

YAKIMA COUNTY PUBLIC SERVICES DEPARTMENT
Planning Division, Long Range Planning Section

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DATE: July 23, 2025

ISSUE: Tree Canopy Coverage Policy Paper

INTRODUCTION

In 2023, under Engrossed Second Substitute House Bill 1181 ([HB 1181](#)), the Washington State legislature made “an evaluation of tree canopy coverage within the urban growth area[s]” a requirement for the Parks and Recreation Element of comprehensive plans.¹

The final bill report does not provide a clear legislative intent for the requirement.² A public hearing held by the Washington State House Appropriations Committee on February 9, 2023, implies that the purpose of the tree canopy coverage evaluation is to examine ways tree canopy coverage can mitigate heat island effects, which in turn, should lower energy bills.³ Furthermore, the legislation did not provide guidance on the methodological requirements for conducting an evaluation, nor did the Department of Commerce (DOC) generate guidance through WACs. This is due to the Parks and Recreation Element not being a required element for the 2026 Periodic Update because the legislature did not allocate funding for this cycle (RCW36.70A.070(10)). The DOC does provide guidance for mitigating heat island effects within the Climate Element documents (see pages 6, 18, 24, 29, 110-111, and 139), however, an in-depth exploration of mitigating heat islands through tree canopy coverage is undefined.⁴

It is important to begin discussing the goals for the tree canopy coverage in Yakima County because this will provide directions for staff to collect the appropriate base-level data for when the Parks and Recreation Element is funded. This may include descriptive data of Yakima County's tree canopies in the urban growth areas that are useful to meet the eventual GMA requirements.

The next section discusses the basics of a tree canopy cover analysis and the current known results of tree canopy coverage in Yakima County. Then, a summary of the best

¹ "CERTIFICATION of ENROLLMENT ENGROSSED SECOND SUBSTITUTE HOUSE BILL 1181 Governor of the State of Washington Secretary of State State of Washington," May 4, 2023, <https://lawfilesext.leg.wa.gov/biennium/2023-24/Pdf/Bills/Session%20Laws/House/1181-S2.SL.pdf?cite=2023%20c%20228%20s%203>. see page 16

² Tharinger Duerr, "Sponsors: House Committee on Appropriations (Originally Sponsored by Representatives," July 23, 2023, <https://lawfilesext.leg.wa.gov/biennium/2023-24/Pdf/Bill%20Reports/House/1181-S2.E%20HBR%20FBR%2023.pdf?q=20250325070212>.

³ Washington State Legislature, "House Appropriations - TVW," TVW, February 10, 2023, <https://tvw.org/video/house-appropriations-2023021209/?eventID=2023021209>.

⁴ Washington Department of Commerce, "IntermediatePlanningGuidance_FINAL.pdf | Powered by Box," deptofcommerce.app.box.com, December 2023, <https://deptofcommerce.app.box.com/s/fpg3h0lbwln2ctqjg7jg802h54je19jx>.

1 available science is presented to inform the staff recommendations that conclude the
2 paper.

3 **BACKGROUND / CURRENT CONDITIONS**

4 Tree canopy coverage (TCC)⁵ refers to all areas covered by tree crowns (including stems
5 and branches) from an aerial view.⁶ There are two common ways to collect data for an
6 analysis of TCC: one is Point Sampling and the second is Full Land Cover Analysis.

7 In Point Sampling, trees are counted through a digital spot counting method and will only
8 contain the specific information recorded for those trees. Point sampling does not
9 constitute as an in-depth analysis, is difficult to document change over time, and is time-
10 intensive due to the collection methods.

11 In a Full Land Cover Analysis, all tree coverage, impervious surfaces, and similar elements,
12 including ecological and biological data, are collected. This method also enables in-
13 depth analysis by overlaying geographic shape files on land-use, property ownership,
14 watershed boundaries, neighborhood demographics, and changes in tree canopy over
15 time. Lastly, if available, information regarding stormwater retention and CO₂
16 sequestration can be obtained through this method. Switching between the two
17 methods leads to inconsistency in the data, which is why it is imperative that the method
18 chosen remains consistent.

19 In early 2025, in coordination with the GIS Division, staff conducted a full land cover
20 analysis with available data from Ecopia.⁷ Ecopia data was selected because it was
21 readily accessible and provided GIS shapefiles that were compatible with Yakima
22 County's analytic tools. The data from Ecopia is sorted into three classes for the Full Land
23 Cover Analysis conducted. One class (Class 7) includes trees, forests, and high
24 vegetation, which counts trees 15-feet and taller, another class (Class 3) counts
25 impervious surfaces covered by the shade of the trees in Class 7, and the last class (Class
26 6) includes low-lying shrubs/vegetation. Table TCC-1 below contains aggregate data of
27 Classes 7 and 3 to determine the current canopy coverage.

28 Table TCC-2 below contains Class 6 data. This variable can be used as a temporary basis
29 to determine what areas are available for further planting based on the presence of
30 more dense vegetation. Class 6 was also used for determining available planting areas
31 as the data did exclude sports fields and orchards from consideration.

32 Finally, Appendix A depicts maps of the TCC in the urban growth areas. The maps do not
33 aggregate Classes 7 and 3 to demonstrate what Ecopia data considers impervious
34 surfaces. A limitation of Class 7 data is that trees under 15-feet are not counted, which
35 undercounts the understory and shorter-shade trees. These trees are also seen in the
36 maps in Appendix A. Importantly though, the Ecopia data does not include the large
37 amounts of commercial agricultural land in the County's UGAs. Other free software does

⁵ The term urban tree canopy (UTC) is another term to discuss tree canopies in urban areas and used interchangeably with TCC in the literature.

⁶ Gang Chen et al., "Tree Canopy Cover and Carbon Density Are Different Proxy Indicators for Assessing the Relationship between Forest Structure and Urban Socio-Ecological Conditions," *Ecological Indicators* vol. 113, no. 106279 (June 2020): <https://doi.org/10.1016/j.ecolind.2020.106279>.

⁷ Data is using 3-foot raster high-resolution data from 2022 statewide aerial imagery

1 include the acreage of orchards and hops in their TCC calculations, leading to inflated
2 numbers and requiring more staff time to 'ground truth' on the back end. The Ecopia
3 data is from high-resolution raster data taken from a 2021-2022 flyover of Washington
4 State.

5

City/Town	Tree Canopy Coverage (Percent)		
	Unincorporated UGA	Incorporated UGA	Entire UGA
Grandview	2.60	3.56	3.30
Granger	3.03	6.59	5.84
Harrah	0.82	6.74	5.57
Mabton	2.07	5.96	4.13
Moxee	1.79	1.57	1.65
Naches	18.86	11.47	13.64
Selah	5.89	5.89	5.89
Sunnyside	4.02	3.67	3.78
Tieton	6.56	7.53	7.10
Toppenish	4.43	6.04	5.14
Union Gap	12.01	5.74	7.07
Wapato	9.45	4.29	7.31
Yakima	10.74	9.64	10.04
Zillah	4.99	4.99	4.99

6

City/Town	Low-Lying Shrubs/Vacant Planting Space (Percent)		
	Unincorporated UGA	Incorporated UGA	Entire UGA
Grandview	0.92	6.09	4.71
Granger	1.62	1.20	1.29
Harrah	5.29	1.16	1.98
Mabton	1.24	1.81	1.54
Moxee	1.77	0.89	1.21
Naches	4.12	5.01	4.75
Selah	7.72	6.80	7.16
Sunnyside	2.19	2.10	2.13
Tieton	1.36	2.07	1.75
Toppenish	2.73	2.17	2.48
Union Gap	16.54	7.80	9.65
Wapato	3.73	1.76	2.91
Yakima	10.00	3.09	5.62
Zillah	3.15	3.42	3.31

1 PlanIT Geo, a private TCC analytics company, states that the average TCC for desert
2 cities is 12%.⁸ Based on the current results, the Town of Naches would be the only
3 jurisdiction on par with the 12% metric and the City of Yakima is the next closest at 10.04%.
4 The City of Union Gap meets the 12% when only considering the unincorporated part of
5 their UGA. All three of these jurisdictions have major rivers (the Naches and the Yakima
6 respectively) within their UGAs, providing more favorable conditions for large vegetative
7 cover than other cities within the county.

8 The main questions regarding TCC policies and goals are: one, whether the current TCC
9 is optimized at its present state; second, if not, what changes will yield increased, or goal-
10 defined TCC results; third, does the TCC meet Yakima County's needs in mitigating heat
11 island effects; and fourth, how to balance water resources needs between new and
12 existing development with TCC needs? The next section examines a brief TCC literature
13 review to present the various ways Yakima County can address these questions.

14 **DISCUSSION**

15 Utilizing the stated criteria from the Washington State House Appropriations February 9,
16 2023, hearing, the primary aim of the TCC is to reduce the heat island effect and, in turn,
17 lower energy costs. The Environmental Protection Agency defines heat islands as those
18 areas where "cities replace natural land cover with dense concentrations of pavement,
19 buildings, and other surfaces that absorb and retain heat. The heat island effect
20 increases energy costs (e.g., for air conditioning), air pollution levels, and heat-related
21 illness and mortality."⁹ Heat islands are not bound by municipal geographical units and
22 can include multiple cities in one area (e.g., Yakima, Selah, Union Gap, and Moxee
23 contiguous area).

24 Tree Size

25 To reduce heat island effects, trees must be sufficiently large with dense, and generally
26 overlapping, canopies. Two criteria measuring this 'largeness' are *leaf area density* (LAD)
27 and crown size. LAD is the "sum of one-sided leaf area per unit volume" and is essential
28 in documenting urban microclimates of canopy structures.¹⁰ The crown is the area of a
29 tree's stems, leaves, and branches.¹¹ These criteria provide a strong basis to measure the
30 inward (LAD) and outward (crown) canopy coverage of trees.

31 Multiple studies have found that larger trees with greater crown size and denser foliage
32 provide better shading and cooling effects compared to smaller or sparsely foliated
33 trees. The canopy surface area and density directly influence a tree's ability to block
34 incoming solar radiation and reduce surface temperatures through shading. Another
35 variable influencing the productivity of the shading is a high evapotranspiration rate,

⁸ Alec Sabatini, "How to Set Effective, Evidence-Based Urban Tree Canopy Goals," PlanIT Geo™, April 20, 2021, <https://planitgeo.com/library/how-to-set-effective-evidence-based-urban-tree-canopy-goals/>.

⁹ EPA, "Reduce Heat Islands | US EPA," US EPA, February 14, 2025, <https://www.epa.gov/green-infrastructure/reduce-heat-islands>.

¹⁰ Ge Gao et al., "Estimating Plant Area Density of Individual Trees from Discrete Airborne Laser Scanning Data Using Intensity Information and Path Length Distribution," *International Journal of Applied Earth Observation and Geoinformation* vol. 118, no. 103281 (April 1, 2023): 1, <https://doi.org/10.1016/j.jag.2023.103281>.

¹¹ Sten Gillner et al., "Role of Street Trees in Mitigating Effects of Heat and Drought at Highly Sealed Urban Sites," *Landscape and Urban Planning* vol. 143 (November 2015): 34, <https://doi.org/10.1016/j.landurbplan.2015.06.005>.

1 which cools the surrounding air, generally a challenge in the Yakima Basin due to its low
2 humidity and hot spring/summer temperatures.

3 A 2015 study, by Giller et. al., examining street trees' ability to mitigate heat island effects
4 in highly-surfaced (i.e., impervious surface) urban sites confirmed that the higher a tree's
5 LAD, the more impervious surface temperatures fall within the microclimate of the tree.¹²
6 Their research also showed that continually cool air temperatures, a high LAD and
7 transpiration rate (i.e., plants releasing water vapor into the air) are all required. Air
8 temperatures under trees were found to remain high even with high LADs due to the high
9 levels of transpiration needed to cool air temperature.¹³ Though the study was
10 conducted in Dresden, Germany, it is relevant because it confirms that both the high
11 levels of LAD and transpiration rates are requisites to continually maintain a cool
12 microclimate. Again, for Yakima County, this is an issue as the 90 to 100+ degree weather
13 during the summer months does not allow for the moisture to replenish in the leaves,
14 yielding low transpiration rates.¹⁴ The benefits of shade in reducing temperatures¹⁵ and
15 providing cooler shaded areas during heat events¹⁶ provided by a high LAD are not in
16 dispute; the issue revolves around the allocation of water resources needed to maintain
17 a high LAD and transpiration rate.

18 Similar aspects are observed when examining the crown structure. The larger a tree's
19 crown, the more solar radiation is blocked and not absorbed into the ground,
20 consequently lowering surface temperatures.¹⁷ A 2024 study examined tree coverage in
21 neighborhoods within Melbourne, Australia, to determine if reaching a 30% TCC was
22 possible by either: one, proceeding with current levels; two, maximizing tree size; or, three,
23 maximizing the number of trees with large, dense crown structure.¹⁸ The researchers
24 modeled 30 years into the future and separated/re-aggregated the results based on
25 public and private ownership of land.¹⁹

26 The modeled maximum tree number scenario under high rainfall conditions (18.82
27 inches), led to a 10.8% increase in TCC and an average TCC increase of 4.6% under these
28 favorable moisture conditions. However, these conditions (i.e., higher rainfall) exceed
29 what is typically available in Yakima (7.87 inches annually), meaning the same scale of
30 canopy expansion may not be achievable due to the region's much drier climate.

31 The distinction between public lands and private lands by the researchers is an important
32 difference to document. First, both public and private lands are not the same when it
33 comes to vacant, available planting spaces because private lands fail to consider

¹² Sten Gillner et al., "Role of Street Trees in Mitigating Effects of Heat and Drought at Highly Sealed Urban Sites," 41.

¹³ Sten Gillner et al., "Role of Street Trees in Mitigating Effects of Heat and Drought at Highly Sealed Urban Sites," 39.

¹⁴ R.K. Chaturvedi et al., "Functional Traits Indicate a Continuum of Tree Drought Strategies across a Soil Water Availability Gradient in a Tropical Dry Forest," *Forest Ecology and Management* vol. 482, no. 118740 (February 2021): <https://doi.org/10.1016/j.foreco.2020.118740>.

¹⁵ Carly D. Ziter et al., "Scale-Dependent Interactions between Tree Canopy Cover and Impervious Surfaces Reduce Daytime Urban Heat during Summer," *Proceedings of the National Academy of Sciences* vol. 116, no. 15 (March 25, 2019): 7575–80, <https://doi.org/10.1073/pnas.1817561116>.

¹⁶ Briony A. Norton et al., "Planning for Cooler Cities: A Framework to Prioritize Green Infrastructure to Mitigate High Temperatures in Urban Landscapes," *Landscape and Urban Planning* vol. 134, no. 3 (February 2015): 127–38, <https://doi.org/10.1016/j.landurbplan.2014.10.018>.

¹⁷ Sten Gillner et al., "Role of Street Trees in Mitigating Effects of Heat and Drought at Highly Sealed Urban Sites," 41.

¹⁸ Patricia Rettondini Torquato et al., "Insufficient Space: Prioritizing Large Tree Species and Planting Designs Still Fail to Meet Urban Forest Canopy Targets," *Landscape and Urban Planning* vol. 256, no. 105827 (April 2025): 4, <https://doi.org/10.1016/j.landurbplan.2024.105287>.

¹⁹ Patricia Rettondini Torquato et al., "Insufficient Space: Prioritizing Large Tree Species and Planting Designs Still Fail to Meet Urban Forest Canopy Targets," 2

1 heavily impervious surface areas (roads) and public lands fail to consider large amounts
2 of non-impervious areas (residential yards). The Melbourne study provides an example of
3 this issue, as when only counting public lands in the maximize tree size scenario (and with
4 high rainfall in the year) yielded a 37% TCC rate, which would not include private lots.

5 The 2024 study also found that focusing on planting trees with “large crown area[s] at
6 maturity” in current practices would increase TCC between 5-7%.²⁰ In prioritizing the
7 placement of trees, the TCC for the Melbourne neighborhood was increased and
8 strengthened. The same can be done for the TCC in the UGAs with Yakima County by
9 prioritizing the placement of trees with large crowns at maturity and in appropriate
10 ecological areas (e.g., being a part of the Yakima River TCC).

11 Ecological Benefits

12 There are two good metrics to measure the ecological strength of a TCC network. The
13 first, *Landscape Connectivity*, is the measurement of how well a landscape, including
14 trees, facilitates or hinders the ability of animals to move throughout the natural
15 corridors.²¹ The second, *Functional Connectivity*, focuses on the specific attributes of the
16 landscape that provide benefits to animals and plants, such as food, shelter, and
17 habitat.²²

18 A recent study of TCC, by Zhang et al., on vacant lots in Hartford, Connecticut, found
19 high-density development of all vacant lots, as expected, led to a decrease in
20 landscape connectivity, specifically 13% from the existing baseline.²³ The area of the TCC
21 did not decrease by 13%, but rather, the connectivity within the TCC went down. The
22 same study found that increasing TCC does not necessarily increase landscape
23 connectivity.²⁴ An area could have a large TCC, but that does not correlate to a
24 connected TCC network. Therefore, Yakima County should maintain the landscape
25 connectivity of the existing TCC in the UGAs, and consider landscape connectivity when
26 making decisions on where new trees are to be added. The Hartford study found that this
27 type of focus of placing new trees with landscape connectivity in mind leads to more
28 purposeful tree regulations.²⁵

29 *Functional Connectivity* should be given similar attention. This approach focuses on
30 targeted replanting of native botanical species to support existing TCC ecological
31 attributes. Landscape and Functional connectivity can also be used in determining the
32 location of sitescreening for new development. The same approach can be applied for
33 administrative adjustment applications seeking a full reduction to the sitescreening
34 requirements. Consequently, applicants can propose planting new trees on the property

²⁰ Patricia Rettondini Torquato et al., “Insufficient Space: Prioritizing Large Tree Species and Planting Designs Still Fail to Meet Urban Forest Canopy Targets,” 5.

²¹ Philip D. Taylor et al., “Connectivity Is a Vital Element of Landscape Structure,” *Oikos* 68, no. 3 (December 1993): 571, <https://doi.org/10.2307/3544927>.

²² Pan Zhang, Robert T Fahey, and Sohyun Park, “The Importance of Current and Potential Tree Canopy on Urban Vacant Lots for Landscape Connectivity,” *Urban Forestry & Urban Greening* vol. 94, no. 128235 (April 1, 2024): 2, <https://doi.org/10.1016/j.ufug.2024.128235>.

²³ Pan Zhang, Robert T Fahey, and Sohyun Park, “The Importance of Current and Potential Tree Canopy on Urban Vacant Lots for Landscape Connectivity,” 6.

²⁴ Conefore 2.6 is a free software our GIS Division attempted to use, but could not and could not get in contact with the developers.

²⁵ Pan Zhang, Robert T Fahey, and Sohyun Park, “The Importance of Current and Potential Tree Canopy on Urban Vacant Lots for Landscape Connectivity,” 6.

1 to bolster the landscape and functional connectivity aspects of the TCC as a means of
2 benefiting the public and the natural environment if reductions to site screen
3 requirements are sought. The same applies to land-use applications within critical areas
4 and shorelines of Washington State, supporting the TCC network, which can assist in
5 restoration activities and be another mitigation method for projects.

6 Increasing both landscape and functional connectivity will lead to an increase in shade
7 coverage on some level. The research on the benefits of shade in providing daytime
8 cooling effects indicates that tree canopies can reduce afternoon average
9 temperatures primarily through shading and evapotranspiration.²⁶ Surface temperature
10 reduction through the shading of urban street corridors, with added vegetation, again
11 has a significant impact in reducing surface temperatures.²⁷ The lower surface
12 temperature often leads to lower requirements for irrigation, though the impact also
13 depends on the water needs of the species. Drought-resistant shade trees like those used
14 in xeriscaping are beneficial examples to highlight, which also incorporate water
15 conservation methods.

16 Xeriscaping

17 Xeriscaping involves the use of rock, pavers/pathways, shrubs, and vegetation in various
18 designs to create arid-like landscapes that require less water. Xeriscaping can be quite
19 varied (see Appendix B). Low-lying cover provides nutrients for the soil and has lower
20 watering requirements.

21 Xeriscaping entire areas is not always appropriate and does not mitigate all heat island
22 effects. Research has shown that converting large turf areas to xeriscaping can worsen
23 urban heat island effects, as the exposed rocks retain more heat, reducing overnight
24 natural cooling effects.²⁸ A study of a neighborhood in Tempe, Arizona, and a
25 neighborhood in Phoenix found that xeriscaping leads to the greatest change in cool
26 effects on the microscale level as opposed to large changes within a neighborhood.²⁹
27 The study focused on making a neighborhood in Tempe that was largely mesic (i.e., a
28 typical residential landscaping with vegetative species that retain more moisture) and a
29 neighborhood in Phoenix that was more xeric in nature, covered in 10%, 25%, and then
30 50%, respectively, of xeriscaping.³⁰ The 50% level yields non-favorable results as rocks
31 retain heat overnight. A key point of the study is that xeriscaping to reduce heat island
32 effects is most effective when combining low-level shrubs with shade trees to increase
33 canopy coverage and evapotranspiration effects.³¹

34 Economic Considerations

²⁶ Loïc Gillerot et al., “Urban Tree Canopies Drive Human Heat Stress Mitigation,” *Urban Forestry & Urban Greening* vol. 92, no. 128192 (February 1, 2024): <https://doi.org/10.1016/j.ufug.2023.128192>.

²⁷ Christopher P. Loughner et al., “Roles of Urban Tree Canopy and Buildings in Urban Heat Island Effects: Parameterization and Preliminary Results,” *Journal of Applied Meteorology and Climatology* vol. 51, no. 10 (October 2012): 1775–93, <https://doi.org/10.1175/jamc-d-11-0228.1>.

²⁸ Winston T.L. Chow and Anthony J. Brazel, “Assessing Xeriscaping as a Sustainable Heat Island Mitigation Approach for a Desert City,” *Building and Environment* vol. 47 (January 2012): 171, <https://doi.org/10.1016/j.buildenv.2011.07.027>.

²⁹ Winston T.L. Chow and Anthony J. Brazel, “Assessing Xeriscaping as a Sustainable Heat Island Mitigation Approach for a Desert City,” 179.

³⁰ Winston T.L. Chow and Anthony J. Brazel, “Assessing Xeriscaping as a Sustainable Heat Island Mitigation Approach for a Desert City,” 172 and 174.

³¹ Winston T.L. Chow and Anthony J. Brazel, “Assessing Xeriscaping as a Sustainable Heat Island Mitigation Approach for a Desert City,” 179.

1 The most direct financial benefits of increased TCC come from increased stormwater
2 retention, water conservation, an increase in property values, and absorption of carbon
3 from the atmosphere. A study published in *Urban Climate*³² examined the impact of
4 urban tree shade on residential irrigation demand in semi-arid climates. The findings
5 indicate that tree shade can significantly reduce the need for residential irrigation by
6 lowering soil temperatures and reducing evaporation rates. While this study was not
7 conducted in Yakima, its conclusions are relevant and suggest that increasing tree shade
8 could lead to irrigation cost savings in similar climates.

9 Studies have shown that areas with full tree canopy cover can experience significantly
10 lower temperatures. For instance, neighborhoods with full tree cover have a two to five
11 times lower probability of exceeding human health temperature thresholds compared
12 to areas without trees.³³ Combining tree planting with reflective roofs and permeable
13 pavements can substantially mitigate extreme heat by reflecting rays rather than
14 absorbing them.³⁴ Even a modicum of reflection to mitigate heat effects during heat
15 events can have cost-saving effects by reducing energy needs and medical costs from
16 heat-related illness.

17 Tree canopies play a crucial role in stormwater management by intercepting rainfall,
18 reducing runoff, and enhancing infiltration. Trees help stabilize soil by reducing the
19 impact of raindrops, slowing overland stormwater flow, and increasing water infiltration.
20 For example, a large tree can retain between 166 to 332 gallons of water, mitigating
21 flood risks and reducing the burden on urban drainage systems.³⁵ The same study found
22 that a 30% increase in tree cover could reduce stormwater runoff by 58%, highlighting
23 trees' role in flood mitigation.³⁶ They can prevent erosion by up to 7%, reducing the need
24 for additional erosion control structures.³⁷ Urban trees perform biofiltration, improving soil
25 health and aiding in stormwater management, which contributes to overall soil
26 stabilization.³⁸ A secondary effect of the reduced runoff is a reduction of dirt washed into
27 lakes and rivers, which reduces sedimentation. Reduced runoff also means that heavy
28 metals and other pollutants from roads, parking lots, and roofs are not carried into our
29 water supply. This, in turn, reduces the load on water treatment facilities for treating those
30 elements.

31 Implementing permeable paving surfaces allows water to filter through, reducing runoff
32 and erosion.³⁹ These surfaces can also provide rooting space for urban trees, promoting

³² Austin Troy et al., "The Impact of Urban Tree Shade on Residential Irrigation Demand in a Semi-Arid Western U.S. City," *Sustainable Cities and Society* vol. 100, no. 105026 (January 2024): <https://doi.org/10.1016/j.scs.2023.105026>.

³³ Ailene K. Ettinger et al., "Street Trees Provide an Opportunity to Mitigate Urban Heat and Reduce Risk of High Heat Exposure," *Scientific Reports* vol. 14, no. 1 (February 13, 2024): 3266, <https://doi.org/10.1038/s41598-024-51921-y>.

³⁴ "Urban Tree Canopy Assessment | U.S. Climate Resilience Toolkit," Climate.gov, 2025, https://toolkit.climate.gov/tool/urban-tree-canopy-assessment?utm_source=chatgpt.com.

³⁵ Adam Berland et al., "The Role of Trees in Urban Stormwater Management," *Landscape and Urban Planning* vol. 162, no. 162 (June 1, 2017): 167-77, <https://doi.org/10.1016/j.landurbplan.2017.02.017>.

³⁶ Gov1, "Urban Tree Diversity Lowers Heat and Flood Risk, Improves Well-Being, Researchers Find," Gov1, May 19, 2025, https://www.gov1.com/parks-recreation/adding-trees-helps-cities-resist-heat-and-flooding-studies-show?utm_source=chatgpt.com.

³⁷ University of California - San Diego, "Why We Plant Trees: The Importance of the Campus Urban Tree Canopy," https://facilitieservices.ucsd.edu/_files/WhyWePlantTrees-9.20.22.pdf, September 20, 2022.

³⁸ University of California - San Diego, "Why We Plant Trees: The Importance of the Campus Urban Tree Canopy," https://facilitieservices.ucsd.edu/_files/WhyWePlantTrees-9.20.22.pdf, September 20, 2022.

³⁹ Kiran Tota-Maharaj and Miklas Scholz, "Efficiency of Permeable Pavement Systems for the Removal of Urban Runoff Pollutants under Varying Environmental Conditions," *Environmental Progress & Sustainable Energy* vol. 29, no. 3 (February 9, 2010): 358-69, <https://doi.org/10.1002/ep.10418>.

1 healthy growth without damaging sidewalks. De-compacted soils also support
2 understory plants by allowing for more water infiltration, better nutrient retention, and
3 easier root expansion. Designing parking islands with drought-tolerant plants
4 (xeriscaping) reduces water usage and maintenance needs while providing mitigation
5 of heat island effects.

6 The presence of trees and green spaces has been linked to increased property values.⁴⁰
7 A study found that a 10% increase in tree cover within 100 meters of a home can raise its
8 sale price by approximately \$1,371, while a similar increase within 250 meters can boost
9 the price by about \$836. The trees in Denver, Colorado, provide an estimated annual
10 benefit of \$551 million through property value increases, stormwater retention, and
11 carbon sequestration.⁴¹ Denver's TCC is estimated to cover 20% of the city and
12 encompasses 2.2 million trees.⁴²

13 By integrating these strategies outlined above Yakima County can mitigate heat island
14 effects, while promoting soil stability and maintaining infrastructure integrity without
15 incurring additional financial burdens.

16 **OBJECTIVE RECOMMENDATIONS**

17 Staffs' recommendation on the TCC are:

- 18 1. Incorporate ongoing water conservation efforts throughout Yakima County by
19 preserving existing TCC ecological functions and adding new trees where they
20 contribute to those ecological functions and landscape connectivity.⁴³ Pursuing these
21 objectives aims to strengthen existing TCC networks and enhance them where
22 possible.
- 23 2. Reducing heat island effects by adding green infrastructure (like bioswales) among
24 all types of development, promoting building materials that reflect solar radiation,
25 and requiring xeriscaping within small strips of land within parking lots. Promoting
26 shelters for shade during heat events and examining ways private landowners can
27 mitigate heat effects during extreme heat events.
- 28 3. Based on the Melbourne example above, Yakima County's evaluation should not
29 differentiate between public and private lands. The one exception may be
30 disaggregating the category of available, vacant planting spaces to obtain data on
31 the exact areas local governments have jurisdiction over.

32 The analysis above provides the basis for the objectives in the TCC evaluation to balance
33 the challenge of managing water resources between new and existing development.
34 The objectives serve as potential inputs for the evaluation. This process begins by
35 establishing a baseline of data and arriving at the goals for the evaluation. Once the
36 inputs and desired outcomes for the TCC are known, a logic model can be generated

⁴⁰ Heather Sander, Stephen Polasky, and Robert G. Haight, "The Value of Urban Tree Cover: A Hedonic Property Price Model in Ramsey and Dakota Counties, Minnesota, USA," *Ecological Economics* vol. 69, no. 8 (June 2010): 1646–56, <https://doi.org/10.1016/j.ecolecon.2010.03.011>.

⁴¹ Austin Troy et al., "The Impact of Urban Tree Shade on Residential Irrigation Demand in a Semi-Arid Western U.S. City," 1-2.

⁴² Julia Fennell, Colorado Newsline August 4, and 2021, "Report Highlights 'Tree Equity' Gaps in Colorado Neighborhoods," Colorado Newsline, August 4, 2021, <https://coloradonewsline.com/2021/08/04/report-highlights-tree-equity-gaps-in-colorado-neighborhoods/>.

⁴³ Benjamin Longbottom; Aley Gordon, "Beyond All Drought: Improving Urban Water Conservation in the West through Integrative Water and Land Use Policy," *Natural Resources Journal* vol. 63, no. 1 (Winter 2023): 90.

1 detailing the full process. The following items are staffs' recommendations to be met
2 before the next periodic update in 2036:

- 3 1. Establish a baseline landscape connectivity score for the TCC in all fourteen UGAs.
- 4 2. Generate a landscape connectivity map for the TCC in all fourteen UGAs to guide
5 future tree additions.
- 6 3. Establish a baseline functional connectivity score for the TCC in all fourteen UGAs
- 7 4. Generate a functional connectivity map for the TCC in all fourteen UGAs for tree
8 additions.
- 9 5. Identify all available public planting spaces within all UGAs.
- 10 6. Identify as many trees, shrubs, and low-lying vegetative species as possible within all
11 UGAs.
- 12 7. Establish a heat map index for all UGAs.
- 13 8. Continue to research available data to better decipher TCC, specifically studies and
14 or tools that can identify:
 - 15 – Tree species
 - 16 – CO2 Sequestration
 - 17 – Monetize stormwater retention benefits
 - 18 – Change-over-time
 - 19 – Water conservation metrics
 - 20 – Easily combinable with land-use, property ownership, critical areas, and
21 County right-of-way layers
- 22 9. Look for opportunities to provide feedback on TCC analysis to the Department of
23 Commerce based on the research found in this policy paper.
- 24 10. Coordinate with all fourteen cities, the Yakima Valley Conference of Government,
25 and the Yakama Nation in ensuring consistency across plans and in establishing
26 public outreach efforts.
- 27 11. Ensure objectives remain flexible to meet state requirements as they become
28 known.

29 The objectives of the evaluation should provide information for Yakima County to address
30 the following questions:

- 31 1. How should trees lost during the development process be replaced to ensure
32 landscape and functional connectivity are maintained?
- 33 2. What should xeriscaping development standards require?
- 34 3. Should there be a tree/vegetative species list of all allowed new species to be
35 planted within the unincorporated parts of Yakima County? How would code
36 enforcement work?
- 37 4. What criteria should be used in granting administrative adjustments to sitescreening
38 and landscaping with new TCC objectives in mind?
- 39 5. What requirements should there be for new public streets to align with TCC goals and
40 requirements?
- 41 6. After the conclusion of the evaluation, would that be an opportune time for a full
42 review of YCC 19.21 Sitescreening and Landscaping? What coordination on codes
43 and polices with the cities to allow for a smooth transition of the built environment as
44 annexations into the UGA occur?

1 7. What are other ways to mitigate public health issues caused by heat islands through
2 recreational means?

3 **CONCLUSIONS**

4 At the heart, the goal is to reduce the heat island effect and, if possible, lower energy
5 costs as well. The utilization of the TCC is one tool to accomplish this endeavor. Expanding
6 the TCC does have added benefits of increasing property values, assisting in stormwater
7 retention, increasing soil stability, and adding greenery to areas lacking such. However,
8 this will come with increased water usage across the County where levels are already
9 stretched. Full junior water rights are not being delivered for the third year in a row. Due
10 to these circumstances, increasing the TCC for the sole reasoning of heat island
11 mitigation may not best suit the needs of Yakima County. Strengthening the TCC on
12 connectivity and ecological functions will assist the TCC in mitigating heat island effects
13 within the county, but on a slower pace.

14 The Parks and Recreation Element of the comprehensive plan can address heat island
15 effects by focusing on establishing more public, shaded, recreational areas to mitigate
16 discomfort during heat waves. Reducing heat island effects also requires a shift in building
17 materials and shifting development standards to decrease impervious surface expansion
18 during the building process. Natural Settings and Natural Hazards are other relevant
19 elements where the implementation of heat island mitigation goals and policies should
20 be addressed.

22 Finally, we can utilize this policy paper as a tool for further advocacy to the State
23 regarding our needs for an evaluation. Finding available tree canopy cover data for this
24 policy paper proved challenging. The GIS Division and staff explored all possible sources
25 for accessible and adaptable data. Several publicly available datasets were identified
26 that unfortunately fell short of these criteria. For instance, the often-cited iTree data is
27 categorized by census block groups or tracts, which either encompass large rural areas
28 along with the cities or stretch beyond city limits into areas farther outside their UGAs. The
29 UGAs seldom adhere to any geographic units defined by the US Census, which is
30 commonly referenced by publicly accessible data.

31 Additionally, three different state departments are gathering TCC data. The Washington
32 State Department of Fish & Wildlife's high-resolution data on impervious surfaces, land
33 cover, and various tree height levels is currently incomplete for Yakima County as of the
34 publication of this paper. The Washington State Department of Natural Resources' Tree
35 Equity Score Analyzer provides valuable socioeconomic data regarding poverty,
36 education, and pollution, but is structured by US census tracts as geographic units. The
37 Washington State Department of Commerce will eventually be assigned by the
38 legislature to develop WACs for the TCC. Yakima County should leverage its position as
39 a significant rural county to emphasize the existing resources within state departments
40 and the necessity for collaboration on TCC, urban forestry, and planning guidelines
41 among them before the Parks and Recreation Element TCC evaluation becomes
42 mandatory.

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APPENDIX A

Ecopia Maps of Tree Canopy Cover within the Urban Growth Areas

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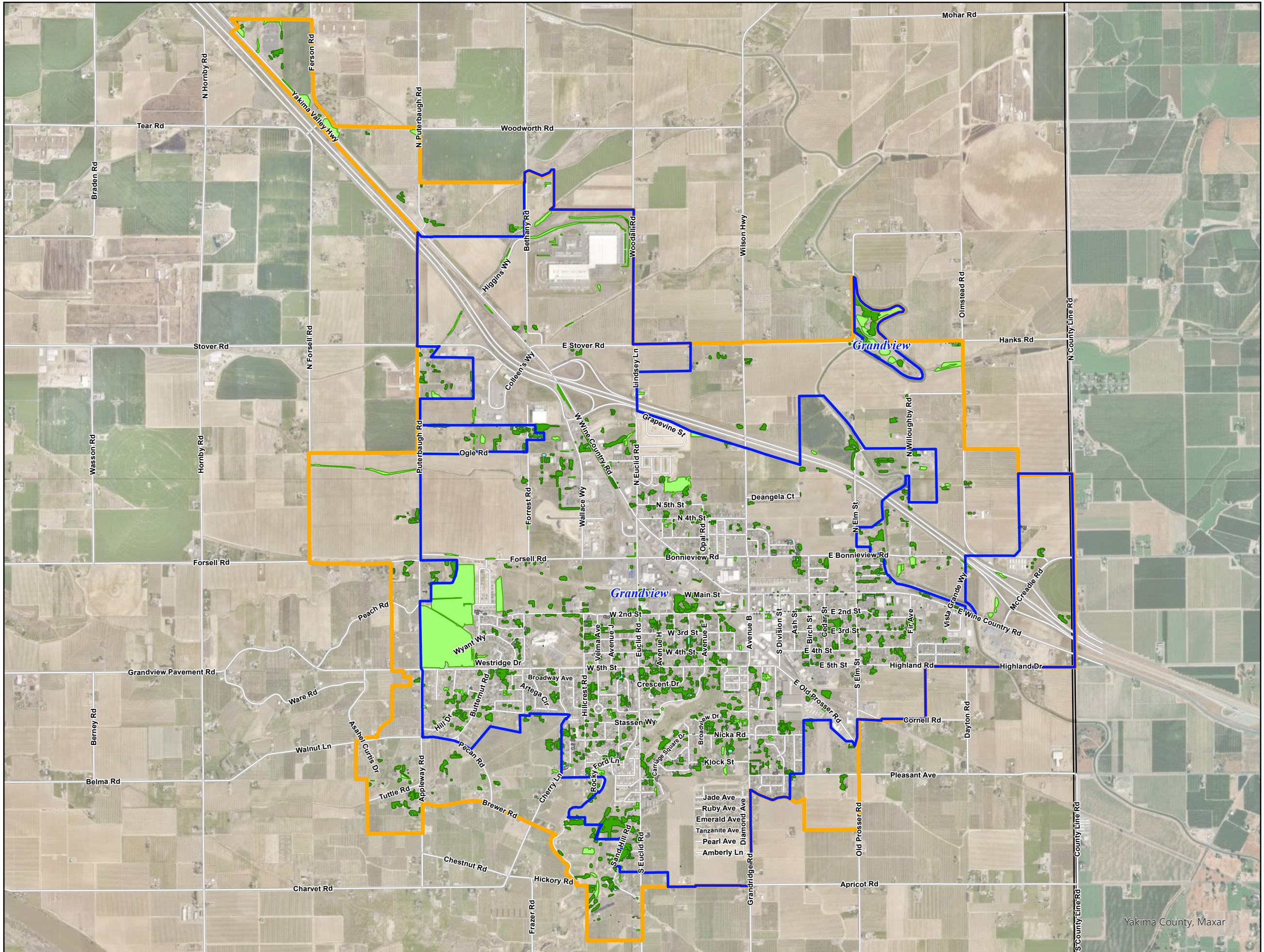
Appendix B

Xeriscaping Examples

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APPENDIX A

Ecopia Maps of Tree Canopy Cover within the Urban Growth Areas



YAKIMA COUNTY

Tree Canopy Cover City of Grandview

Land Cover Ecopia Data

2021 - 2022

- Impervious, Covered By Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- Yakima County Boundary
- City Limits
- Urban Growth Boundary
- All Roads



1 inch equals 2,380 feet



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YAKIMA COUNTY

Tree Canopy Cover City of Granger

Land Cover Ecopia Data 2021 - 2022

- Impervious, Covered By Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- City Limits
- Urban Growth Boundary
- All Roads

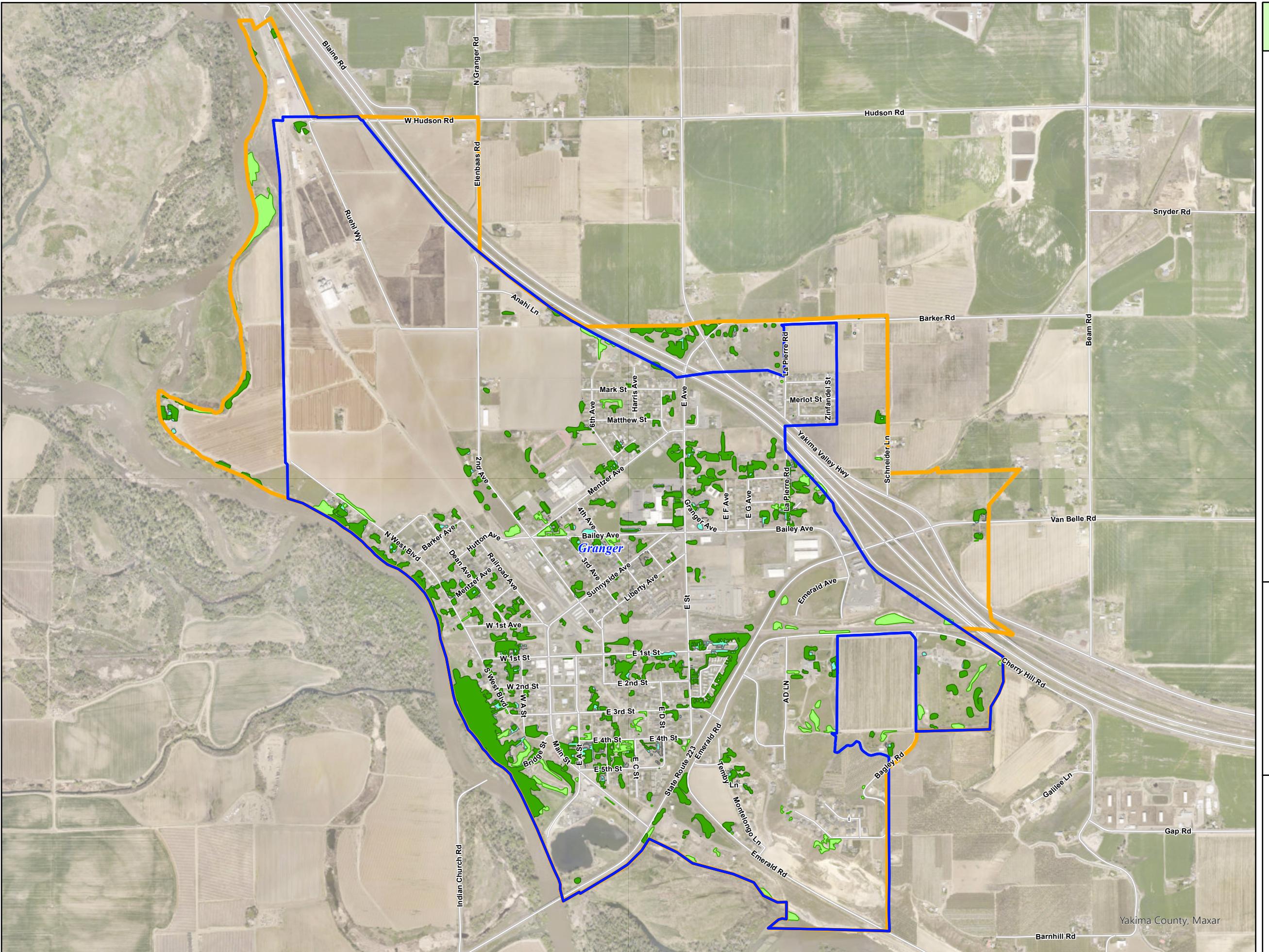


0 310 620 1,240 1,860 2,480
Feet

1 inch equals 1,200 feet

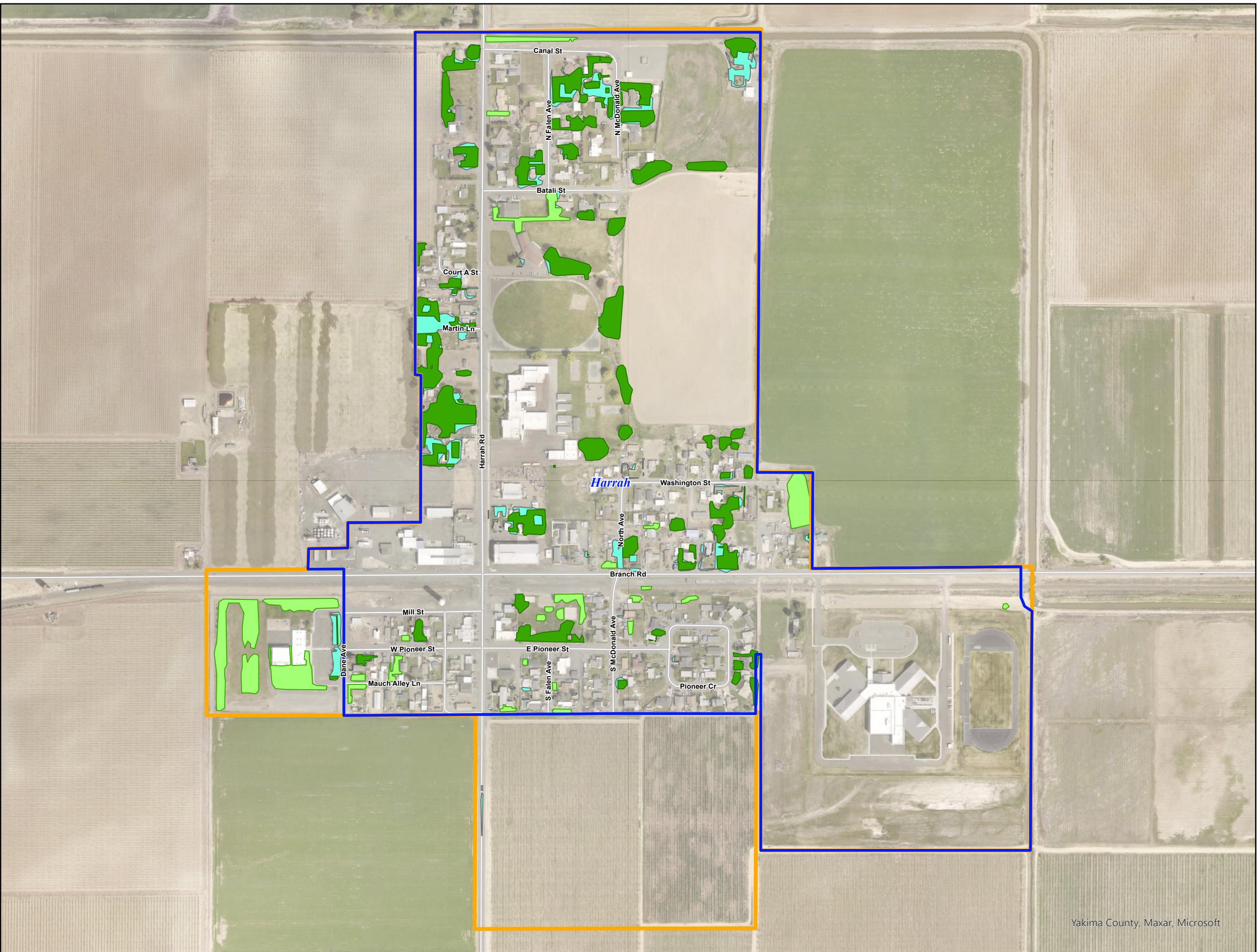


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YAKIMA COUNTY

Tree Canopy Cover Town of Harrah



Land Cover Ecopia Data

2021 - 2022

- Impervious, Covered By Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- City Limits
- Urban Growth Boundary
- All Roads



0 112.5 225 450 675 900
Feet

1 inch equals 450 feet



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YAKIMA COUNTY

Tree Canopy Cover City of Mabton

Land Cover Ecopia Data

2021 - 2022

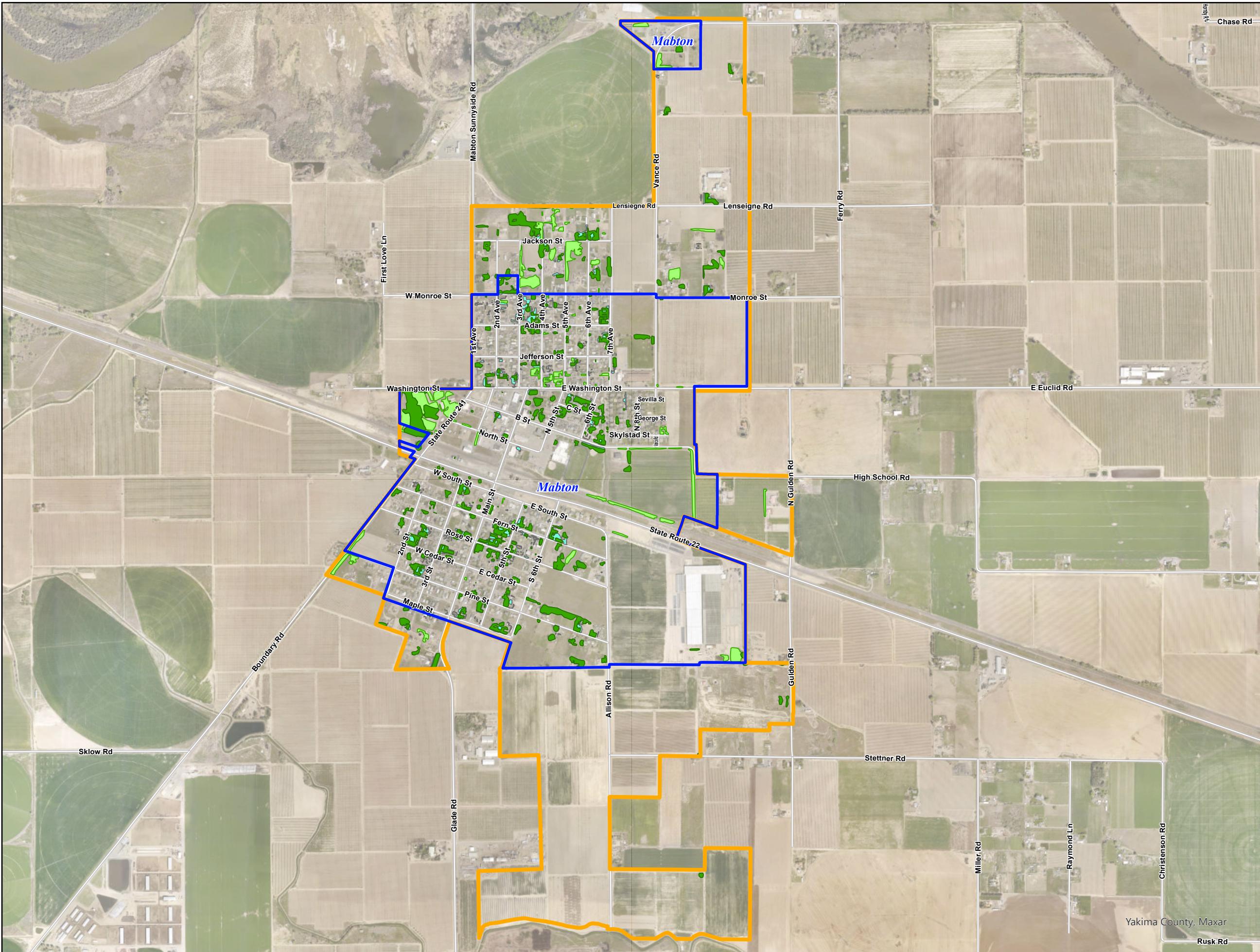
- Impervious, Covered By Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- City Limits
- Urban Growth Boundary
- All Roads



0 345 690 1,380 2,070 2,760
1 inch equals 1,350 feet

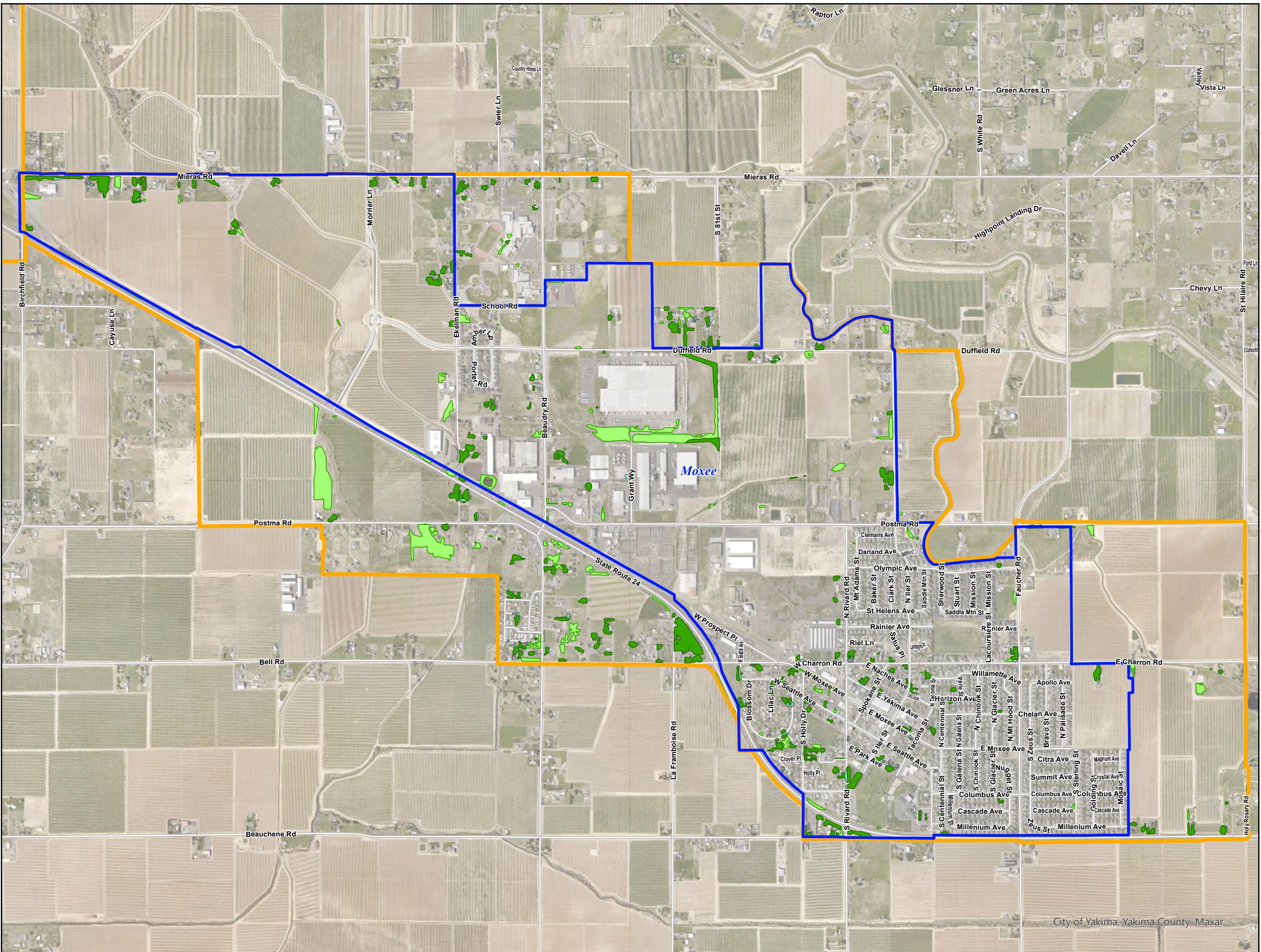


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YAKIMA COUNTY

Tree Canopy Cover City of Moxee



Land Cover Ecopia Data

2021 - 2022

- Impervious, Covered By Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- City Limits
- Urban Growth Boundary
- All Roads



0 350 700 1,400 2,100 2,800
Feet

1 inch equals 1,420 feet



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YAKIMA COUNTY

Tree Canopy Cover Town of Naches

Land Cover Ecopia Data

2021 - 2022

- Impervious, Covered By Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- City Limits
- Urban Growth Boundary
- All Roads

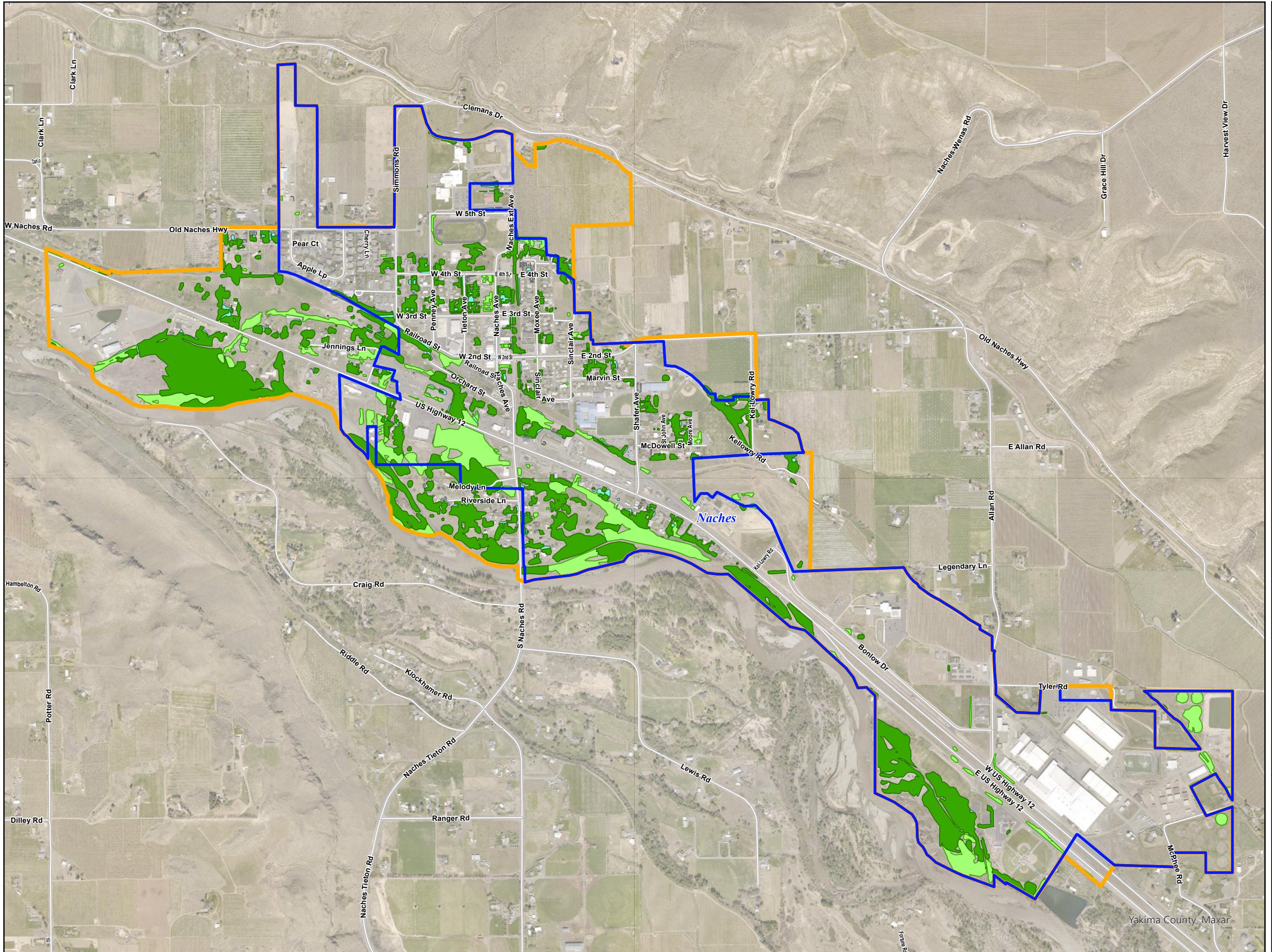


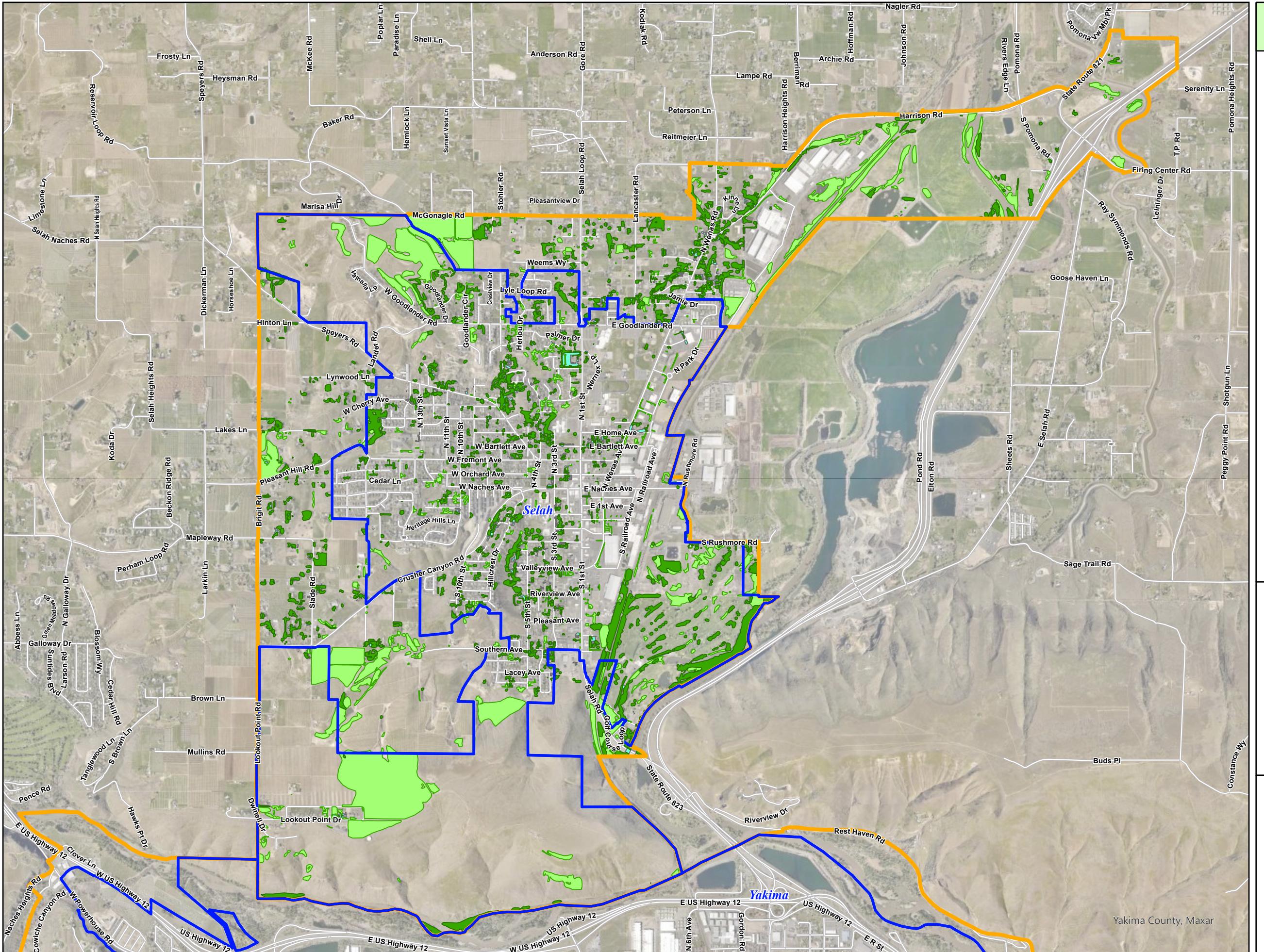
0 250 500 1,000 1,500 2,000
Feet

1 inch equals 1,050 feet



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YAKIMA COUNTY

Tree Canopy Cover City of Selah

Land Cover Ecopia Data

2021 - 2022

- Impervious, Covered By Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- City Limits
- Urban Growth Boundary
- All Roads

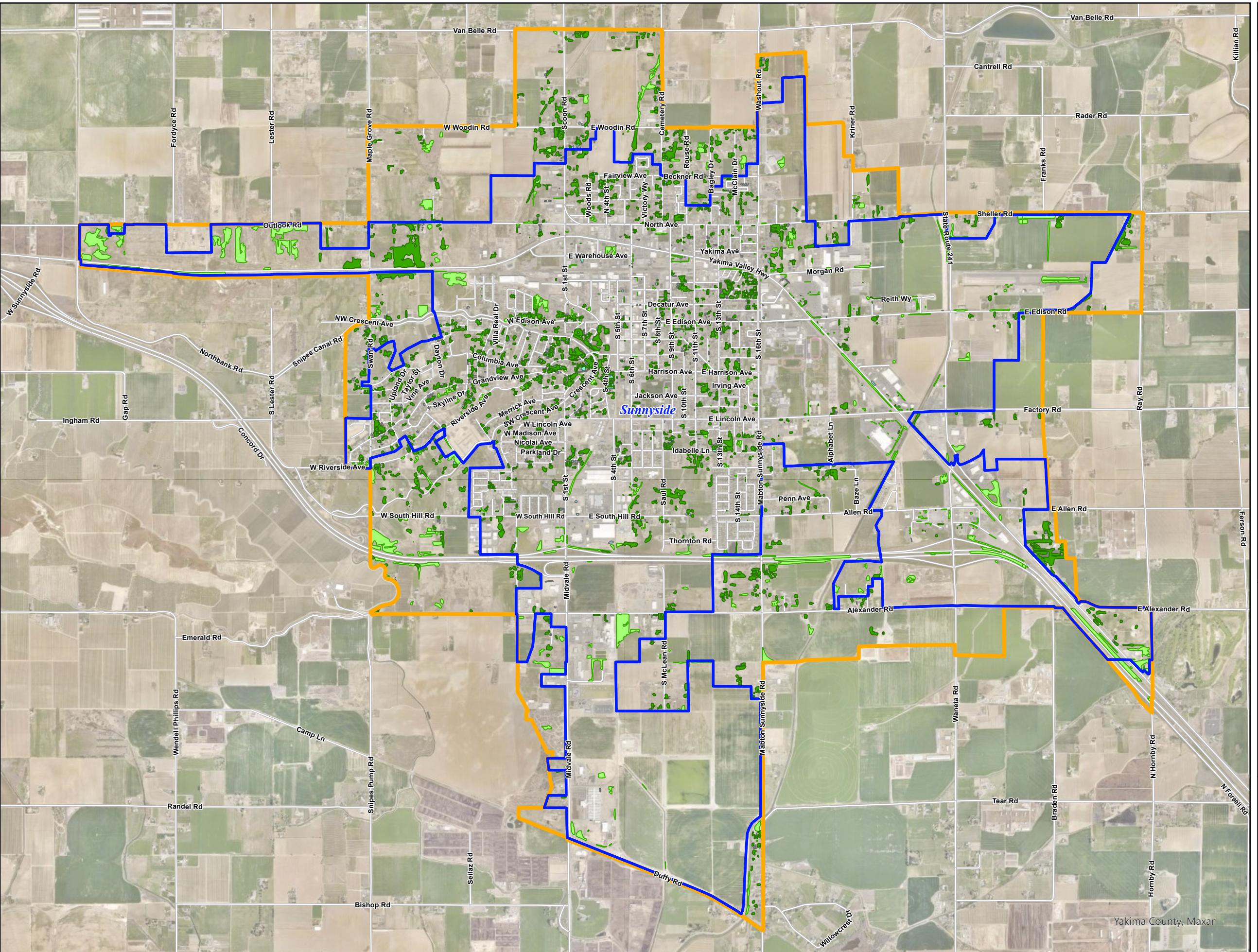


A scale bar at the top of the map indicates distances in feet. It features a black horizontal bar with white tick marks and labels. The labels are: 0, 500, 1,000, 3,000, 3,000, and 4,000. The word "Feet" is written in black text to the right of the scale bar.

1 inch equals 2,300 feet



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YAKIMA COUNTY

Tree Canopy Cover City of Sunnyside

Land Cover Ecopia Data

2021 - 2022

- Impervious, Covered By Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- City Limits
- Urban Growth Boundary
- All Roads



A horizontal scale bar consisting of a black bar with three white rectangular segments. The first two segments are of equal width, and the third segment is twice as wide as each of the first two. To the right of the bar, the word "Miles" is written in a black, sans-serif font.

1 inch equals 2.54 centimeters

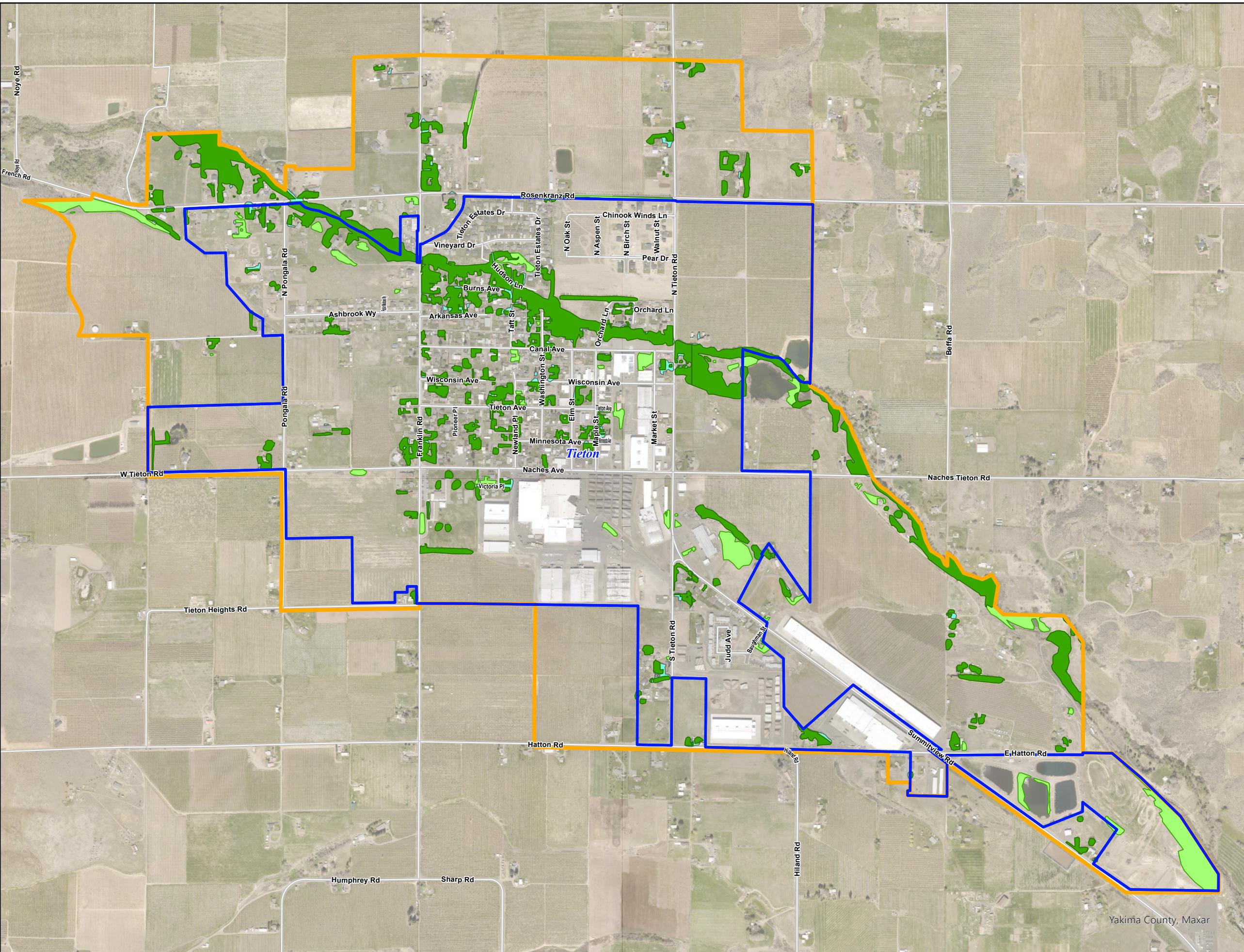


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YAKIMA COUNTY

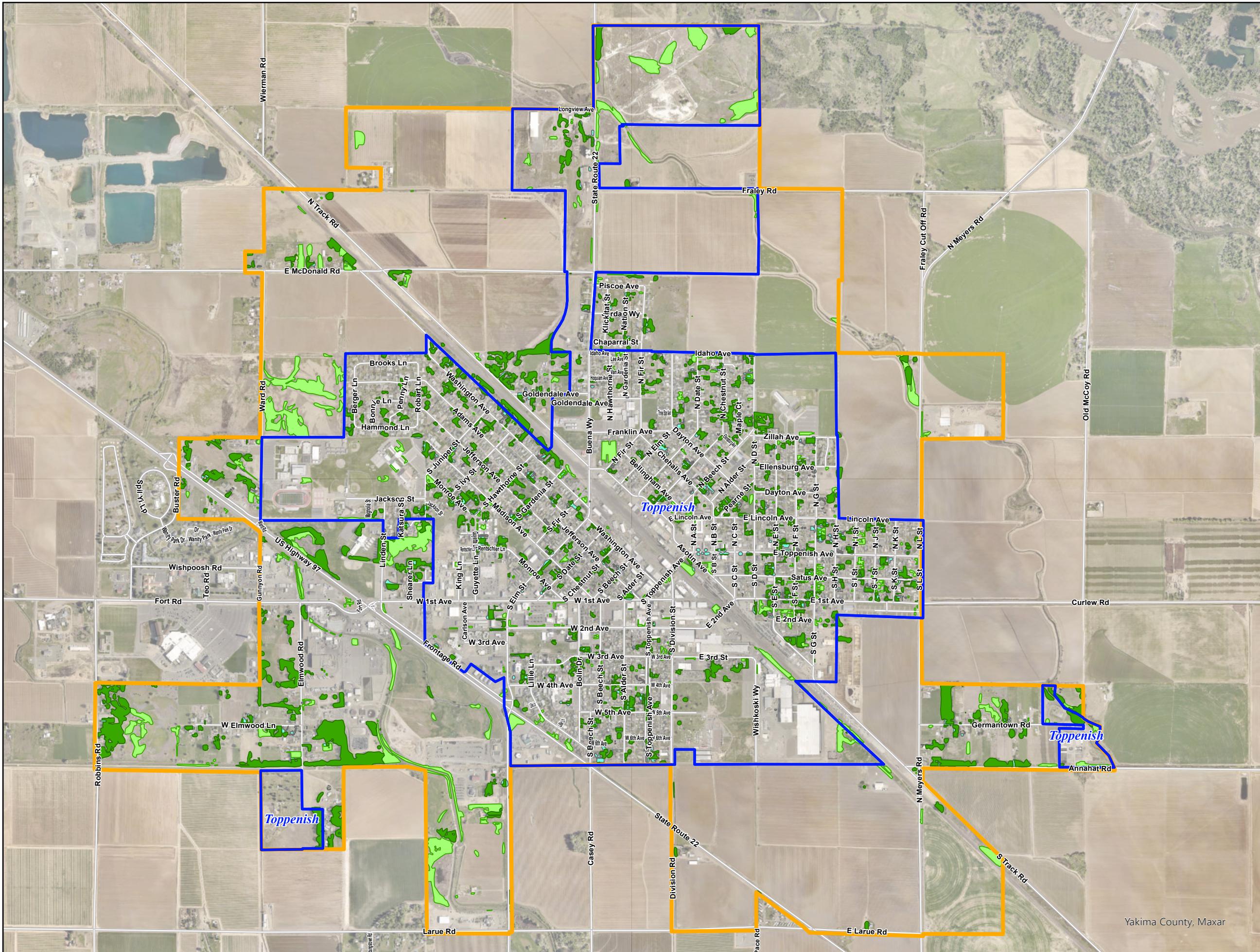
Tree Canopy Cover City of Tieton



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YAKIMA COUNTY

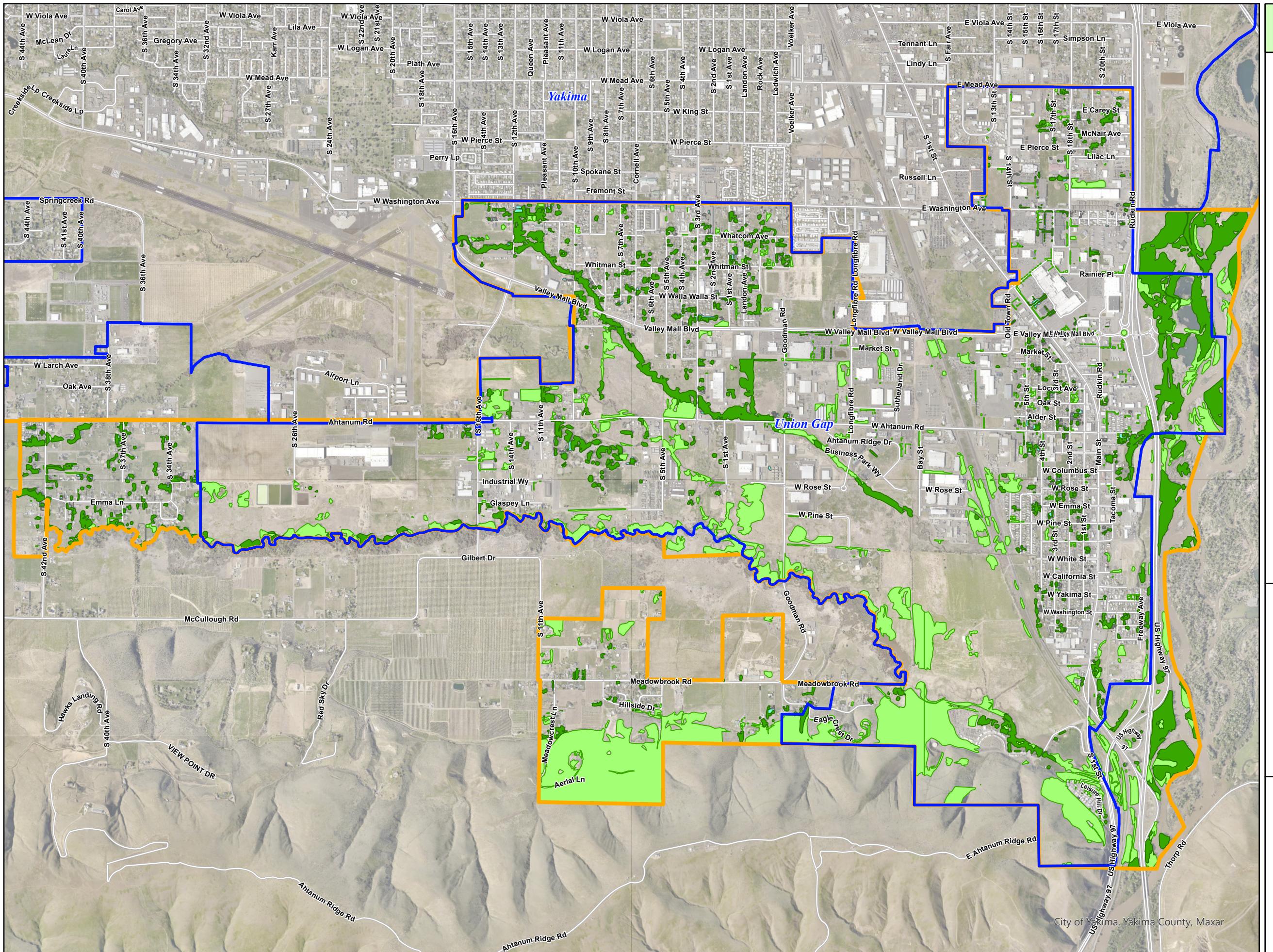
Tree Canopy Cover City of Toppenish



0 375 750 1,500 2,250 3,000
1 inch equals 1,500 feet



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YAKIMA COUNTY

Tree Canopy Cover City of Union Gap

Land Cover Ecopia Data

2021 - 2022

- Impervious, Covered By Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- City Limits
- Urban Growth Boundary
- All Roads



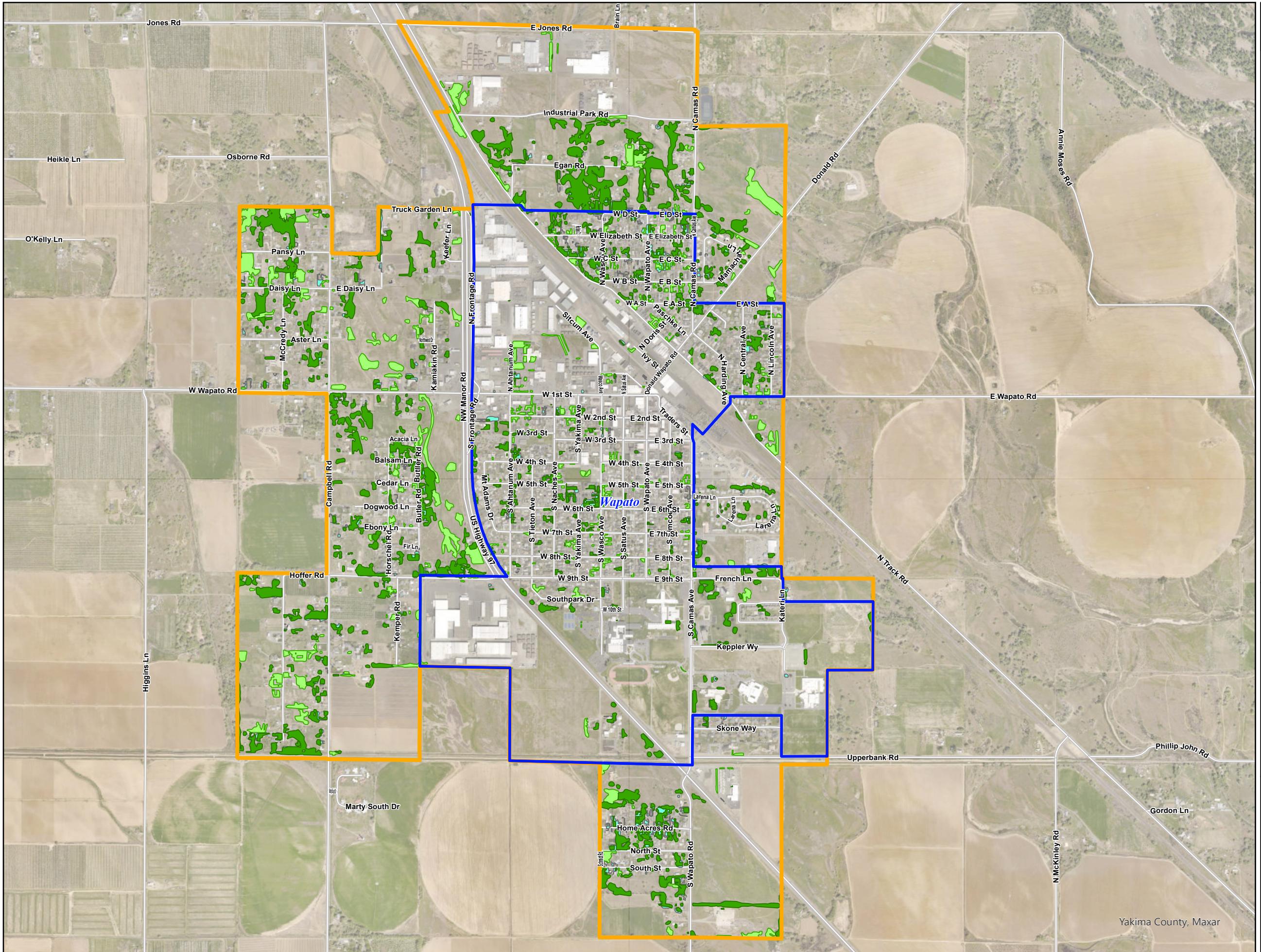
Feet

500 1,000 2,000 3,000 4,000

1 inch equals 2,000 feet



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YAKIMA COUNTY

Tree Canopy Cover City of Wapato

Land Cover Ecopia Data

2021 - 2022

- Impervious, Covered By Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- City Limits
- Urban Growth Boundary
- All Roads



Feet

1 inch equals 1,350 feet

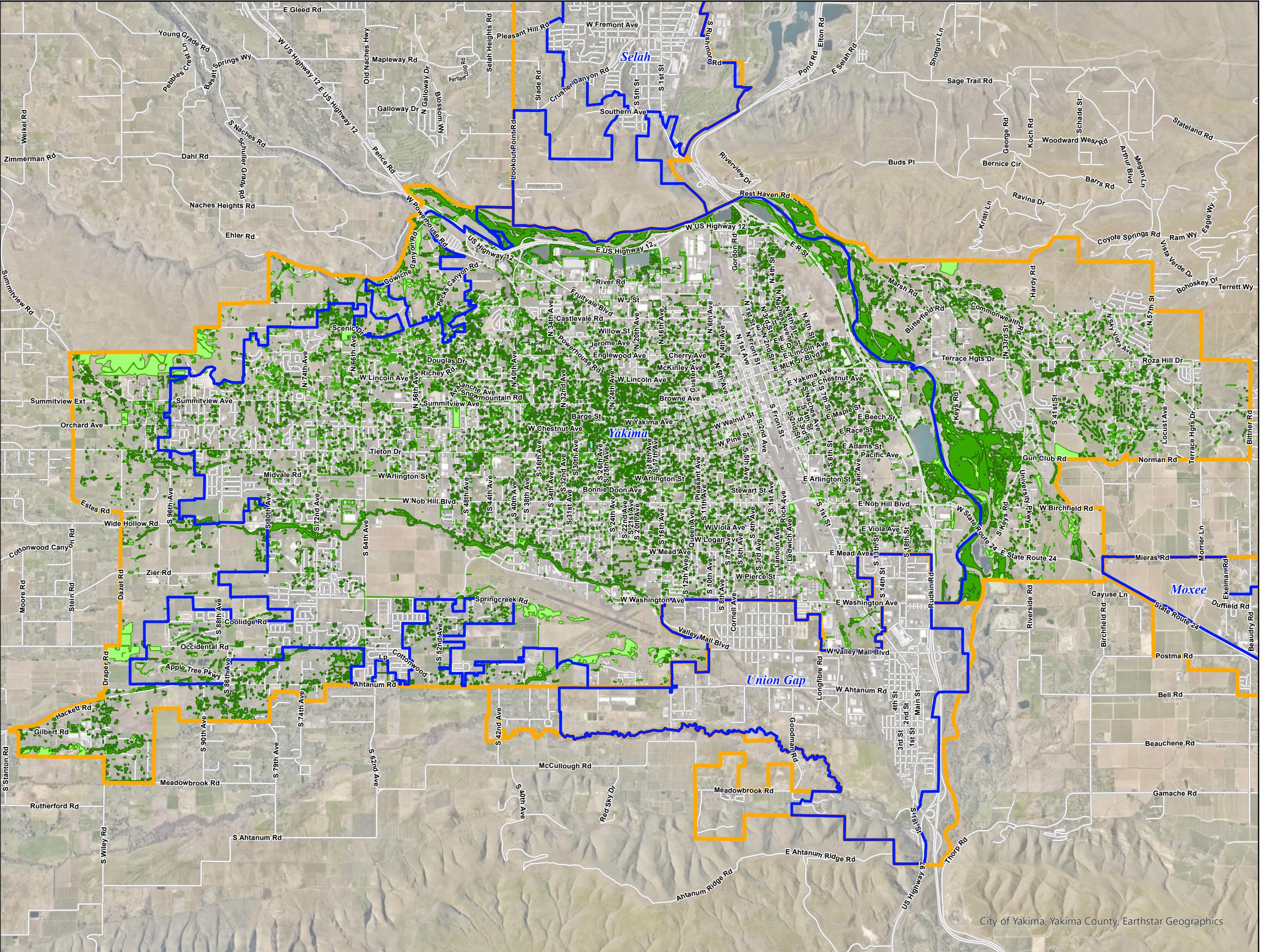


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YAKIMA COUNTY

Tree Canopy Cover City of Yakima



Land Cover Ecopia Data

2021 - 2022

- Impervious, Covered by Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- City Limits
- Urban Growth Boundary
- All Roads



0 0.25 0.5 1 1.5 2
Miles
1 inch equals 5,050 feet



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YAKIMA COUNTY

Tree Canopy Cover City of Zillah

Land Cover Ecopia Data

2021 - 2022

- Impervious, Covered By Trees
- Shrub/Low Vegetation
- Tree/Forest/High Vegetation
- City Limits
- Urban Growth Boundary
- All Roads

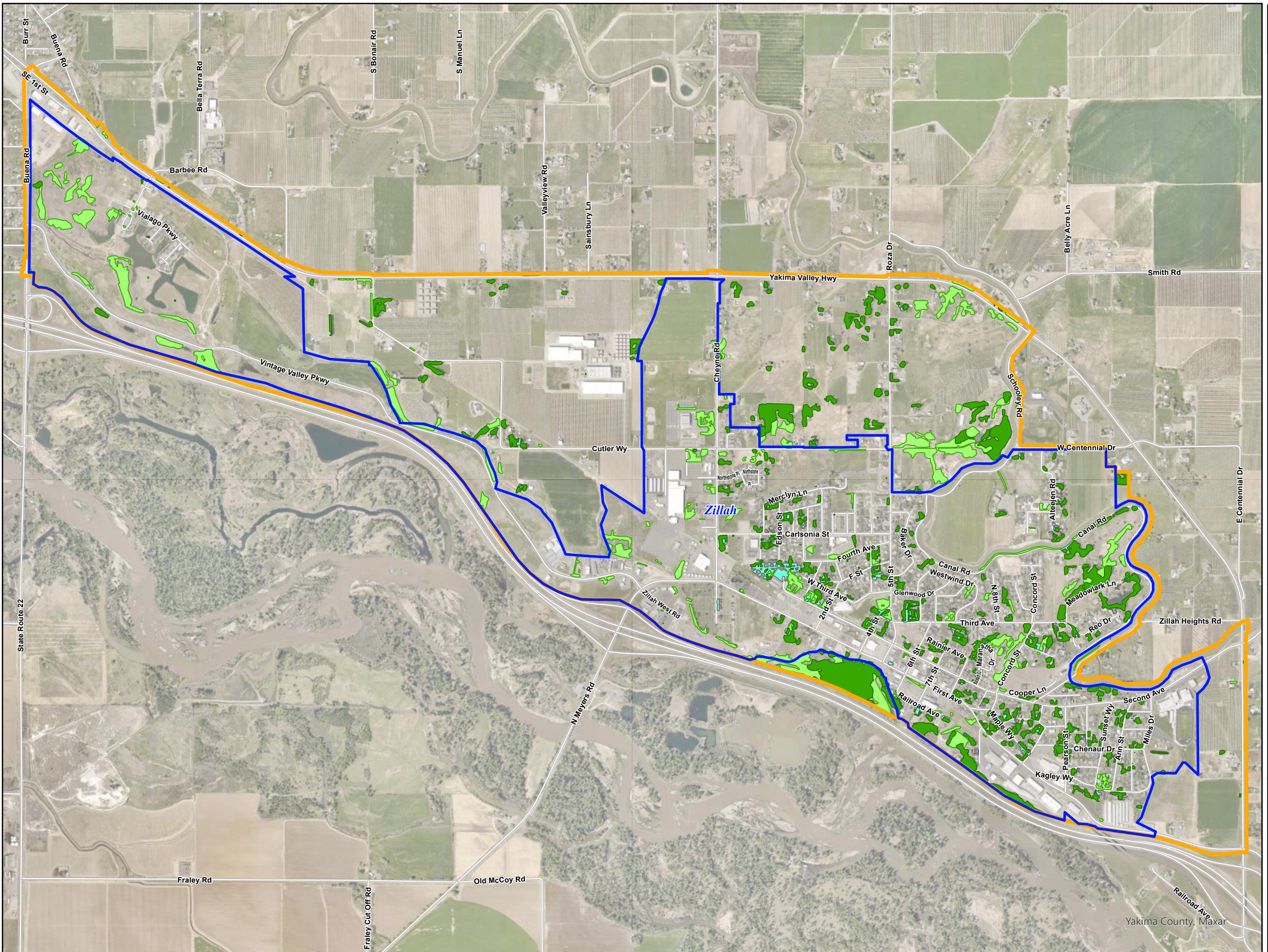


0 362.5 725 1,450 2,175 2,900
Feet

1 inch equals 1,420 feet



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This map was derived from several databases. The
County cannot accept responsibility for any errors.
Therefore, there are no warranties for this product.
Date: 6/4/2025



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Appendix B

Xeriscaping Examples

Native Perennials

A proactive method of adding color, variety of native species, and pollinator plants to areas.

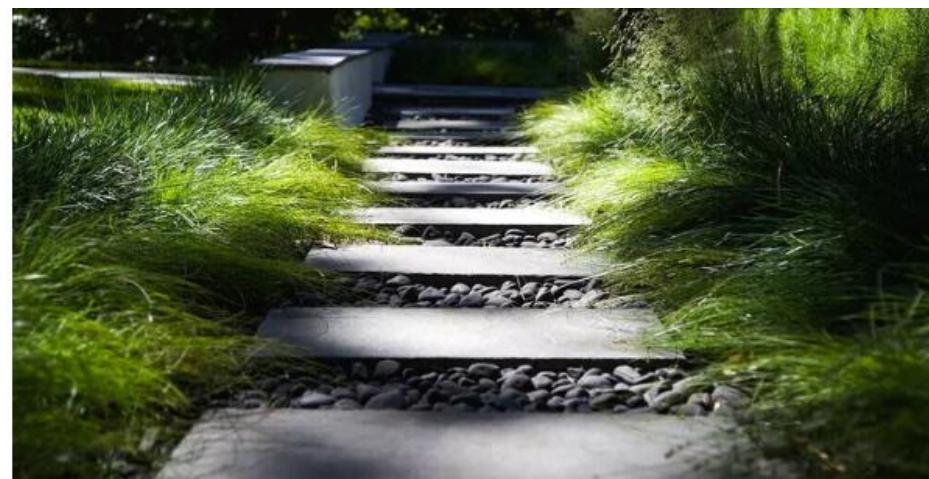
Courtesy of Jeff Epping



Purposeful Landscaping

Graveling, decorative paving, and mulched pathways assist in beautifying areas, reducing heat absorption into the ground, can be unique, and a good way to use unused construction materials.

Courtesy of Clive Nichols, GETTY Images, and Refugia



Ground Covers

Ground covers assist greatly in mitigating heat island effects, continual use of water maintaining water rights, stabilizing soils, and often low-maintenance cost.

Courtesy of GETTY Images



Succulents and Potted Plants

Succulents are another way to add color and variety to xeriscaping. Potted plants provide another way to direct people through the space, are often easily exchangeable and customizable, and provide different colors and textures to the space.



Courtesy of Longwood Gardens and GETTY IMAGES