flows through some of the largest remaining areas of contiguous forest within the City limits. Pine Lake Creek historically supported a substantial kokanee run and is still

considered one of four primary spawning streams by the Kokanee Work Group, despite reduced spawning populations in recent years.

The City has selected NHC to develop a basin plan for the Pine Lake Creek watershed that considers both future development and climate resiliency in prioritizing and designing projects and solutions.

In support of the Project, Aspect completed a desktop-level GIS-based geological survey of the basin. We created maps of surface conditions, including ground surface topography, aerial photography, surficial geology, slopes, wetlands, critical areas, and existing facilities. Existing geotechnical reports and studies within the area of study were included in the review to incorporate measured data where available and are listed at the end of this memorandum.

We evaluated the combination of this GIS data and existing reported soils data to develop a shallow infiltration feasibility map that identifies areas expected to have high, medium, and low capacity for shallow infiltration. We also developed a map of existing stormwater management infrastructure (Figure 2), which is primarily comprised of catch basins with scattered area drains. This memorandum is intended for use by NHC as input to further investigate particular areas or sites This memorandum is intended for use by NHC as input to further investigate particular areas or sites within the basin as preferential stormwater infiltration areas.

The following sections provide an overview of local geology and available geotechnical data, a description of data reviewed for the infiltration feasibility GIS-based analysis, the resulting shallow infiltration feasibility map, and our recommended next steps for the Project.

Overview of Local Geology

Local soils will directly inform the feasibility for infiltration across the basin. Based on our review of the geologic map (Booth et al., 2012), the basin is underlain by a sequence of Pleistocene Vashon Stade continental glacial deposits consisting of stratified recessional deposits (Qvr), ice-contact deposits (Qvi), glacial till (Qvt), and advance outwash (Qva). Underlying the sequence of Vashon Stade glacial deposits are undifferentiated pre-Fraser glacial deposits (Qpf).

The recessional deposits consist chiefly of poorly graded sand and gravel with few fines. The unit is subdivided according to origin and topographic form with outwash in the basin. The ice-contact deposits consist chiefly of poorly sorted silt, sand, and gravel. The glacial till deposits consist of a diamict[1] of dense to very dense silty sand with gravel. The advance outwash consists of poorly graded sand gravel with very few fines. The pre-Fraser glacial deposits are undifferentiated and can consist of very dense deposits of silt, sand, and gravel.

Younger nonglacial deposits present in the basin consist of mass-wastage deposits (Qmw), landslide deposits (Qls), wetland deposits (Qw), alluvial fan deposits (Qf), and alluvial deposits (Qal).

A map showing the surficial geology of the basin is presented on Figure 3.

[1] Diamict is defined as a well-graded to poorly graded deposit that contains particles ranging in size from clay to boulders, suspended in a matrix of mud or sand.

Data Review

Aspect compiled and reviewed data, including GIS data from the City, King County, and various state agencies, as well as geotechnical reports from the Washington State Department of Natural Resources (DNR) subsurface database (DNR, 2024) and made available by the City. The following sections describe the various data we reviewed.

Topography

King County Light Detection and Ranging (LiDAR) data with a 3-ft cell size resolution covers the basin. Ground surface elevations and 10-foot topographic contours were developed from the 2021 King County LiDAR data as shown on Figure 4. The basin topography ranges from Elevation 445[2] feet in the south to Elevation 30 feet in the northwest portion of the Project area.

Critical Areas

The City has established a set of Critical Areas Regulations protect health, safety, welfare, and property by minimizing adverse environmental impacts due to development within and near to critical areas. (City, 2022)

The mapped extent of critical areas was provided from the City's Critical Area Inventory maps and GIS data from the City's data (2023). Mapped critical areas for geologic hazards within the basin are listed below and shown on Figure 5.

- **Erosion Hazard Areas** – *City of Sammamish Erosion Hazard Areas* map show areas subject to erosion hazards. There are erosion hazard areas mapped within the north central portion of the basin (Figure 5).
- **Landslide Hazard Areas** – *The City of Sammamish Landslide Hazard* maps approximately 70 acres of landslide hazard area within the north central portion of the basin (Figure 5).
- **Seismic Hazard Areas** – *The City of Sammamish Seismic Hazard Areas* map shows an isolated seismic hazard area in the northwest tip of the basin where it outlets into Lake Sammamish.

There are otherwise no known hazards in the basin.

Geotechnical, Soil, and Groundwater Data Review

Aspect reviewed available GIS data and reports to characterize the soil and the soil's potential to infiltrate stormwater runoff. Our methods and findings are described below.

Geotechnical and Soil Data

Using the *Washington Geological Survey 1:24,000 Surficial Geologic Units* map and geotechnical reports available from DNR and provided by the City, Aspect mapped 27 subsurface locations within the basin to assess feasibility for stormwater infiltration. In general, the subsurface data corroborate the geologic mapping with outwash and till units observed as mapped on Figure 3.

[2] 1 Elevations referenced to North American Vertical Datum of 1988 (NAVD88).

Groundwater Data

There is no available GIS layer that maps depth to groundwater or areas of shallow groundwater across the basin. Areas of shallow groundwater are typically less than ideal for infiltration. In general, shallow groundwater can be expected to perch on glacial till and the pre-Fraser deposits in the basin. There is no groundwater data available within the western portion of the basin that includes deposits of outwash.

Shallow Infiltration Feasibility Assessment and Map

We assimilated the mapped data and previous studies and assessed shallow infiltration feasibility within the basin. The unique combinations of the factors show areas that are more or less likely to be feasible for infiltration. The individual factors of the following input data within the basin are:

- Geologic Hazard Areas
- Surface Slope Classification
- Soil Permeability

Geologic Hazard Areas

Three input datasets from the City's available Critical Area Inventory were used to identify geologic hazard areas not suitable for infiltration site locations. Erosion, Landslide, and Seismic Hazard areas were considered poor for shallow infiltration (Figure 5).

Surface Slope Classification

The steepness of a surface slope is a factor in the potential for runoff to effectively infiltrate. If the ground surface is too steep, water can daylight down the slope from the point of infiltration. Steeper slopes can pose design challenges. The City's Critical Area regulations define medium landslide hazards as areas with slopes between 15 and 40 percent. Spatial analysis was used to calculate the slope percentage over the basin from the King County 2021 LiDAR data (King County, 2021). Areas within the basin fall within one of three categories:

- Good: Slopes less than 8 percent
- Moderate: Slopes between 8 and 15 percent
- Poor: Slopes greater than 15 percent

These categories reflect previous observations across the region of slopes in relation to infiltration and potential hazard issues due to ground surface slope. The surface slope categories present over the basin are shown on Figure 6.

Soil Permeability

The permeability of a soil is the primary factor in determining its feasibility for infiltration. Typically, higher permeability soils are more feasible for shallow stormwater infiltration. If the soil cannot infiltrate runoff effectively, flooding and water quality issues can occur.

The properties of the surface soils in the basin were evaluated for their permeability and categorized into two permeability groups (Figure 7):

- Low permeability (infiltration estimated at 0-5 inches/hour)
- High permeability (infiltration estimated at greater than 5 inches/hour)

Soil Infiltration Map

Figure 8 shows areas across the basin that are expected to have good, moderate, and poor capacity for shallow infiltration (generally less than 10 feet deep).

- Good – Shallow infiltration is expected to be feasible, unlikely to pose hazards, and cost effective.
- Moderate – Shallow infiltration is expected to be feasible with slopes are between 8 and 15 percent.
- Poor – Shallow infiltration is expected to have a low potential or risks to impact geologic hazards could be high. Areas shown mapped as Poor may not necessarily exhibit poor infiltration upon further site investigation.

Recommendations and Next Steps

Our recommendations for next steps on the Project are to:

- Identify explorations that include borings and monitoring wells in the basin where infiltration appears most feasible.
- Identify potential pilot infiltration testing locations at potential stormwater retrofit sites.

References

Booth, D.B., T.J. Walsh, K.G. Troost, S.A. Shimel (Booth, et al,) 2012, Geologic Map of the East Half of the Bellevue South 7.5' x 15' Quadrangle, Issaquah Area, King County, Washington. U.S. Geological Survey, Scientific Investigations Map 3211.

City of Sammamish, 2022, Critical Areas Regulations, Chapter 21.03.020, accessed January 11, 2024.

City of Sammamish, 2023 Critical Area GIS Data accessed on June 20, 2023

King County KCGIS Center GIS, 2021 LiDAR data, accessed on August 6, 2023, http://www5.kingcounty.gov/gisdataportal/Default.aspx.

Washington Department of Natural Resources (DNR), 2024, Subsurface Database, accessed on January 2, 2024, https://geologyportal.dnr.wa.gov/2d-view#wigm?-14199785,-13055064,5755625,6320648?Subsurface_Geology,Borehole_information

Reports Reviewed for Infiltration Mapping

Dodds Geoscience Inc., 2000, Geotechnical Engineering Report, Proposed Residence, 20808 S.E. 20th Street, Sammamish, Washington, for Scott and Monica Anderson, July 20, 2000.

Earth Consultants, Inc., 1988, Geotechnical Engineering Study, Peck's Bog, Southeast 28th Street and 212th Avenue Southeast, King County, Washington, for Mr. Dave Kline, May 20, 1988.

Zipper Zeman Associates, Inc., 1998, Report, Geotechnical Services, Proposed New Garage for Reddy Residence, 929 East Lake Sammamish Shore Lane, King County, Washington, for Jim and Peggy Reddy, November 2, 1998.

Limitations

Work for this project was performed for City of Sammamish (Client), and this report was prepared consistent with recognized standards of professionals in the same locality and involving similar conditions, at the time the work was performed. No other warranty, expressed or implied, is made by Aspect Consulting (Aspect).

Recommendations presented herein are based on our interpretation of site conditions, geotechnical engineering calculations, and judgment in accordance with our mutually agreed-upon scope of work. Our recommendations are unique and specific to the project, site, and Client. Application of this report for any purpose other than the project should be done only after consultation with Aspect.

Variations may exist between the soil and groundwater conditions reported and those actually underlying the site. The nature and extent of such soil variations may change over time and may not be evident before construction begins. If any soil conditions are encountered at the site that are different from those described in this report, Aspect should be notified immediately to review the applicability of our recommendations.

It is the Client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, and agents, are made aware of this report in its entirety. At the time of this report, design plans and construction methods have not been finalized, and the recommendations presented herein are based on preliminary project information. If project developments result in changes from the preliminary project information, Aspect should be contacted to determine if our recommendations contained in this report should be revised and/or expanded upon.

The scope of work does not include services related to construction safety precautions. Site safety is typically the responsibility of the contractor, and our recommendations are not intended to direct the contractor’s site safety methods, techniques, sequences, or procedures. The scope of our work also does not include the assessment of environmental characteristics, particularly those involving potentially hazardous substances in soil or groundwater.

All reports prepared by Aspect for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect. Aspect’s original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Please refer to Appendix A titled “Report Limitations and Guidelines for Use” for additional information governing the use of this report.

We appreciate the opportunity to perform these services. If you have any questions please call Chip Barnett, Senior Engineering Geologist, at 206-413-5398.

Attachments:
Figure 1 – Site Location Map
Figure 2 – Stormwater Map
Figure 3 – Surficial Geologic Units
Figure 4 – Surface Elevation
Figure 5 – Geologic Hazard Areas
Figure 6 – Surface Slope Classification
Figure 7 – Soil Permeability
Figure 8 – Shallow Infiltration Feasibility
Appendix A – Report Limitations and Guidelines for Use

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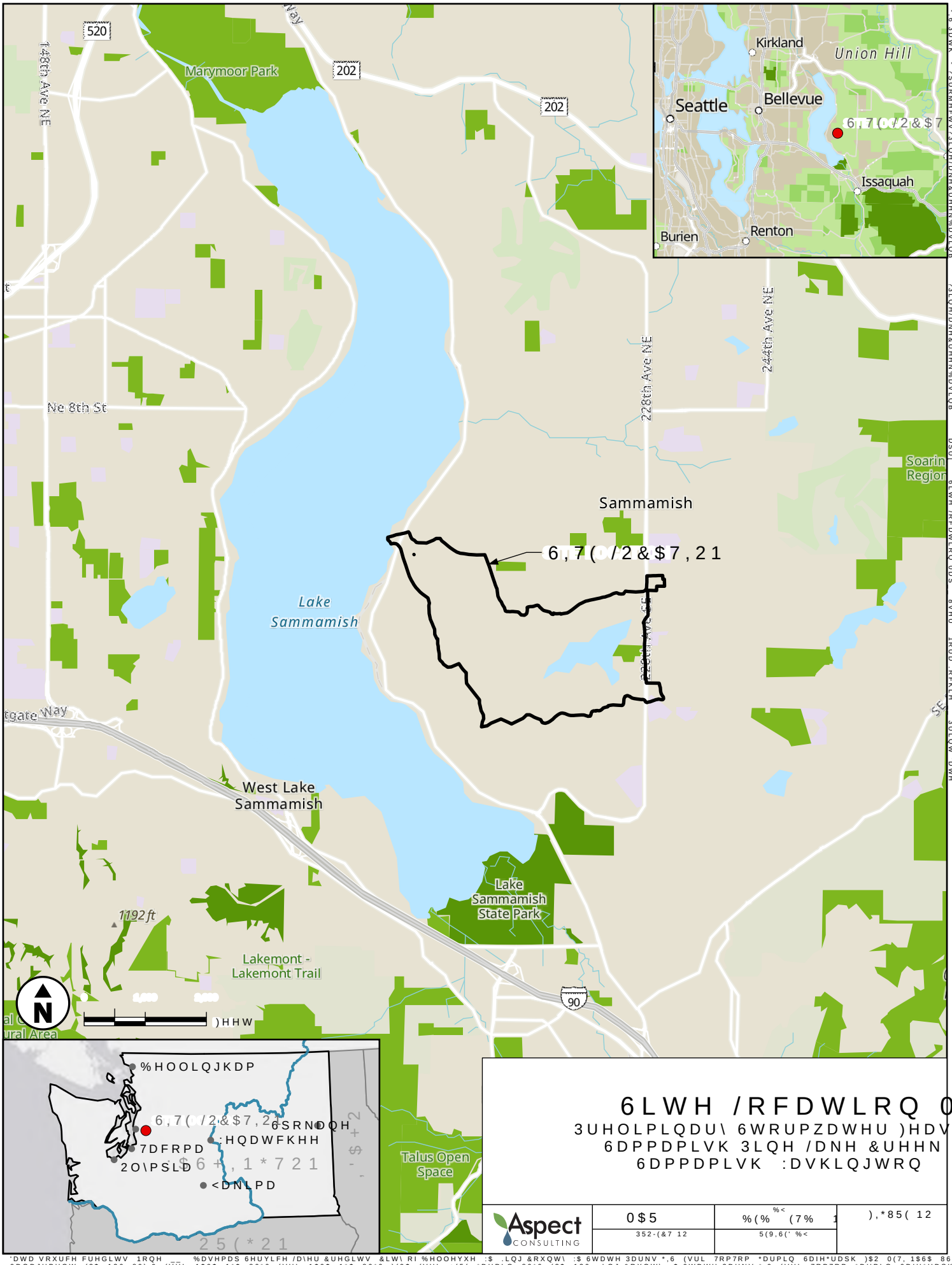
FIGURES



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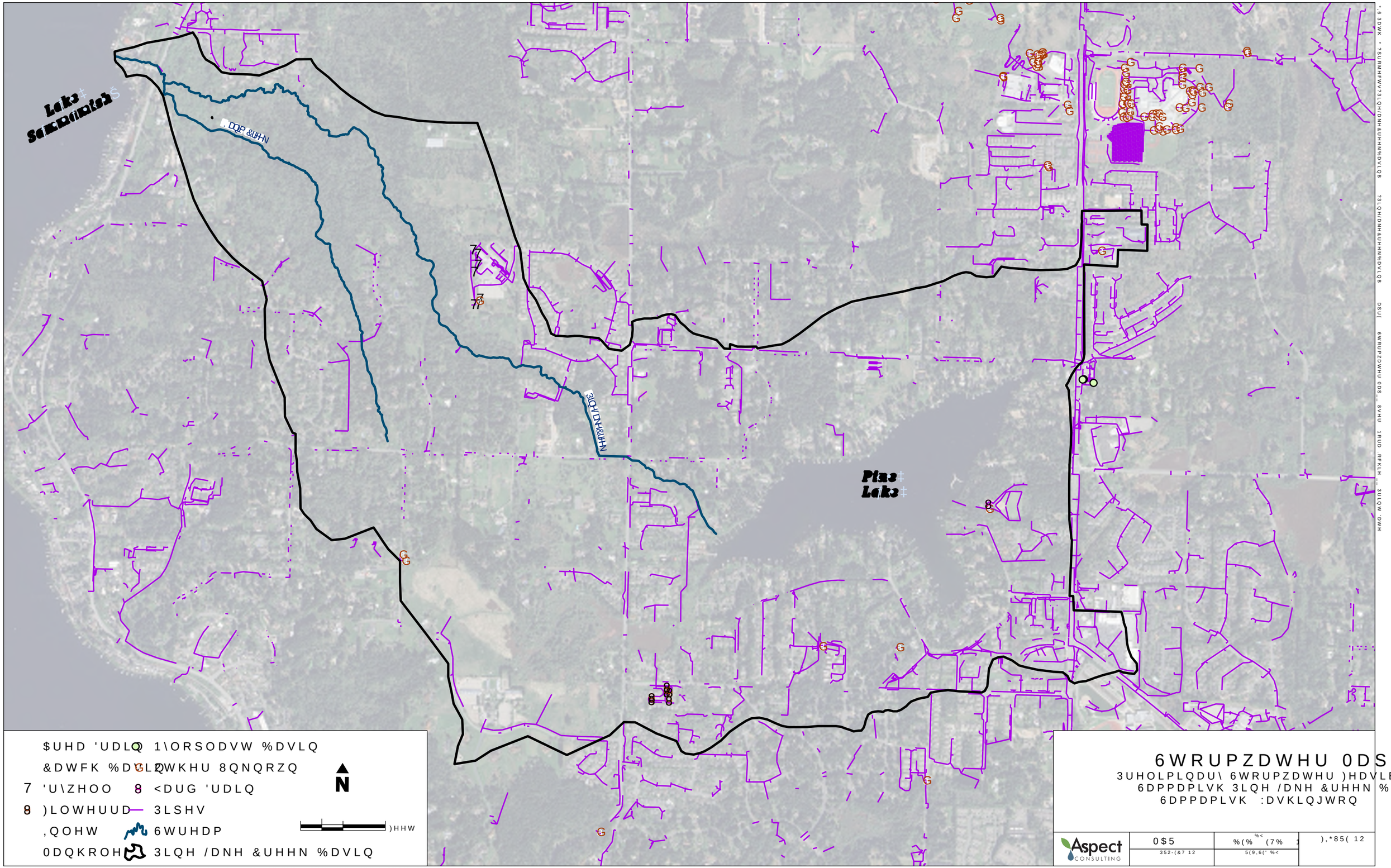

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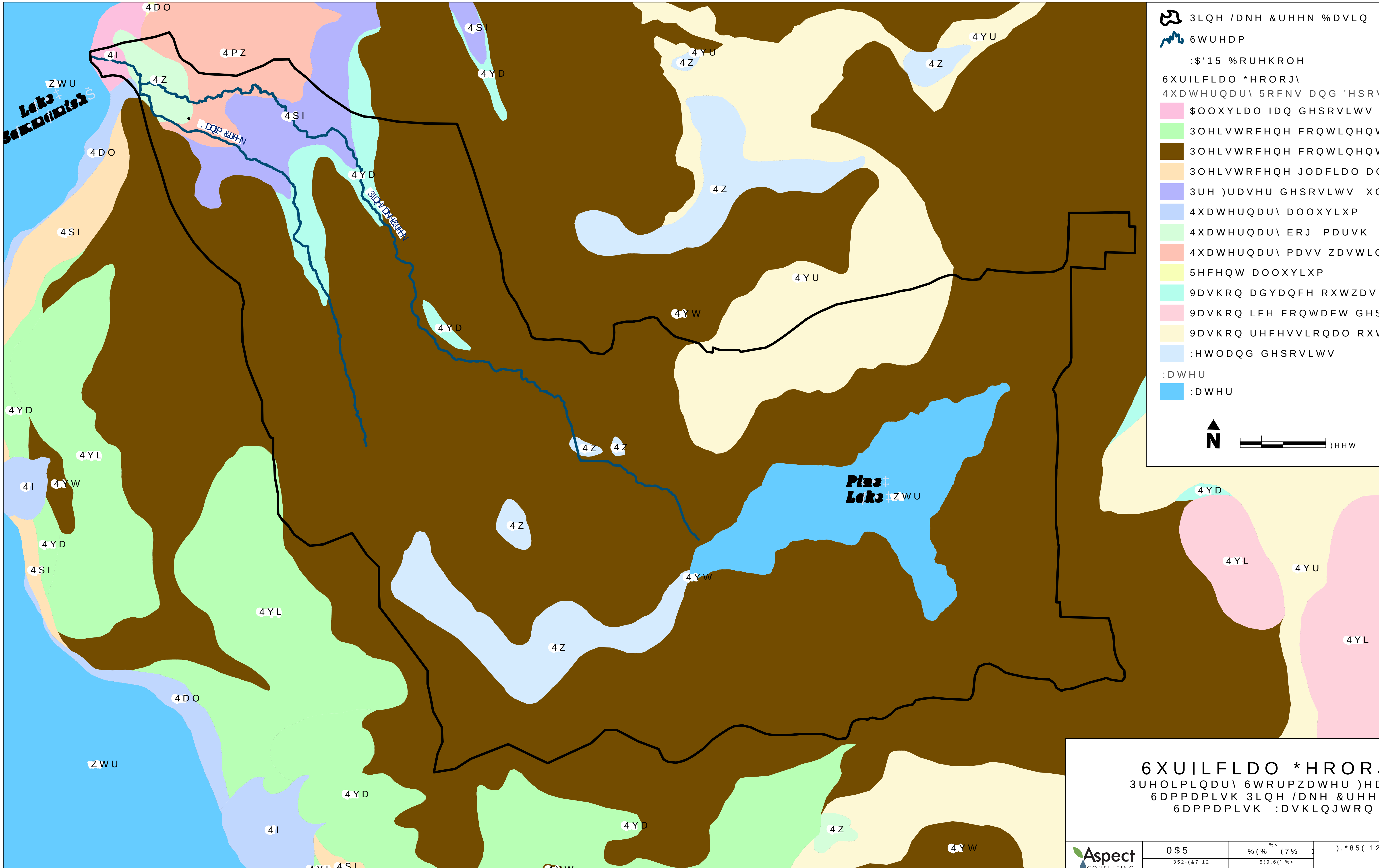

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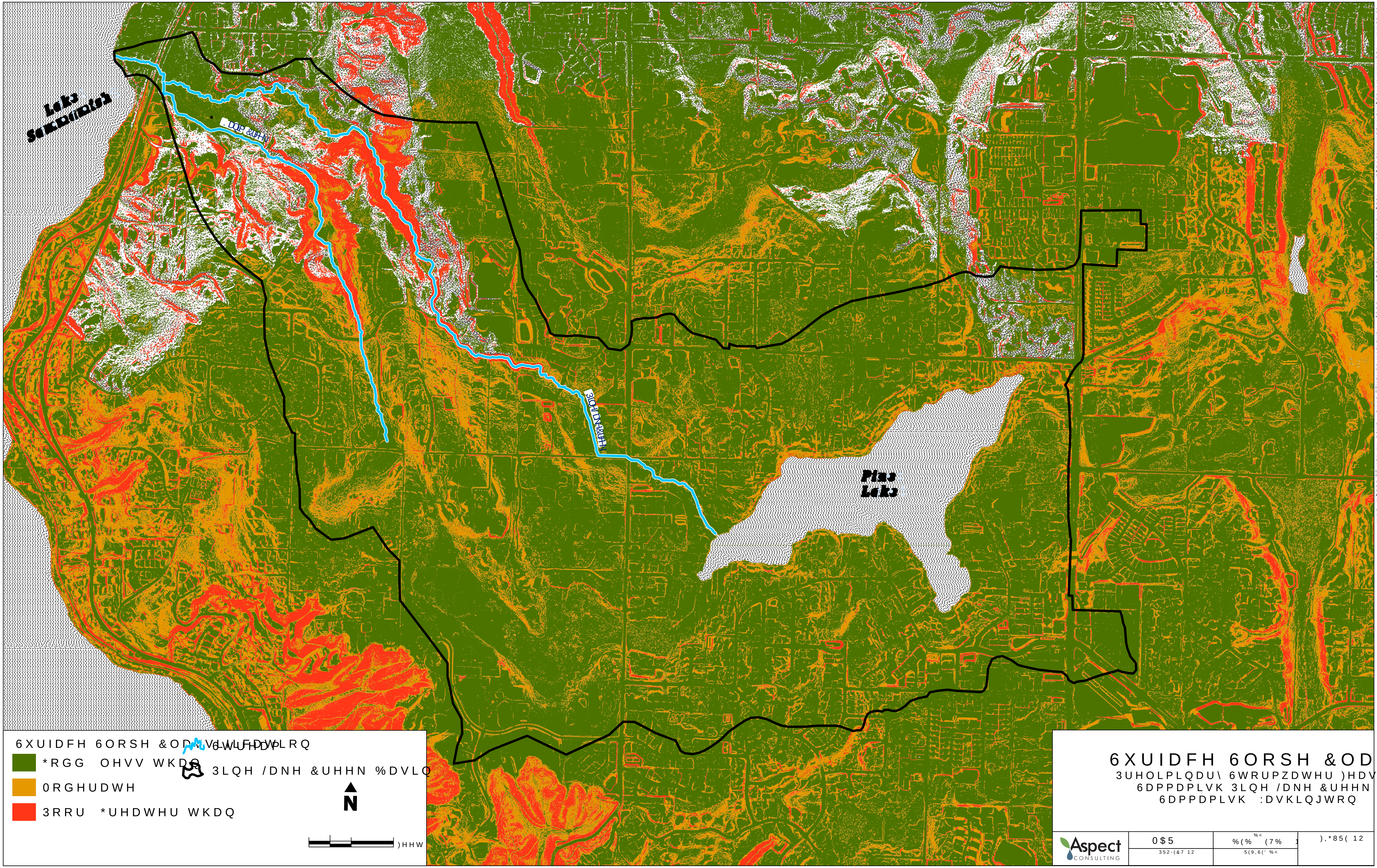
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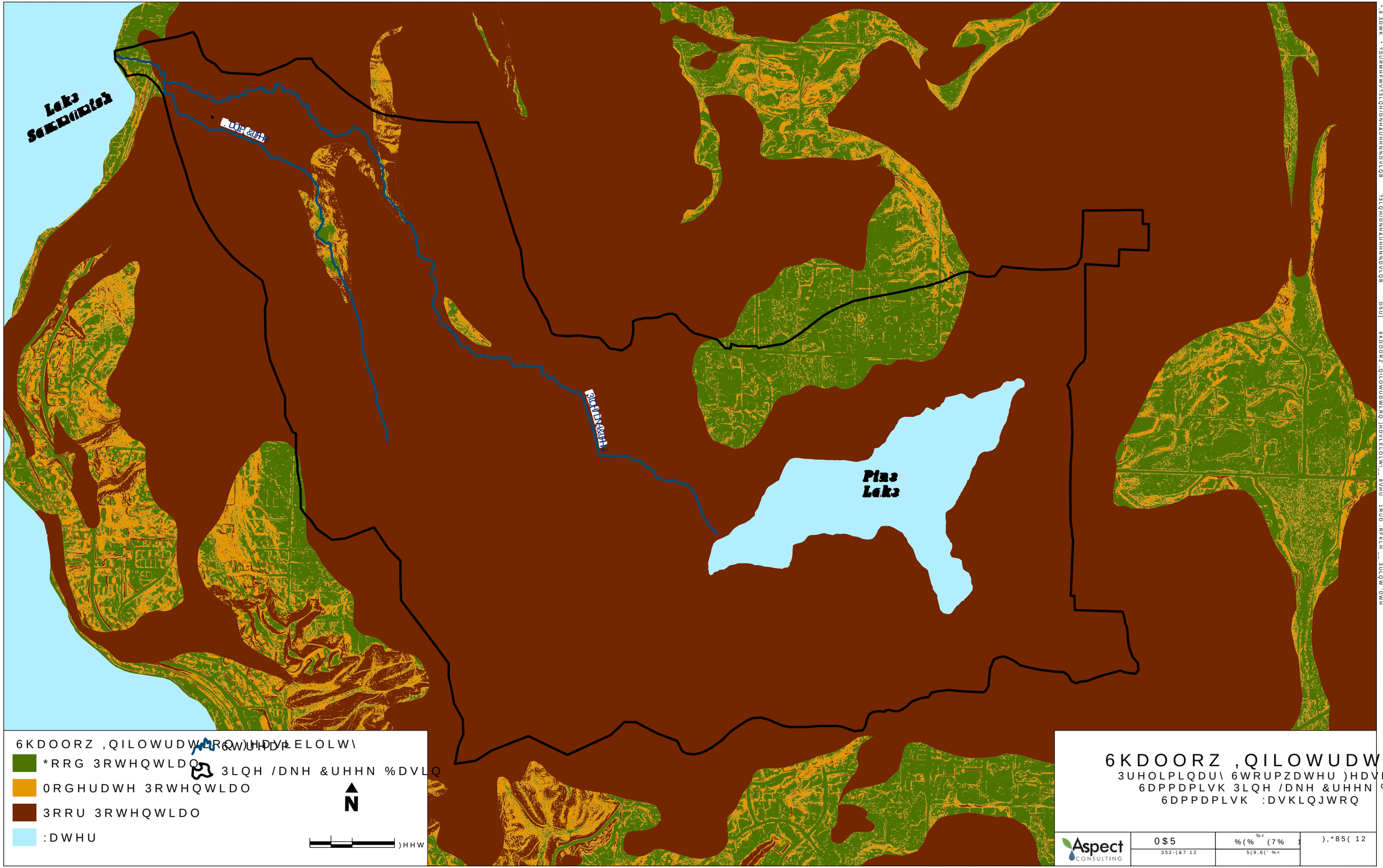

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APPENDIX A

Report Limitations and Guidelines for Use

APPENDIX A

Report Limitations and Guidelines for Use

REPORT LIMITATIONS AND GUIDELINES FOR USE

This Report and Project-Specific Factors

Aspect Consulting, LLC (Aspect) considered a number of unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you
- Not prepared for the specific purpose identified in the Agreement
- Not prepared for the specific real property assessed
- Completed before important changes occurred concerning the subject property, project or governmental regulatory actions

Geoscience Interpretations

The geoscience practices (geotechnical engineering, geology, and environmental science) require interpretation of spatial information that can make them less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Use Guidelines" apply to your project or site, you should contact Aspect.

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual limitations. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with our Agreement with the Client and recognized geoscience practices in the same locality and involving similar conditions at the time this report was prepared.

Property Conditions Change Over Time

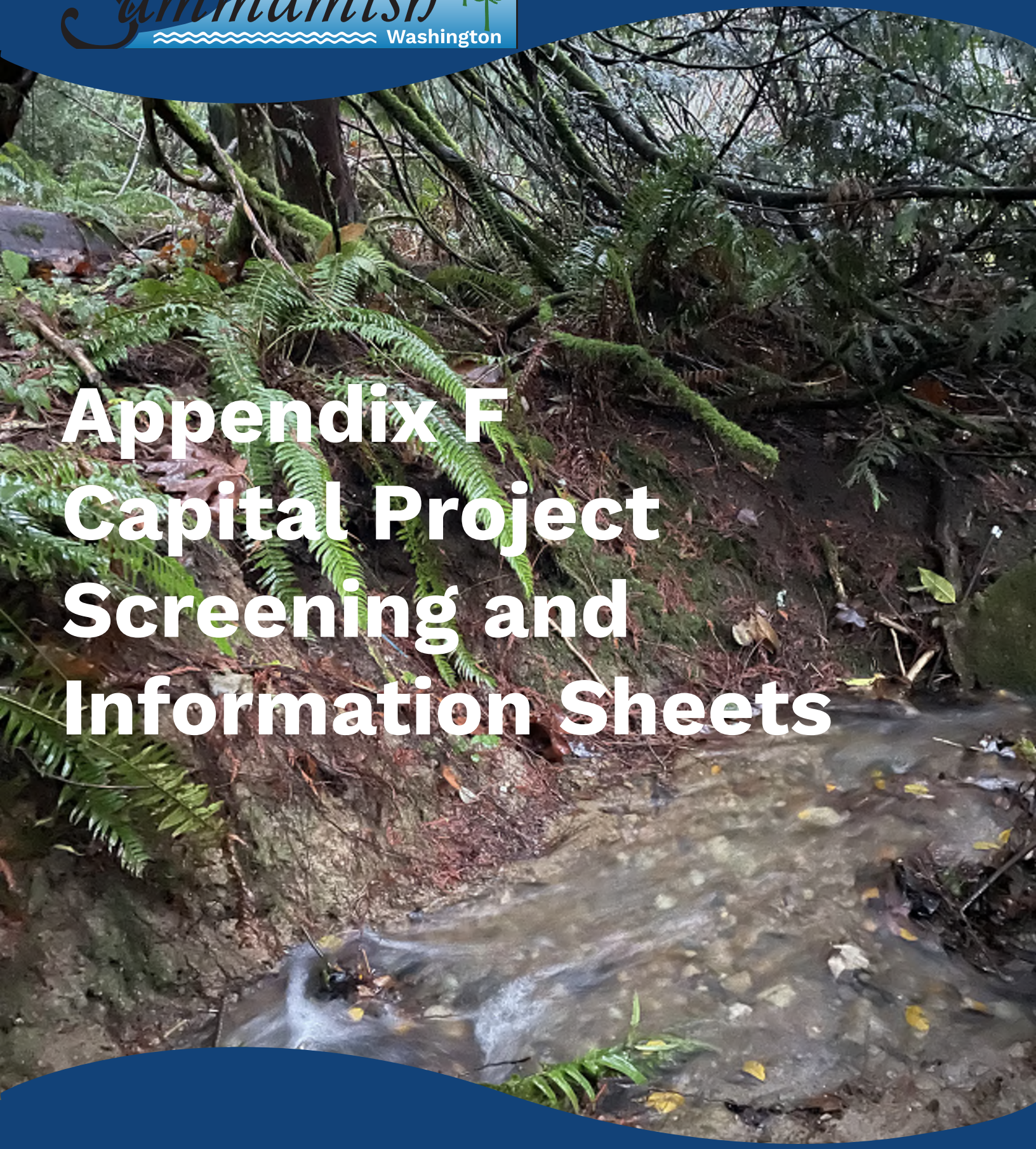
This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as a change in property use or occupancy, or by natural events, such as floods, earthquakes, slope instability, or groundwater fluctuations. If any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Discipline-Specific Reports Are Not Interchangeable

The equipment, techniques, and personnel used to perform a geotechnical or geologic study differ significantly from those used to perform an environmental study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions, or recommendations (e.g., about the likelihood of encountering underground storage tanks or regulated contaminants). Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

We appreciate the opportunity to perform these services. If you have any questions, please contact the Aspect Project Manager for this project.

City of Sammamish Washington



Appendix F Capital Project Screening and Information Sheets

Capital Project Identification and Screening

Capital projects were identified by review of the City's retrofit strategy and gaps in basin stormwater treatment, review of previously identified projects and strategies, direct observation, and staff, stakeholder, and community input.

An initial GIS screening was conducted using methodology developed in the retrofit strategy to determine parcels that would be appropriate for restoration or stormwater retrofit. The general methodology is outlined in the City of Sammamish Retrofit Strategy and Guidance Manual (Sammamish, 2021). Parcels were scored and ranked for restoration or retrofit potential. Figures F-1 and F-2 show the results of the parcel screening for restoration and retrofit, respectively.

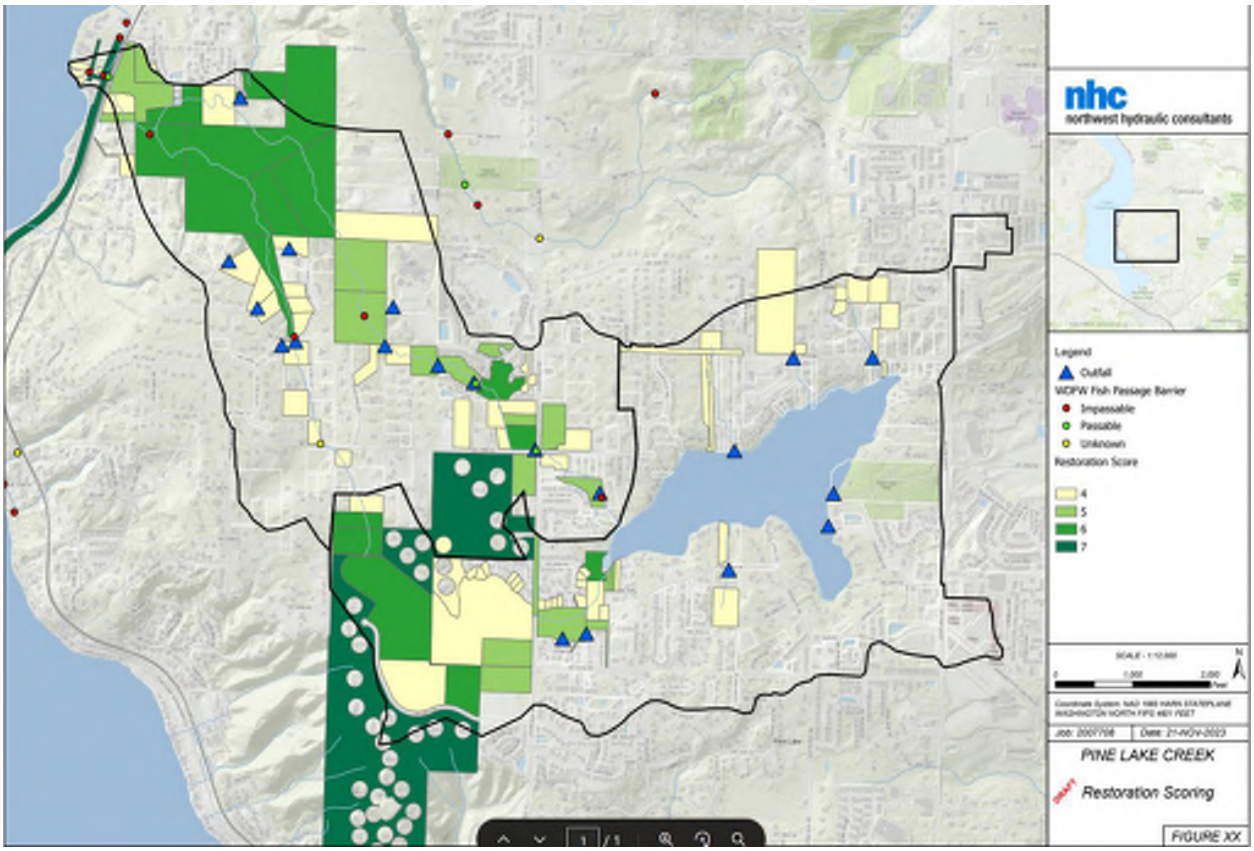


Figure F-1. Results of GIS-based Restoration Screening

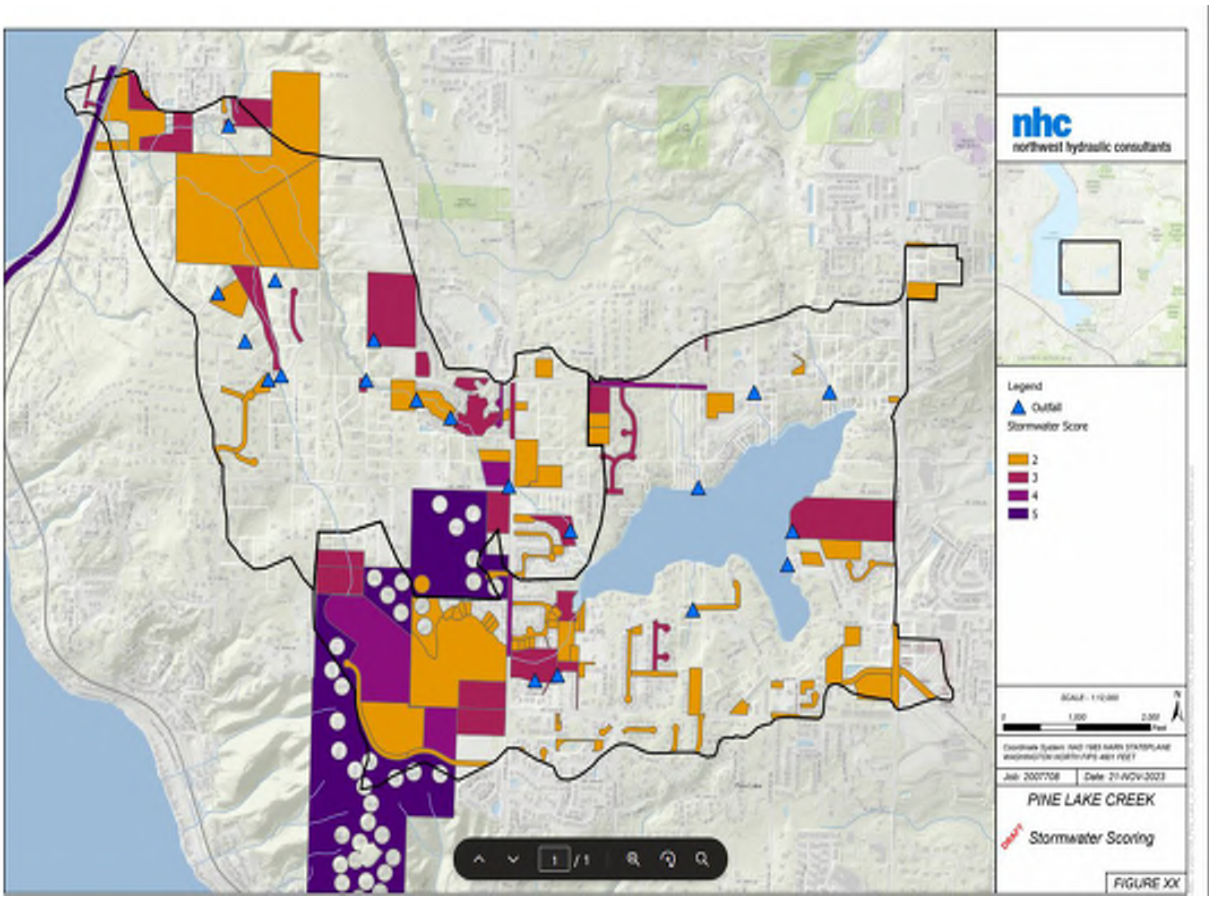


Figure F-2. Results of GIS-based Retrofit Potential Screening

After the initial screening, the parcels were reviewed in more detail to determine whether problems were reported or direct observations indicated that restoration was needed. Several parcels in the Pine Lake Creek corridor were included in the initial capital project list for restoration near the mouth (green squares in the upper left corner of Figure F-1). One of the retrofit sites identified by the GIS analysis is a recommended CIP project. After a closer review of the analysis, more appropriate retrofit sites were identified based on field conditions and direct observations.

Prioritization

Thirteen potential capital projects were initially identified, including restoration projects and stormwater retrofit projects. The projects were ranked using the City's stormwater capital improvement project prioritization methodology (City of Sammamish 2018. Resolution No. R2018-804). The methodology uses six

criteria to evaluate capital projects against one another, including:

- Environmental benefits —how many benefits the project solution provides such as flow control, infiltration, riparian habitat, water quality, etc.
- Growth and climate change — how well the project addresses future growth and or climate impacts.
- Maintenance — whether the project solves a maintenance problem or accessibility for maintenance crews.
- Safety — whether the project solves a safety issue and what the severity and frequency of the issue is.
- Population benefited — how many people benefit from the project (i.e., a neighborhood, the entire City, etc.)
- Time sensitivity — whether the project is linked to an urgent or non-urgent issue or opportunity, permit, or project.

The list of capital projects was refined after discussion with city staff. Projects located on private parcels were eliminated from further consideration because they would require easements, acquisition, or cooperation with landowners. The city was more interested in proceeding with capital projects that were more easily implementable on public property. This resulted in the initial list being refined to eight capital projects and all of the restoration projects on private property were eliminated from consideration or inclusion on the CIP.

Additional projects on the list were eliminated after further investigation revealed that improvements were less significant than originally thought. The final capital projects recommended for Pine Lake Creek basin were developed into summary sheets included in this appendix. The locations of the capital projects are shown in Figure F-3 and the summary sheets follow.

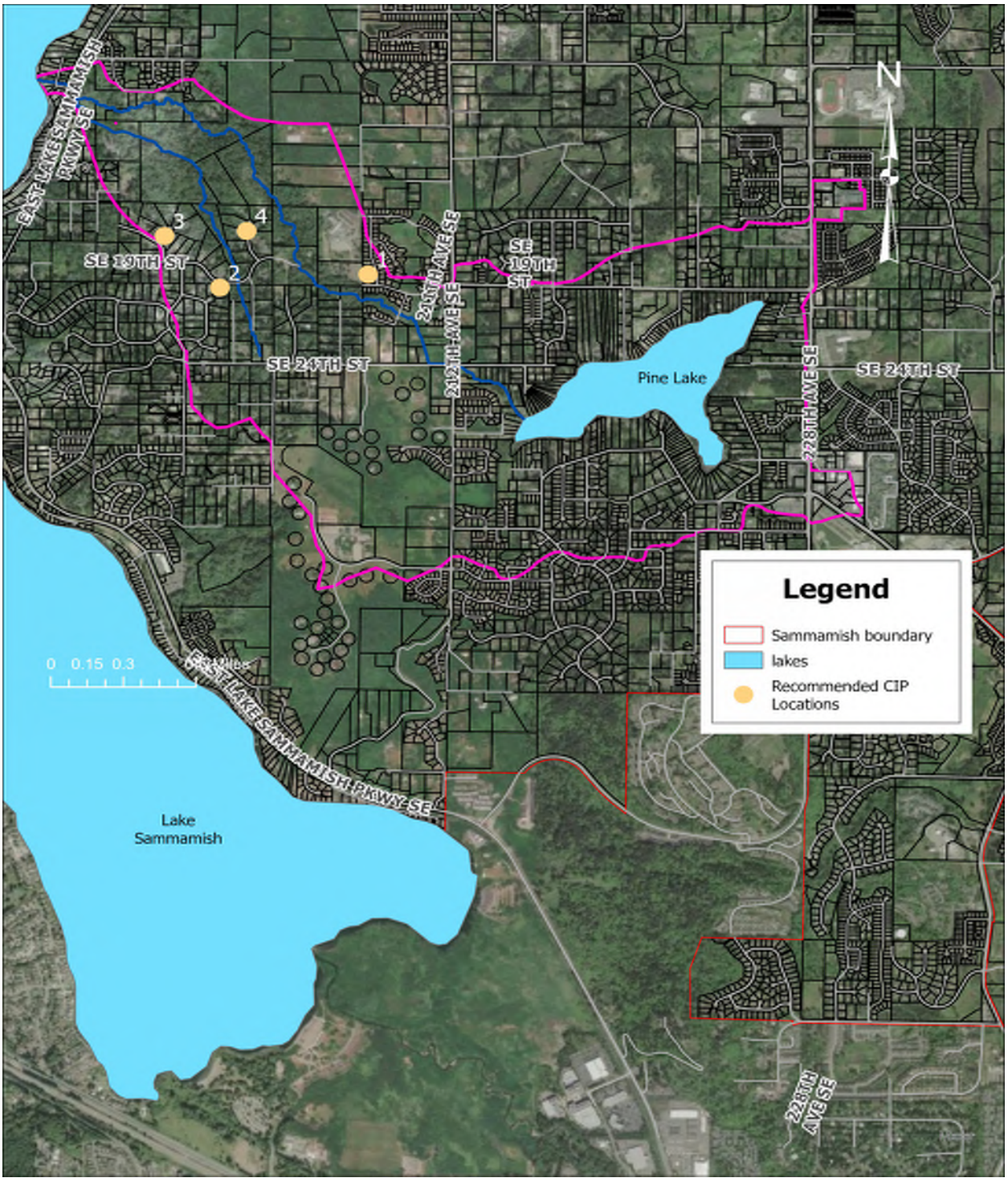


Figure F-3. Locations of Recommended Capital Projects

Pine Lake Creek Basin Plan
Capital Project Fact Sheet

Capital Project #1
D92928

Cost (2024 dollars): $1,412,500
Stormwater Pond Retrofit

Vicinity Map

Plan View

Project Description:

Pond retrofit to improve detention, flow control, and water quality. There is an opportunity to expand the pond, which was built in 2000's prior to current flow control design standards.

Design Considerations:

- Survey and geotechnical investigation will be needed to investigate groundwater, soil stability, and available footprint for design decisions.
- Existing utility infrastructure will need preserved or replaced.
- Ideal design will maintain/reuse established foliage and pond infrastructure to the extent feasible.

Potential Benefits:

- Will reduce peak flows and erosion in Pine Lake Creek.
- Will improve water quality in Pine Lake Creek.
- May be grant eligible.

Potential Challenges:

- Traffic access during construction.
- Noise associated with construction.

Pine Lake Creek Basin Plan
Capital Project Fact Sheet

Capital Project #1
D92928

CIP Project Prioritization Scoring: 65/100

Environmental Benefit	Facility/Maintenance Improvements	Safety	Population Benefited	Time-Sensitive Opportunity
30/30	20/25	0/25	10/10	5/10

Project Schematic

Planning Level Cost Estimate

Item No.	Estimated Quantity	Unit	Description	Unit Cost	Amount
1	1	LS	Mobilization	$ 75,000.00	$ 75,000.00
2	1	CALC	Minor Change	$ 10,000.00	$ 10,000.00
3	1	LS	SPCC Plan	$ 1,500.00	$ 1,500.00
4	1	LS	Clearing and Grubbing	$ 8,000.00	$ 8,000.00
5	1	LS	Erosion Control and Water Pollution Prevention	$ 12,000.00	$ 12,000.00
6	1	LS	Project Temporary Traffic Control	$ 5,000.00	$ 5,000.00
7	1	LS	Removal of Structures and Obstructions	$ 2,500.00	$ 2,500.00
8	1	LS	Landscape Restoration & Plantings	$ 7,000.00	$ 7,000.00
9	1	EST	Licensed Surveying, Incl. Asbuilts	$ 7,000.00	$ 7,000.00
10	300	LF	Removing and replacement of Chain Link Fence w/Black Vinyl Coating	$ 80.00	$ 24,000.00
11	4900	CY	Excavation, Embankment and Grading, Incl Haul	$ 30.00	$ 147,000.00
12	3300	CY	Engineering Soils	$ 80.00	$ 264,000.00
13	2500	SF	Retaining and Baffle Walls	$ 65.00	$ 162,500.00
14	1	LS	Adjust Existing Utilities	$ 5,000.00	$ 5,000.00
15	1	EA	Storm and Pond Structure Improvements	$ 12,000.00	$ 12,000.00
			Subtotal =		$ 742,500.00
			Contingency (30%)		$ 222,800.00
			Sales Tax (10.2%)		$ 75,735.00
			Environmental Permitting and Documentation (15%)		$ 111,400.00
			Administration (5%)		$ 37,200.00
			Preliminary Engineering, PS&E and Construction Management (30%)		$ 222,800.00
			Total Construction Cost:		$ 1,412,500.00

Pine Lake Creek Basin Plan
Capital Project Fact Sheet

Capital Project #2
D92928

Cost (2024 dollars): $3.2 M
Retrofit and Restoration

Vicinity Map

Plan View

Project Description:

Stormwater outfall has noticeable erosion and overflow, with downstream excessive peak flows. Updated detention infrastructure is proposed to reduce peak flows during storms, reduce erosion, and improve water quality.

Design Considerations:

- Surveying and geotechnical investigations will be needed.
- Clearing and grubbing will need to consider established foliage, especially trees.
- Current infrastructure shows signs of failing, which may complicate construction.

Potential Benefits:

- Reduce high flows, erosion, and improve water quality in Kanim Creek.
- Expanded detention capabilities with large upstream area may provide significant improvements over current detention capacity.
- Reduce maintenance needs for erosion at outfall.

Potential Challenges:

- Neighborhood access impacts during construction, especially for property with easement.
- Noise associated with construction activities.
- Construction area would require restoration.

Pine Lake Creek Basin Plan
Capital Project Fact Sheet

Capital Project #2
D92924

CIP Project Prioritization Scoring: 70/100

Environmental Benefit	Facility/Maintenance Improvements	Safety	Population Benefited	Time-Sensitive Opportunity
30/30	25/25	0/25	10/10	5/10

Project Schematic

CIP #2
Stream restoration with stormwater retrofits and low impact development.

Planning Level Cost Estimate

Item No.	Estimated Quantity	Unit	Description	Unit Cost	Amount
1	1	LS	Mobilization	$ 150,000.00	$ 150,000.00
2	1	CALC	Minor Change	$ 10,000.00	$ 10,000.00
3	1	LS	SPCC Plan	$ 1,500.00	$ 1,500.00
4	1	LS	Clearing and Grubbing	$ 10,000.00	$ 10,000.00
5	1	LS	Erosion Control and Water Pollution Prevention	$ 10,000.00	$ 10,000.00
6	1	LS	Project Temporary Traffic Control	$ 5,000.00	$ 5,000.00
7	1	LS	Removal of Structures and Obstructions	$ 20,000.00	$ 20,000.00
8	1	LS	Landscape Restoration & Plantings	$ 10,000.00	$ 10,000.00
9	1	EST	Licensed Surveying, Incl. Asbuilts	$ 22,500.00	$ 22,500.00
10	1000	CY	Excavation, Embankment and Grading, Incl Haul	$ 80.00	$ 80,000.00
11	1	LS	Adjust Existing Utilities	$ 5,000.00	$ 5,000.00
12	39000	CF	Stormwater detention vaults	$ 30.77	$ 1,200,000
13	1	EA	Storm system improvements	$ 5,000.00	$ 5,000.00
				Subtotal =	$ 1,529,000.00
				Contingency (30%)	$ 458,700.00
				Sales Tax (10.2%)	$ 155,958.00
				Geotechnical Study (15%)	$ 230,000.00
				Environmental Permitting and Documentation (20%)	$ 305,800.00
				Administration (5%)	$ 76,500.00
				Preliminary Engineering, PS&E and Construction Management (30%)	$ 458,700.00
				Total Construction Cost:	$ 3,214,700.00

Pine Lake Creek Basin Plan
Capital Project Fact Sheet

Capital Project #3
Loree Estates @ 198th Pl SE

Cost (2024 dollars): $347,100
Detention and LID

Vicinity Map

Plan View

Project Description:

This project retrofits the street edge with a bioswale. This bioswale will include foliage and rock to assist with erosion control along the shoulder, provide water quality treatment, and enhance the aesthetics of the street edge. Bioswale is designed to include detention to the extent feasible.

Design Considerations:

- Effective design will incorporate feedback from the local neighborhood on aesthetics and design decisions.
- Geotechnical investigations will be needed to assess infiltration feasibility.
- Engineered soils may be used to increase infiltration for detention.

Potential Benefits:

- Reduces erosion and improves water quality at stormwater outfall.
- Addresses water quality and detention concerns.
- Pilot project provides templates for elsewhere in the City.

Potential Challenges:

- Right-of-way and traffic access to neighborhood during construction.
- Noise associated with construction activities. Neighborhood feedback and opinions on frontage changes can be positive or negative, which may help or harm future efforts.

Pine Lake Creek Basin Plan
Capital Project Fact Sheet

Capital Project #3
Loree Estates @ 198th Pl SE

CIP Project Prioritization
Scoring: 65/100

Environmental Benefit	Facility/Maintenance Improvements	Safety	Population Benefited	Time-Sensitive Opportunity
30/30	25/25	0/25	5/10	5/10

Project Schematic

Planning Level Cost Estimate

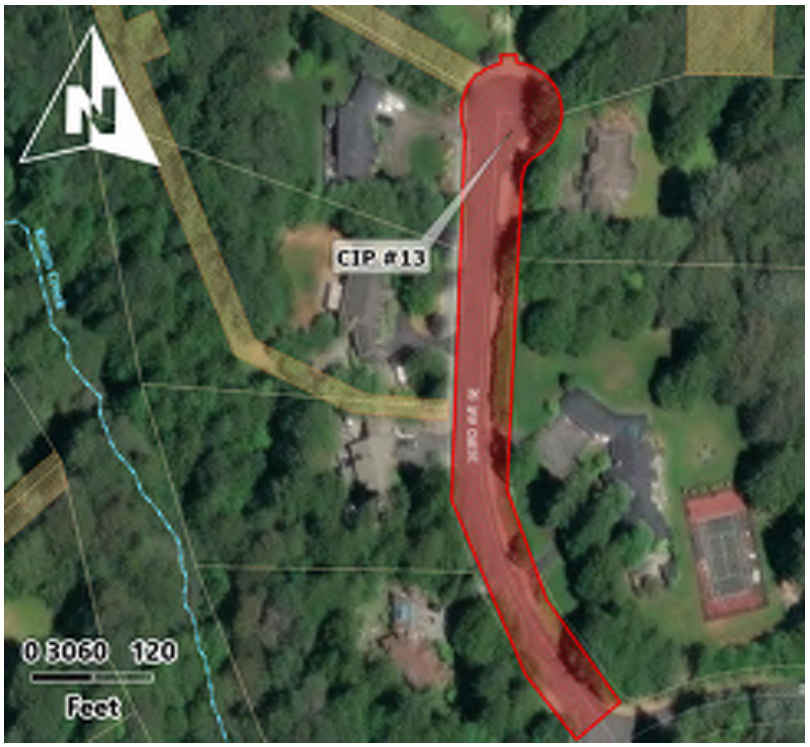
Item No.	Estimated Quantity	Unit	Description	Unit Cost	Amount
1	1	LS	Mobilization	$ 6,500.00	$ 6,500.00
2	1	CALC	Minor Change	$ 5,000.00	$ 5,000.00
3	1	LS	SPCC Plan	$ 1,500.00	$ 1,500.00
4	1	LS	Clearing and Grubbing	$ 5,000.00	$ 5,000.00
5	1	LS	Erosion Control and Water Pollution Prevention	$ 1,000.00	$ 1,000.00
6	1	LS	Project Temporary Traffic Control	$ 5,000.00	$ 5,000.00
7	1	LS	Removal of Structures and Obstructions	$ 2,500.00	$ 2,500.00
8	1	LS	Landscape Restoration & Plantings	$ 5,000.00	$ 5,000.00
9	1	EST	Licensed Surveying, Incl. Asbuilts	$ 5,000.00	$ 5,000.00
10	160	CY	Excavation, Embankment and Grading, Incl Haul	$ 30.00	$ 4,800.00
11	40	CY	Engineering Soils	$ 80.00	$ 3,200.00
12	3	EA	Weirs	$ 1,500.00	$ 4,500.00
13	1	LS	Cement Concrete Traffic Curb & Gutter	$ -	$ -
14	1	LS	Adjust Existing Utilities	$ 2,000.00	$ 2,000.00
15	1	EA	Storm and Bioswale pipes and structures	$ 15,000.00	$ 15,000.00
				Subtotal =	$ 66,000.00
				Contingency (30%)	$ 19,800.00
				Sales Tax (10.2%)	$ 6,732.00
				Property/Right of Way Acquisition (0.25 AC)	$ 217,800.00
				Geotechnical Study (10%)	$ 7,000.00
				Environmental Permitting and Documentation (10%)	$ 6,600.00
				Administration (5%)	$ 3,300.00
				Preliminary Engineering, PS&E and Construction Management (30%)	$ 19,800.00
				Total Construction Cost:	$ 347,100.00

Pine Lake Creek Basin Plan
Capital Project Fact Sheet

Capital Project #4
203rd Ave SE Water Quality LID Pilot Project

Cost (2024 dollars): $221,300
Water Quality LID Pilot Project

Vicinity Map



Plan View

Project Description:

This project retrofits the street edge for low impact development by including a bioswale. This bioswale will assist with erosion control along the shoulder, provide water quality treatment, and enhance the aesthetics of the street edge.

Design Considerations:

- Effective design will incorporate feedback from the local neighborhood on design decisions.Depending on locations, right of ways may need to be obtained.
- Utility locations, including existing stormwater, need to be considered.
- Geotechnical and surveying will be needed.

Potential Benefits:

- Reduces erosion and improves water quality at stormwater outfall.
- Showcase benefits of LID for other neighborhoods.

Potential Challenges:

- Traffic access to neighborhood during construction.
- Noise associated with construction activities.
- Neighborhood pushback on frontage changes is possible.
- Maintenance on vegetated facilities.

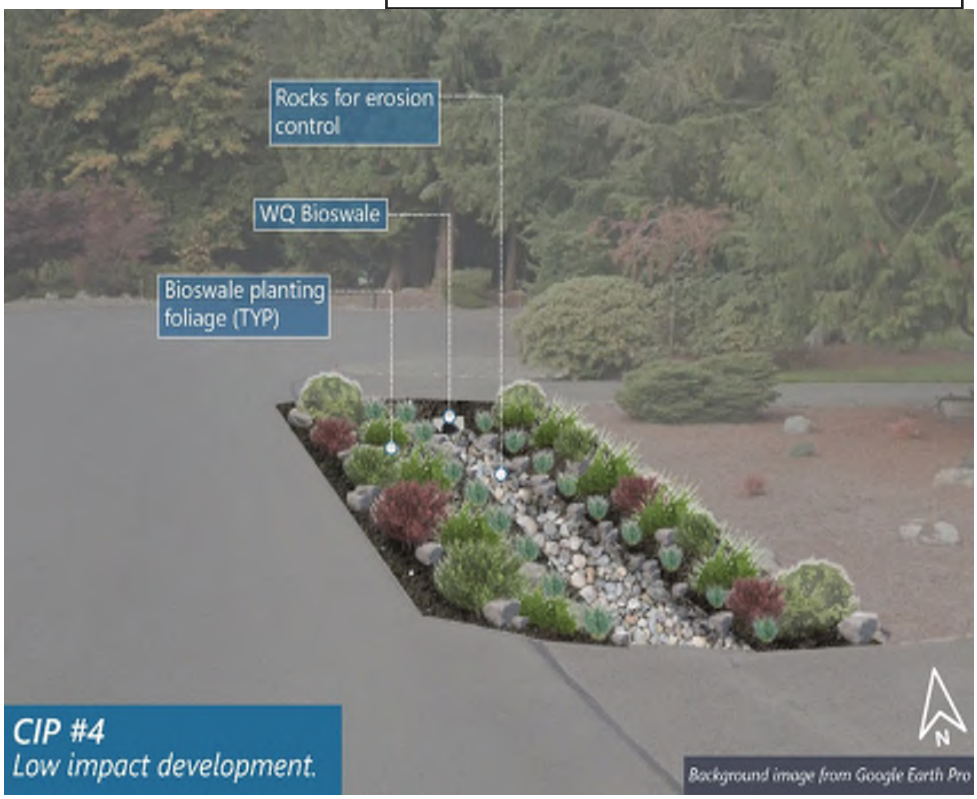
Pine Lake Creek Basin Plan
Capital Project Fact Sheet

Capital Project #4
203rd Ave SE Water Quality LID Pilot Project

CIP Project Prioritization Scoring: 45/100

Environmental Benefit	Facility/Maintenance Improvements	Safety	Population Benefited	Time-Sensitive Opportunity
25/30	10/25	0/25	5/10	5/10

Project Schematic



Planning Level Cost Estimate

Item No.	Estimated Quantity	Unit	Description	Unit Cost	Amount
1	1	LS	Mobilization	$ 5,000.00	$ 5,000.00
2	1	CALC	Minor Change	$ 5,000.00	$ 5,000.00
3	1	LS	SPCC Plan	$ 1,500.00	$ 1,500.00
4	1	LS	Clearing and Grubbing	$ 1,000.00	$ 1,000.00
5	1	LS	Erosion Control and Water Pollution Prevention	$ 1,000.00	$ 1,000.00
6	1	LS	Project Temporary Traffic Control	$ 5,000.00	$ 5,000.00
7	1	LS	Removal of Structures and Obstructions	$ -	$ -
8	1	LS	Landscape Restoration & Plantings	$ 5,000.00	$ 5,000.00
9	1	EST	Licensed Surveying, Incl. Asbuilts	$ 5,000.00	$ 5,000.00
10	50	CY	Excavation, Embankment and Grading, Incl Haul	$ 30.00	$ 1,500.00
11	20	CY	Engineering Soils	$ 80.00	$ 1,600.00
12	1	LS	Cement Concrete Traffic Curb & Gutter	$ 3,800.00	$ 3,800.00
13	1	LS	Adjust Existing Utilities	$ 2,000.00	$ 2,000.00
14	1	EA	Storm and Bioswale pipes and structures	$ 7,500.00	$ 7,500.00
				Subtotal =	$ 44,900.00
				Contingency (30%)	$ 13,500.00
				Sales Tax (10.2%)	$ 4,579.80
				Property/Right of Way Acquisition (0.15 AC)	$ 130,680.00
				Geotechnical Study (10%)	$ 5,000.00
				Environmental Permitting and Documentation (15%)	$ 6,800.00
				Administration (5%)	$ 2,300.00
				Preliminary Engineering, PS&E and Construction Management (30%)	$ 13,500.00
				Total Construction Cost:	$ 221,300.00

City of Sammamish Washington

Appendix G Programmatic Project Information Sheets

Programmatic Action Summary Sheet Assumptions

The summary sheets provided in this Appendix provide basic information and rationale for programmatic actions that the City may choose to implement in the Pine Lake Creek Basin or other basins to accomplish goals to improve water quality, habitat, and support storm and surface water objectives. Some of the actions, such as the targeted education and outreach to Lake-side homeowners were identified by community members at the engagement events conducted during the Pine Lake Creek Basin planning process. Other projects were identified by the project team as ways to engage community and residents with actions that would be helpful to preserve and protect the Pine Lake Creek Basin. The basin is largely under private ownership, therefore it is necessary to identify ways to use of existing city resources, such as the property acquisition fund, to acquire property that protects storm and surface water functions.

The City may choose to implement these actions as resources, partnerships, or opportunities allow. The recommended for implementation is within the next three years (2026 - 2028) to take advantage of momentum and interest from the community, however, the actions are not dependent on any other projects or programs and may be delayed if there are other priorities.

Planning level cost estimates were developed using some basic assumptions of what may be included in each action. A higher hourly rate was assumed for the technical work in the event that the city chooses to use a contractor in lieu of city staff. Additionally, project management time was assumed for city staff as a percentage of the overall level of effort, regardless of who completes the work.

Pine Lake Creek Basin Plan
Programmatic Action Sheet

Programmatic Action #1
Targeted Education for Lakeside Residents

Cost (2024 dollars): $57,000
One-time plus update dashboards

Description:
This action will consolidate informational resources on-line and in print for lakeside residents on a variety of topics of interest including invasive vegetation management, dock cleaning and repair, alternative landscaping techniques, water quality monitoring data and opportunities, and identification of harmful algae. The information will be targeted to all lakeside residents in Sammamish and will leverage materials from other agencies; individual web pages and dashboards specific to data from each lake within the city's jurisdiction.

Rationale:
- There is inconsistency among lake-side residents and a lack of understanding by some on how to manage their property and infrastructure to protect water quality and facilitate recreational activities and aesthetics that the community desires.
- Strong community support and desire for consolidated information specific to lakes.

Assumptions:
- Conduct survey of lakeside residents to find out what information they need.
- Develop materials (webpage or print) that provides information on lakeside management geared toward homeowners. Other agencies have resources that can be leveraged for this program.
- Develop dashboards of lake water quality data.
- Conduct focus groups to ensure user-friendly website.

Deliverables:
- Survey of residents.
- Website content, including water quality dashboards.
- Possible print documentation.

Programmatic Action #1
Targeted Education for Lakeside Residents

Anticipated Elements:

The anticipated elements of this programmatic action include conducting a brief survey of lakeside residents to find out what type of information would be useful to them so that the educational resources provided on the website and in print documentation are useful. It is expected that much of the content will be available from other entities (King County, Department of Ecology, and others), but will need to be consolidated in one location for easy reference. This programmatic action assumes a print booklet will be produced as well, however, the survey could assess whether that is needed or necessary depending on what the needs of the community are.

Water quality dashboards will present data from King County and volunteer water quality monitors in an easy to understand manner to help the community relate to and understand their connection to the lake. It is suggested that focus groups be held in advance of the website going live to ensure that it is user-friendly and conveys the right information. An example of a successful water quality dashboard is City of Kirkland's Water Quality Dashboard.

Planning Level Cost Estimate

Task	Description	Labor Hours	Labor Cost	Direct Costs	Total
PM	Admin	36	$ 7,200.00		$ 7,200.00
1	Conduct survey of lakeside residents	20	$ 4,000.00	$ 2,000.00	$ 6,000.00
2	Develop website and dashboards	100	$ 20,000.00		$ 20,000.00
3	Conduct focus groups	120	$ 24,000.00		$ 24,000.00
	Total	276	$ 55,200.00	$ 2,000.00	$ 57,200.00

FTE and Rate Assumption	
Administration (0.15* FTE)	0.15
Rate	$ 200.00

Pine Lake Creek Basin Plan
Programmatic Action Sheet

Programmatic Action #2
Property Acquisition Fund

Cost (2024 dollars): $18,400
One-time

Description:

This project involves generally using the city's existing approach for land acquisition within the parks, recreation and open space department and the current surface water property acquisition fund (SW-608) to acquire easements and/or parcels for surface water protection or projects in the Pine Lake Creek Basin. Currently, the 2025 - 2030 Stormwater Capital Improvement Plan includes approximately $200K per year set aside for property acquisition that preserve natural resources that provide a surface water benefit.

Rationale:

- The city already has a property acquisition fund programmed into the Stormwater Capital Improvement Plan.
- The Pine Lake Creek Basin has many good surface water characteristics, including contiguous forest cover in riparian areas, large wetlands, and good water quality, that should be protected.

Assumptions:

- There are no additional funds recommended for set aside for this programmatic action. Existing stormwater property acquisition funds would be used for identified easements or opportunities in the basin.
- If native growth protection easements (Programmatic Action #3) are pursued, property acquisition funds should be considered for easements.

Deliverables:

- Evaluate and develop land acquisition criteria to support storm and surface water purposes.
- Identify sites to flag for future opportunities if they become available for sale.

Programmatic Action #2
Property Acquisition Fund

Anticipated Elements:

The anticipated elements of this programmatic action include evaluating existing 2017 Sammamish Land Acquisition Strategy and Implementation Program for relevance to the property acquisition fund in the Stormwater Capital Improvement Plan. Some of the criteria in the strategy may not be relevant to storm and surface water functions (i.e., utilities available at perimeter of the property or expanded waterfront access).

The 2017 document should be evaluated within the context of relevant acquisition methods, types of surface water functions that could or should be preserved in the Pine Lake Creek Basin, and strategies that could be used to meet preservation goals.

Planning Level Cost Estimate

Task	Description	Labor Hours	Labor Cost	Direct Costs	Total
PM	Admin	12	$ 2,400.00		$ 2,400.00
1	Evaluate existing city land acquisition strategies and criteria	40	$ 8,000.00		$ 8,000.00
2	Identify goals for Pine Lake Creek Basin and potential parcels for preservation	40	$ 8,000.00		$ 8,000.00
	Total	92	$ 18,400.00	$ -	$ 18,400.00

FTE and Rate Assumption	
Administration (0.15* FTE)	0.15
Rate	$ 200.00

Pine Lake Creek Basin Plan
Programmatic Action Sheet

Programmatic Action #3
Bog Education

Cost (2024 dollars): $32,200
On-going

Project Description:

This project involves providing naturalist-led educational field trips and/or workshops focused on the city's sphagnum bogs, which includes bogs located in Pine Lake Creek Basin. The bog education program could integrate a combination of web-based information and fact sheets describing the unique characteristics and functions of bogs in Sammamish, along with naturalist-led field trips, classes and workshops to learn more about unique vegetation, wildlife, and aquatic organisms that occupy these ecosytems.

Project Rationale:

- Community members are interested in the natural resources unique to Sammamish and will support preservation of these resources more if they learn how unique and interesting they are.
- Sphagnum bogs provide natural surface water functions but are highly impacted by stormwater runoff.

Assumptions:

- The city will promote educational materials on their website that informs community members about wetland and bog characteristics and relationship to surface and stormwater.
- Naturalist-led field trips or events will provide opportunities for residents to learn more and find out what actions they can do to ensure healthy bogs.

Deliverables:

- Web content for city website.
- Event agenda for naturalist-led field trips.
- Social media posts advertising field trips.

Programmatic Action #3
Bog Education

Anticipated Elements:

The anticipated elements of this programmatic action include developing accurate, appropriate content for the community to understand and appreciate wetlands and sphagnum bogs.

Naturalist-led workshops will provide opportunities for community members to learn more and experience bogs first-hand so that they can appreciate the significance of these unique wetlands, their plants, and aquatic life. The education program may include field trips to different types of bogs in Sammamish with different features, including some that have been degraded by stormwater and human development.

Planning Level Cost Estimate

Task	Description	Labor Hours	Labor Cost	Direct Costs	Total
PM	Admin	21	$ 4,200.00		$ 4,200.00
1	Develop web content appropriate for general public	60	$ 12,000.00		$ 12,000.00
2	Develop and facilitate up to 2 field trips/workshops per year	80	$ 16,000.00		$ 16,000.00
	Total	161	$ 32,200.00	$ -	$ 32,200.00

FTE and Rate Assumption	
Administration (0.15* FTE)	0.15
Rate	$ 200.00