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MGIS

Geography 564 - Winter 2018
Due March 15, 2018

Evaluation of Open Space Opportunities for a Selected Area of Interest (AOI) in the Cedar River Watershed, King County, Washington

Project Introduction

In a prepared simulation for this class project (Project), our Group 3 hypothetical GIS company (Geography-564 Inc) has been contracted on a limited basis by the King County government to assist in a study on a certain swathe of land regarding its future development. We are to create a loose cost-benefit assessment comparing four different developmental perspectives; full commercial development, recreational development, sustainable forestry, and open space preservation. The area of interest is 28-square miles in size, heavily forested, and located southeast of Tiger Mountain, southwest of Snoqualmie, and northeast of Maple Valley (Figure 1).

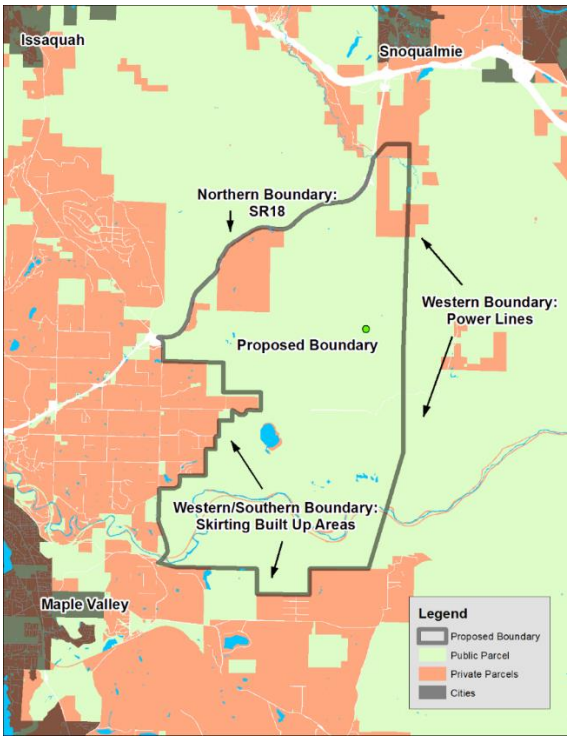

Figure 1.Project Area of Interest (AOI).

The Project is approached through a nuanced GIS-based workflow (*geodesign workflow*) because it involves a group of four stakeholders and will be used for planning, improvement programming and project implementation (PPI) decision situations, as well as others. While each stakeholder perspective may only consider a limited portion of the AOI, only areas within the AOI will be considered over all. Stakeholders are not acting as decision-makers. They are providing balanced, impartial intelligence to their client in the form of a GIS based analytical assessment. In geodesign terms, they are going as far as the impact model. Geography 564 Inc. has assigned one of each of four focal perspectives to a

separate land use planner (class Group 3 member) in the company's Planning and Development Department.

My Stakeholder Role

As a stakeholder in a group of four stakeholders, I am both representing and advocating open space preservation inclusions in the Project's AOI. It is my responsibility to prepare this report for use in comparison and evaluation procedures with the other three other stakeholders (see Stakeholder Roles in Appendix 6). However, each stakeholder is working on his/her individual report apart of one another. Presumably at some point there will be a meeting of the entire group scheduled to determine the common currency for use in a group stakeholder multi-criteria evaluation and comparison process. But to-date there has been no meeting scheduled.

Open Space Definition

Project open space is considered land set aside in public or private for non-profit ownership for protecting its natural resource values or ecosystem services (e.g., fish and wildlife habitat, flood mitigation, and water quality) exclusively for non-consumptive uses in perpetuity. This non-consumptive purpose must be reflected in all parcel management goals and objectives and must be legally enforceable through a preservation focused land steward under a third-party conservation easement. The conservation easement must be adequately funded through a perpetuity non-wasting endowment or another dedicated funding source capable of serving as a non-wasting endowment. Any property where management goals allow consumptive uses and / or are either unprotected or inadequately protected cannot be considered open space under this definition. For example, a parcel that allows even limited commercial timber harvest or is protected through a covenant or a deed restriction (no matter how restrictive) cannot be considered open space using this definition.

Open Space Goals and Objectives

The primary values, goals, objectives, and criteria descriptions for this project are in Table 1. Natural resource protection and passive recreation are considered subsets of the overarching open space value. The goals and objectives set here should be viewed as minimum interim ecologically focused targets that can be appended upon if such opportunities become available. It should also be noted that these goals are biased to primarily focus on aquatic and aquatic transition areas. This is reflective of the life-cycle requirements of imperiled species in the Project AOI and the regulatory / planning framework established to help protect and recover them. To some extent it also reflects the limited amount of current up-to-date related spatial datasets available for use in GIS applications. This should be considered a living document, subject to periodic review and refinement as new data and empirical information become available. The most important accomplishment this document could make would be to help set into motion a successful system for planning, implementing, monitoring, tracking and updating imperiled species and habitat recovery progress in the Project AOI.

Table 1. Refined Values Structures.

Values	Goals/Targets	Objectives	Criteria
Open Space	Provide local and regional open space preservation opportunities	Provide at least 300-acres of open space on at least 3 separate parcels	Parcel location and size adequately buffered from ambient disturbance
Natural Resource Protection	Protect imperiled species and their habitats	Provide at least 500-acres protected upland and 300-acres of protected aquatic area designations in at least 5 separate areas	Imperiled species habitat suitability criteria / Parcel and aquatic area location and size adequately buffered from ambient disturbance
Passive Recreation	Provide preservation areas compatible with non-consumptive recreation opportunities	Provide at least 350-acres of upland and 200-acres of aquatic areas for passive recreational use in at least 5 separate areas	Parcel and aquatic area location and size adequately buffered from ambient disturbance

Open Space Model – Environmental

A literature review was used to discern the specific ecological elements that were used in the GIS model to represent the focal species and habitats for model geoprocessing applications.

Model Theory (Reid and Hilton 1998)

1. Riparian systems contribute to the stream aquatic food web through fallen leaves, branches and associated invertebrates.
2. Riparian systems help maintain water quality by filtering sediments, chemicals, and nutrients from upland sources.
3. Riparian systems help shade streams and maintain air and water temperature regimes suitable for the survival of native species.
4. Riparian systems help maintain bank cohesion and prevent adverse sedimentation into natural salmonid spawning gravels.
5. Riparian systems contribute woody debris that subsequently contribute to channel forming processes and suitable salmonid pool /riffle complexes that function both as sediment sinks and food processors for detrital breakdown, as well as providing transport flows suitable for maintain sediment free spawning redds.
6. Properly functioning riparian systems help prevent channel degradation and facilitate the maintenance of stream channel / floodplain connectivity.

Model Theory (Burel and Baudry 2004)

1. Species cannot be discussed outside of the context of their habitat requirements.
2. Landscapes develop along hierarchical spatial and temporal scales at varying levels of anthropogenic disruption.

3. The rates of species immigration and extinction on actual and / or de facto island habitat fragments (habitat types isolated by human related disturbances such as urbanization or agriculture) depend respectively on island / habitat patch sizes and distances from the mainland and / or species source habitat.
4. Habitat / species dynamic equilibriums post disturbance experience a temporal lag period.
5. Habitat has both horizontal and vertical structure.

Model Theory (Watts et al. 2005)

1. Regarding patches, it is useful to distinguish between 'edge species' and 'interior species.'
2. Corridors help facilitate the movement of species between patches. It is often useful from a conservation perspective to focus on habitat requirements and corridor movements for keystone species and their respective metapopulations.
3. Barriers must be considered, both natural and human related, when considering existing habitat suitability and future planning for species / habitat conservation.
4. The 'mosaic' of patches viewed depends on the focal scale of the species / habitat of interest.

Model Theory (Franklin and Lindenmayer 2009)

1. The matrix (dominating overarching habitat element) of habitat patches is a foundational architecture from which species habitat relationships must be researched and understood.
2. Anthropogenic disruptions such as clearcutting and urbanization have an isolation effect on many species.

Model Theory (McGarigal 2018)

1. A definition of patch is less important than understanding the following: (a) the patch must be defined relative to the phenomenon under investigation or management; (b) that, regardless of the phenomenon under consideration (e.g., a species, geomorphological disturbances, etc.), patches are dynamic and occur at multiple scales; and (c) that patch boundaries are only meaningful when referenced to a focal scale.
2. Habitat Corridors constitute linear landscape elements that provide survivorship, natality, and movement. They passively increase landscape connectivity for the focal organism(s).
3. Facilitated Movement Corridors constitute linear landscape elements that provide for survivorship and movement, but not necessarily natality, between other habitat patches. They actively increase landscape connectivity for the focal organism(s).

Model Theory (EPA 2002)

1. Amphibians are considered indicator species with respect to many aspects of habitat degradation, including but not necessarily limited to habitat fragmentation, hydrologic modifications, water pollution, and large-scale climate variability.

Selection of Model Variables

Model variables were selected based on the key ecological elements itemized and listed during the literature review used in developing a model theory:

- Variable 1. AOI_COHO_Buffer775 Feature Class
- Variable 2. AOI_CHINOOK_Buffer775 Feature Class
- Variable 3. AOI_BULLTROUT_Buffer775 Feature Class
- Variable 4. AOI_SOCKEYE_Buffer775 Feature Class
- Variable 5. AOI_STEELHEAD_Buffer775 Feature Class
- Variable 6. AOI_OPENSPACE_EXISTING Feature Class
- Variable 7. AOI_WETLANDS Buffer1640 Feature Class
- Variable 8. AOI_WATER_Bodies Buffer1640 Feature Class
- Variable 9. AOI_FLOOD100 Feature Class
- Variable 10. AOI_SteepSlopes Feature Class

Data Acquisition, Archival, and Use

Based on the variables selected, data are being acquired from a variety of sources (Appendix 6) and stored for model building and application in a file geodatabase (Appendix 7). The keystone and focal species selected for the AOI are Federally listed and / or otherwise imperiled migratory salmonids and amphibians.

Model Criteria Applied to GIS Analysis

1. Wetlands and Water Body feature class data were aggregated as amphibian habitat with a selective focus on amphibian metrics associated with forested landscapes (landscape vegetative cover is determined using aerial image surveillance in the AOI). Wetlands adjacent to larger areas of King Co. forests are more likely to have greater native amphibian species diversity. Amphibian richness is highest in wetlands that retain at least 60% of adjacent area in forest land up to and exceeding 1,640-ft (500-m) from the wetland (Richter & Azous 2001).

2. Open space riparian widths in associations with salmonid streams was calculated at five Douglas-fir potential tree heights (Leslie and Reed 1998) at 100-years of age (44-meters x 3.28 ~ 145-feet) x 5 = 725-feet) from OHW (Means and Helm 1985). Assuming a 100-ft stream width (see Stream Order 5 width in Figure 2):

   29.3-meters x 3.28-ft ~ 100-feet | 100-feet / 2 = 50-feet | 725-feet + 50-feet = 775-feet
   775-feet x 2 = 1,550-feet stream corridor width.

Order (ω)	n_ω	$\bar{l}_\omega$ (km)	Total length (km)	Width (m)
1	28 550 000	1.6	45 660 000	0.8
2	6 000 000	3.7	22 061 000	1.8
3	1 260 000	8.5	10 660 100	3.7
4	264 000	19.5	5 151 100	8.3
5	55 500	44.8	2 489 000	29.3
6	11 700	103.2	1 202 700	73.3
7	2450	237.4	581 200	131.5
8	515	546.2	280 800	264.5
9	110	1256.7	135 700	608.5
10	23	2891.7	65 600	988.5
11	5	6653.8	31 700	803.0
12	1	6437.0	6440	3079.0

Figure 2. Relationships between stream order and stream width (Downing et al 2012).

Table 2. Steep Slopes.

Value	Slope (%)	Approximate degrees	Terminology
1	30 - 45	16.5 - 24	Very strong slope
2	45 - 70	24 - 35	Extreme slope
3	70 - 100	35 - 45	Steep slope
4	> 100	> 45	Very steep slope

3. Flood prone areas (1-percent recurrence interval) and steep slopes (Table 2) protected as open space serve to protect existing fish and wildlife habitat while reducing risks of property loss as well as human injury or death.

4. Overall Level 1 Ecological Integrity Assessment score (Table 3) for the wetland polygon metrics scores are weighted according to their perceived importance for affecting onsite ecological integrity. Wetlands and water bodies as open space retain their capability to support native amphibian habitat at optimum suitability levels that also indicate support for a broader suite of native species (EPA 2002).

5. Areas with an existing open space land use designation were recognized in the model as a layer to be considered in the open space ranking calculation and assigned a value of 1.

Table 3. Wetland Modified WDNR Ecological Integrity Score (Values are for class project use only).[1]

Rank	Value	Description	Definition Source
A	5	Undisturbed	WDNR/USFWS
B	4	Moderately Undisturbed	WDNR/USFWS
C	3	Moderately Disturbed	WDNR/USFWS
D	1	Significantly Disturbed	WDNR/USFWS

Data Processing

ESRI Model Builder was used to create a logical model framework (Table 4) aimed at spatially identifying the most important areas in the AOI to procure open space preservation areas based on the criteria parameters used in the model (Figure 5). Except for the 'steep slope' raster, value data

Table 4. Open Space Area Criterion and Value Weights.

Variable	Criterion	Value
COHO	Present/Absent	1 / 0
CHINOOK	Present/Absent	1 / 0
BULLTROUT	Present/Absent	1 / 0
SOCKEYE	Present/Absent	1 / 0
STEELHEAD	Present/Absent	1 / 0
EXISTING OPEN SPACE	Present/Absent	1 / 0
WETLANDS/Water Bodies	Present/Absent	1 – 5 / 0 | 1 / 0
100-yr FLOOD	Present/Absent	1 / 0
STEEP SLOPES	Present/Absent	1 - 5 / 0

[1] NatureServe's automated approach to assessing buffer and landscape context metrics using GIS was modified by the WNHP/DNR. The method was applied to all known Natural Heritage Wetlands and a subset of polygons contained within the National Wetland Inventory (NWI). Only vegetated Lacustrine and Palustrine polygons were targeted. This later dataset was clipped to this Project's AOI for use in this Open Space analysis.

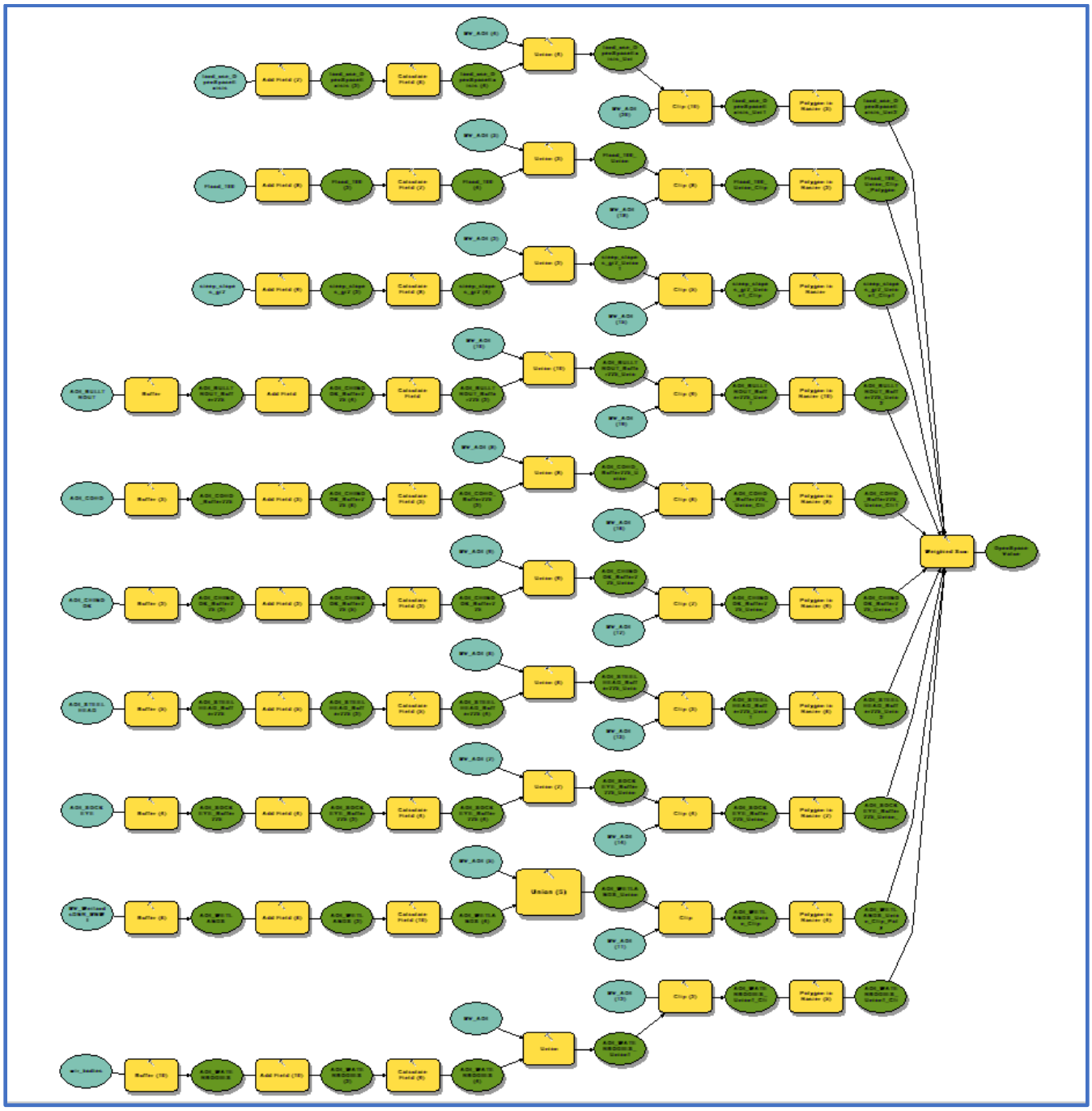

Figure 5. Preliminary AOI open space model diagram.

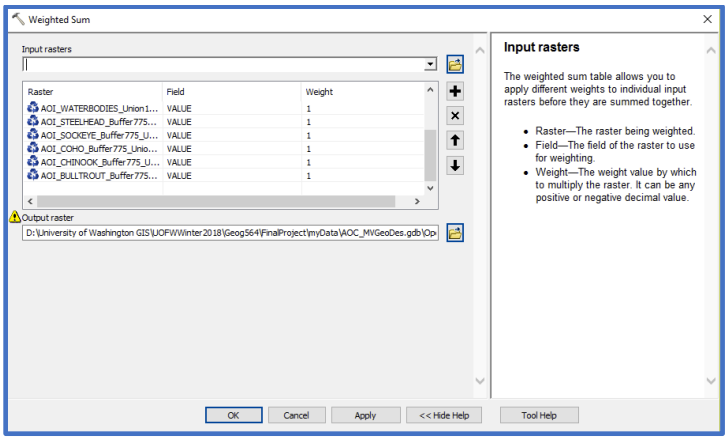

Figure 3. Open space unweighted sum.

were assigned in vector layers representing each model criterion and then each layer underwent a union to a Project AOI polygon (which assumed a 0 value for each record not occupied by the variable value(s)). Each of the resulting vector datasets were then converted to rasters and the subsequent raster layers (with geo-referenced pixels) were summed in an '*unweighted*' application[2] of the weighted sum tool (Figure 3) in ESRI Spatial Analyst Toolbox. The output raster was then classified (Figure 4) and

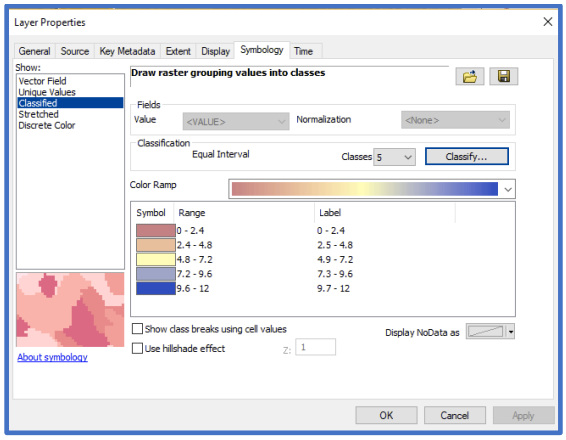

Figure 4. Open space unweighted sum classification.

added to the display of an ArcMap Project (Figure 6). These value outcomes were then normalized to a scale of 0 to 1 (Table 5) for use in comparisons with other stakeholder criteria.

Preliminary Results Discussion

These modeled outcomes should be considered preliminary and subject to amendment as new information and / or data become available. Also, open space value assignments are predominantly based on the author's collection, interpretation, and application of existing and Project specific geo-

[2] Values were pre-weighted while in vector format so there was no need to use the weight function in the weighted sum tool.

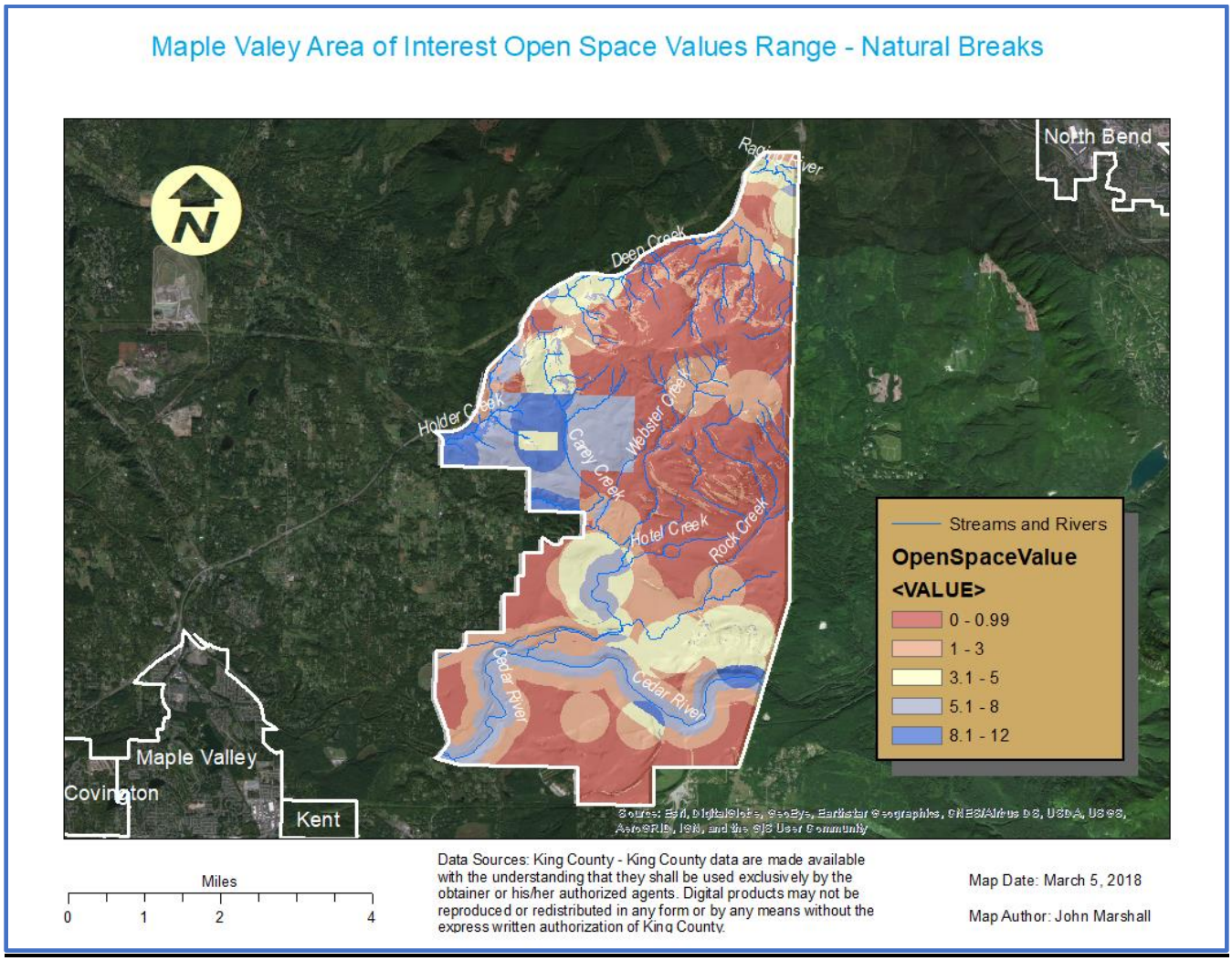

Figure 6. Preliminary AOI open space value range outcomes.

Table 5. Normalization and Ranking of Open Space Values.

Natural Breaks AOI Open Space Value	Normalized AOI Open Space Values	Ordinal Rank
0 – 0.99	0 – 0.825	Low
1.0 – 3.0	0.826 – 0.25	Medium-Low
3.1 – 5.0	0.26 – 0.417	Medium
5.1 – 8.0	0.418 – 0.67	Medium-High
8.1 – 12.0	0.68 – 1.0	High

processed feature class and raster datasets. The emphasis of evaluation is on aquatic and aquatic transition habitat types. The framework for this model is based on a hypothetical class project aimed at finding sustainable planning scenarios that could accommodate several stakeholder interests in a common hypothetical version of the AOI. The actual AOI has a much more complex set of natural resources and a much more diversified land use history than those represented in this model. This highly oversimplified model approach has little to no foundation for application in the real world AOI.

Open Space Model - Economic

In an attempt to find a common currency between stakeholders, a preliminary workflow was developed to provide a monetary value to open space in the Project AOI. This value was intended to be based on documented dollars that could represent a 'societal willingness-to-pay' for open space (Marshall 1985) in the AOI. Willingness-to-pay is defined as the maximum amount a public entity is willing to pay to acquire and protect land for its ecosystem service related values (e.g., fish and wildlife habitat, flood mitigation, scenic values, etc.) . In other words, it is the price a land protection missioned public or private non-profit buyer is willing to pay, and the seller is willing to accept.

The working theory was that the parcel sales prices for each of the properties inside the Project AOI sold to King County Parks and the City of Seattle (see Appendix 3) could be factored for inflation to 2018 dollars and that the mean sales price of these transactions could be used to represent the monetary value of open space ecosystem services in the AOI. The sales transactions are recorded by the King County Assessor's Office and can be viewed on-line (see Appendix 4).

Implementation Problems

Closer scrutiny of the King County Deeds and other property sales transaction documents revealed several logistical problems (Note that some of this information is evident from the documents and some of it was provided over the telephone by King County Parks and City of Seattle staff):

- Sometimes the properties were sold in batches for a single price, making individual property sales prices likely lower than they would have been if sold individually.
- The links to the sales transaction documents were not operational for some of the properties.
- Some properties went through several transactions, each with different types of deeds, making it difficult to know which transaction, if any, represented the desired 'willingness-to-pay' metric (see Appendix 4).

Collectively, these implementation problems were judged too severe to overcome, at least within the time frame required to finish this assignment. My sense is that I would need to get direct access to King County Assessor's Office hard copy files before I could discern if a traditional open space 'willingness-to-pay' approach is feasible for application in this Project AOI.

Open Space Land Appraisal Values (Surrogate 'Wilingness-to-Pay')

Since a direct 'willingness-to-pay' approached was not feasible, at least in the near-term, a decision was made to use a surrogate metric to represent 'willingness-to-pay', appraisal value. Each property parcel in the AOI has been assigned an appraised dollar value. The appraised value is established using an algorithm designed to bring previous appraisals of the property into synchronization with current 'fair-market-values' for similar properties in the region. In other words, it is measure of a predicted sales price for the property. In order to distill these appraised values into a single representative monetary value for open space in the AOI, the following workflow was used:

1. ***Select TaxpayerOwner*** [3]
   From parcels
   Where TaxpayerOwner = 'King County Parks' OR TaxpayerOwner = 'Seattle City of SPU-WTR'

2. **Field Calculator:**
   PropValPerAcre = [AppLandVal] / [AcresTaxRecord]

3. ***Export Data as AOI_OS35***

4. ***Select PropValPerAcre***
   From AOI_OS35
   Where PropValPerAcre >=300 AND PropValPerAcre <=6000

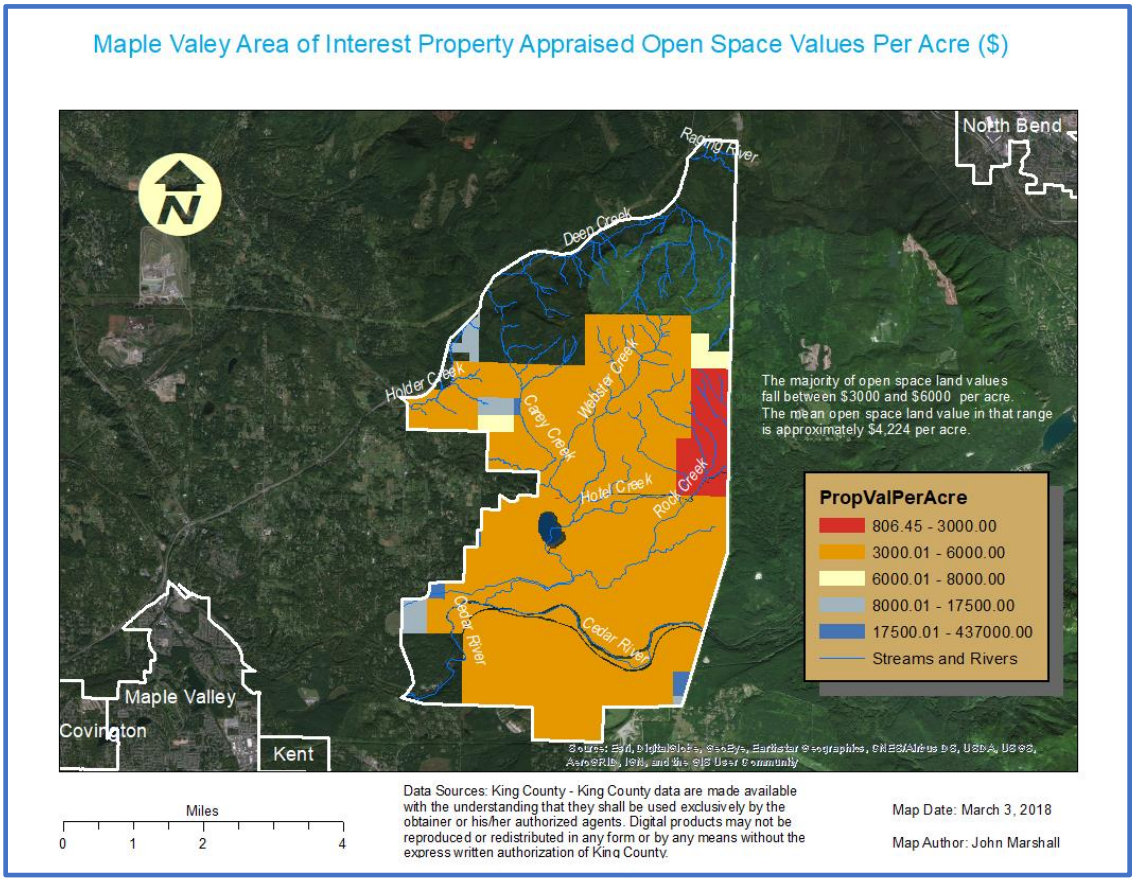

Figure 9. Appraised Land Values Per Acre for Selected Open Space in the AOI.

The majority of land parcels in the selected ownerships (King County and City of Seattle) fall in the 3000 to 6000 dollars per acre range (Figure 9). In this range, the mean appraised value per acre of open space in the AOI is determined to be about $4,224 per acre. This is the dollar value representing open space inside the AOI.

[3] King County Park ownerships are currently designated as open space and the City of Seattle has entered into a Habitat Conservation Plan (see Appendix 10) for the properties in their ownership in the AOI (USFWS 2000).

Table 6. Normalization and Ranking of Open Space Monetary (Appraisal)Values.

Natural Breaks AOI Open Space Value ($)	Normalized AOI Open Space Values	Ordinal Rank
806.45 - 3000	0 – 0.067	Low
3001 – 6000	0.068 – 0.137	Medium-Low
6001 – 8000	0.138 – 0.183	Medium
8001 – 17500	0.184 – 0.400	Medium-High
17501 – 43700	0.401 – 1.0	High

Implementation Caveats All Properties[4]

- The buyers of the properties may have not managed some or all of the properties strictly for their preservation values. In other words, there may be a history of allowing consumptive uses (e.g., commercial timber harvest) that would not meet the open space definition used for this Project.
- Some of the properties were sold through a condemnation procedure, calling into question the whole concept of 'willingness-to-pay.'
- Post-sale protection documents for most if not all the properties are reportedly in the form of covenants and deed restrictions, not the third-party and endowment enabled conservation easements required by this Project to qualify as 'open space' protection.

Implementation Caveats Appraisal Properties

The foundation for the appraised value of these properties is much more likely to be based on more traditional market transactions such as single and multi-family occupancy parcels (the designated present use for most of these properties) as opposed to a public or private for non-profit organization purchasing property for its conservation or ecosystem service values. But because open space appraisals are generally done post traditional market appraisals, this may still qualify as a surrogate societal 'willingness-to-pay' metric.

While there are many reasons to question the validity of the open space dollar metric derived, it is all relatively meaningless without understanding how the metric will be used in a decision between open space vs one or more alternative land uses. If it is a matter of comparing two values in a ratio where open space dollar metric is the numerator and a decision for open space requires the ratio to be greater than 1.0, then the deciding factors will likely be strongly tied to the land use zoning used to evaluate the appraisal values of the lands proposed for alternative uses and / or their anticipated calculated capitalized economic rents with respect to their stakeholder's preferred alternative use(s).

[4] Note: these caveats apply both to the 'willingness-to-pay' metric and the surrogate 'willingness-to-pay' metric.

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Appendix 1. Open Space Model Python Script

```
# -*- coding: utf-8 -*-
# ---------------------------------------------------------------------------
# OSModel_PyScrpt.py
# Created on: 2018-02-22 17:28:31.00000
#   (generated by ArcGIS/ModelBuilder)
# Description:
# ---------------------------------------------------------------------------

# Import arcpy module
import arcpy


# Local variables:
steep_slopes_gt7 = "D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Geology\\steep_slopes_gt7"
steep_slopes_gt7__2_ = steep_slopes_gt7
steep_slopes_gt7__4_ = steep_slopes_gt7__2_
MV_AOI__2_ = "MV_AOI"
steep_slopes_gt7_Union1 = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\steep_slopes_gt7_Union1"
MV_AOI__15_ = "MV_AOI"
steep_slopes_gt7_Union1_Clip = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\steep_slopes_gt7_Union1_Clip"
steep_slopes_gt7_Union1_Clip1 = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\steep_slopes_gt7_Union1_Clip1"
Flood_100 = "D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Hydrology\\Flood_100"
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Flood_100__4_ = Flood_100__2_
MV_AOI__3_ = "MV_AOI"
Flood_100_Union = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\Flood_100_Union"
MV_AOI__18_ = "MV_AOI"
Flood_100_Union_Clip = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\Flood_100_Union_Clip"
Flood_100_Union_Clip_Polygon = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\Flood_100_Union_Clip_Polygon"
land_use_OpenSpaceExists = "D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\LandUse\\land_use_OpenSpaceExists"
land_use_OpenSpaceExists__2_ = land_use_OpenSpaceExists
land_use_OpenSpaceExists__4_ = land_use_OpenSpaceExists__2_
MV_AOI__4_ = "MV_AOI"
land_use_OpenSpaceExists_Uni = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\land_use_OpenSpaceExists_Uni"
MV_AOI__20_ = "MV_AOI"
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MV_WetlandsDNR_MNWI = "MV_WetlandsDNR_MNWI"
AOI_WETLANDS = "D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_WETLANDS"
AOI_WETLANDS__2_ = AOI_WETLANDS
AOI_WETLANDS__4_ = AOI_WETLANDS__2_
MV_AOI__5_ = "MV_AOI"
AOI_WETLANDS_Union = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_WETLANDS_Union"
MV_AOI__11_ = "MV_AOI"
AOI_WETLANDS_Union_Clip = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_WETLANDS_Union_Clip"
AOI_WETLANDS_Union_Clip_Poly =
"C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_WETLANDS_Union_Clip_Poly"
wtr_bodies = "wtr_bodies"
```

AOI_WATERBODIES = "D:\\University of Washington GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_WATERBODIES"
AOI_WATERBODIES__2_ = AOI_WATERBODIES
AOI_WATERBODIES__4_ = AOI_WATERBODIES__2_
MV_AOI = "MV_AOI"
AOI_WATERBODIES_Union1 = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_WATERBODIES_Union1"
MV_AOI__12_ = "MV_AOI"
AOI_WATERBODIES_Union1_Clip = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_WATERBODIES_Union1_Clip"
AOI_WATERBODIES_Union1_Clip_ = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_WATERBODIES_Union1_Clip_"
AOI_STEELHEAD = "D:\\University of Washington GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_STEELHEAD"
AOI_STEELHEAD_Buffer775 = "D:\\University of Washington GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_STEELHEAD_Buffer775"
AOI_STEELHEAD_Buffer775__2_ = AOI_STEELHEAD_Buffer775
AOI_STEELHEAD_Buffer775__4_ = AOI_STEELHEAD_Buffer775__2_
MV_AOI__6_ = "MV_AOI"
AOI_STEELHEAD_Buffer775_Unio = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_STEELHEAD_Buffer775_Unio"
MV_AOI__13_ = "MV_AOI"
AOI_STEELHEAD_Buffer775_Unio1 = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_STEELHEAD_Buffer775_Unio1"
AOI_STEELHEAD_Buffer775_Unio2 = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_STEELHEAD_Buffer775_Unio2"
AOI_SOCKEYE = "D:\\University of Washington GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_SOCKEYE"
AOI_SOCKEYE_Buffer775 = "D:\\University of Washington GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_SOCKEYE_Buffer775"
AOI_SOCKEYE_Buffer775__2_ = AOI_SOCKEYE_Buffer775
AOI_SOCKEYE_Buffer775__4_ = AOI_SOCKEYE_Buffer775__2_
MV_AOI__7_ = "MV_AOI"
AOI_SOCKEYE_Buffer775_Union = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_SOCKEYE_Buffer775_Union"
MV_AOI__14_ = "MV_AOI"
AOI_SOCKEYE_Buffer775_Union_ = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_SOCKEYE_Buffer775_Union_"
AOI_SOCKEYE_Buffer775_Union_1 = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_SOCKEYE_Buffer775_Union_1"
AOI_COHO = "D:\\University of Washington GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_COHO"
AOI_COHO_Buffer775 = "D:\\University of Washington GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_COHO_Buffer775"
AOI_CHINOOK_Buffer775__6_ = AOI_COHO_Buffer775
AOI_COHO_Buffer775__2_ = AOI_CHINOOK_Buffer775__6_
MV_AOI__8_ = "MV_AOI"
AOI_COHO_Buffer775_Union = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_COHO_Buffer775_Union"
MV_AOI__16_ = "MV_AOI"
AOI_COHO_Buffer775_Union_Cli = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_COHO_Buffer775_Union_Cli"
AOI_COHO_Buffer775_Union_Cli1 = "C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_COHO_Buffer775_Union_Cli1"

```
AOI_CHINOOK = "D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_CHINOOK"
AOI_CHINOOK_Buffer775__2_ = "D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_CHINOOK_Buffe
r775"
AOI_CHINOOK_Buffer775__5_ = AOI_CHINOOK_Buffer775__2_
AOI_CHINOOK_Buffer775 = AOI_CHINOOK_Buffer775__5_
MV_AOI__9_ = "MV_AOI"
AOI_CHINOOK_Buffer775_Union =
"C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_CHINOOK_Buffer775_Union"
MV_AOI__17_ = "MV_AOI"
AOI_CHINOOK_Buffer775_Union_ =
"C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_CHINOOK_Buffer775_Union_"
AOI_CHINOOK_Buffer775_Union_1 =
"C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_CHINOOK_Buffer775_Union_1"
AOI_BULLTROUT = "D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_BULLTROUT"
AOI_BULLTROUT_Buffer775 = "D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_BULLTROUT_B
uffer775"
AOI_CHINOOK_Buffer775__4_ = AOI_BULLTROUT_Buffer775
AOI_BULLTROUT_Buffer775__2_ = AOI_CHINOOK_Buffer775__4_
MV_AOI__10_ = "MV_AOI"
AOI_BULLTROUT_Buffer775_Unio =
"C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_BULLTROUT_Buffer775_Unio"
MV_AOI__19_ = "MV_AOI"
AOI_BULLTROUT_Buffer775_Unio1 =
"C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_BULLTROUT_Buffer775_Unio1"
AOI_BULLTROUT_Buffer775_Unio2 =
"C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_BULLTROUT_Buffer775_Unio2"
OpenSpaceValue = "D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\OpenSpaceValue"

# Process: Add Field (9)
arcpy.AddField_management(steep_slopes_gt7, "Value", "SHORT", "", "", "", "", "NULLABLE", "NON_REQUIRED", "")

# Process: Calculate Field (8)
arcpy.CalculateField_management(steep_slopes_gt7__2_, "Value", "1", "VB", "")

# Process: Union (2)
arcpy.Union_analysis("'D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Geology\\steep_slopes_gt7' #;MV_AOI
#", steep_slopes_gt7_Union1, "ALL", "", "GAPS")

# Process: Clip (5)
arcpy.Clip_analysis(steep_slopes_gt7_Union1, MV_AOI__15_, steep_slopes_gt7_Union1_Clip, "")

# Process: Polygon to Raster
arcpy.PolygonToRaster_conversion(steep_slopes_gt7_Union1_Clip, "Value", steep_slopes_gt7_Union1_Clip1,
"CELL_CENTER", "Value", "10")

# Process: Add Field (8)
arcpy.AddField_management(Flood_100, "Value", "SHORT", "", "", "", "", "NULLABLE", "NON_REQUIRED", "")

# Process: Calculate Field (7)
arcpy.CalculateField_management(Flood_100__2_, "Value", "1", "VB", "")
```

```
# Process: Union (3)
arcpy.Union_analysis("'D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Hydrology\\Flood_100' #;MV_AOI #",
Flood_100_Union, "ALL", "", "GAPS")

# Process: Clip (8)
arcpy.Clip_analysis(Flood_100_Union, MV_AOI__18_, Flood_100_Union_Clip, "")

# Process: Polygon to Raster (2)
arcpy.PolygonToRaster_conversion(Flood_100_Union_Clip, "Value", Flood_100_Union_Clip_Polygon,
"CELL_CENTER", "Value", "10")

# Process: Add Field (7)
arcpy.AddField_management(land_use_OpenSpaceExists, "Value", "SHORT", "", "", "", "", "NULLABLE",
"NON_REQUIRED", "")

# Process: Calculate Field (6)
arcpy.CalculateField_management(land_use_OpenSpaceExists__2_, "Value", "5", "VB", "")

# Process: Union (4)
arcpy.Union_analysis("'D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\LandUse\\land_use_OpenSpaceExists'
#;MV_AOI #", land_use_OpenSpaceExists_Uni, "ALL", "", "GAPS")

# Process: Clip (10)
arcpy.Clip_analysis(land_use_OpenSpaceExists_Uni, MV_AOI__20_, land_use_OpenSpaceExists_Uni1, "")

# Process: Polygon to Raster (3)
arcpy.PolygonToRaster_conversion(land_use_OpenSpaceExists_Uni1, "Value", land_use_OpenSpaceExists_Uni2,
"CELL_CENTER", "Value", "10")

# Process: Buffer (6)
arcpy.Buffer_analysis(MV_WetlandsDNR_MNWI, AOI_WETLANDS, "1640 Feet", "FULL", "ROUND", "ALL", "",
"PLANAR")

# Process: Add Field (6)
arcpy.AddField_management(AOI_WETLANDS, "Value", "SHORT", "", "", "", "", "NULLABLE", "NON_REQUIRED",
"")

# Process: Calculate Field (10)
arcpy.CalculateField_management(AOI_WETLANDS__2_, "Value", "3", "VB", "")

# Process: Union (5)
arcpy.Union_analysis("'D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_WETLANDS'
#;MV_AOI #", AOI_WETLANDS_Union, "ALL", "", "GAPS")

# Process: Clip
arcpy.Clip_analysis(AOI_WETLANDS_Union, MV_AOI__11_, AOI_WETLANDS_Union_Clip, "")

# Process: Polygon to Raster (4)
arcpy.PolygonToRaster_conversion(AOI_WETLANDS_Union_Clip, "Value", AOI_WETLANDS_Union_Clip_Poly,
"CELL_CENTER", "Value", "10")

# Process: Buffer (10)
```

```
arcpy.Buffer_analysis(wtr_bodies, AOI_WATERBODIES, "1640 Feet", "FULL", "ROUND", "ALL", "", "PLANAR")

# Process: Add Field (10)
arcpy.AddField_management(AOI_WATERBODIES, "Value", "SHORT", "", "", "", "", "NULLABLE",
"NON_REQUIRED", "")

# Process: Calculate Field (9)
arcpy.CalculateField_management(AOI_WATERBODIES__2_, "Value", "1", "VB", "")

# Process: Union
arcpy.Union_analysis("'D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_WATERBODIES'
#;MV_AOI #", AOI_WATERBODIES_Union1, "ALL", "", "GAPS")

# Process: Clip (2)
arcpy.Clip_analysis(AOI_WATERBODIES_Union1, MV_AOI__12_, AOI_WATERBODIES_Union1_Clip, "")

# Process: Polygon to Raster (5)
arcpy.PolygonToRaster_conversion(AOI_WATERBODIES_Union1_Clip, "Value",
AOI_WATERBODIES_Union1_Clip_, "CELL_CENTER", "Value", "10")

# Process: Buffer (5)
arcpy.Buffer_analysis(AOI_STEELHEAD, AOI_STEELHEAD_Buffer775, "775 Feet", "FULL", "ROUND", "ALL", "",
"PLANAR")

# Process: Add Field (5)
arcpy.AddField_management(AOI_STEELHEAD_Buffer775, "Value", "SHORT", "", "", "", "", "NULLABLE",
"NON_REQUIRED", "")

# Process: Calculate Field (5)
arcpy.CalculateField_management(AOI_STEELHEAD_Buffer775__2_, "Value", "1", "VB", "")

# Process: Union (6)
arcpy.Union_analysis("'D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_STEELHEAD_Bu
ffer775' #;MV_AOI #", AOI_STEELHEAD_Buffer775_Unio, "ALL", "", "GAPS")

# Process: Clip (3)
arcpy.Clip_analysis(AOI_STEELHEAD_Buffer775_Unio, MV_AOI__13_, AOI_STEELHEAD_Buffer775_Unio1, "")

# Process: Polygon to Raster (6)
arcpy.PolygonToRaster_conversion(AOI_STEELHEAD_Buffer775_Unio1, "Value",
AOI_STEELHEAD_Buffer775_Unio2, "CELL_CENTER", "Value", "10")

# Process: Buffer (4)
arcpy.Buffer_analysis(AOI_SOCKEYE, AOI_SOCKEYE_Buffer775, "775 Feet", "FULL", "ROUND", "ALL", "",
"PLANAR")

# Process: Add Field (4)
arcpy.AddField_management(AOI_SOCKEYE_Buffer775, "Value", "SHORT", "", "", "", "", "NULLABLE",
"NON_REQUIRED", "")

# Process: Calculate Field (4)
arcpy.CalculateField_management(AOI_SOCKEYE_Buffer775__2_, "Value", "1", "VB", "")

# Process: Union (7)
```

```
arcpy.Union_analysis("'D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_SOCKEYE_Buffe
r775' #;MV_AOI #", AOI_SOCKEYE_Buffer775_Union, "ALL", "", "GAPS")

# Process: Clip (4)
arcpy.Clip_analysis(AOI_SOCKEYE_Buffer775_Union, MV_AOI__14_, AOI_SOCKEYE_Buffer775_Union_, "")

# Process: Polygon to Raster (7)
arcpy.PolygonToRaster_conversion(AOI_SOCKEYE_Buffer775_Union_, "Value", AOI_SOCKEYE_Buffer775_Union_1,
"CELL_CENTER", "Value", "10")

# Process: Buffer (3)
arcpy.Buffer_analysis(AOI_COHO, AOI_COHO_Buffer775, "775 Feet", "FULL", "ROUND", "ALL", "", "PLANAR")

# Process: Add Field (3)
arcpy.AddField_management(AOI_COHO_Buffer775, "Value", "SHORT", "", "", "", "", "NULLABLE",
"NON_REQUIRED", "")

# Process: Calculate Field (3)
arcpy.CalculateField_management(AOI_CHINOOK_Buffer775__6_, "Value", "1", "VB", "")

# Process: Union (8)
arcpy.Union_analysis("'D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_COHO_Buffer775
' #;MV_AOI #", AOI_COHO_Buffer775_Union, "ALL", "", "GAPS")

# Process: Clip (6)
arcpy.Clip_analysis(AOI_COHO_Buffer775_Union, MV_AOI__16_, AOI_COHO_Buffer775_Union_Cli, "")

# Process: Polygon to Raster (8)
arcpy.PolygonToRaster_conversion(AOI_COHO_Buffer775_Union_Cli, "Value", AOI_COHO_Buffer775_Union_Cli1,
"CELL_CENTER", "Value", "10")

# Process: Buffer (2)
arcpy.Buffer_analysis(AOI_CHINOOK, AOI_CHINOOK_Buffer775__2_, "775 Feet", "FULL", "ROUND", "ALL", "",
"PLANAR")

# Process: Add Field (2)
arcpy.AddField_management(AOI_CHINOOK_Buffer775__2_, "Value", "SHORT", "", "", "", "", "NULLABLE",
"NON_REQUIRED", "")

# Process: Calculate Field (2)
arcpy.CalculateField_management(AOI_CHINOOK_Buffer775__5_, "Value", "1", "VB", "")

# Process: Union (9)
arcpy.Union_analysis("'D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_CHINOOK_Buffe
r775' #;MV_AOI #", AOI_CHINOOK_Buffer775_Union, "ALL", "", "GAPS")

# Process: Clip (7)
arcpy.Clip_analysis(AOI_CHINOOK_Buffer775_Union, MV_AOI__17_, AOI_CHINOOK_Buffer775_Union_, "")

# Process: Polygon to Raster (9)
arcpy.PolygonToRaster_conversion(AOI_CHINOOK_Buffer775_Union_, "Value", AOI_CHINOOK_Buffer775_Union_1,
"CELL_CENTER", "Value", "10")
```

```
# Process: Buffer
arcpy.Buffer_analysis(AOI_BULLTROUT, AOI_BULLTROUT_Buffer775, "775 Feet", "FULL", "ROUND", "ALL", "",
"PLANAR")

# Process: Add Field
arcpy.AddField_management(AOI_BULLTROUT_Buffer775, "Value", "SHORT", "", "", "", "", "NULLABLE",
"NON_REQUIRED", "")

# Process: Calculate Field
arcpy.CalculateField_management(AOI_CHINOOK_Buffer775__4_, "Value", "1", "VB", "")

# Process: Union (10)
arcpy.Union_analysis("'D:\\University of Washington
GIS\\UOFWWinter2018\\Geog564\\FinalProject\\myData\\AOC_MVGeoDes.gdb\\Environmental\\AOI_BULLTROUT_B
uffer775' #;MV_AOI #", AOI_BULLTROUT_Buffer775_Unio, "ALL", "", "GAPS")

# Process: Clip (9)
arcpy.Clip_analysis(AOI_BULLTROUT_Buffer775_Unio, MV_AOI__19_, AOI_BULLTROUT_Buffer775_Unio1, "")

# Process: Polygon to Raster (10)
arcpy.PolygonToRaster_conversion(AOI_BULLTROUT_Buffer775_Unio1, "Value",
AOI_BULLTROUT_Buffer775_Unio2, "CELL_CENTER", "Value", "10")

# Process: Weighted Sum
arcpy.gp.WeightedSum_sa("C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\steep_slopes_gt7_Union1_Clip1 VALUE
1;C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\Flood_100_Union_Clip_Polygon VALUE
1;C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\land_use_OpenSpaceExists_Uni2
1;C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_WETLANDS_Union_Clip_Poly VALUE
1;C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_WATERBODIES_Union1_Clip_
1;C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_STEELHEAD_Buffer775_Unio2
1;C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_SOCKEYE_Buffer775_Union_1 VALUE
1;C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_COHO_Buffer775_Union_Cli1
1;C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_CHINOOK_Buffer775_Union_1
1;C:\\Users\\John\\Documents\\ArcGIS\\Default.gdb\\AOI_BULLTROUT_Buffer775_Unio2 1", OpenSpaceValue)
```

Appendix 2. Open Space Areas in 10-miles of AOI

A 10-mile proximity line was created around the Project AOI in an Arc-Map Project to capture all land use designations that might possibly qualify as open space per the definition above (see Figures 1, 2, and 3). Nearly 300 separate designations collectively comprising over 59,000-acres were identified.

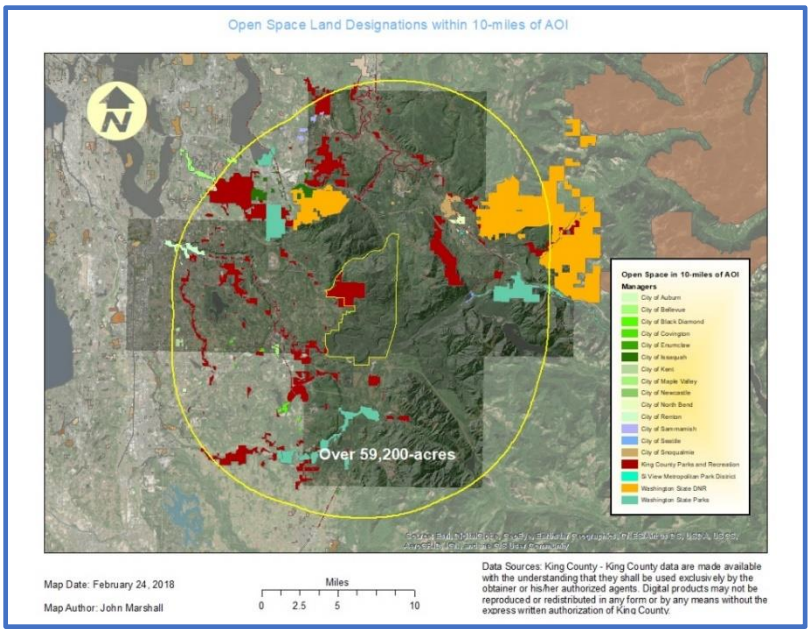


Figure 1. Designated open spaces by managers in the region around the AOI (see Appendix 2 for a list of site names).

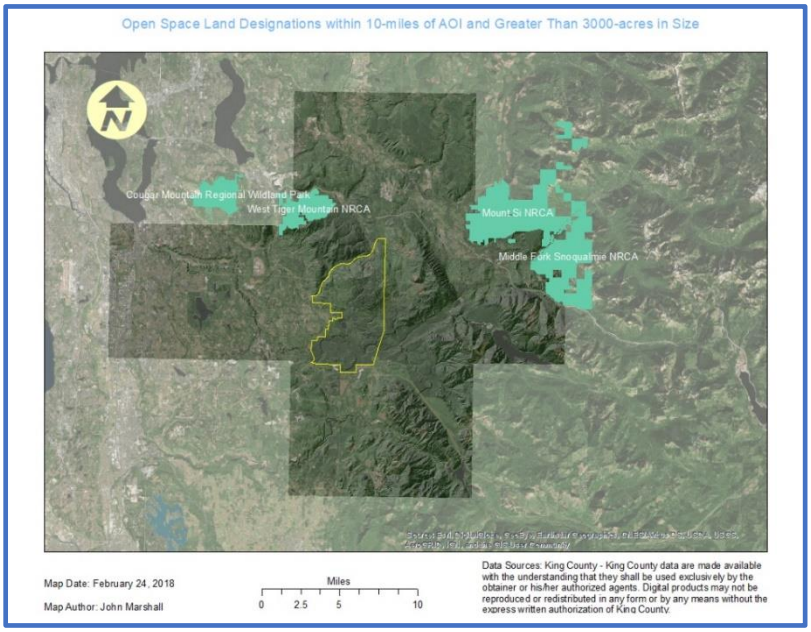


Figure 2. Open space designations greater than 3000-acres in the region around the AOI.

Four of those designations are greater than 3000-acres in size. This provides an insight into how important relatively undisturbed natural areas in our focal area are to the region's ecological and social wellbeing.

PARK NAME	PARK NAME	PARK NAME
Jacobsen Tree Farm	Cedar Creek Park -	Foothills Trail Site
Green River Natural Area	Covington Lake Wilderness Park	Nolte State Park
Lake Youngs Park	Lake Wilderness Local Extension	Hyde Lake Park
Lake Youngs Trail Site	Wetland 79 Natural Area	Levdansky Park
Green Tree Park	BN Peninsula Natural Area	Landsburg Park - Seattle
Soos Creek To Lake Youngs Trail Site	Big Bend Natural Area	Ravensdale Retreat Natural Area
Soos Creek Park and Trail	Landsburg Reach Natural Area	Sugarloaf Mountain Forest
North Meridian Park	Rock Creek Natural Area	Echo Lake Interchange Site
Clark Lake Park	Danville-Georgetown Open Space	Instebo Park
Wilson Playfields	Fernwood Park	Nowak Natural Area
Soos Creek Shop Complex	Evergreen Park - Covington	Taylor Mountain Forest
Friendship Park	Jenkins Creek Park	Fall City Park West
Crystal View Park	Jenkins Creek Natural Area	Fall City Natural Area
Covington Open Space	Jenkins Creek Trail	Tokul Creek Forest
Covington Community Park	Cedar Valley Park	Quigley Park
Gerry Crick Skate Park	Green To Cedar Rivers Trail Site	Fall City Park
Lake Meridian Park	Black Diamond Open Space	Canyon Creek Headwaters Natural Area
Soos Creek Park - Kent	Henrys Ridge Open Space	Mitchell Hill Connector Forest
East Ridge Park	Ravensdale Park	Whitaker Park
Seven Oaks Park	Cemetery Reach Natural Area	Fisher Creek Park
Springwood Park	Squak Valley Park	Crestview Park - Snoqualmie
Green View Park	Issaquah Creek Natural Area	Ironwood Park
Sun Meadows Park	Squak Mountain State Park	Eagle Park
Meridian Glen Park	Squak Mountain State Park - County	Denny Peak Park
Service Club Community Park	Cougar/Squak Corridor	Woody Creek Park
May Valley Park	Squak Mt/Tiger Mt Corridor	Koinonia Park
Kiwanis Park - Renton	Cedar Grove Natural Area	Snoqualmie Community Park
Coalfield Park	Jones Reach Natural Area	Azalea Park
May Valley 164th Natural Area	Log Cabin Reach Natural Area	Cascade Park - Snoqualmie
Cedar River to Lake Sammamish Trail Site	Middle Issaquah Creek Natural Area	Chanticleer Park
Maplewood Heights Park	Mirrormont Park	Autumn Park
Maplewood Park	Belmondo Reach	Thompson Park - Snoqualmie
Maplewood Roadside Park	Natural Area	Hoff Park
Maplewood Park - Renton	Maple Valley Heights Park	Silent Creek Park

Riverview Park - Renton	Wetland 14 Natural Area	Cottonwood Park
Cedar River Natural Zone	Spring Lake/Lake Desire Park	Raven Park
Heather Downs Park	Cedar Grove Road Natural Area	Steller Park
Cedar River Trail Site - Renton	Lower Lions Reach Natural Area	Dogwood Park
Tiffany Park	Middle Issaquah Creek Lease Site	Bog Natural Area
Maplewood Golf Course	Steven and Rosina Kipper Reserve	Cottonwood Natural Area
Ron Regis Park	Beaver Lake Preserve	Curtis Park
Cavanaugh Pond Natural Area	Pine Lake Park	Kinsey Park
Ricardi Reach Natural Area	Beaver Lake Park	Muir Park
McGarvey Park Open Space	Klahanie Park	Borden Park
Lake Desire 2 Natural Area	Duthie Hill Park	Carmichael Park
Renton Park	Grand Ridge Park	Preston Ridge Forest
Cascade Park	East Plateau Trail Site	Issaquah Preston Trail Site
Boulevard Lane Park	Lake Sammamish State Park	Preston Athletic Fields
Petrovitsky Park	Timberlake Park	Preston Snoqualmie Trail Site
Lake Youngs Trailhead	Meerwood Park	Preston Park
Coal Creek Natural Area	Lewis Creek Natural Area	Preston Mill
Lakemont Park and Open Space	Sammamish Cove Park	Raging River Natural Area
Lakemont - Lakemont Trail	Emily Darst Park	Bybee Park
Lakemont - Deer Run Park and Open Space	East Lake Sammamish Trail Site	Jacobia Park
Winfield Open Space	Pickering Farm	Swenson Park
Cougar Ridge East Open Space	Grand View Park	Satterlee Park
Cougar Ridge West Open Space	Black Nugget Park	Jeanne Hansen Park
Tralee Park	Tradition Plateau NRCA	Carnation Marsh Natural Area
China Creek Open Space	Central Park - Issaquah	Griffin Creek Natural Area
Forest View Park	Depot Park - Issaquah	Mount Si NRCA
Highlands Trails	Veterans Memorial Field	Tollgate Farm - North Bend
Ballybunion Park	Rainier Greenway	Tollgate Farm
Gleneagles Park	Salmon Run Nature Park	Snoqualmie Point Park
Cougar Mountain Regional Wildland Park	Confluence Park	Si View Park and Community Center
Bass Lake Complex Natural Area	Centennial Park - Issaquah	Shamrock Park
Lake Sawyer Park	Walen Hill Park	William Henry Taylor Park
Covington Natural Area	Berntsen Park	Gardiner Weeks Memortal Park
Lake Sawyer Regional Park	Tibbetts Valley Park	Riverfront Park
Coal Car Historical Triangle	Harvey Manning Park at Talus	Si View Neighborhood Park
Ginder Creek Site	Talus Native Growth Protection Area	Tanner Trail
Black Diamond BMX Park	Hillside Park	Little Si Natural Area
Jones Lake Open Space	Mine Hill Park	Torguson Park
Union Stump Historical Park	Gibson Park	E J Roberts Park

Eagle Creek Park	Cornick Park	Tannerwood Neighborhood Park
Black Diamond Bridge Site	Community Center Park - Issaquah	Tanner Landing Park
Flaming Geyser Natural Area	Ingi Johnson Park	Rattlesnake Mountain Scenic Area
Flaming Geyser State Park	West Tiger Mountain NRCA	Boxley Creek Site
Flaming Geyser Park	Patterson Creek Natural Area	Rattlesnake Lake Recreation Area
Whitney Bridge Park	Ravenhill Open Space	Railroad Park
Lower Newaukum Creek Natural Area	Soaring Eagle Regional Park	Sandy Cove Park
Lake Francis Park	Thirty Acres Park	Meadowbrook Farm
Mouth Of Taylor Reach Natural Area	Snoqualmie Valley Trail Site	Riverview Park - Snoqualmie
Peterson Lake Natural Area	Fell Hill Park	Centennial Fields
Shadow Lake Natural Area	Landsburg Kanaskat Trail Site	Three Forks Natural Area - Snoqualmie
Fred V. Habenicht Rotary Park	Crow Marsh Natural Area	Three Forks Park
Cedar River Trail Site	Jellum Site	Middle Fork Snoqualmie Natural Area
Lower Peterson Creek Corridor Natural Area	Palmer Jellum Connection	Middle Fork Snoqualmie NRCA
Dorre Don Reach Natural Area	Kanaskat Palmer Recreation Area	Twin Falls State Park
Take-A-Break Park	Kanaskat Natural Area	Iron Horse State Park
Cedar Creek Park	Hanging Gardens Site	Olallie State Park

Figure 3. List of Potential Open Space Site Names within 10-Miles of the Project AOI.

Appendix 3. Appraised Values, Ownership, and Land Use of Parcels in Project AOI.

Major Land Owner Perspectives

City of Seattle (City). Seattle Public Utilities operates water supply facilities in the Cedar River Watershed to provide 2/3 of the drinking water for 1.4 million people in the Seattle metropolitan area (the other 1/3 of the water supply comes from the City's South Fork Tolt River Watershed). In addition, Seattle City Light operates a hydroelectric power facility on the Cedar that provides about 1% of the City's electricity supply.

The upper 90,546 acres (2/3) of the watershed are owned solely by the City and support important habitat for fish and wildlife. A number of fish and wildlife species found in the watershed and river basin are either already listed as threatened or endangered under the Endangered Species Act, are proposed for listing, or could be at risk in the future. These species of concern include bull trout, coho salmon, Chinook salmon, sockeye salmon, steelhead trout, northern spotted owl, and marbled murrelet, among others.

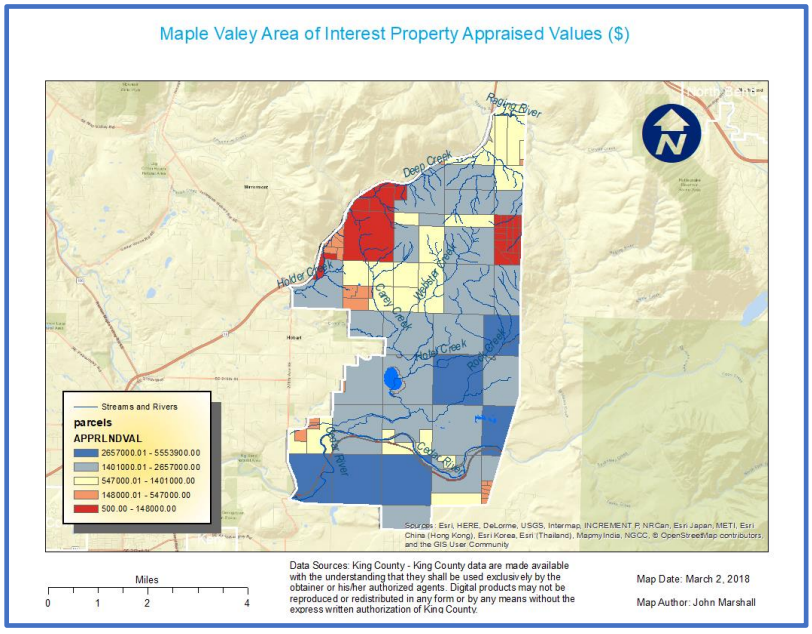


Figure 1. Appraised Land Values in AOI.

https://gismaps.kingcounty.gov/iMap/

Providing a safe and reliable supply of drinking water to customers is the first priority of Seattle Public Utilities, and species of concern in the basin may be inadvertently affected by some water supply operations and land management activities. Habitat conservation planning is a tool the City uses to achieve both species protection and water supply protection. The Cedar River Watershed Habitat Conservation Plan (HCP) is intended to make significant contributions to regional efforts to sustain and restore declining salmon and steelhead stocks in the Lake Washington Basin as well as protect and enhance habitat for a wide variety of wildlife. Management of the Cedar River Watershed represents a

very important regional opportunity in protecting both salmonid fisheries and species dependent upon late-successional and old-growth conifer forests.

King County Parks Open Space (KCP). KCPs protect rivers, streams, and natural areas that connect communities and provide recreation, respite, and habitat for wildlife. They help ensure everyone can access green spaces - particularly those most impacted by unequal investment in this integral component of our green infrastructure. Clean air, clean water, and resiliency to a changing climate are essential ecological services which are in need of our stewardship. At a price of $10 – $12 per year for the median homeowner, KCPs can make significant progress in sensitive habitat acquisition, protection, livability, health, and an improved overarching ecological integrity for those who live in the region.

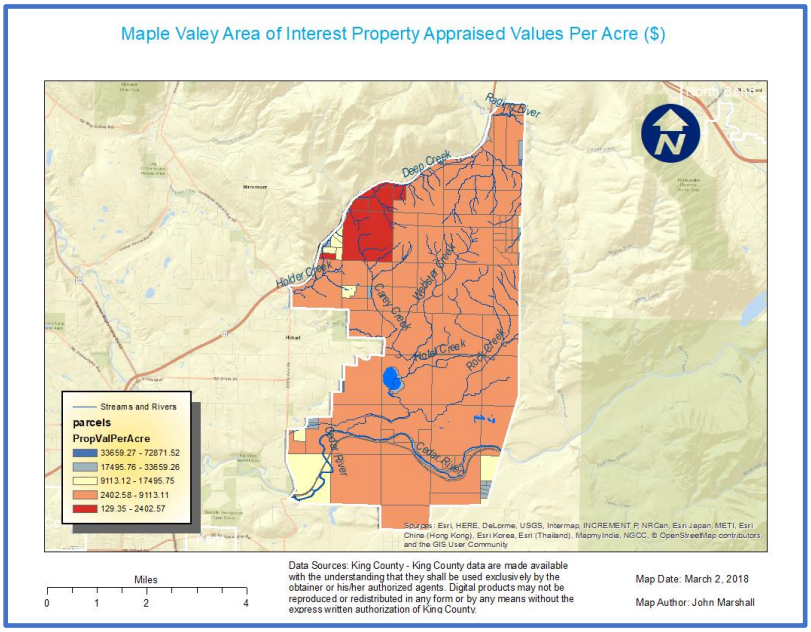


Figure 2. Appraised Land Values Per Acre in AOI.

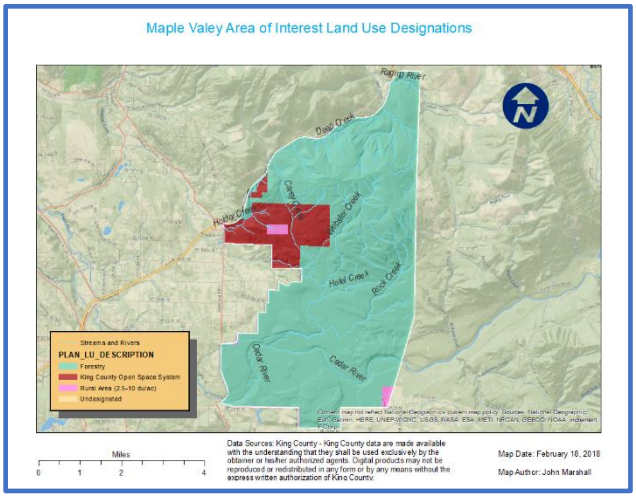


Figure 4. Land use designations in the AOI.

The area inside the AOI has three County land use designations: 1) Forestry, 2) Open Space, and 3) Rural Area (see Figure 4). There are five major land owners in the AOI (see Figure 5):

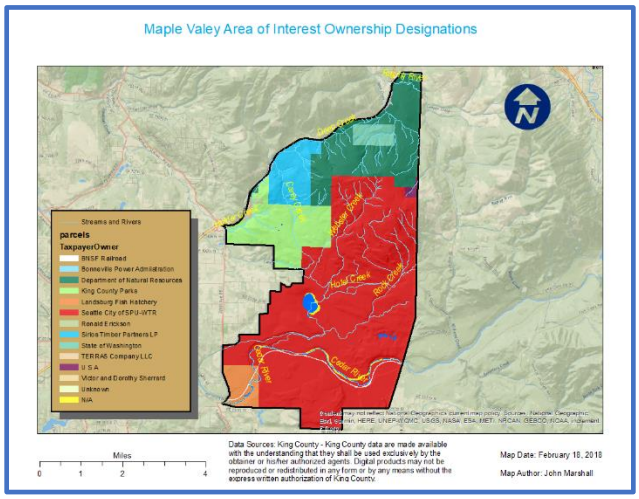


Figure 5. Land ownership designations in the AOI.

King County Parks, City of Seattle, Washington Department of Natural Resources (DNR), Sirios Timber Partners, and Landsburg Fish Hatchery. There a two primary 'Current Use' designations: 1) Vacant-Single Family or Vacant-Multi-Family and 2) Public Utility. Two substantially sized areas do not show a 'Current

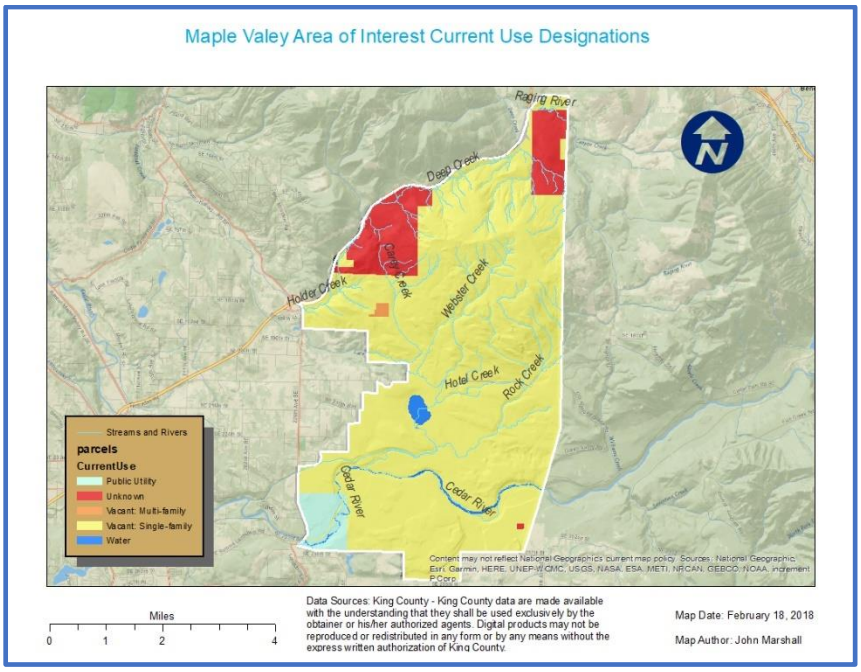


Figure 6. Current land use designations in the AOI.

Use' designation but based on their ownerships (private timber company and DNR), they are likely used for commercial timber harvest.

ID	TaxpayerOwner	OwnershipType	Current Use	AppLand Val ($)	Acres	PropValPerAcre ($)	TaxLot
1	Seattle City of SPU-WTR	Public	Vacant: Single-family	1485000	378.20	3926.53	222079001
2	Seattle City of SPU-WTR	Public	Vacant: Single-family	2156000	524.92	4107.31	322079001
3	Seattle City of SPU-WTR	Public	Vacant: Single-family	2187000	539.46	4054.05	422079002
4	King County Parks	Public	Vacant: Single-family	1488000	236.21	6299.42	522079001
5	Seattle City of SPU-WTR	Public	Vacant: Single-family	2574000	473.67	5434.12	822079001
6	Seattle City of SPU-WTR	Public	Vacant: Single-family	330000	9.29	35532.79	822079020
7	Seattle City of SPU-WTR	Public	Vacant: Single-family	2372000	549.02	4320.42	922079001
8	Seattle City of SPU-WTR	Public	Vacant: Single-family	500	0.65	326.40	922079020
9	Seattle City of SPU-WTR	Public	Vacant: Single-family	2278000	643.54	3539.78	1022079001
10	Seattle City of SPU-WTR	Public	Vacant: Single-family	2443000	467.34	5227.40	1122079001
11	Seattle City of SPU-WTR	Public	Vacant: Single-family	2439000	339.54	7183.22	1422079001
12	Seattle City of SPU-WTR	Public	Vacant: Single-family	2457000	628.07	3911.97	1522079001
13	Seattle City of SPU-WTR	Public	Vacant: Single-family	1627000	394.25	4126.79	1622079001
14	Seattle City of SPU-WTR	Public	Vacant: Single-family	1258000	218.86	5748.07	1622079010
15	Seattle City of SPU-WTR	Public	Vacant: Single-family	2415000	608.65	3967.83	1722079001
16	Seattle City of SPU-WTR	Public	Vacant: Single-family	404000	17.01	23752.95	1822079003
17	Seattle City of SPU-WTR	Public	Vacant: Single-family	1109000	194.74	5694.74	1822079004
18	Seattle City of SPU-WTR	Public	Vacant: Single-family	523000	38.87	13455.08	1822079010
19	Seattle City of SPU-WTR	Public	Vacant: Single-family	705000	77.36	9113.11	1822079013
20	Seattle City of SPU-WTR	Public	Vacant: Single-family	384000	19.66	19530.09	1822079023
21	Seattle City of SPU-WTR	Public	Vacant: Single-family	24000	0.57	13709.52	1822079058
22	Seattle City of SPU-WTR	Public	Vacant: Single-family	3172000	644.40	4922.41	2022079001
23	Seattle City of SPU-WTR	Public	Vacant: Single-family	2796000	629.08	4444.59	2122079001
24	Seattle City of SPU-WTR	Public	Vacant: Single-family	1792000	395.44	4531.68	2222079001
25	Seattle City of SPU-WTR	Public	Vacant: Single-family	1100000	207.01	5313.66	2222079005

26	Seattle City of SPU-WTR	Public	Vacant: Single-family	1472000	109.45	13448.69	2322079001
27	Seattle City of SPU-WTR	Public	Vacant: Single-family	216000	12.35	17495.75	2322079009
28	Seattle City of SPU-WTR	Public	Vacant: Single-family	206000	10.14	20321.17	2322079061
29	Seattle City of SPU-WTR	Public	Vacant: Single-family	236000	11.46	20598.83	2322079062
30	Seattle City of SPU-WTR	Public	Vacant: Single-family	237000	12.12	19559.03	2322079063
31	Seattle City of SPU-WTR	Public	Unknown	214000	7.27	29452.99	2322079064
32	Seattle City of SPU-WTR	Public	Vacant: Single-family	208000	7.68	27081.75	2322079065
33	Seattle City of SPU-WTR	Public	Vacant: Single-family	227000	0.32	72871.52	2322079066
34	Seattle City of SPU-WTR	Public	Vacant: Single-family	341000	49.84	6841.82	2623079017
35	Seattle City of SPU-WTR	Public	Vacant: Single-family	221000	33.44	6609.12	2623079027
36	Seattle City of SPU-WTR	Public	Vacant: Single-family	229000	36.47	6279.56	2623079030
37	Seattle City of SPU-WTR	Public	Vacant: Single-family	148000	4.40	33659.26	2623079031
38	Seattle City of SPU-WTR	Public	Vacant: Single-family	148000	4.21	35157.67	2623079032
39	Seattle City of SPU-WTR	Public	Vacant: Single-family	1771000	479.14	3696.17	2723079007
40	Seattle City of SPU-WTR	Public	Vacant: Single-family	1732000	313.93	5517.21	2822079001
41	Seattle City of SPU-WTR	Public	Vacant: Single-family	991000	239.59	4136.18	2823079003
42	King County Parks	Public	Unknown	248000	19.29	12858.17	3023079001
43	King County Parks	Public	Vacant: Single-family	294000	23.28	12629.99	3023079022
44	King County Parks	Public	Unknown	336000	26.54	12659.14	3023079023
45	King County Parks	Public	Unknown	321000	25.74	12472.23	3023079024
46	King County Parks	Public	Vacant: Single-family	1929000	452.36	4264.28	3123079003
47	King County Parks	Public	Vacant: Single-family	738000	145.97	5055.84	3223079001
48	King County Parks	Public	Vacant: Multi-family	341000	39.95	8535.03	3223079009
49	King County Parks	Public	Vacant: Single-family	507000	78.80	6434.21	3223079011
50	King County Parks	Public	Vacant: Single-family	308000	13.34	23087.05	3223079014
51	King County Parks	Public	Vacant: Single-family	402000	40.10	10025.45	3223079015

52	King County Parks	Public	Vacant: Single-family	734000	160.15	4583.10	3223079021
53	King County Parks	Public	Vacant: Single-family	798000	163.68	4875.25	3223079027
54	Seattle City of SPU-WTR	Public	Vacant: Single-family	1155000	324.99	3553.92	3323079001
55	King County Parks	Public	Vacant: Single-family	840000	159.16	5277.65	3323079005
56	King County Parks	Public	Vacant: Single-family	793000	158.22	5011.97	3323079009
57	Seattle City of SPU-WTR	Public	Vacant: Single-family	2115000	645.34	3277.35	3423079001
58	Seattle City of SPU-WTR	Public	Vacant: Single-family	1662000	345.39	4812.00	3523079005
Average						**11570.20**	

Appendix 4. Example Land Transaction

As per the entries in Table 1, property transactions in the AOI related to their respective open space status are complicated by different landowners, different types of transactions, and different transaction dollar amounts. They are also spread out over various periods of time. The acquisition of the existing covenants or deed restrictions for each AOI subject parcel appears to be cumbersome and labor intensive. Anecdotal information provided by King County staff informs some of the transaction were made under condemnation procedures and that post transaction covenants and / or deed restrictions have varying degree of protection from commercial uses of the properties, leaving some room for questioning: 1) the actual dollar amounts of the transactions, 2) their qualifications as "willingness-to-pay" types of transactions, and 3) whether their current uses qualify them as open space designations under the definition of open space used in this class project.

Table 1. Property Transactions for Tax Lot 3223079009.

Excise Number	Recording Number	Document Date	Sale Price	Seller Name	Buyer Name	Instrument	Sale Reason
2656167	20140304000829	2/25/2014	$0.00	ZAPEL EDWIN+BETTY	KING COUNTY	Quit Claim Deed	Other
2486692	20110413001760	4/4/2011	$305,000.00	KING-COUNTY GOVT	WASHINGTON STATE GOVT+WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES	DEED	None
2486690	20110413001759	4/4/2011	$462,000.00	BRIGHAM GORIA JEAN+BOYSEN REVOCABLE TRUST JOHN F & ROSE E	KING-COUNTY GOVT	Statutory Warranty Deed	None
1263101	199208181578	8/14/1992	$0.00	BOYSEN JOHN F+ROSE E	BOYSEN JOHN F	Quit Claim Deed	Other

Deed: Any legal instrument in writing which passes, affirms or confirms an interest, right, or property and that is signed, attested, delivered, and in some jurisdictions, sealed. It is commonly associated with transferring (conveyancing) title to property.

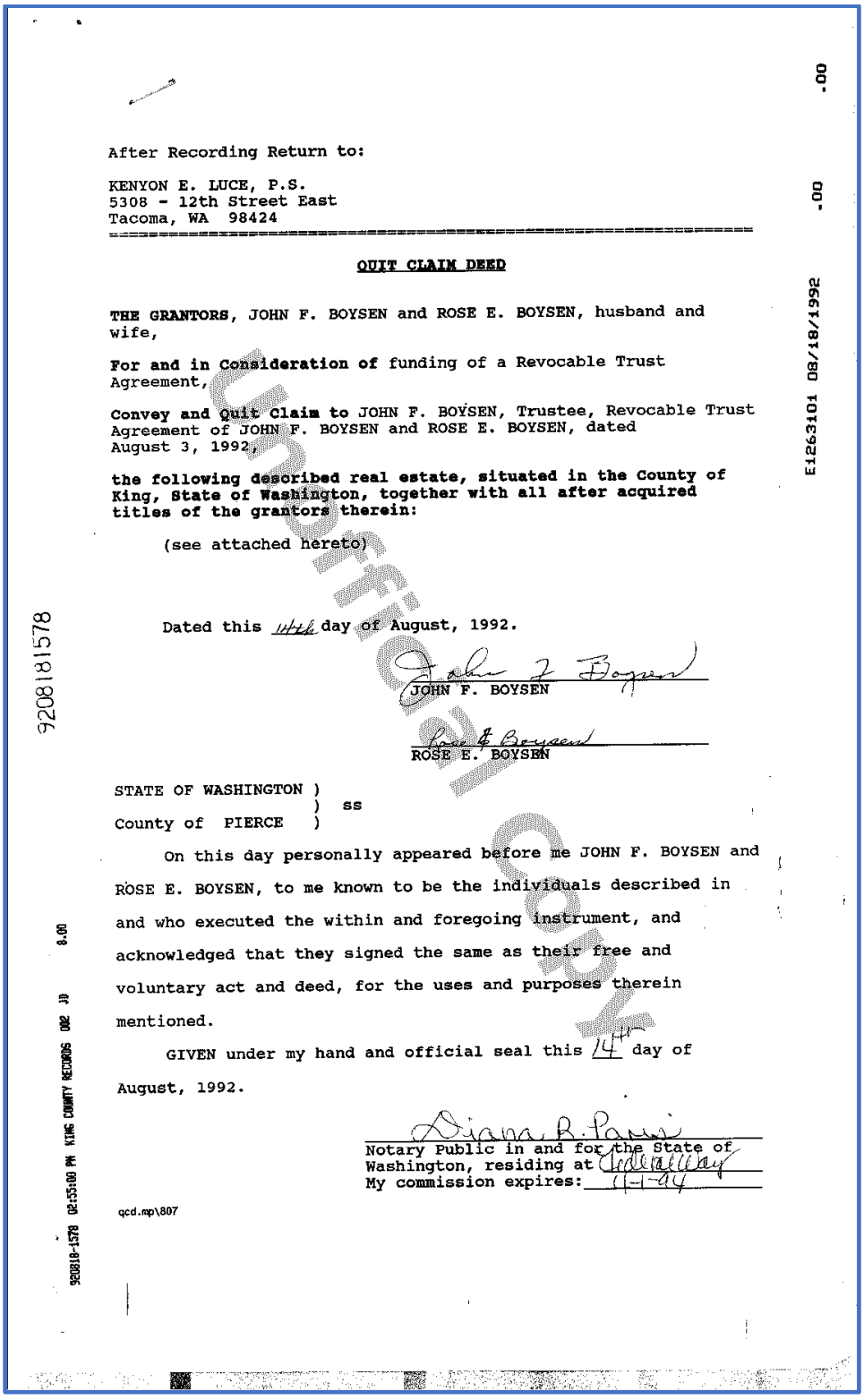
Statutory Warranty Deed: a form of real property conveyance in some states. It is typically an abbreviated form of a **warranty deed**, authorized by a statute that allows a **deed** in the **statutory** form to include the standard title covenants found in a **warranty deed** by implication, without the necessity of stating them.

Quitclaim Deed: a legal instrument that is used to transfer interest in real property. The entity transferring its interest is called the *grantor,* and when the quitclaim deed is properly completed and executed, it transfers any interest the grantor has in the property to a recipient, called the *grantee.* The owner/grantor terminates ("quits") any right and claim to the property, thereby allowing the right or claim to transfer to the recipient/grantee.

Unlike most other property deeds, a quitclaim deed contains no title covenant and thus offers the grantee no warranty as to the status of the property title; the grantee is entitled only to whatever interest the grantor actually possesses at the time the transfer occurs. This means that the grantor does not guarantee that he or she actually owns any interest in the property at the time of the transfer,

Figure 1. Aerial image of property tax lot 3223079009.

Because of this lack of warranty, quitclaim deeds are most often used to transfer property between family members, as gifts, placing personal property into a business entity (and vice versa) or in other special or unique circumstances. An example use for a quitclaim deed is in divorce, whereby one spouse terminates any interest in the jointly owned marital home, thereby granting the receiving spouse full rights to the property.



After Recording Return to:

KENYON E. LUCE, P.S.
5308 - 12th Street East
Tacoma, WA 98424

E1263101 08/18/1992 .00 .00

QUIT CLAIM DEED

THE GRANTORS, JOHN F. BOYSEN and ROSE E. BOYSEN, husband and wife,

For and in Consideration of funding of a Revocable Trust Agreement,

Convey and Quit Claim to JOHN F. BOYSEN, Trustee, Revocable Trust Agreement of JOHN F. BOYSEN and ROSE E. BOYSEN, dated August 3, 1992,

the following described real estate, situated in the County of King, State of Washington, together with all after acquired titles of the grantors therein:

(see attached hereto)

9208181578

Dated this 14th day of August, 1992.

John F. Boysen
JOHN F. BOYSEN

Rose E. Boysen
ROSE E. BOYSEN

STATE OF WASHINGTON)
) ss
County of PIERCE)

On this day personally appeared before me JOHN F. BOYSEN and ROSE E. BOYSEN, to me known to be the individuals described in and who executed the within and foregoing instrument, and acknowledged that they signed the same as their free and voluntary act and deed, for the uses and purposes therein mentioned.

GIVEN under my hand and official seal this 14th day of August, 1992.

Diana R. Powell
Notary Public in and for the State of Washington, residing at Gig Harbor
My commission expires: 11-1-94

qcd.mp\807

9208181578 02:55:00 PM KING COUNTY RECORDS 002 JD 8.00

Figure 2. Quit Claim Deed 1992.

AFTER RECORDING MAIL TO:

King County, Water and Land Resources Div.
201 South Jackson, #600
Seattle, Wa. 98104

20110413001759
PACIFIC NW TIT WD 64.00
PAGE-001 OF 003
04/13/2011 16:15
KING COUNTY, WA

E2486690
04/13/2011 16:11
KING COUNTY, WA
TAX $8,228.60
SALE $462,000.00 PAGE-001 OF 001

Filed for Record at Request of:
Pacific Northwest Title Company

PACIFIC NORTHWEST TITLE
562565-12

STATUTORY WARRANTY DEED

File No: **1126532 (SAO)** Date: **April 4, 2011**

Grantor(s):
Grantee(s): **King County**
Abbreviated Legal: **SW 1/4, 32-23-07**
Additional Legal on page:
Assessor's Tax Parcel No(s): **322307900900** (3)64

THE GRANTOR(S) Gloria Jean Brigham, Successor Trustee for the John F. Boysen and Rose E. Boysen Revocable Trust dated 8/3/1992 for and in consideration of **Ten Dollars and other Good and Valuable Consideration**, in hand paid, conveys, and warrants to **King County, a political subdivision of the State of Washington**, the following described real estate, situated in the County of **King**, State of **Washington**.

LEGAL DESCRIPTION: Real property in the County of King, State of Washington, described as follows:

See Attached Exhibit "A"

This project was funded in part by and is subject to the terms of the Open Space, Regional Trails, and Woodland Park Zoo levy lid lift authorized by King County Ordinance 15760 and approved by voters in August 2007. The county covenants that the property will be used for the purposes contemplated by Ordinance 15760, that the property shall not be transferred or conveyed except by deed providing that the property shall continue to be used for purposes contemplated by Ordinance 15760, and that the property shall not be convertd to a different use unless other equivalent property within the County shall be received in exchange therefore.

Figure 3. Statutory Warranty Deed 2011.

After Recording Return To:
Washington State Department of Natural Resources
Asset and Property Management Division
Attn: Robin Searl
1111 Washington Street SE
P. O. Box 47014
Olympia, WA 98504-7014

20110413001760
PACIFIC NW TIT D 73.00
PAGE-001 OF 012
04/13/2011 16:15
KING COUNTY, WA

E2486692
04/13/2011 16:13
KING COUNTY, WA
TAX $10.00
SALE $305,000.00
PAGE-001 OF 001

CONSERVATION EASEMENT DEED PACIFIC NORTHWEST TITLE 562565

Grantor: King County (12) 13

Grantee: State of Washington, acting by and through the Department of Natural Resources

Abbreviated Legal Description: A Portion of Section 32, Township 23 North, Range 7 East, W.M.

Complete legal description is at pages _____ to _____ (Exhibit A) attached hereto.

Property Tax Parcel Account Numbers: 322307-9009

Page 1 of 12

Figure 4. Deed 2011.

King County Water and Land Resource Division
Atn: Robert Jackson
201 South Jackson Street, Suite 600
Seattle, WA 98104

201403040000829
STEWART TITLE QCD 74.00
PAGE-001 OF 003
03/04/2014 15:41
KING COUNTY, WA

E2656167
03/04/2014 15:39
KING COUNTY, WA
TAX $10.00
SALE $0.00
PAGE-001 OF 001

Grantor: Edwin J. Zapel and Betty Jean Zapel husband and wife
Grantee: King County a political subdivision of the State of Washington
Legal Des: Ptn: S31 and S32,T22 N R07E; S05, T22N R07E
Tax ID #: : 312307-9003; 322307-9011; 322307-9009; 322307-9001; 322307-9014; 322307-9021; 322307-9027

01148-26315
QUIT CLAIM DEED (3) STEWART TITLE

The Grantor herein, Edwin J. Zapel and Betty Jean Zapel, husband and wife for the purpose of clearing title and consideration of mutual benefits and other valuable consideration, conveys and quit claims unto **King County**, a political subdivision of the State of Washington, all rights, title and interest, including any easements or permitted rights for ingress and egress and any after acquired title in the following described real property:

All roads and road right of ways located in Sections 31 and 32, Township 22 North, Range 07 East, and Section 5, Township 22, Range 07 East, in King County Washington.

DATED this 25 day of February, 2014.

Edwin J. Zapel

Betty Jean Zapel

Figure 5. Quit Claim Deed 2014.

Appendix 5. An Overall Workflow Diagram Marshall's Responsibilities

1. Acquire and document spatial data useable for prioritizing open space acquisition(s) in the Project' AOI.

2. Create and populate a file geodatabase with the germane data acquired.

3. Develop a model theory for open space protection.

4. Based on the model theory, develop and apply a GIS based multiple criteria evaluation (MCE) normalized numeric open space rating system.

5. Classify the model output in the Project's AOI and draft graphic representations, including maps.

6. Take the lead in coordinating with other team members in drafting and submitting the Project's first 'Status Report' and submitting the remaining documents generated by the Project team to our class Canvas web page.

7. Prepare defense for open space alternative(s) for use in the Project team's final decision analyses.

8. Prepare portion of Project team's report relating to open space alternatives analyses for later integration into the final decision report.

9. Prepare portion of Project team's formal presentation that explains the methods used in applying the open space alternatives development.

Appendix 6. Stakeholder Role

Preservation (John Marshall):

1. What is the inventory of highly sensitive natural resources in the AOI?

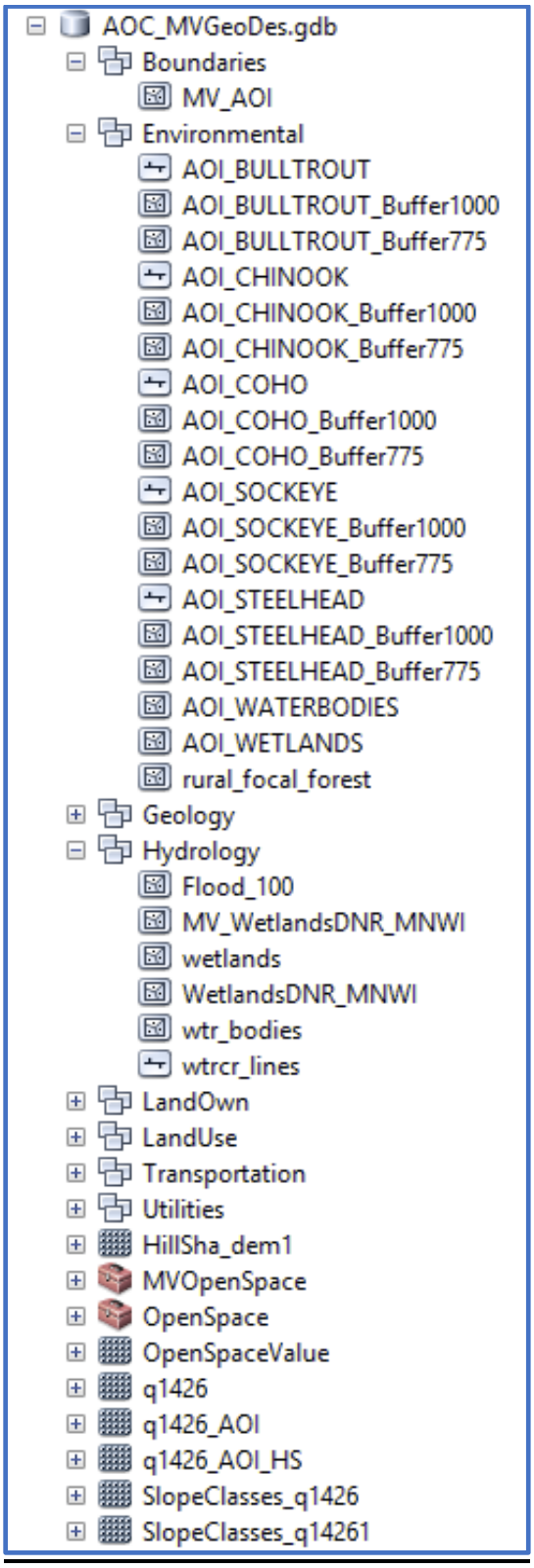
2. Where are there existing threats to highly sensitive natural resources in the AOI?

3. Where are the opportunities for preservation of highly sensitive natural resources in the AOI?

4. Where are the opportunities for non-consumptive development (e.g., hiking, camping, bird watching, nature photography, etc.) compatible with sensitive natural resources in the AOI?

5. What landscape level provisions are necessary to help protect preservation areas from ambient disturbances, including but not necessarily limited to noise, light pollution, human encroachment, water pollution, and air pollution?

Appendix 7. Refined File Open Space Geodatabase Schema Structure



Appendix 8. Geodatabase Information Log.

Feature Datasets	Scope	Feature Classes	Definitions of Feature Classes	Data Sources
Transportation	General	Major highways, roads, bridges, crosswalks, overpasses & hiking trails	A series of networks used to determine the flow of traffic or people, or vehicles.	King County https://www5.kingcounty.gov/gisdataportal/
Hydrology	Focal	Lakes, rivers, streams, wetlands, FEMA Flood 100-year	Hydrologic networks used to determine the flow of water.	USGS https://nhd.usgs.gov/data.html WDNR Heritage / USFWS NWI FEMA https://msc.fema.gov/portal/advanceSearch#searchresultsanchor
National Watershed Boundary Dataset (WBD)	Focal	Hydrologic Units (HU)	A comprehensive aggregated collection of hydrologic unit data consistent with the national criteria for delineation and resolution. It defines the areal extent of surface water drainage to a point.	USGS https://nhd.usgs.gov/data.html
Land use planning	Focal	Zoning	Land use zoning	King County https://www5.kingcounty.gov/gisdataportal/

Land ownership	General	Parcels (Assessed Value)	Parcel ownerships	King County https://www5.kingcounty.gov/gisdataportal/
Environment	Focal	Vegetation; sensitive areas; salmonid spawning, migration, rearing; critical habitat.	Environmental data of sensitive natural resources	WDOE https://ecology.wa.gov/Research-Data/Data-resources/Geographic-Information-Systems-GIS/GIS-data StreamNet https://www.streamnet.org/data/interactive-maps-and-gis-data/
Geology	Focal	Fault zones, Land slides, Soils	Geologic hazard areas	King County https://www5.kingcounty.gov/gisdataportal/
Utilities	Focal	Electric, Sewer & Water	Existing water and sewer pipe networks	King County https://www5.kingcounty.gov/gisdataportal/
Federally Listed Salmonids	Focal	DPS & Critical Habitat	Existing migration networks	NOAA / StreamNet http://www.westcoast.fisheries.noaa.gov/maps_data/Species_Maps_Data.html https://www.streamnet.org/data/interactive-maps-and-gis-data/
Digital Elevation Model (DEM) Open Space Weighted Sum Values	Focal	10-METER resolution rasters	Continuous elevation data Continuous open space values data	https://wagda.lib.washington.edu/data/geography/wa_state/ http://gis.ess.washington.edu/data/raster/tenmeter/byquad/wenatchee/index.html Geoprocessing outcome using GIS open space model

NAD 1983 HARN StatePlane Washington North FIPS 4601 Feet

Appendix 9. Annotated Bibliography

Preservation: Ecosystem Services-A

Burel, Francoise and J. Baudry. 2004. ***Landscape ecology: Concepts, methods, and applications*****, Science Publishers, Inc. Enfield, New Hampshire.** A discussion of landscape ecological theory development and history in relation to contemporary application and utility. Reveals a definitive biogeographical perspective.

Downing, J.A., J.J. Cole, C.M. Duarte, J.J. Middelburg, J.M. Melack, Y.T. Prairie, P. Kortelainen, R.G. Striegl, W.H. McDowell & L.J. Tranvik. 2012. ***Global abundance and size distribution of streams and rivers***, Inland Waters, 2:4, 229-236. https://doi.org/10.5268/IW-2.4.502. Provides a table displaying typical stream lengths and widths for various stream orders as classified in Strahler.

Franklin, J.F. and D.B. Lindenmayer. 2009. ***Importance of matrix habitats in maintaining biological diversity***, PNAS 2009 January, 106 (2) 349-350. Explores research contradicting the results predicted by biogeographical theories that patch size and isolation are good predictors of patch occupancy for most of the species reviewed. This is an important result given the centrality of the patch size-isolation tenet to much of academic conservation biology and its wide application in conservation planning and resource management.

K.P. Bell, D. Huppert, and R.L. Johnson, ***"Willingness to Pay for Local Coho Salmon Enhancement in Coastal Communities,"*** Marine Resource Economics 18, no. 1 (2003): 15-31. Salmon restoration and enhancement are dominant environmental policy issues in Oregon and Washington. In response to salmon species listings under the Endangered Species Act, salmon protection and recovery actions are being implemented throughout the Pacific Northwest at substantial opportunity costs. The authors examine the willingness to pay (WTP) of coastal residents for local coho salmon enhancement programs. A contingent valuation study is completed using survey responses from five rural, coastal communities of Oregon and Washington, where coho salmon are prevalent. The empirical results indicate that coastal residents are willing to pay for local coho salmon enhancement and that WTP varies considerably with individual opinions of the merit of the enhancement program.

Larson, J.S. 1976. ***Models for Assessment of Freshwater Wetlands***. Water Resources Research Center, University of Massachusetts, Pub. No. 32, 86 pp.

Leslie M. Reid and Sue Hilton. 1998. ***Buffering the Buffer***. USDA Forest Service Gen. Tech. Rep. PSW-GTR-168. Makes a case that defends at least 4 to 5 potential tree-heights to dictate the buffer width distances from native Pacific Northwest fish-bearing streams if woody debris inputs are to be maintained at rates found in undisturbed forested channels.

Leslie Richardson, John Loomis. 2009. ***The total economic value of threatened, endangered and rare species: An updated meta-analysis***. *Ecological Economics* **68**:5, 1535-1548.

Marshall, J.L. 1985. ***Value Assessment of Jackson-Frazier Wetland, Benton County, Oregon: A Case Study*****.** Master of Science Thesis, Department of Geography, Oregon State University, Corvallis, OR. In addition to wildlife habitat, flood mitigation, and scenic area assessments, a fair market value willingness to pay model is modified and used to assess the economic preservation value of a wetland in the mid-Willamette Valley, Oregon. Real Estate transactions involving purchases of parks and wildlife refuges are used to help gauge the model.

McGarigal, K. 2018. ***UMass Landscape Ecology Lab***, Department of Environmental Conservation, University of Massachusetts, Amherst, MA. https://www.umass.edu/landeco/. Provides a wide scope of information related to landscape ecology theory and applications.

Means, J.E. and M.E. Helm. 1985. ***Height growth and site index curves for Douglas-fir on Dry Sites in the Willamette National Forest***. USDA, Forest Service, Research Paper, PNW-341. 17-pp. https://www.fs.fed.us/pnw/pubs/pnw_rp341.pdf. This study provides height growth and site index curves for Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) on hot, dry sites in the Willamette National Forest in western Oregon. Stems of 40 trees were dissected; 27 of the trees were suitable for construction of height growth and site index curves, and they provided 505 observations of height, site, and age.

Puget Sound Regional Council. 2018. ***Draft Regional Open Space Conservation Plan***. Puget Sound Regional Council Information Center, 1011 Western Avenue, Suite 500, Seattle, Washington. Open space includes a wide spectrum of public and private, urban and rural, natural and working lands. It includes lands such as trails, forests, farms, wetlands, floodplains, and shorelines. The basic geography of the ecological systems that form open spaces is the watershed. What happens in one part of a watershed impacts other parts of the watershed. Consequently, this plan considers open spaces by watershed. Open space is critical natural infrastructure for the region that provides essential economic, recreational, cultural, aesthetic, and ecological services. As of 2015, open spaces in the region provided at least $11.4 to $25.2 billion annually to the economy. These benefits include clean water, food, recreation, flood storage, carbon storage, and wood products. Open spaces contribute to both the physical and mental health of residents in region. They filter air and water, provide recreational opportunities, improve attention, and provide a sense of wellbeing.

Richter, K. O., and A. L. Azous. 2001. ***Amphibian distribution, abundance, and habitat use***. Pages 143-165 in A. L. A. a. R. R. Horner, editor. Wetlands and Urbanization: Implications for the Future. Lewis Publishers, Boca Raton, FL. Quantitative metric research related to amphibian species / habitat relationships with emphasis on landscape level analyses.

Stephen J. Jordan, Timothy O'Higgins, John A. Dittmar. 2012. ***Ecosystem Services of Coastal Habitats and Fisheries: Multiscale Ecological and Economic Models in Support of Ecosystem-Based Management***. *Marine and Coastal Fisheries* **4**:1, 573-586.

Strahler, A.N. (1952). ***Hypsometric (Area-Altitude) Analysis of Erosional Topography*****. Geological Society of America Bulletin, 63, 1117-1141.** Theory and structure of stream classification system based on hydrologic and geomorphic principles.

Watts, K., W. Humphrey, M. Griffiths, C. Quine, and D. Ray. 2005. ***Evaluating biodiversity in fragmented landscapes: Principles***, Forestry Commission, Edinburgh, EH12 7AT. https://www.forestry.gov.uk/pdf/fcin073.pdf/$FILE/fcin073.pdf A focal look at biodiversity in UK forests. It evaluates the impacts of forest management on biodiversity, to maintain and enhance the wildlife value at a landscape scale and explores the development of biodiversity evaluation tools to enable forest and land managers to make informed choices to provide sustainable forest landscapes for the future. It attempts to explain the scientific principles behind the approaches being developed such as Biological and Environmental Evaluation Tools for Landscape Ecology (BEETLE).

U.S. EPA. 2002. ***Methods for Evaluating Wetland Condition: Using Amphibians in Bioassessments of Wetlands***, Office of Water, U.S. Environmental Protection Agency, Washington, D.C. EPA-822-R-02-022. Provides strategies for using the presence of amphibian species to better understand their interactive dependence on their respective surrounding landscapes.

U.S. Fish and Wildlife Service. 2000. ***Biological and Conference Opinion for the Proposed Issuance of a Section 10(a)(1)(B) Incidental Take Permit (PRT-TE020907-0) to the City of Seattle (Seattle Public Utility) for the Cedar River Watershed Habitat Conservation Plan***, U.S. Fish and Wildlife Service, Western Washington Office, Olympia, Washington. An Endangered Species Act (16 U.S.C. 1531 et seq.) Biological and Conference Opinions to address a multi-species Habitat Conservation Plan (HCP) prepared by the City of Seattle for HCP coverage of the City's 90,545-acre Cedar River Municipal Watershed and the City's water supply and hydroelectric operations in the Cedar River.

Preservation: Ecosystem Services-B[5]

Boyd, J., and S. Banzhaf. 2007. What are ecosystem services? The need for standardized environmental accounting units. ***Ecological Economics*** **63.2–3: 616–626.** The authors defined ecosystem services as components of nature, directly enjoyed, consumed, or used; they suggested that services are end products of nature. They stated that practical units of measurement are stocks (e.g., number of bees), and that services are spatially explicit.

[5] Excerpted from: Alejandra Echeverri & Kai M.A. Chan, Institute for Resources, Environment, and Sustainability. The University of British Columbia, Vancouver, Canada, 2202 Main Mall, V6T 1Z4

Appendix 10. U.S. Fish and Wildlife Service Biological Opinion on City of Seattle Habitat Conservation Plan

The Fish and Wildlife Service provided Endangered Species Act (16 U.S.C. 1531 et seq.) Biological and Conference Opinions to address a multi-species Habitat Conservation Plan (HCP) prepared by the City of Seattle for HCP coverage of the City's 90,545-acre Cedar River Municipal Watershed and the City's water supply and hydroelectric operations in the Cedar River. This HCP is not for planned development, but rather it is a set of mitigation and conservation commitments related to on-going reservoir management and water supply operations, hydroelectric power generation, and watershed management activities.

The HCP is a negotiated set of commitments from Seattle Public Utility, two state agencies (WDOE and WDFW), and three federal agencies (FWS, NMFS, and USACOE). The City's commitments are included in the HCP and the agreements with other parties to the HCP are included in the HCP appendices (e.g., Instream Flow Agreement and Landsburg Mitigation Agreement). A Conference Opinion is included to cover species that are currently unlisted but that may become listed in the 50-year time span of the HCP. The activities covered under the HCP are restricted to City operations and facilities on species using those waters and covered by the HCP. It does not apply to other public agencies or private parties.

The major focus of the HCP is the protection of old-growth dependent species and the protection and restoration of naturally functioning, late successional and old-growth dominated ecosystems. In addition to creating fish passage (both juvenile and adult migratory salmonids) at the Landsburg diversion dam site and fish screening at the City of Seattle water intake facility, numerous wetland, riparian and instream habitat restoration projects, there will be no commercial harvest of timber allowed and there will be an aggressive road decommissioning program in the Cedar River Watershed.

Habitat for amphibians such as northwestern salamander, long-toed salamander, roughskin newt, western toad, northern red-legged frog, and Cascade frog, etc. are widely distributed in the Cedar River Watershed. Their habitat includes both forested and open wetlands, lakes, ponds, sphagnum bogs, riparian area, slow moving streams, and meadows that will all be placed in a reserve status and protected under the HCP.