FACET

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TECHNICAL MEMORANDUM

Date:	July 10, 2025
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From:	Sam Payne, Ecologist & Wildlife Biologist; and Nell Lund, Senior Ecologist
Project Name:	Bellevue CAO Update
Facet Number:	2411.0456.00

Bellevue Stream Buffer Analysis

This memo presents the findings of an evaluation of stream protections in the City of Bellevue. Current buffer widths are reviewed relative to Washington Department of Fish and Wildlife (WDFW) recommendations and riparian functions. This analysis was prepared to support City review of stream regulations for the periodic update to Land Use Code (LUC) Part 20.05H – Critical Areas Overlay.

In 2020 WDFW published a best available science synthesis on riparian ecosystems (Volume 1)[1] followed by guidance (Volume 2)[2]. WDFW recommends regulating streams as riparian management zones (RMZ) with width established based on their site potential tree height (SPTH) model. This WDFW guidance represents a shift in stream protection that differs from Bellevue's current stream classification and buffer protection approach.

A spatial analysis was conducted as a part of this review to evaluate the differences in current stream buffer extents relative to SPTH. This analysis also informs Facet's ongoing Best Available Science (BAS) review for the upcoming CAO update.

Methods

To evaluate the difference between RMZ and existing CAO buffers, available data is processed in GIS to create layers which contain all streams in Bellevue and buffers or RMZs in each scenario. This process

[1] Quinn, T., G.F. Wilhere, and K.L. Krueger, technical editors. 2020. Riparian Ecosystems, Volume 1: Science Synthesis and Management Implications. Habitat Program, Washington Department of Fish and Wildlife, Olympia, Washington

[2] Rentz, R., A. Windrope, K. Folkerts, and J. Azerrad. 2020. Riparian Ecosystems, Volume 2: Management Recommendations. Habitat Program, Washington Department of Fish and Wildlife, Olympia. Washington State Department of Commerce (Commerce). (2018), Critical Areas Handbook: A Handbook for Reviewing Critical Areas Regulations. Growth Management Services. Olympia, WA.

begins with the aggregation of relevant data, as detailed in Table 1. Shoreline waterbodies are excluded from the analysis because they are regulated in the Shoreline Master Program rather than the CAO.

The streams were buffered according to their stream type per the Bellevue stream data using the values from the City's current CAO (Table 2) and based on the corresponding SPTH value. Statistics metrics are derived from values where streams intersect modeled SPTH polygons.

The analysis is subject to the following assumptions:

- Streams with an unknown type were assigned Type N, although some exceptions were made when another stream type could be reasonably inferred based on proximity and connectivity to other adjacent streams.
- The SPTH values assigned to streams are based on an overlapping SPTH polygon.
- Buffers and RMZs from streams outside the city limits, but which may extend to the city, are not included.
- Since Bellevue's buffer requirements vary between developed and undeveloped sites, the greatest of the two potential buffers outcomes is used in the analysis.
- The buffer increases associated with steep slopes and floodplain presence in Bellevue are not considered in this analysis. Therefore, current buffer depictions are an underestimate where steep slopes and/or floodplains are near streams.

Landcover within each of the mapped buffer options were evaluated to estimate the relative ecological benefit of a buffer increase. High resolution land cover data from Ecopia (1-meter pixel size) was utilized to determine the vegetated cover and impervious surfaces within each buffer type. In addition to evaluating the city as a whole, these metrics are also summarized for areas where stream buffer widths increase due to steep slope or floodplain critical areas. These buffer expansions allow for existing stream buffers in Bellevue to be much wider than standard buffers, making it important to identify stream segments where such increases occur. This analysis helps highlight areas where current buffer extents may be underestimated and reveals differences in land use composition in locations with the greatest buffer increases. These categories are identified and segmented with geoprocessing tools to include intersecting stream lines with floodplains and steep slopes (buffered by 50 feet to indicate a top-of-bank mechanism trigger) and clipping a vector-transformed Ecopia dataset to the current and potential SPTH buffer distances after removing overlap.

Table 1. Data and sources used in this analysis.

Data Type	Data Source	Last Updated
Streams	City of Bellevue	2023
Steep Slopes	City of Bellevue	2023
100-Year Floodplain	FEMA	2020

Data Type	Data Source	Last Updated
SPTH	200 Year Site Index for King County[3]	2024
Land Cover	Ecopia	2021-2022 Imagery
City Boundary	WA Geospatial data portal	2023

Table 2. Bellevue CAO Buffer Widths per LUC 20.25.H.075.

	Undeveloped Site		Developed Site	
Stream Type	**Buffer Width (ft)**	**Setback (ft)**	**Buffer Width (ft)**	**Setback (ft)**
Type F	100	20	50	50
Type N	50	15	25	25
Type O	25	15	25	None

Results

Bellevue contains approximately 85.5 river miles of streams, of which 89% have corresponding SPTH data, leaving 9.7 river miles with no SPTH data. Bellevue's stream dataset identifies 61% of streams as Type F and 39% as Type N or unknown (Table 3). No streams are designated as Type O in the reviewed data.

Table 3. Total length of streams with SPTH data in the city.

Stream Type	Stream Miles
Type F	52.1
Type N	33.4
Type O	0.0
Total	**85.5**

The SPTH values WDFW provides in Bellevue range between 100-231 feet (Figure 1). The distribution is skewed, with a large proportion of values falling within a narrow mid-spread range of 187 to 196 feet, with a mean value 180 feet (Figure 2). Specifically, the minimum value is 100 feet, the first quartile is 187 feet, the median is 196 feet, the third quartile is 196 feet, and the maximum is 231 feet. This distribution of current buffers and potential SPTH RMZs is also shown as a bar chart in Figure 3.

[3] WDFW and NRCS. 2024. "PHS Riparian Site Potential Tree Height (SPTH)." https://geo.wa.gov/documents/073e8eb38a3949dfa43bc555b914df04/explore.

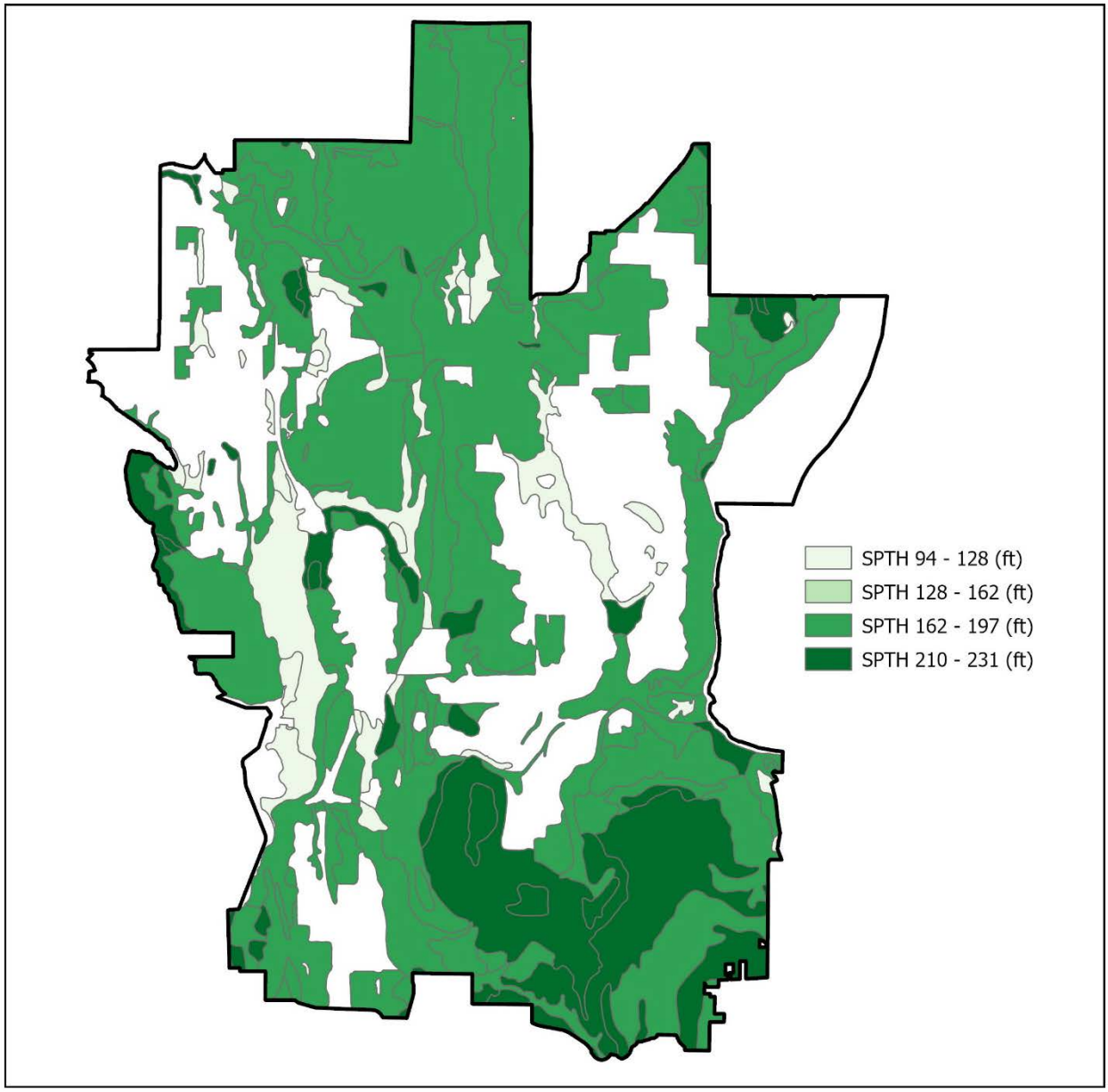

Figure 1. $SPTH_{200}$ distribution in Bellevue, white indicates no data.

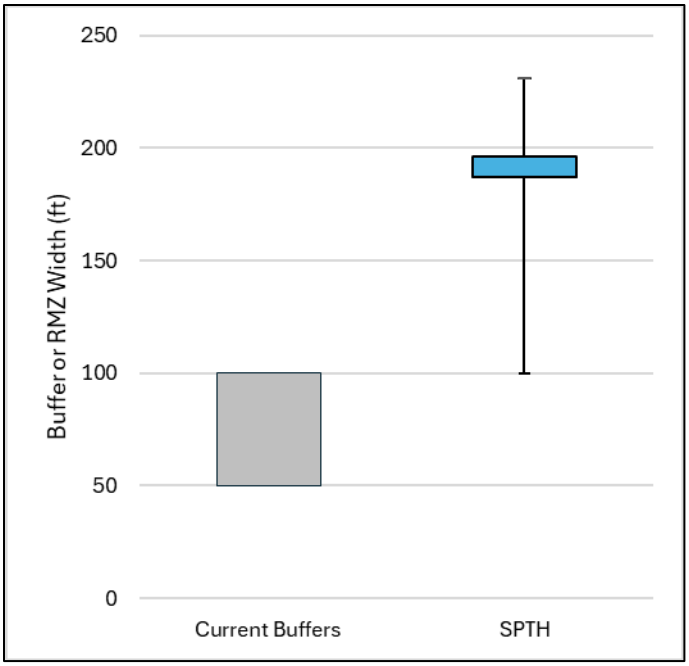

Figure 2. Box plot of current buffers and $SPTH_{200}$ values for all streams in Bellevue.

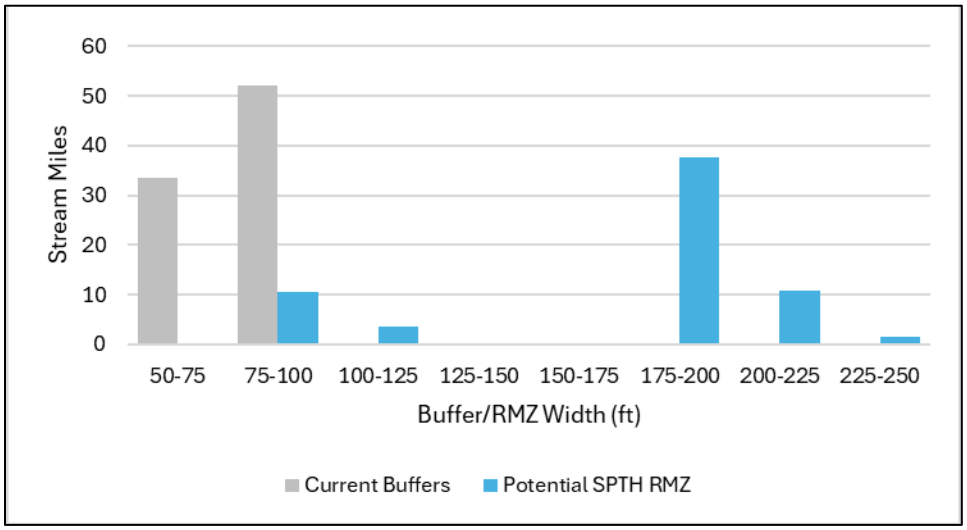

Figure 3. Distribution of current buffer and potential SPTH RMZ widths. There are fewer SPTH stream miles due to the incomplete SPTH dataset.

Currently, no streams in Bellevue have buffers that exceed the WDFW's RMZ recommendations. All streams are equal or narrower than the SPTH value. Of these, 12.8% match SPTH values, while the remaining 87.2% have buffers narrower than the recommended values. The distribution of these stream miles are estimated based on stream type in Table 4. It is important to note, that this analysis underestimates current buffer areas which are measured from top-of-bank, not the ordinary high watermark.

Under Bellevue's current CAO regulations, steam buffers are measured from top-of-bank when adjacent to steep slope or active floodplain. Although evaluating the influence of this regulation on Bellevue's buffer widths was outside the scope of this study, it is estimated that 65% streams in the city are subject to these buffer increases.

Table 4. Comparison of RMZ and existing buffers by stream miles.

	Stream Miles		
Category	**Type F**	**Type N**	**Total**
RMZ < Buffer	0	0	0
RMZ = Buffer	9.7	0	9.7
RMZ > Buffer	34.1	31.5	65.6

Stream buffers are also evaluated in terms of total area to better understand their distribution across different land use types. The implementation of the SPTH framework is estimated to add approximately 1,679 acres of new buffer area, although this study area is limited to areas where SPTH data is currently available. The majority of newly added buffer area is forested (56.08%), shrub/low vegetation (4.53%), open water (1.27%), land cover types which generally provide the intended ecological functions of riparian buffers.

Covering 10.70% of the total area, unclassified land primarily consists of lawns, turf, or other non-impervious surface which is not captured by the defined land use types. While these areas provide some ecological benefits, they do not provide the same level of function as lands with forest or vegetative cover. The remaining 27.4% of land area is covered by impervious developments.

Table 5. Land use comparison in areas affected by potential buffer expansion under SPTH framework, relative to standard buffer extents.

Land Cover	Area (Ac)	Area (%)
No Data	0.95	0.06%
Unclassified	179.60	10.70%
Impervious	384.36	22.90%
Impervious, Covered by Tree	74.71	4.45%
Shrub/Low Vegetation	75.97	4.53%
Tree/Forest/ High Vegetation	941.35	56.08%
Open Water	21.31	1.27%
Railroad	0.28	0.02%

1 Area subject to top-of-bank, current buffer width is measured from steep slope and/or floodplain

Current stream buffers estimated from stream centerlines are compared to SPTH width recommendations in Figure 4 below. Figure 5 provides a snapshot of how mapped steep slopes and floodplains overlap with stream buffer and SPTH mapping. As shown in Figure 6, more than half the streams in Bellevue are subject to steep slope or floodplain related buffer increases.

Discussion

Based on this analysis, adopting a regulatory framework which uses SPTH to define RMZ widths would result in a substantial increase in buffer distances, from an average of 80 feet under current regulations to approximately 180 feet, representing more than a two-fold increase. Since the SPTH framework does not differentiate by stream type, the greatest changes would occur to Type N streams. This could translate to an increase in protection for up to 181 feet of riparian habitat in those areas with a STPH value of 231 feet. It is important to note, however, that this analysis does not account for buffer adjustments related to steep slopes. Buffers are measured from the top-of-bank rather than the ordinary high water mark, which can lead to substantial larger buffer extents, particularly in ravines, where streams commonly occur.

As the City considers this assessment, we recognize stream regulations will be reviewed from an implementation perspective and are balanced with other GMA requirements. Given the dense urban environment in Bellevue, WDFW riparian management recommendations for urban areas are provided in WDFW *Riparian Ecosystems Volume 2: Management Recommendations* (Rentz 2020), Section 3.3 include:

- maintaining and improving functions through regulatory and voluntary means,
- identifying and prioritizing restoration,
- maintaining and improving riparian connections, and
- applying stormwater management.

TOP-OF-BANK VS. ORDINARY HIGH WATERMARK

Bellevue's requirement to measure stream buffers from the top-of-bank is more protective than ordinary high watermark (OHWM) alone. However, OHWM can be combined with required buffer increases when standard buffers overlap with steep slopes, geologic hazard area, channel migration zones, and floodways to achieve similar protections. OHWM is the standard for stream delineation methodology. Use of OHWM would be consistent with language in Section 404 of the Clean Water Act, the Washington Administrative Code (WAC) 220-660-030, and the Revised Code of Washington (RCW) 90.58.030 and guidance documents including *Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State* (Anderson, et al. 2016) and *National Ordinary High Water Mark Field Delineation Manual for Rivers and Streams* (David, et al. 2025).

STREAMS OF LOCAL SIGNIFICANCE

The City may choose to designate streams of local significance based on mapped fish species distributions, basin condition, or other local priorities. Those named streams could be assigned buffer widths that may differ from the buffers assigned by water type.

RIPARIAN VEGETATION

Riparian vegetation provides several critical functions including shade, nutrient inputs, and habitat corridors. For riparian/stream buffer areas to provide intended functions they are presumed to be densely vegetated with native trees, shrubs and groundcover plants typical of our ecoregion.

WATER QUALITY

WDFW recommends a minimum 100-foot buffer width to provide pollutant removal for water quality (Quinn et al. 2020; Rentz et al. 2020).

Water quality can also be supported by incentivizing low impact development and/or Salmon-Safe project certifications.

DAYLIGHTING STREAMS

To support restoration, the City may choose to provide regulations that specifically address daylighting streams at sites with existing legally established nonconforming uses. Restoration actions recommended by WDFW include protecting existing habitat, connecting fragmented habitats, restoring natural processes, and creating or enhancing habitat. For stream daylighting or enhancement projects, this may include riparian vegetation improvements, increasing off-channel habitat, reversing channel incision, improving channel morphology, improving streambank stability, and increased quantity of large woody debris (Rentz et al. 2020).

References

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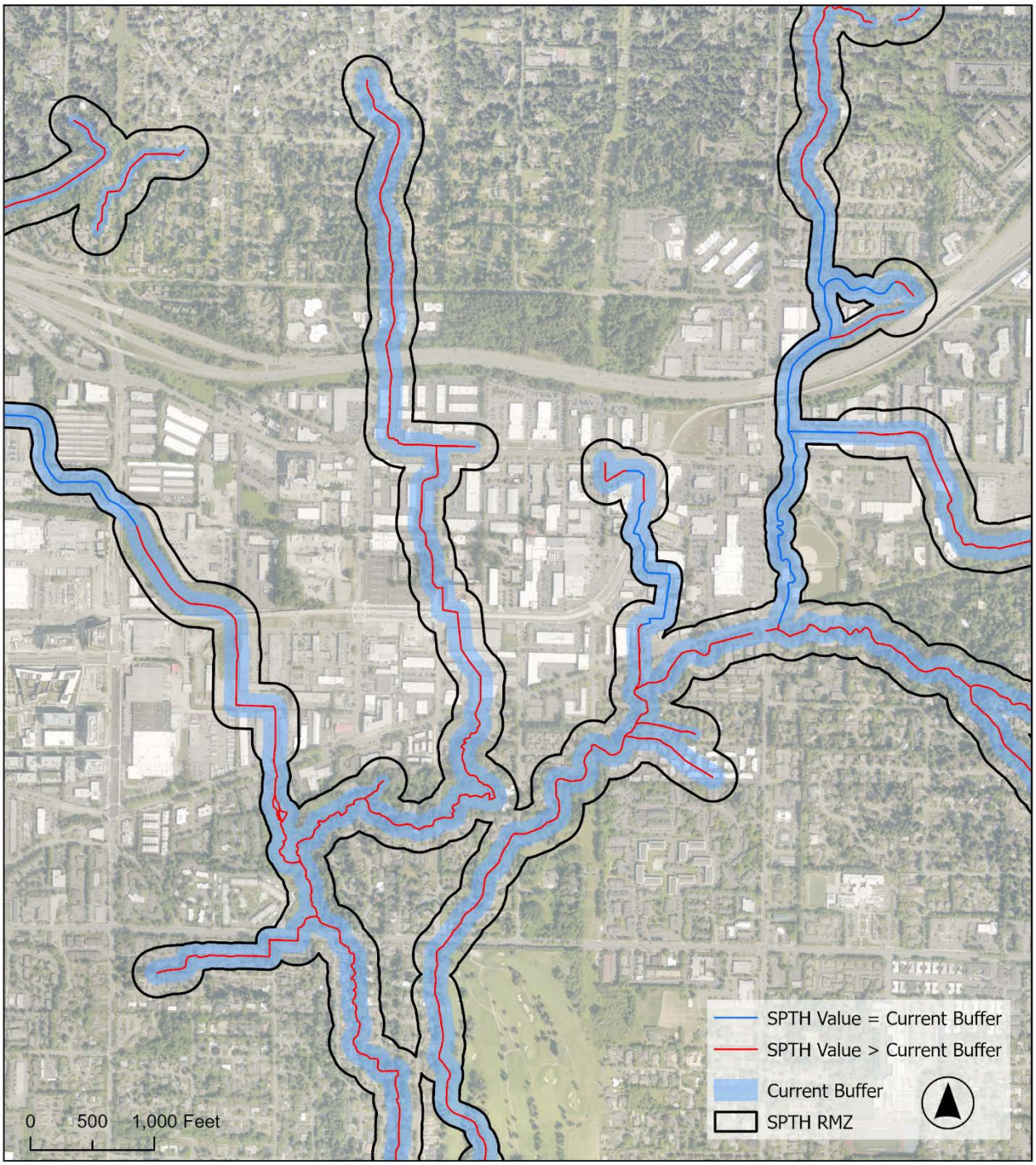

Figure 4. Comparison of potential SPTH RMZs and current buffers in example location.

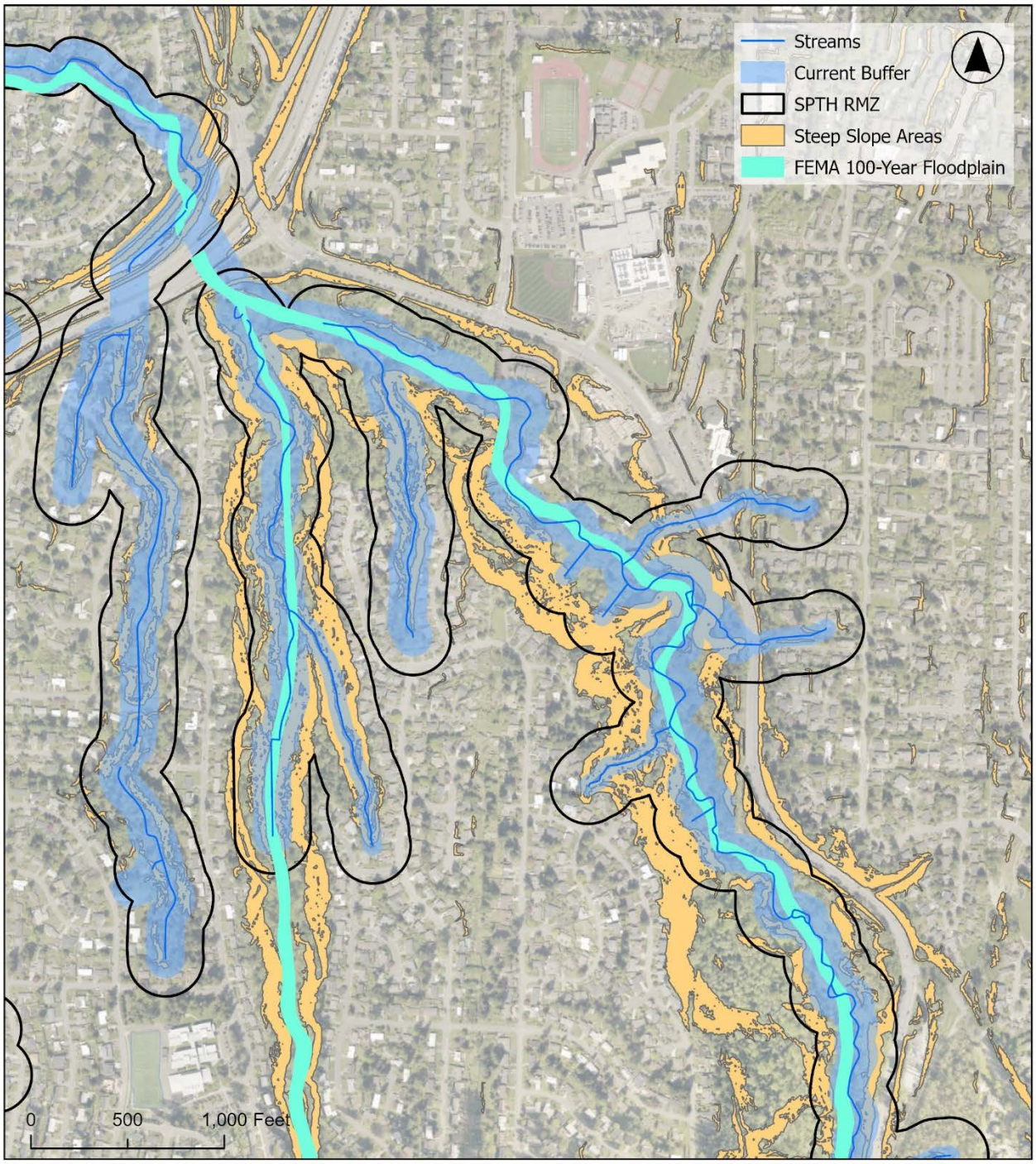

Figure 5. Visualization of the steep slope and floodplain extents and buffers in an example location.

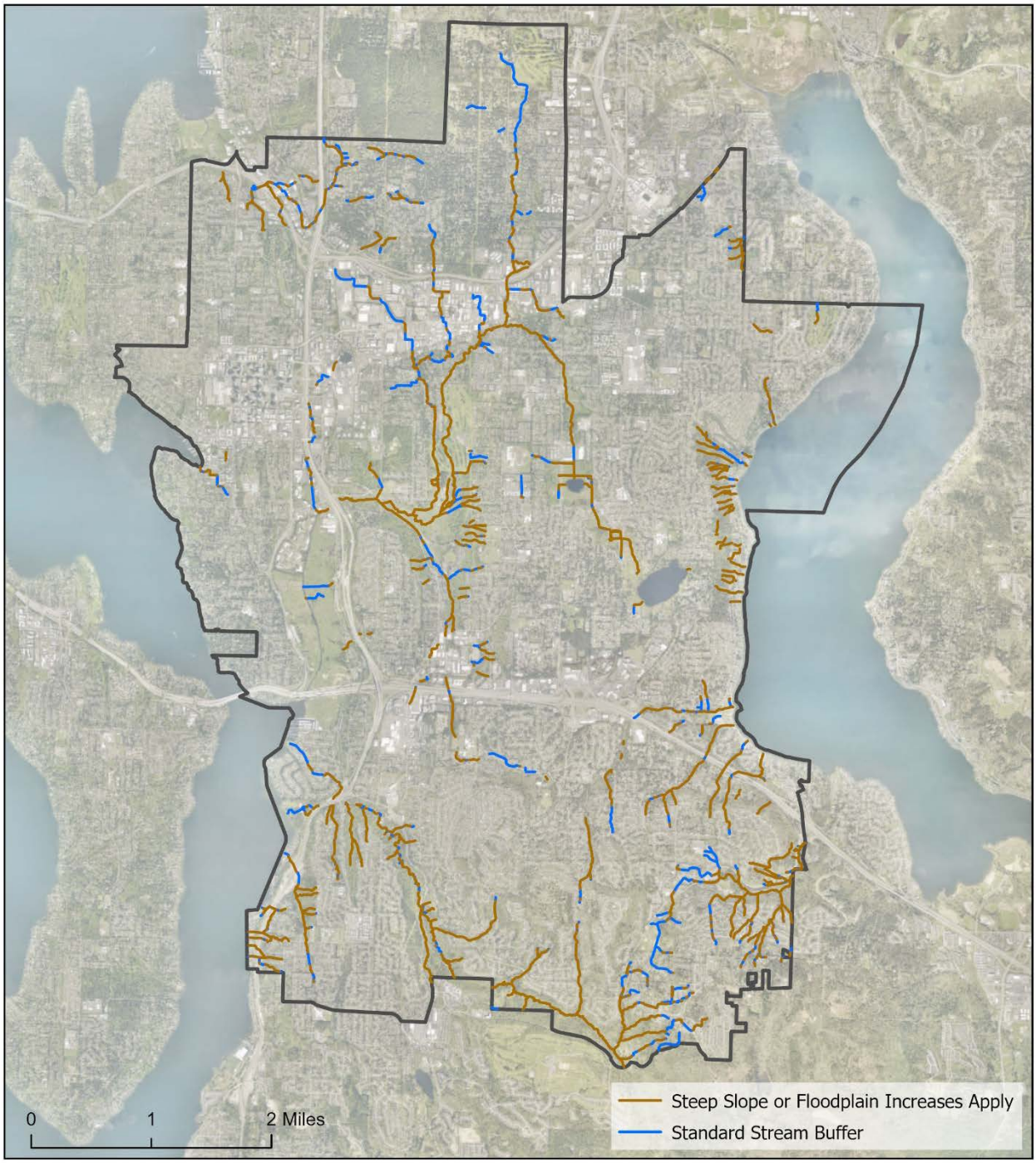

Figure 6. Visualization of streams in Bellevue where steep slope and floodplain related buffer increases are applicable.