Landscape Structure: Composition and Configuration.

The Spatial Context of Priority Nearshore Restoration in Puget Sound, Washington.

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Abstract

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The Puget Sound region of Washington State has undergone enormous change over the past century. A burgeoning population and resulting urban development have permanently altered the historical shoreline as well as the underlying biogeophysical processes which create and maintain the modern shoreline. In 2001, the Washington State Department of Fish and Wildlife in cooperation with the U.S. Army Corps of Engineers began a project to examine the Puget Sound shoreline, identify areas which had been degraded, and develop a methodology to determine where and how restoration might take place. This effort to create a framework through which regional strategic restoration might be implemented was named the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP). The project had a number of specific environmental goals, which included choosing to work with sites where restoration would create habitat complimentary with surrounding terrain, ensuring restoration would create diverse habitats, and reconnecting habitats between restoration sites and surrounding landscapes.

In 2014 PSNERP identified thirty-six sites, from an initial list of 1,544 sites, where restoration should be prioritized. While PSNERP had focused on natural systems, the project was funded with public monies, and transparency and public accountability were highlighted in the framework. This study attempts to incorporate public perception of the spatial context of restoration with an examination of PSNERP's natural scientific perspective on restoration. The landscape structure surrounding each of the thirty-six priority sites was analyzed in terms of natural composition and public access configuration. Three compositional lenses and two configurational lenses were used to understand if PSNERP's framework had been successful in selecting sites capable of fulfilling stated environmental goals, while also including public participation. Comparisons of composition and configuration indicate that many of the landscape extents around priority sites retained moderate amounts of natural habitat, some habitat diversity endured, and the potential for habitat reconnection was present. However, many of the priority sites were fairly isolated within the landscape and public interaction opportunities with proposed restoration were limited. PSNERP appears to have been moderately successful in achieving the habitat goals established in the strategic framework, while little public access exists at many of the proposed restoration sites.

Acknowledgments

This project was constructed through trial and error over a longer time than any master's thesis has the right to be. From a deep, personal standpoint I must thank both my committee members, along with the faculty and staff of the School of Marine and Environmental Affairs, for being willing to allow me to return to the program and revisit this project multiple times over a number of years. Thank you to my committee chair Tom Leschine. The amount of time Professor Leschine took from his personal schedule to meet with and advise a wayward student was beyond anything expected. Without Professor Leschine's conversational input, intellectual critiques, and editorial feedback this project would not exist. Thank you to my committee member Miles Logsdon. This project was conceived in a brainstorming session in Professor Logsdon's office many years ago. Professor Logsdon's continued input as the project developed, his enthusiasm, and his conceptual redesign of the flawed first iteration of this project, gave me both the opportunity and determination to see this idea through. Thank you again to both of you.

Finally, I would like to thank my family and friends for putting up with me and my need to come back to this thesis so many times over the years. Be assured I am more exhausted than you are of hearing about this never ending project. Thank you for everything. I finished.

Fall down seven times, stand up eight.
–Japanese Proverb

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Introduction

Coastal areas in the United States are experiencing substantial population growth, increasing the desire for diminishing coastal resources while simultaneously increasing the pressures on said resources (Beatley et al. chp. 1 2002). Coastal resources can be both natural and cultural and often contain an economic component. In this study, the term coastal natural resource refers specifically to the bio-geophysical processes of the coast and the habitats created by such processes. Seaside communities nationwide are coping with a patchwork of legacy polices regarding coastal resources, some of which have ignored natural resource use (Morrison 2001), were implemented to favor maximum resource use (Kriesel et al. 2004), or simply could not foresee future resource needs (Kriesel and Friedman 2003). The combination of increased demand, reduced supply, and historically ineffective or insufficient management tools has led many coastal communities to seek out new governance strategies (Kay and Alder chp. 3 1999). Policies focused on sustainable resource use have been gaining attention (Beatley et al. chp. 1 2002; Layzer chp. 1 & 2 2008).

All resources, regardless of non-coastal or coastal origin, are increasingly seen as desirable, with proper resource management an important element of good governance (Levine et al. 2015, Lockwood et al. 2010, Coke and Brown 1976). Coastal areas have drawn specific attention due to growing demands on a limited supply of unique resources. The value of these once mostly ignored coastal natural resources has been recognized and incorporated into policy. Currently, 34 of 35 US coastal and Great Lakes states and territories have coastal management programs (Office for Coastal Management 11-3-2019: https://coast.noaa.gov/czm/mystate/). Many management schemes still tend to favor development or exploitation over sustainable use (Peterson and Lowe 2009). Yet, as resources have continued to be consumed a multitude of policies have been created which attempt to diminish non-sustainable resource use, while balancing coastal natural resource priorities. One sustainable use strategy receiving increased interest among coastal policy makers is the idea of coastal restoration (Diefenderfer et al. 2009).

Restoration is widely accepted by the scientific and policy communities as a legitimate tool of resource management (Woolley and McGinnis 2000). Historically, restoration was primarily used as a resource management tool in non-coastal areas (Beechie et al. 2010) while only being used in limited fashion in coastal situations (Beatley et al. chp. 3 2002, Kay and Alder chp. 1 1999). Rapidly increasing coastal populations in the latter half of the 20th century wrought substantial changes to coastal social and ecological systems, leading policy makers to begin purposefully managing coastlines as well as upland areas (Diefenderfer et al. 2009, Cooper and McKenna 2008). Initial coastal management policies were predominately implemented to boost development, infrastructure, and associated economic interests (Birch and Reyes 2018, Cicin-Sian and Knecht chp. 1 & 2 2000, Titus 1998). As coasts were modified to suit human use, concerns arose regarding the reduction or disappearance of natural coastal systems and the resources those natural systems provided (Peterson and Lowe 2009), including mitigation of increasing coastal hazards associated with sea level rise and climate change (Woodruff et al. 2013, FitzGerald et al. 2008). In response, policies have adapted over time to now include prevention of resource loss, sustainable resource use, and restoration of natural resource areas as vital components of any management scheme (Timm et al. 2004).

One of the numerous modern policies being practiced by resource managers is that of coastal restoration. Restoration efforts of varying intensities have been attempted at many locations throughout the coastal states, producing equally varied results (Layzer 2008). As a management technique, restoration has become popular enough that some coastal projects have been mislabeled restoration, either inadvertently (Gianou 2014, Johannessen 2009) or purposefully, to take advantage of the potentially significant monies involved (Johannessen 2009, Johannessen 2000). Many completed coastal restorations are considered successful (Johannessen 2001, Zelo et al. 2000). Successful coastal restoration projects have been found to share common elements. Two recent studies (Johannessen 2009, Layzer p. 289 2008) suggest that a detailed understanding of ecological systems, high local governance capacity, and public support are factors critical to the success of coastal restoration.

As with other coastal states, Washington State faces increasing demand on a limited supply of coastal area and has incorporated restoration into resource use policies. Washington State has a well-established history with ecosystem scale resource management attempts, with both success (McLeod and Leslie p.201 2009) and failure (Broadhurst and Walkinshaw 1998), and has been at the forefront of regional scale cooperative management measures (Lee 1993). In 2001 Washington State took the first steps toward applying a regional restoration approach to the estuarine and nearshore areas of Puget Sound with the creation of a new initiative, the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP). PSNERP began as a joint venture of the Washington State Department of Fish and Wildlife (WDFW) and the United States Army Corps of Engineers (USACE) (Van Cleve et al. 2004). PSNERP’s purpose was to develop a regional systematic and strategic methodology for performing coastal restoration actions in Puget Sound (Greiner 2010). As envisioned, PSNERP would develop a methodological framework through which candidate sites could be selected, processed and restored. The completed framework could then be used to assist any organization with funding, developing, and conducting nearshore restoration in Puget Sound. By expending the money necessary to establish the foundational process of restoration decision making, PSNERP's work would be able to relieve some of the monetary and temporal commitments from individual organizations, increasing the amount of nearshore restoration in Puget Sound and directing such restoration into areas of maximum return (Clancy et al. 2009). PSNERP's framework would also eliminate duplicate efforts, merge compatible efforts, and unify a plethora of fragmented and sometimes conflicting social-ecological desires into a regional strategy for nearshore restoration.

PSNERP drew heavily from previous work in Washington State, the Chesapeake Bay Restoration, Florida Everglades Restoration, and California's numerous attempts at managing water resources on a regional scale (Van Cleve et al. 2004). While these projects served as predecessors, each had numerous difficulties and substantial drawbacks. PSNERP was purposefully designed to take a different tack focused on the scientific underpinnings of bio-physical nearshore interactions while excluding real world socio-political considerations regarding restoration (Cereghino et al. 2012).

As PSNERP's framework developed, a detailed historical baseline was established (Simenstad et al. 2011) and an assessment of need created (Schlenger et al. 2011) to consider 1,544 potential restoration sites along Puget Sound (Cereghino et al. 2012). Eleven years after PSNERP's inception in 2001, a strategic methodology was finalized and thirty-six priority restoration areas were identified (Figure 1). The identification of these priority sites was a milestone in PSNERP's organizational history, marking the change from development to operation. Each of the priority sites was comprehensively described to 10% restoration completion in a conceptual design report (Environmental Science Associates 2012).

In 2015, 11 of the 36 priority sites were forwarded for funding approval in a future Water Resources Development Act (Puget Sound Nearshore Ecosystem Restoration Project 2014). In 2016 $451 million USD was authorized for the restoration of 3 of the priority sites in the Water

Infrastructure Improvements for the Nation Act (Puget Sound Nearshore Ecosystem Restoration Project 2016, WIIN Act 2016; Figure 1).

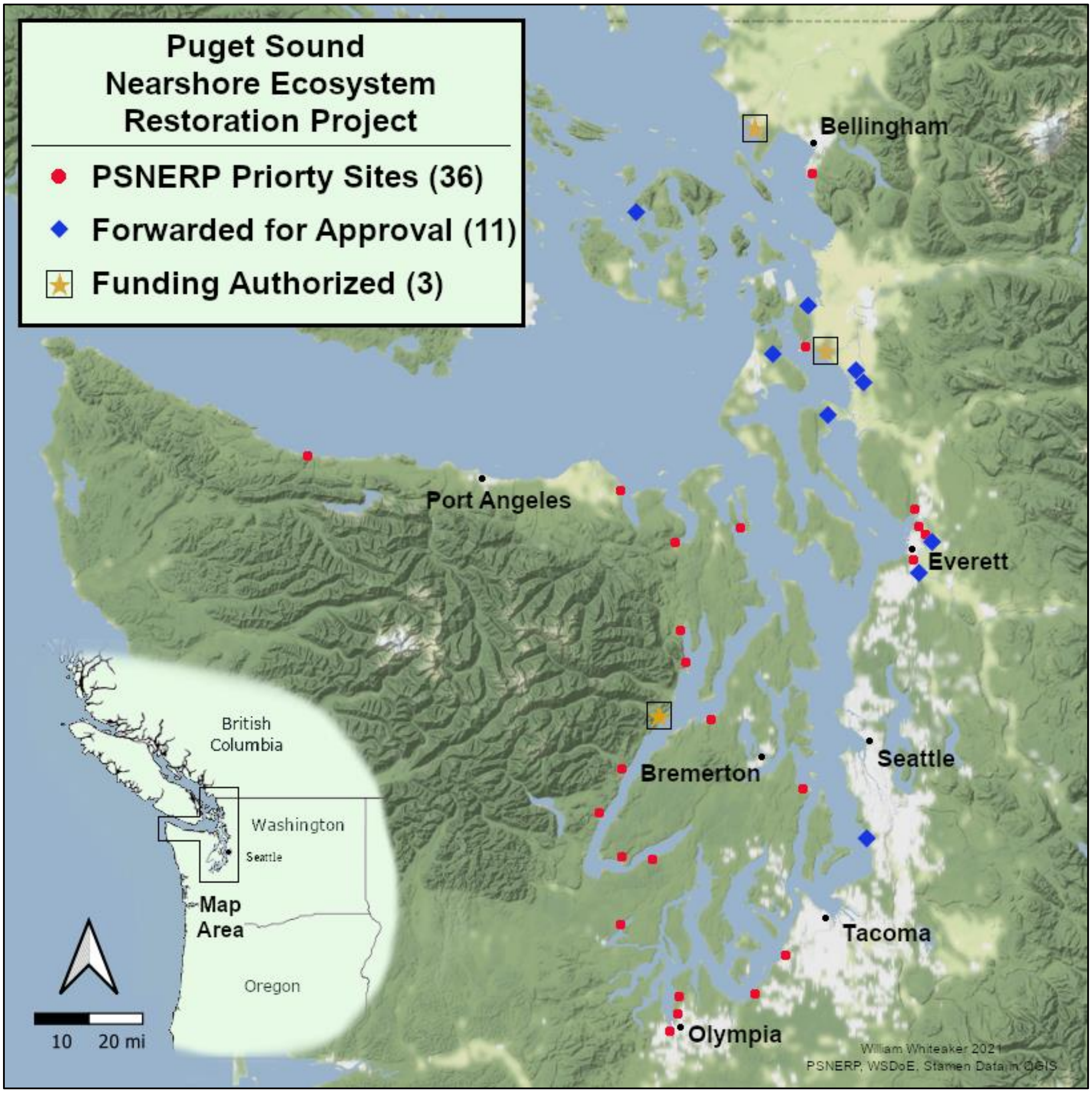


Figure 1 The estuary of Puget Sound connecting to the eastern Pacific Ocean in northwest Washington State, USA. PSNERP identified thirty-six shoreline locations around the Puget basin as candidate sites for priority restoration (red, blue, and gold symbols) from more than 1,544 initially suggested areas (Cereghino et al. 2012).

With three priority sites approved for federal funding, and others advanced by non-PSNERP restoration organizations (Puget Sound Nearshore Ecosystem Restoration Project 11-4-

2019: http://www.psnerp.ekosystem.us), the final "real world work" stage of PSNERP's methodology is transpiring. Since some portion of PSNERP is now heading towards conclusion, with $451 million dollars in public funding, I undertook an examination of the landscape settings of the 36 priority sites to determine how closely these selected areas fit the greater context of PSNERP's goals. One of the central tenets of PSNERP's philosophy was habitat as a key component of ecological restoration (Fresh et al. 2004). PSNERP sought to both restore habitat diversity and to restore linkages between habitats (Fresh et al. 2004). PSNERP's strategy focused on the biophysical realities of habitat restoration in selecting priority sites, regardless of whether restoration of a particular site found social acceptance with the local community (Cereghino et al. 2012). However, PSNERP recognized that such restoration would be undertaken with public monies and therefore attempted to create a transparent process which valued public input while producing the most cost effective results (Cereghino et al. 2012). In incorporating this inclusive accountable methodology, PSNERP recognized that modern coastal governance operates with high expectation that citizen input will not only be sought, but will influence government decision making (Clancy et al. 2009, Van Cleve et al. 2004).

Landscape Structure

In this study I employ geospatial data to examine the structure of the landscapes surrounding the restoration areas PSNERP identified as priority sites. Landscape structure is traditionally defined via two attributes: composition and configuration (Dunning et al. 1992, Turner 1989, Forman and Godron chp. 6 1986). Composition describes the components which make up the landscape, while configuration describes the arrangement of those components (Walz 2011, McGarigal and Marks 1995, Forman and Godron chp. 6 1986). The composition of the landscapes surrounding PSNERP's priority sites provides some indication of whether the restoration goals of increased habitat diversity and habitat reconnection can be attained at a specific site. If the surrounding landscapes are similar in composition to what PSNERP plans for the restored priority areas, the chances of successful long term restoration are increased (Rudnick et al. 2012, Beechie et al. 2010, Buckley and Haddad 2006, Bell et al. 1997). The configuration of the landscapes surrounding the priority sites expresses the public's socio-economic choices for those landscapes (Moreira et al. 2006, Wiggering et al. 2006, Forman and Godron chp. 8 1986) and will provide some indication of how the public interacts with the landscape near the priority areas. While PSNERP's framework did not explicitly include socio-economics, PSNERP did recognize public input would affect restoration decision making. The amount and public accessibility of natural habitats in the landscapes surrounding the priority sites will be used to examine the extent of the public's desire for natural places in these areas. Restoring a priority site in an area with demonstrable public interest in natural settings would increase the likelihood of maintaining successful restoration (Wyborn et al. 2012, Woolsey et al. 2007).

Landscape Structure – Composition

To understand the composition of the landscapes, this study will use three separate geospatial data layers: land cover, impervious surface, and land use. Clips from these layers will be used to develop conceptual analytic lenses (Misra et al. 2020, Sassen 2010, Head 2008, Costa and Kallick 1993). Using multiple lenses should result in complimentary data, supplementing weaknesses found in any individual lens (Rikalovic et al. 2014, Malczewski 2006). To develop each lens, landscapes will be analyzed to determine the types of habitats present and the magnitude to which any habitat type is dominant. Dominance has been shown to be an indicator of habitat diversity (Hillebrand et al. 2008, Ricotta and Avena 2003) and magnitude of dominance can be influential in how habitats respond to restoration opportunities (Baer et al.

2004, Copeland et al. 2002, O'Neill et al. 1988). Many of the landscapes surrounding priority sites are developed. The resulting dominance of development may significantly limit PSNPERP's goals of increased habitat diversity and habitat reconnection. PSNERP cannot reconnect restored priority sites to habitats which no longer exist. Even if landscapes surrounding PSNERP priority sites have abundant undeveloped land, if that undeveloped land is dominated by a single habitat type, opportunities for increases in habitat diversity and reconnection may be limited. Therefore, the undeveloped portion of the landscapes will be further examined to identify undeveloped habitat types and dominance among those types.

Landscape Structure – Configuration

To understand landscape configuration, this study will use two simple metrics: the total perimeter of a priority site with public access (Access: Immediate), and the number of publicly accessible natural spaces within a given distance of a priority site (Access: Travel) (Spangler et al. 2023, Villanueva et al. 2015, Nicholls 2001). The accessibility of the priority site indicates the public's choices in land use in the landscape surrounding the priority site. More natural spaces, such as parkland, open spaces and natural recreation areas, in the surrounding landscapes may serve as an indication that restoration may be accepted or desired in these areas (Sorensen et al. 2018, Connelly et al. 2002, Gobster 2001). If the priority site were accessible from immediately adjoining lands, public interactions with the site may be increased, thereby increasing perception of restoration success (Özgüner et al. 2012, Woolsey et al. 2007, Tunstall et al. 2000). Similarly, a restoration site which is accessible to the public, even if some reasonable amount of travel is required to access the site, may lead to a more positive public perception of the restoration effort (Gobster et al. 2016, Westling et al. 2014, Woolsey et al. 2007).

Hypothesis and Research Questions

After attending multiple workshops regarding shoreline restoration in Puget Sound, meeting with a number of PSNERP participants, and extensively reviewing PSNERP's published documentation, I undertook this research to examine whether the extent to which PSNERP's science-based approach led to outcomes complementary with societal goals implied by surrounding landscape compositions and accessibility configurations. In operation, PSNERP seemingly focused on the bio-geophysical aspects of restoration to such extent that the human element of the landscape became de-emphasized. This approach led to conflicts which may have been lessened had greater consideration been given to social dimensions. Based on these observations, I have developed the following hypothesis:

PSNERP selected priority restoration sites which are moderately degraded, dissimilar from the surrounding landscapes, and which have limited opportunities for public interaction.

To find evidence supporting or opposing my hypothesis, I have developed the following research questions:

1. If restored, would PSNERP priority sites be similar or dissimilar in landscape structure to their adjacent landscapes?
2. If restored, would PSNERP's priority sites be accessible to the public?

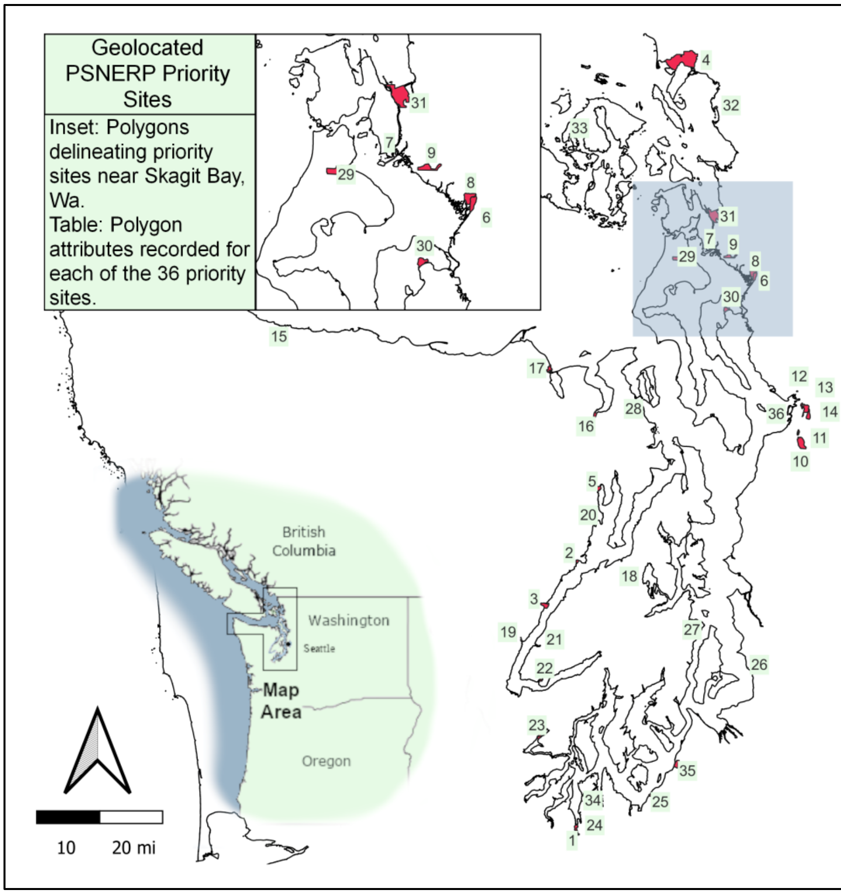
Studying the composition of landscapes around the sites should provide the most insight into the first question, while landscape configuration should inform the second question.

Methods

All data analysis was done in ArcView 10.2 using information publicly available from Washington State and Federal agencies. The majority of data was obtained from the Washington State Geospatial Data Archive (https://wagda.lib.washington.edu/ 10-1-2015) at the University of Washington. Additional datasets were gathered from the Washington Geospatial Open Data Portal (http://geo.wa.gov/ 10-1-2015) and at the federal level from the United States Geological Survey (https://www.usgs.gov/products/data-and-tools/gis-data 10-1-2015).

A Washington State boundary, including marine shoreline, was delineated using the default projection provided by the Washington State Department of Ecology (https://ecology.wa.gov/Research-Data/Data-resources/Geographic-Information-Systems-GIS/Data 10-1-2015) (Figure 2). All subsequent data were transformed into this projection. PSNERP priority project areas were geolocated, as defined in the conceptual design report (CDR) (Environmental Science Associates 2012) by using the same base map imagery as the CDR, and visually identifying the site in GIS as established in the CDR. Select attributes for each of the priority sites were also recorded (Figure 2).

Once the priority sites were spatially defined, an area surrounding each site was identified as the landscape extent to be examined in this research. Specifying landscape extent is a task unique to each study and must be determined by the investigator (Rutchey and Godin 2009, Karau and Keane 2007, Forman and Godron 1986). Landscape extent is normally established using some criteria of importance, such as habitat range or watershed area (Tang and Gustafson 1997, Bailey et al. 1994). This study uses both human values and bio-geophysical criteria in the definition of landscape extent. Initial attempts to create a “human value” landscape extent, delineated at some specific distance from a priority site, did not produce desirable consistency



Site ID	PSNERP ID	Project Name	Process Units	Area (ft²)
1	1003	Deschutes River Estuary Restoration	DES	15960769
2	1012	Duckabush Causeway Replacement and Estuary Restoration	2047, DUC	4321892
3	1047	Hamma Hamma Causeway Replacement and Estuary Restoration	HAM	18876553
4	1055	Nooksack River Delta (Estuary)	7175, 7146, NKS	247387998
5	1076	Big Quilcene River Restoration (1076, 1074, 1077, 1078)	QUL	12301786
6	1091	Milltown Island	SKG	15014733
7	1092	McGlinn Island Causeway	SKG	2554494
8	1101	Deepwater Slough Phase 2	SKG	16166602
9	1102	North Fork Levee Setback	SKG	17745700
10	1126	Everett Marshland Tidal Wetland Restoration	SNH	45440296
11	1127	Everett Riverfront Wetland Complexes	SNH	4318388
12	1136	Quilceda Estuary Restoration	SNH	644813
13	1142	Smith Island Estuary Restoration	SNH	24692865
14	1149	Spencer Island Restoration	SNH	16025458
15	1190	Nearshore Restoration Strategy for Twin Rivers	1027	569205
16	1230	Snow Creek and Salmon Creek Estuary Restoration	1010, 1011	9099476
17	1237	Washington Harbor Tidal Hydrology Restoration Project	1020, 1021	13640001
18	1256	Big Beef Causeway Replacement and Estuary Restoration	2088	153434
19	1346	Lilliwaup Causeway Replacement and Estuary Restoration	2034, 2035	1591897
20	1379	Point Whitney	2052	573660
21	1404	Tahuya Causeway Replacement and Estuary Restoration	2013, 2084	2577932
22	1421	Twanoh State Park Beach Restoration	2028, 2029	699099
23	1447	John's Creek Estuary Restoration Project	3092	8080729
24	1457	Mission Creek Estuary Reconnection	3041	251231
25	1467	Sequalitchew Creek Culvert	3006	2865174
26	1499	Beaconsfield Feeder Bluff Restoration	4015	681001
27	1505	Harper Estuary Restoration Design and Construction	4038, 4039	589072
28	1552	Kilisut Harbor_Oak Bay Reconnection	5007, 5012, 5036	1300056
29	1609	Dugualla Bay Restoration	6025	39633856
30	1618	Livingston Bay - Diked Farmland and Nearshore Habitat	6049, 6050	12258826
31	1633	Telegraph Slough - Phase 1 and 2 (1633, 1635)	7165, SKG	64272233
32	1642	Chuckanut Estuary Restoration	7161	1805976
33	1648	Deer Harbor Estuary Restoration	7055	35183
34	1684	WDNR Marine Lab Bulkhead Softening	3039, DES	334408
35	1801	Chambers Bay Estuarine and Riparian Enhancement	3003, 3004	17632303
36	1805	Snohomish Estuary Mainstem Connectivity	SNH	6235628

William Whiteaker 2021
PSNERP, WSDoE Data in QGIS

Figure 2 Shoreline of Puget Sound with polygons for all thirty-six PSNERP priority sites delineated and colored red. For each polygon, Site ID, PSNERP ID, Project Name, associated Processes Unit ID's, and Area (ft²) were recorded.

across sites. Either the landscape tended to be so vast as to seem unrelated to the priority site, or so small as to be a narrow ribbon of terrain around a priority site, a result unrepresentative of the concept of a sizable landscape within which a priority site would be nestled. Finally a proportional approach was adopted, based on the concept of the rule of thirds from the discipline of visual design (Svobodova et al. 2014, Akhtaruzzamna and Shafie 2011, Berdan 2004). Each "human value" landscape was determined to be three times the areal extent of the associated priority site. This methodology provided enough spatial extent to create a full "landscape" surrounding each priority site, without creating such extensive territory as to be unrelated, from a human perspective, to the priority site. However, human perceptions represent only one component of landscape extent in this study, bio-geophysical processes represent another.

One of PSNERP's undertakings was to catalogue the bio-geophysical functions of the nearshore (Cereghino et al. 2012). PSNERP used this catalogue to spatially organize interacting components of the physical landscape into process units, establishing natural landscape extents. This study takes advantage of the work done by PSNERP, using process units to define natural landscapes, while also incorporating human values into designations of landscape size. The result is a hybrid landscape surrounding each priority site. The extent of the landscape represents some area of value to humans, interwoven with the water and nutrient pathways that actually interact with the priority site.

To create the landscape extents, process units which affected each priority site were identified from the CDR and PSNERP's geodatabase. All process units that affected any specific site were combined into a new layer (Figure 3) allowing independent manipulation of process unit(s) corresponding to each priority site. Once related process units were defined, buffers proportional to each site were created to establish the spatial scale of human importance (Figure 4). These buffers were then clipped by process unit boundaries, integrating the human and bio-geophysical elements of landscape extent (Figures 4 and 5). The defined landscape extent creates analysis windows for each priority site which represent both the human component and natural component of landscape (Figures 5 and 6).

Once created (Figures 4 and 5) and isolated (Figure 6), the spatial extents defined by analysis windows were used to investigate the landscape structure surrounding each priority site (Appendix 1). Structure was examined for both compositional and configurational properties. Composition was explored through the use of three lenses: Land Cover, Impervious Surface, and Land Use. Configuration was explored through two lenses: Immediate Access and access if some Travel Distance was included. Summary data tables for all lenses are found in Appendix 1.

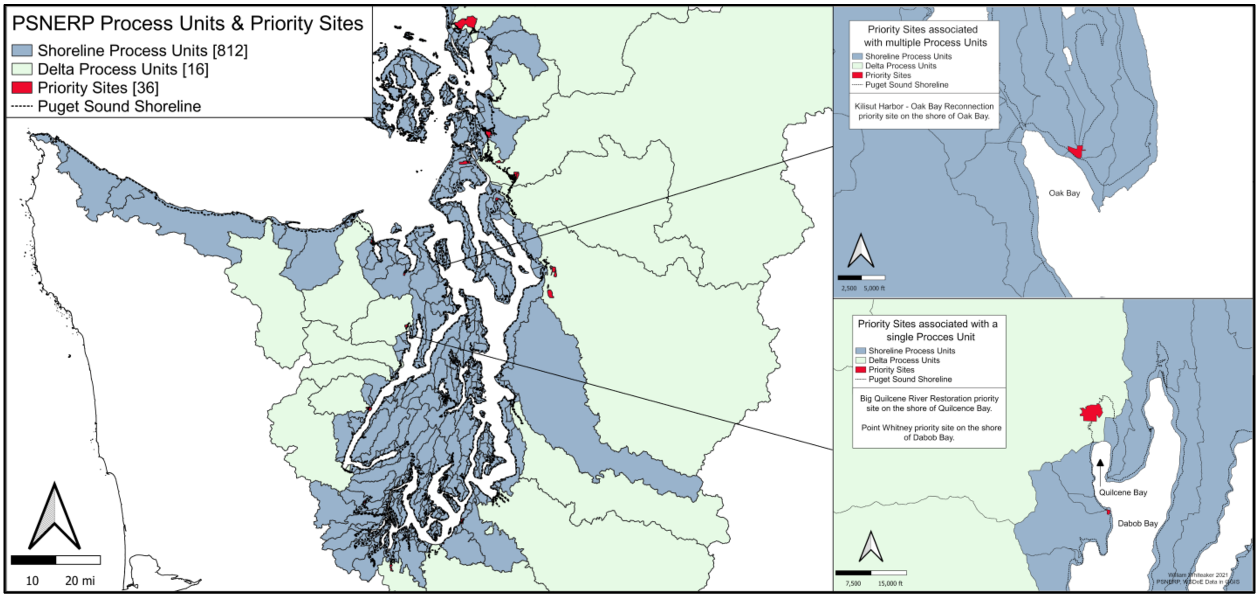


Figure 3 Priority site polygons in red overlaying PSNERP process units. Kilisut Harbor priority site (inset upper right) demonstrates a priority site affected by multiple process units. Big Quilcene River priority site (inset lower right) demonstrates a priority site affected by a single process unit.

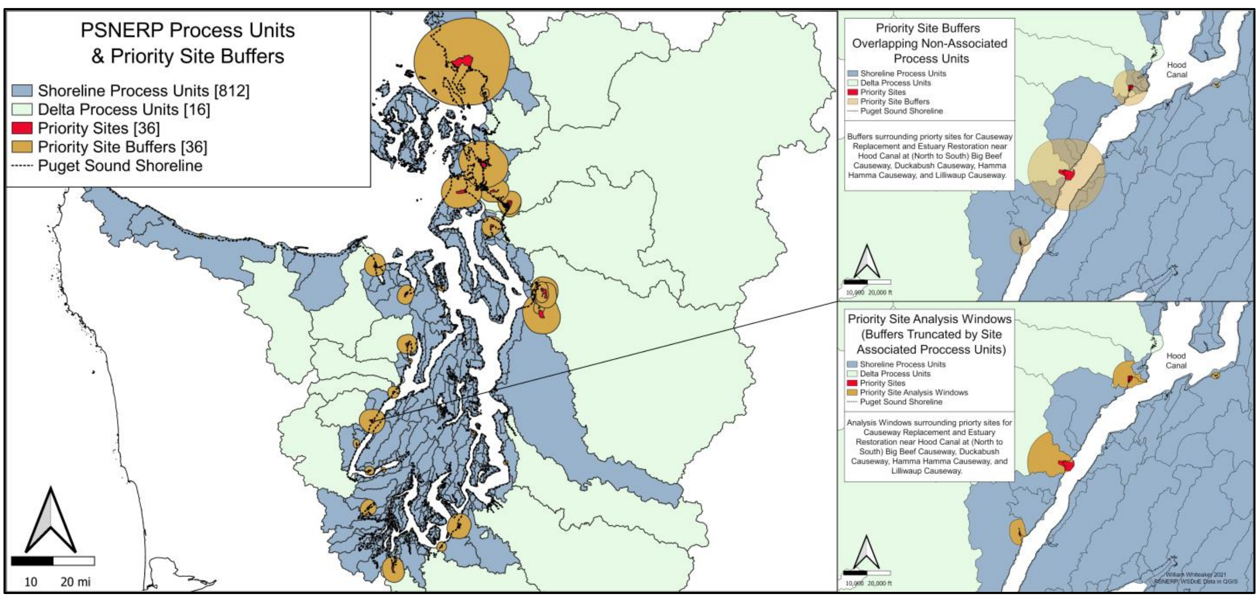


Figure 4 Buffers proportional to priority site areas define the landscape extent of human value surrounding each priority site. Buffers are clipped by the boundaries of PSNERP process units, reflecting the reality of bio-geophysical processes in the determination of landscape scale (inset upper right). Clipped buffers create analysis windows defining landscape scale surrounding each priority site (inset lower right). Analysis windows encompass a portion of the associated process units surrounding each priority site, specifically the nearshore area, but do not necessarily include entire process units.

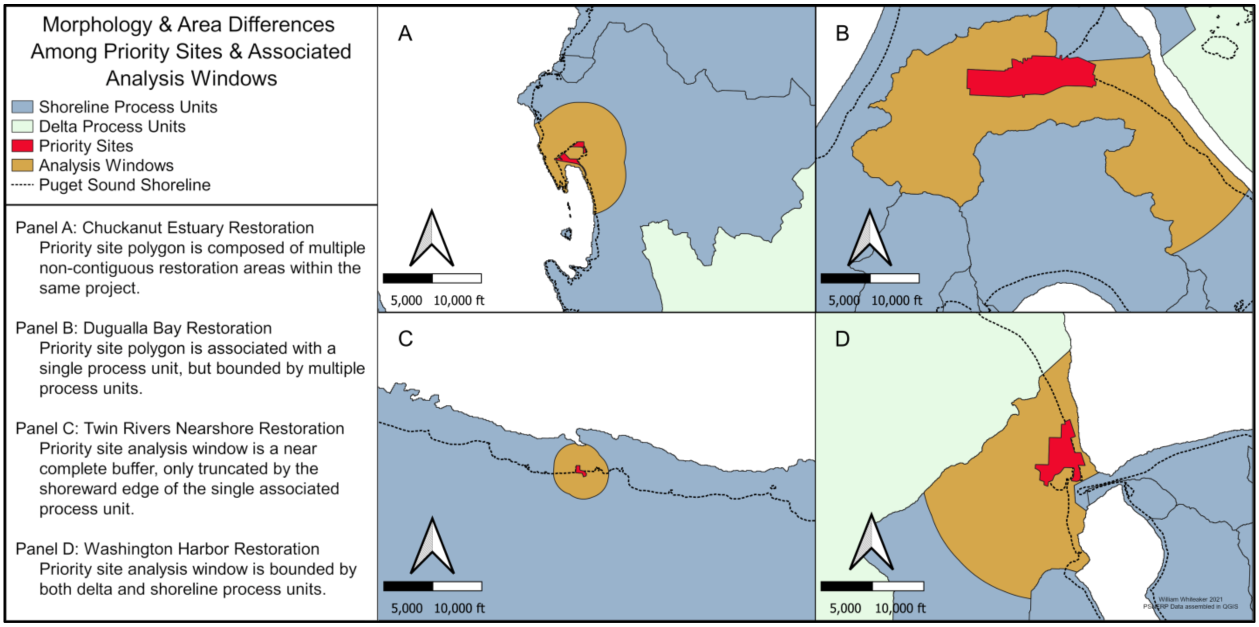


Figure 5 Close up of analysis windows around priority sites along the shoreline of Puget Sound. Analysis windows represent both the human and natural components of landscape extent. In Panels A and C a significant portion of the human value landscape is retained. Panels B and D depict landscape extents of human value significantly altered by the realities of natural bio-geophysical processes surrounding the priority sites.

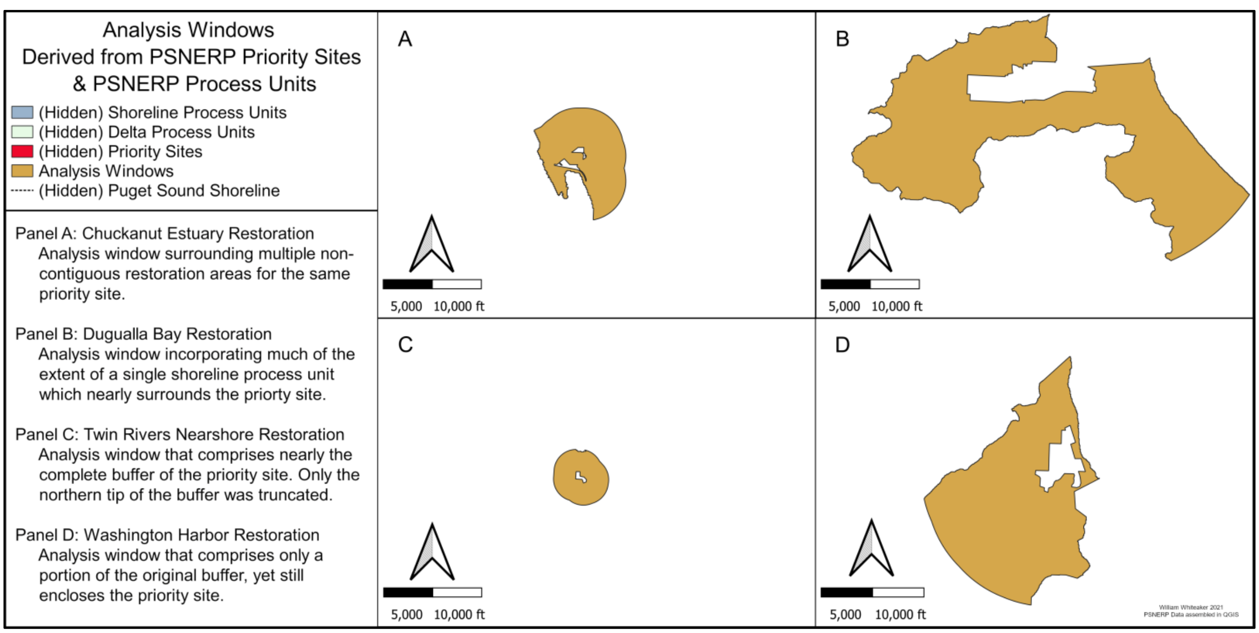


Figure 6 Analysis windows isolated from Figure 5. Analysis windows were created by clipping proportional buffers surrounding each priority site with both process unit boundaries and the shoreline of Puget Sound. Analysis windows define the spatial extent to which the landscape surrounding each priority site is examined in this study.

Landscape Structure – Composition – Land Cover

USGS 30 x 30 m raster land cover data was clipped by the analysis window for each priority site (Figure 7). The clipped data, containing land cover type and number of cells per

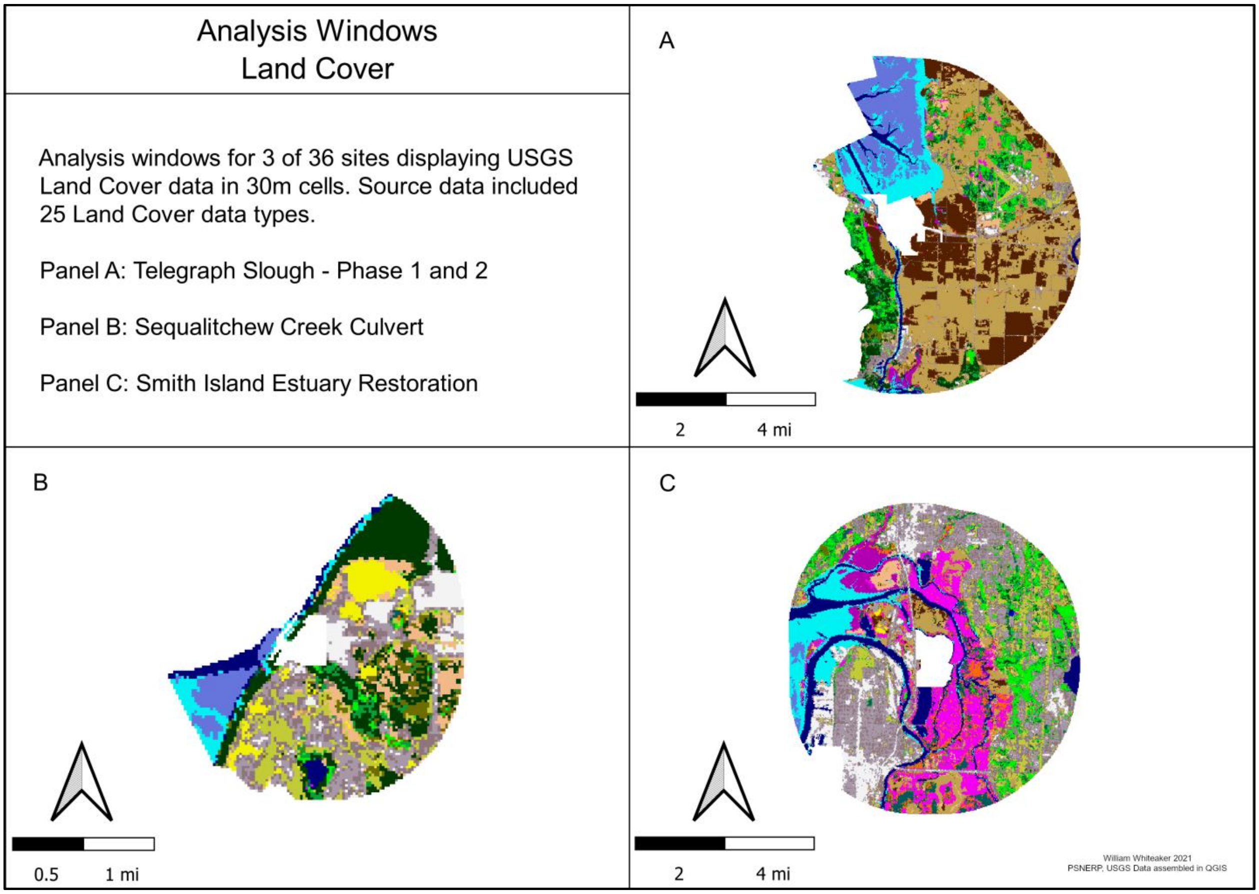


Figure 7 Examples of USGS Land Cover data displayed in the analysis windows associated with three priority sites. Colors indicate differing land cover types. The shape of each priority site is visible in the center of the analysis windows as white space. Analysis windows in this image were selected to demonstrate uniqueness of land cover in the landscape surrounding each priority site. Some landscapes were dominated by a land cover group, such as the brown open lands in Panel A, while others had little to no dominance by any land cover type. Panel B shows multiple land cover types at a small priority site. Panel C shows a larger priority site with significant amounts of developed land in grey, wetlands in pinks, and aquatic land cover in blues.

type, was exported to Microsoft Excel for further analysis. The USGS data contained 25 land cover types, including multiple types of forest, grasslands, built environments, etc. Area for individual land cover types was calculated as ($30m^2$ per cell * number of cells). Corresponding land cover types were associated into five larger groups: aquatic, developed, forest, open land,

and wetland. The 25 land cover type areas were summed by associated groups to determine the percentage area each of the larger groups occupied within an analysis window (Figure 8).

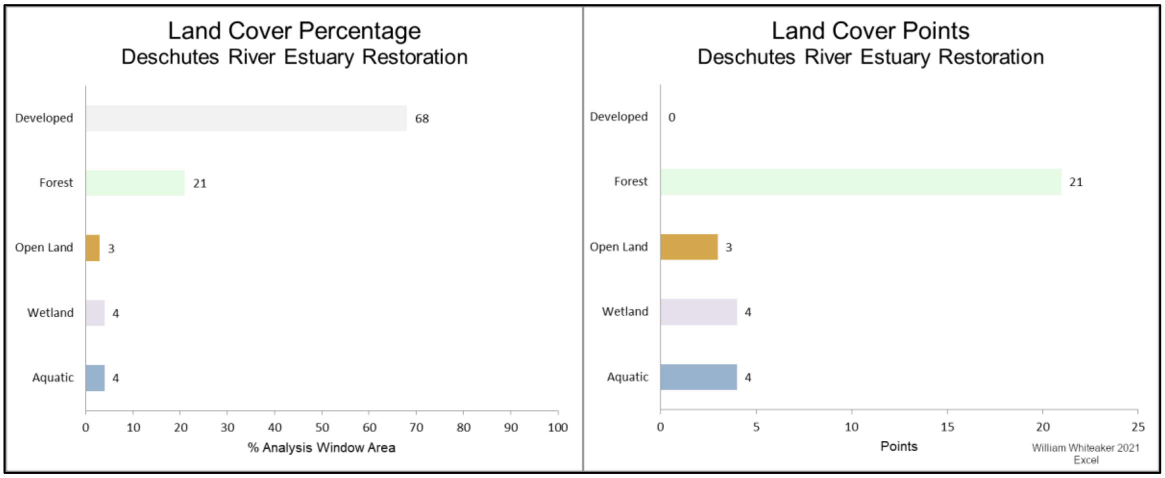


Figure 8 Left Panel: Percentage area of the analysis window for the Deschutes River priority site occupied by each of the five land cover groups. For this particular priority site, developed land was dominant within the landscape, while some forest land cover types maintained a significant presence. Right Panel: Each landscape was also given a series of "points", derived directly from (%) area of land cover, to examine both the amount and diversity of undeveloped habitat remaining in the landscape surrounding a priority site.

While Figures 7 and 8 highlight data specific to four priority sites, each of the thirty-six landscapes surrounding priority sites were analyzed through the land cover lens to describe percentage area, dominance, amount of remaining undeveloped habitat, and diversity of remaining undeveloped habitat. Percentage area and dominance were calculated directly from USGS data, while habitat remaining and habitat diversity were derived from the percentage area analysis. In determining values for habitat remaining and habitat diversity, a scaling metric converting percentage area to points was employed (Figure 8). Points therefore represent both the amount and distribution of undeveloped land. No points were assigned to developed habitat as developed habitat was considered to be of little value in re-establishing natural systems or in reconnecting habitat corridors. A maximum of 25 points was assigned to each of the four remaining natural land cover groups, creating a maximum of 100 points, to measure habitat remaining and habitat diversity. Using this method, dominance of a single undeveloped land cover could be accounted for, with no additional points awarded if dominance of that land cover increased past 25 percent. Only if other undeveloped land covers were also present would more points be assigned. With this system a high point total was only possible if a landscape surrounding a priority site included significant undeveloped land across multiple land cover types (Figure 8).

Landscape Structure – Composition – Impervious Surface

USGS 30 x 30 m raster impervious surface data was clipped by the analysis window for each priority site (Figure 9). The clipped data, containing impervious surface percentages and number of cells per percentage, was exported to Microsoft Excel for further analysis. The USGS data contained 128 impervious surface percentages. Area for individual percentage was calculated as ($30m^2$ per cell * number of cells). Due to the number of classifications within the impervious surface data, and 0-100 percent measurements being divided into 128 classifications, the percentage classifications were associated into five impervious surface groups: 0-20%, 21-40%, 41-60%, 61-80%, and 81-100%. The 128 impervious surface percentages were summed by associated groups to determine the percentage area each of the larger groups occupied within an analysis window (Figure 10).

To establish some continuity between lenses of analysis, the methodology used to structure impervious surface data was similar to that used for land cover data, allowing matching percentage area and points groups. Figures 9 and 10 highlight data specific to four priority sites, however each of the thirty-six landscapes surrounding priority sites were analyzed through the impervious surface lens to describe percentage area, dominance, amount of development throughout the landscape, and diversity of that development. Percentage area and dominance were calculated directly from USGS data, while amount and diversity of development were

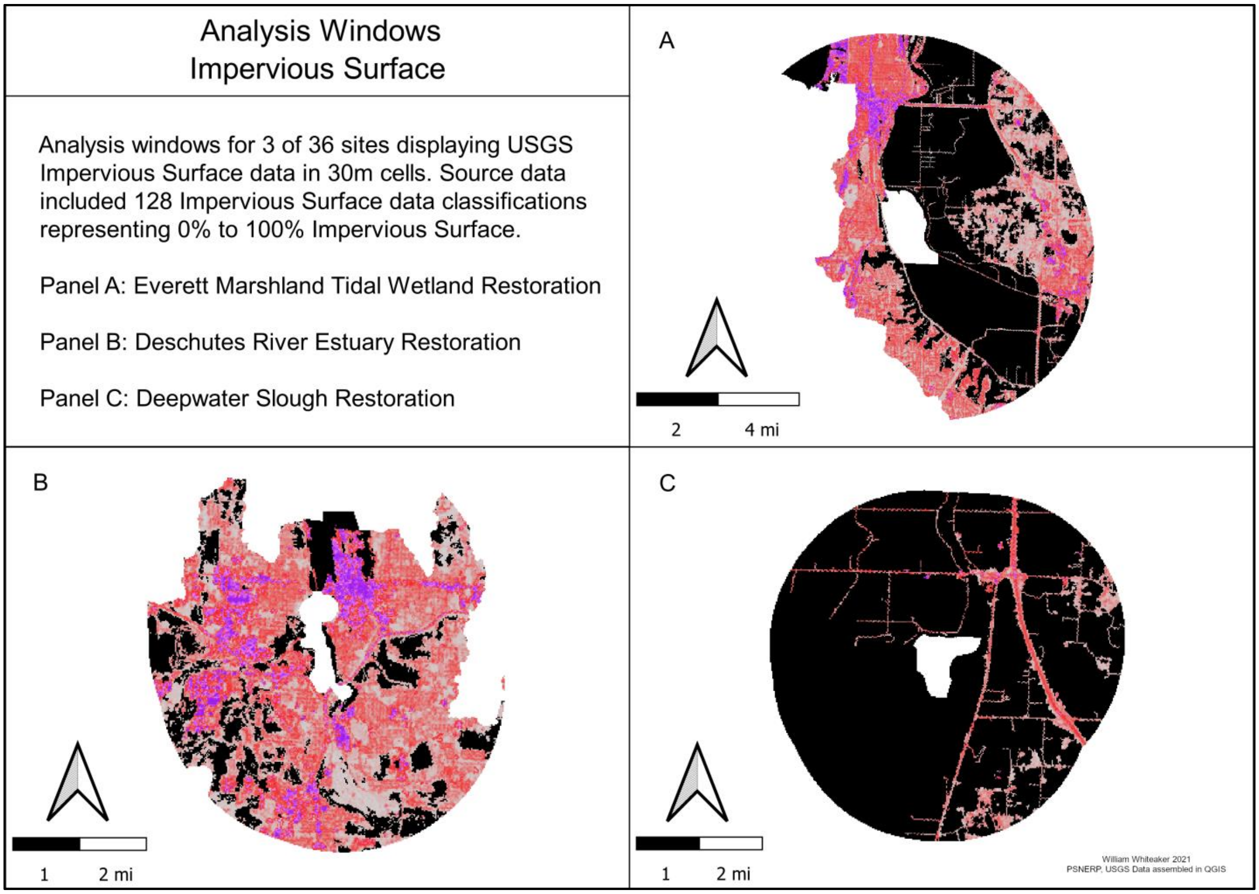


Figure 9 Examples of USGS Impervious Surface data displayed in the analysis windows associated with three priority sites. Colors indicate percentage of impervious surface per cell: black = lowest, indigo = highest. The shape of each priority site is visible in the center of the analysis windows as white space. Analysis windows in this image were selected to demonstrate the vast differences in impervious surface seen among landscapes. Densely populated areas containing high amounts of impervious surface, denoted by dark pinks and purples (Panels A and B), contrast with sparsely populated areas containing little to no impervious surface, denoted by dark greys and black (Panels A and C). Even densely populated landscapes still had significant areas where little to no impervious surface was present (Panel B). Road surfaces are clearly discernable in Panels A and C as linear pink stripping.

derived from the percentage area analysis, with higher degrees of development equated to higher values of impervious surface. In determining values for development amount and development diversity, a direct conversion from percentage area to points was employed (Figure 10). Where the amount of development led to impervious surface values between 81-100%, no points were assigned. This intensity of development was considered to be analogous to the developed category of land cover and therefore of little value in re-establishing natural systems or in reconnecting habitat corridors. To measure diversity in the remaining partially developed habitats, a maximum of 25 points was assigned to each of the four other impervious surface groups, creating a maximum of 100 points. With this system a high point total was only possible if a landscape surrounding a priority site had little intense development and multiple densities of impervious surface were present (Figure 10). Initially a system where a high point total was only

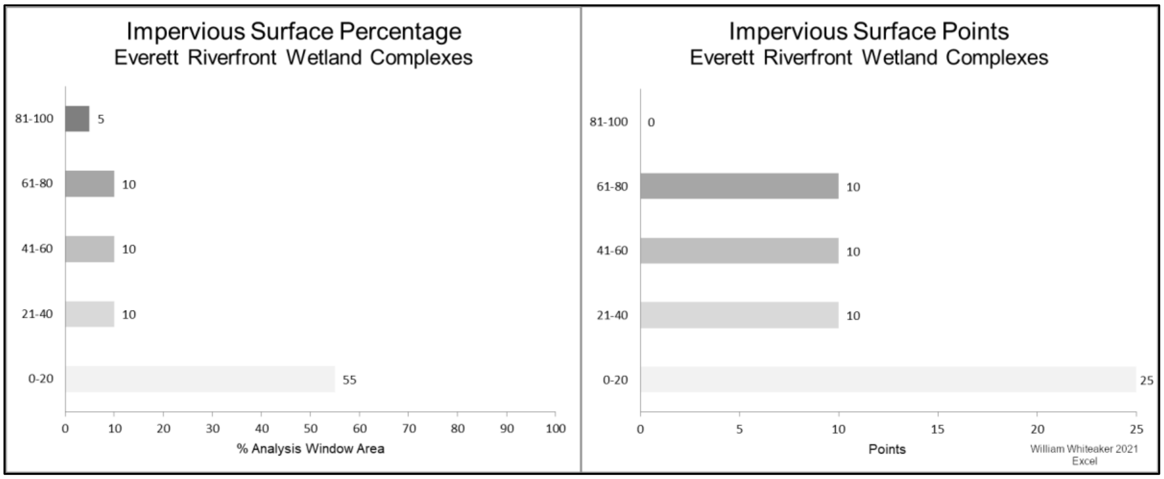


Figure 10 Left Panel: Percentage area of the Everett Riverfront priority site analysis window occupied by each of the five impervious surfaces groups. At this priority site, impervious surface between 0-20% was dominant within the landscape. Other percentages of impervious surface were present and some heavily developed areas, indicated by 80-100% impervious surface, could be detected. Right Panel: Each landscape was also given a series of "points", derived directly from (%) area of impervious surface, to examine both the amount and diversity of remaining undeveloped habitat.

possible if impervious surface values were between 0-20% was used. However, this system resulted in areas of mono-culture farm land receiving high scores. Since mono culture farms do not represent habitat diversity, the point system was changed to include multiple densities of impervious surface. By assigning points to multiple densities, natural, rural, and perhaps even some suburban habitats can be accounted for in the impervious surface data.

Landscape Structure – Composition – Land Use

Washington State Department of Ecology parcel data was clipped by the analysis window for each priority site (Figure 11). The clipped data, containing land use type by parcel and area per parcel, was exported to Microsoft Excel for further analysis. The data contained 72 land use types, predominantly related to development, although some forest and open lands usage types were also present. Area for individual land use types within an analysis window was calculated

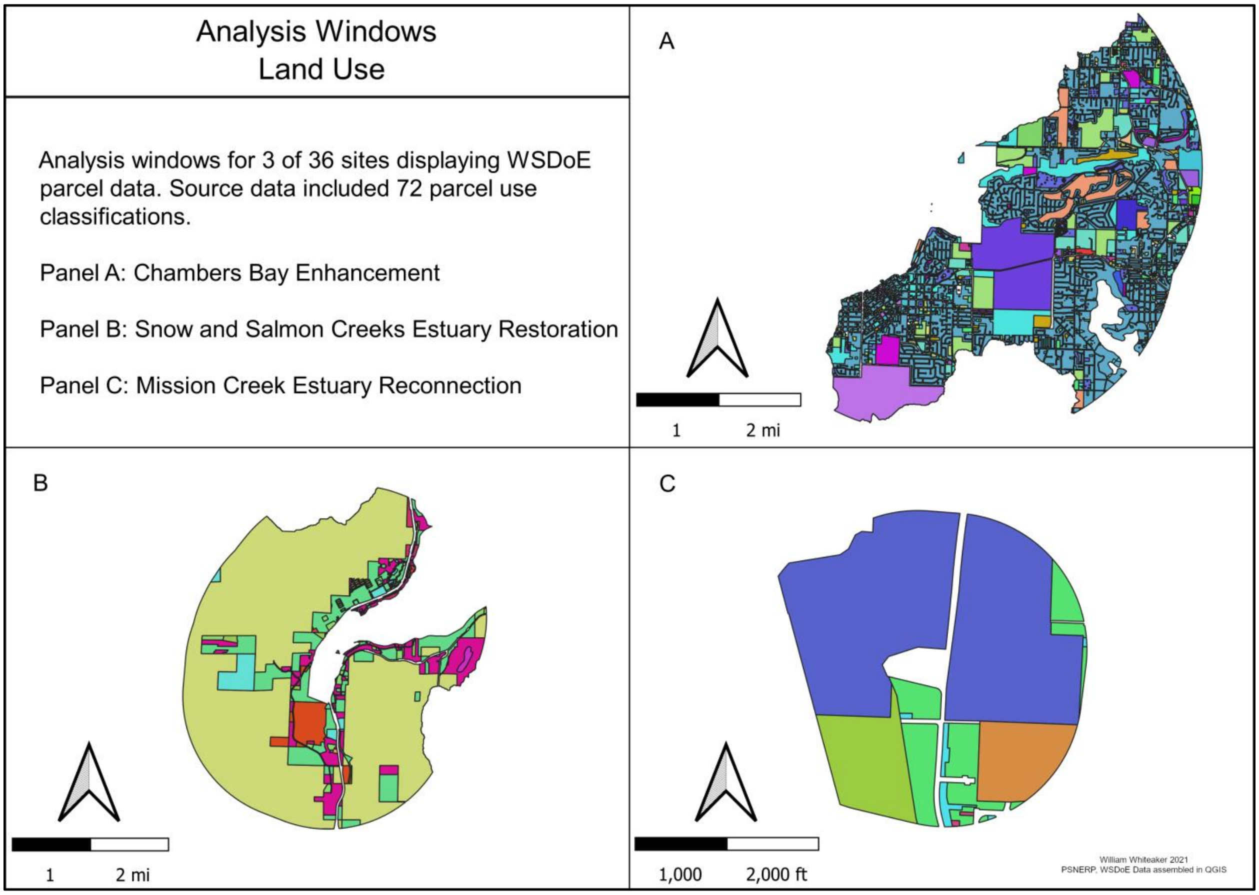


Figure 11 Examples of Washington State Department of Ecology parcel data displayed in the analysis windows associated with three priority sites. Colors indicate land use designations by parcel. The shape of each priority site is visible in the center of the analysis windows as white space. Analysis windows in this image were selected to demonstrate variability in parcel size and land use classification surrounding priority sites. As priority sites vary dramatically in size, so to do the proportional landscape extents surrounding those priority sites. Some landscapes were dominated by the land uses of only a few parcels (Panels B and C), while other landscapes contained numerous parcels and land uses (Panel A).

by summing the areas of the parcels classified as a particular land use. Corresponding land uses were associated into three larger groups: developed, forest, and open land. The 72 land use type areas were summed by these associated groups to determine the percentage area each of the larger groups occupied within an analysis window (Figure 12).

Figures 11 and 12 highlight data specific to four priority sites, however each of the thirty-six landscapes surrounding priority sites were analyzed through the land use lens to describe percentage area, dominance, amount of remaining undeveloped habitat, and diversity of remaining undeveloped habitat. Percentage area and dominance were calculated directly from Washington State Department of Ecology parcel data, while habitat remaining and habitat diversity were derived from the percentage area analysis. In determining values for habitat

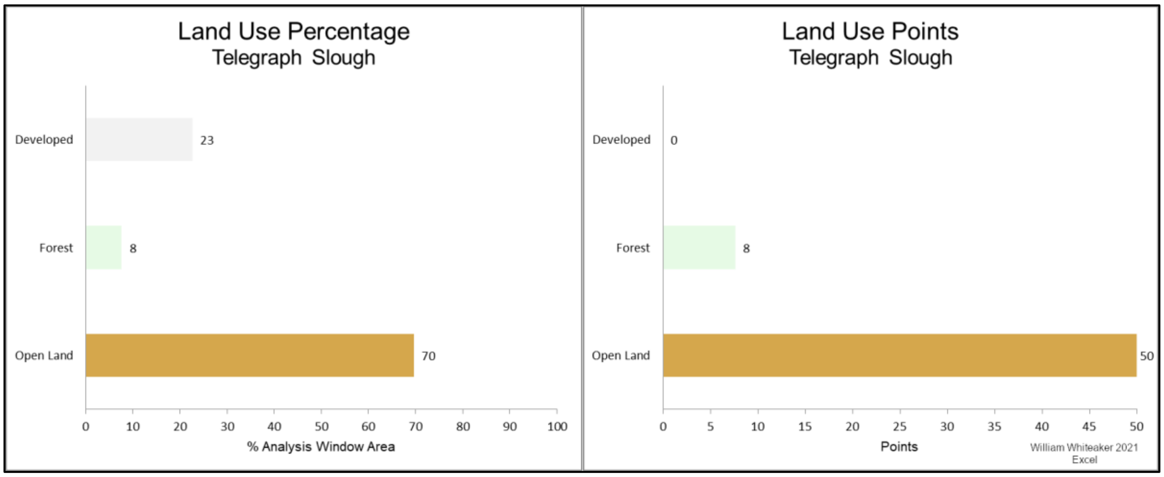


Figure 12 Left Panel: Percentage area of the Telegraph Slough priority site analysis window occupied by each of the three land use groups. For this priority site, open land was dominant within the landscape. Most of the remaining parcels were classified as developed, although some forested parcels remained. Right Panel: Each landscape was also given a series of "points", derived directly from (%) area of land use, to examine both the amount and diversity of undeveloped habitat remaining in the landscape surrounding a priority site.

remaining and habitat diversity, a direct conversion from percentage area to points was employed (Figure 12). No points were assigned to parcels classified as developed since developed parcels were considered to be of little value in re-establishing natural systems or in reconnecting habitat corridors. To ensure habitat diversity, a maximum of 50 points was assigned to land uses designated as either forest or open land. With this system a high point total was only possible if a landscape surrounding a priority site included significant undeveloped land, both as forest and open land (Figure 12). Ideally percentage area and corresponding points would have been grouped in a manner similar to land cover and impervious surface. Unfortunately, and is sometimes the case in science, different data sets did not align so conveniently. 58 of the 72 parcel classifications related to developed land uses. The only land use classifications corresponding to land cover types were for forest and open land. No land use classifications existed for aquatic or wetland areas. As such, land uses for developed, forest, and open land were associated into groups for both percentage area analysis and assignment of points, with points being divided by two groups instead of four but group maximums doubling. This methodology should produce some continuity in the description of landscape extent among the lenses of land cover, impervious surface, and land use.

Landscape Structure – Configuration

The configuration of the landscapes surrounding priority sites was examined to determine the amount and type of public access to the priority site. Public access was defined spatially by two methods. First, how much of a priority site was available to the public, as indicated by how much of a priority site was accessible from the surrounding landscape. Second, within the landscape extent in which a priority site was located, were there other areas that would foster interaction with the potentially restored priority site, and if so how many of those are public areas. As the priority sites were all shoreline areas, both terrestrial and marine aspects of accessibility had to be considered. Therefore, priority sites and associated landscape extents were inspected to determine immediate access, from both terrestrial and marine approaches, and access if travel was required to reach the site, from both terrestrial and marine approaches.

Landscape Structure – Configuration – Public Access: Immediate

Land use types considered indicative of public use of the outdoors were identified in analysis window clips of Washington State Department of Ecology parcel data. Uses identified were public parks, open spaces, open timber spaces, and nature reserves. Parcels in the analysis window having these land use types and being adjacent to priority sites were captured into new layers (Figure 13). The total distance of the shared border between selected parcels and the

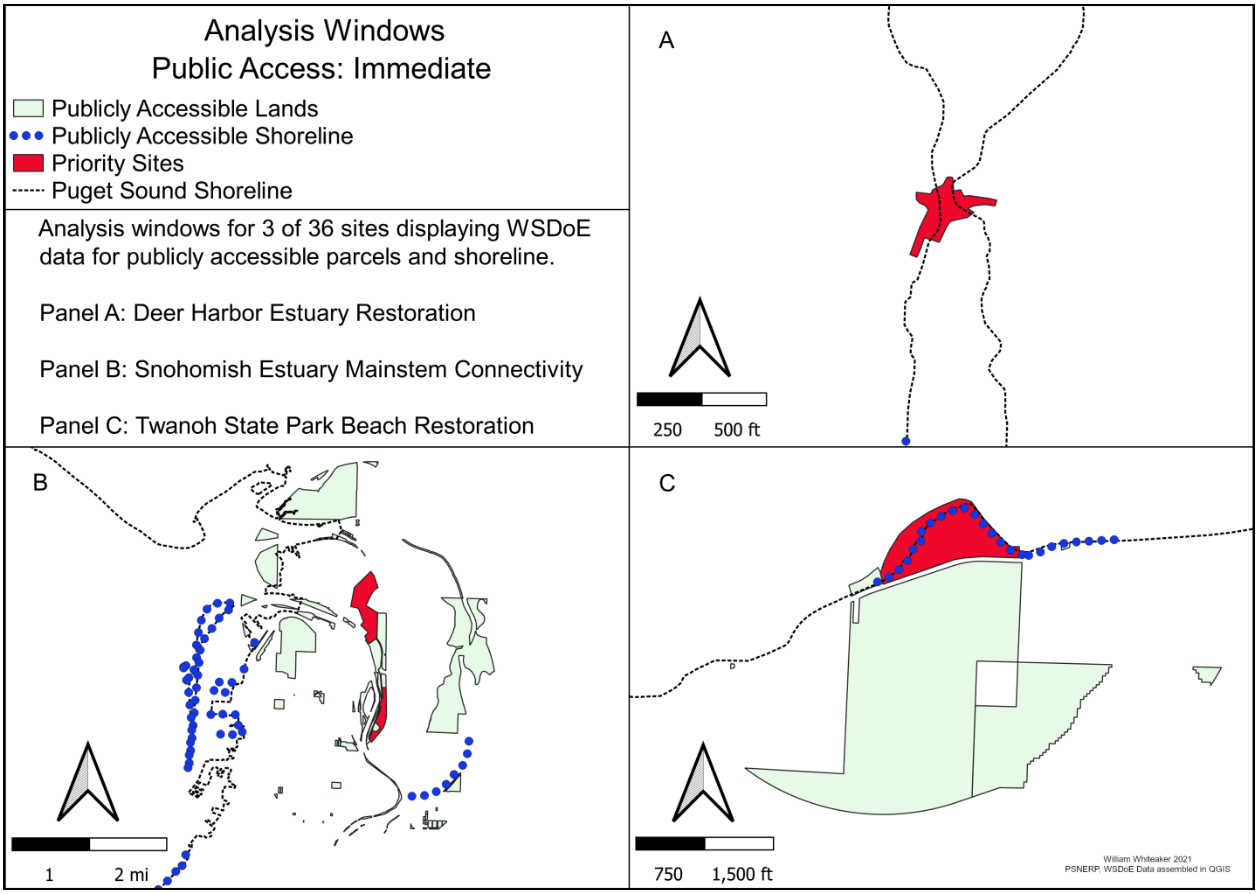


Figure 13 Green parcels indicting outdoor public use and dotted blue public shorelines are shown adjacent to red priority sites. Since only portions of the landscape were selected, analysis window boundaries were not always discernable. Some landscapes, Panel A, had neither "natural" public land use types nor public shorelines adjacent to a priority site. Other landscapes, Panel B, had either public lands or shorelines adjacent to the priority site. In some cases, Panel C, associated parcels such as parking lots were not immediately adjacent to a site.

priority site was calculated and compared to the total perimeter of the priority site. This calculation yielded the percent of the terrestrial priority site perimeter which was accessible to the public from the selected land use types (Figure 14).

However, some site associated parcels were not immediately adjacent to a priority site. In Figure 13 Panel C, an unconnected large parcel of publically accessible land is located south of a priority site. The southern parcel is actually the parking lot, separated by a two lane road, for the park designated as a priority restoration site. The realization that "travel distance" must be considered in evaluating the "public accessibility" of a priority site stems from the parking lot and park seen in Figure 13 Panel C.

Geolocated priority sites (Figure 2) were used to clip Puget Sound shoreline data (https://ecology.wa.gov/Research-Data/Data-resources/Geographic-Information-Systems-GIS/Data 10-15-2019) to define priority site shorelines (Figure 13). Priority site shorelines were then compared to publicly accessible shorelines (https://ecology.wa.gov/Research-Data/Data-resources/Geographic-Information-Systems-GIS/Data 10-15-2019) to determine the percentage of publicly accessible shoreline along each priority site (Figures 13 and 14). This calculation yielded the percent of the marine priority site perimeter which was accessible to the public (Figure 14).

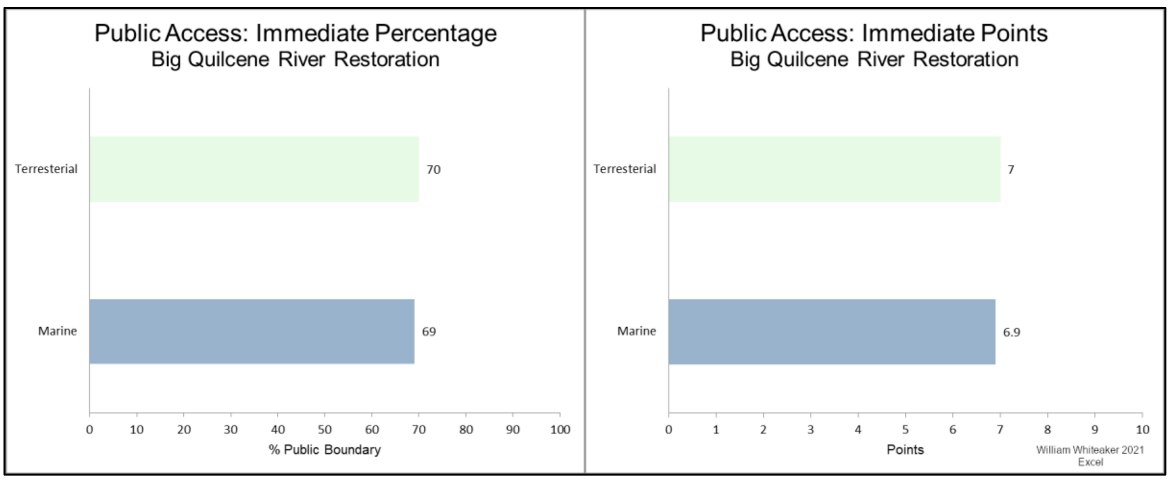


Figure 14 Left Panel: Percent of the terrestrial and marine perimeters accessible to the public at the Big Quilcene priority site. Right Panel: Each priority site was also given a series of "points", derived directly from percentage of publicly accessible perimeter, to be able to make comparisons among the priority sites regarding public accessibility and to be able to compare perimeter landscape configurations to landscape compositions.

The data presented in Figures 13 and 14 is specific to four priority sites; however each of the thirty-six landscapes surrounding priority sites were analyzed to describe the terrestrial and marine components of immediate public access. The percent of the publicly accessible priority site perimeter was calculated directly from parcel and shoreline data. This percent of public perimeter, or configuration of immediate access, was converted directly into points in the same manner as landscape composition, so that configuration and composition could be readily compared (Figure 14).

Landscape Structure – Configuration – Public Access: Travel

Land use types captured in the examination of immediate public access were used again in describing public access over some distance traveled. These land use types were: public parks, open spaces, open timber spaces, and nature reserves. The distance a person might travel to reach a priority site was chosen as the greater of the standard walking distances used in urban development and planning (Fairfax County Planning Commission 2006), with the assumption that people with natural restoration interests would walk farther than the necessary minimums for transit (Santos et al. 2009). Using this methodology, a buffer of 2500 ft. was created around each priority site to incorporate the terrestrial travel distance component of public access (Figure 15). The number of parcels within this buffer that were identified as having land use types indicative of public use of the outdoors were inspected and counted. Each unique land use area was counted once; a park would be counted as a single public access point, but two separate parks would be counted as two public access points. Some parcels were separated by roads, parking lots, or other public facilities, yet were still part of the same park or land use area and were therefore counted as a single public access point (Figure 16).

Determining travel distance for the marine component of public accessibility was more complex than the terrestrial component. Marine travel modes have significant variation in speeds and corresponding potential ranges. A member of the public interested in visiting a priority site with a public shoreline might travel via paddleboard, or sailboat, or powerboat. This travel would most likely take place during a single day, since many public access points to marine areas and many priority sites would be closed during evening hours. Little data was discovered regarding

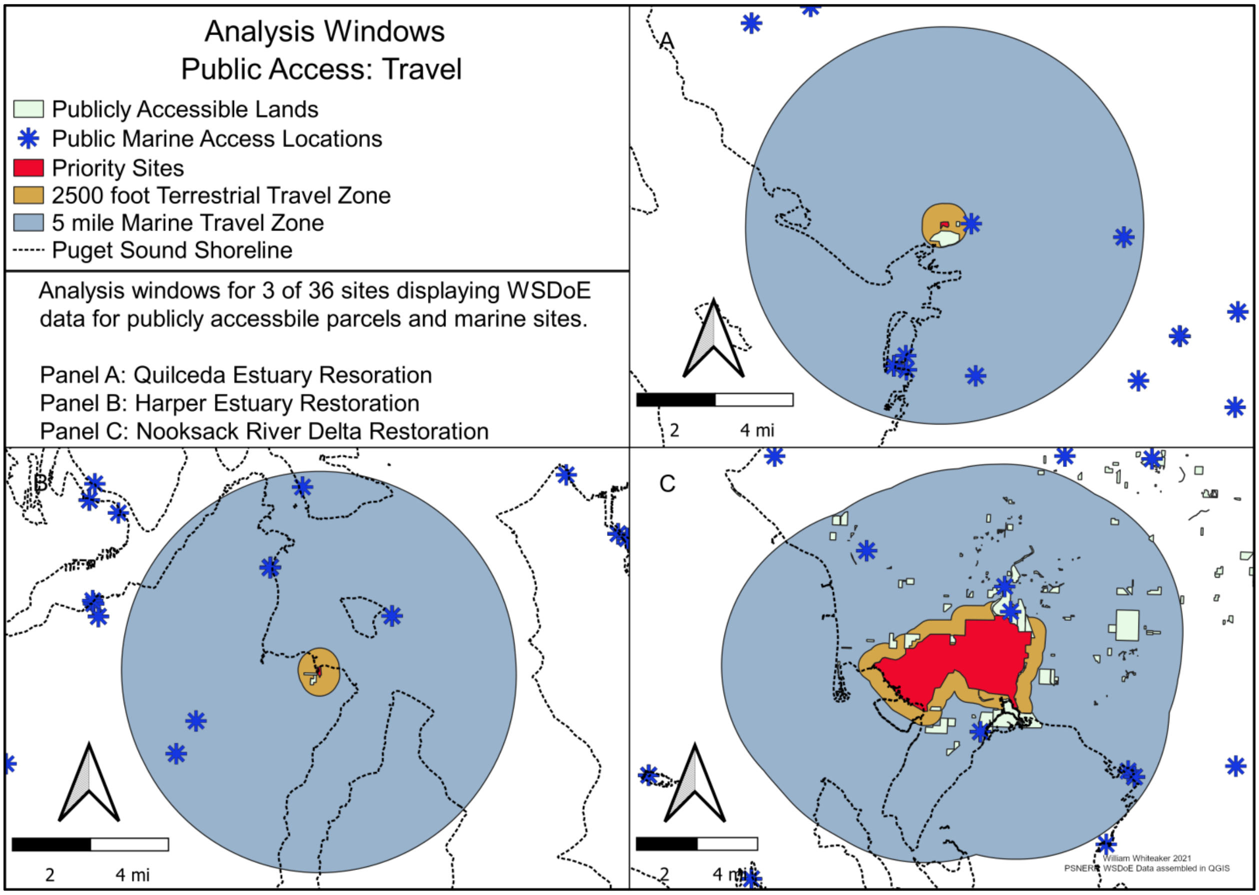


Figure 15 Elements of public access over some travel distance for three selected priority sites. Red priority sites are surrounded by gold zones representing distances over which terrestrial travel may take place. These are in turn encompassed by larger blue zones representing distances over which marine travel may take place. In Panel A, Puget Sound is to the west of the priority site. A large green public access site appears in the terrestrial travel zone. Three of the marine access sites are inland, upriver from the priority site. Puget Sound is east of the priority site in Panel B, where a single site, split into two parcels provides terrestrial access and five sites provide marine access. Panel C shows numerous terrestrial and marine public access sites in travel zones surrounding a large priority site, with Puget Sound to the west.

the extent of public marine travel, so a marine travel distance of five miles, derived from the average length of a terrestrial daily vehicular trip (Puget Sound Regional Council 2015, Santos et al. 2009), was used. Obviously, a person traveling by paddleboard might not travel that distance, while someone in a powerboat might travel much further, but five miles was chosen as a realistic range for this study. A five mile buffer was created for each priority site to represent the marine component of travel distance (Figure 15). Data for public boat launches and public boat moorings or marinas (https://ecology.wa.gov/Research-Data/Data-resources/Geographic-Information-Systems-GIS/Data 10-15-2019) were clipped by the buffer (Figure 15). Public boating facilities within each buffer that could be accessed within a five mile travel distance, without leaving the buffer and returning, were counted as public access points (Figure 16). Multiple moorings at the same marina or multiple boat ramps at the same park were also counted as single access points. Some boating facilities were located within the buffer but on the opposing side of a peninsula or island, requiring a greater than five mile travel distance, and so were not counted.

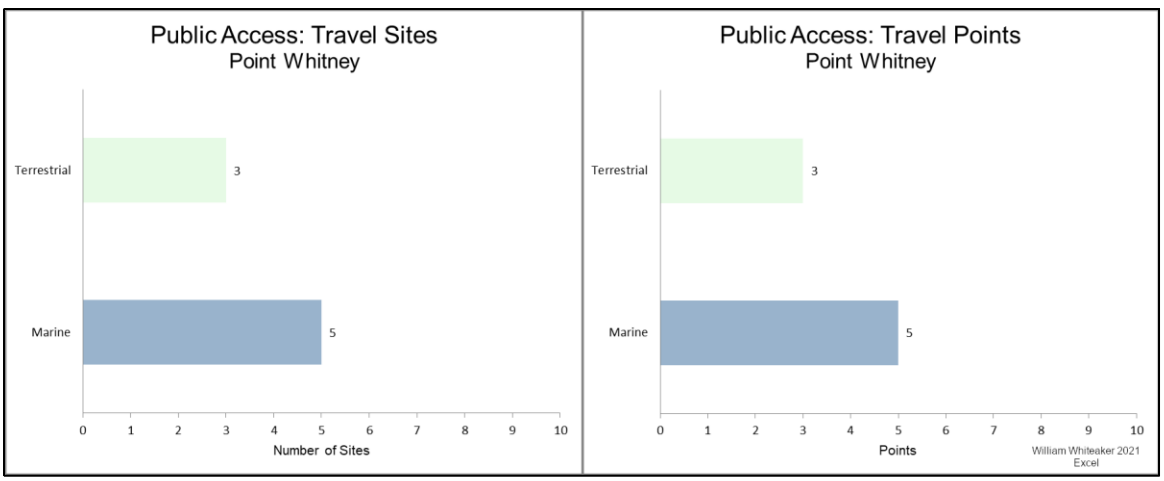


Figure 16 Left Panel: Count of the terrestrial and marine public access areas at the Point Whitney priority site. Right Panel: Each priority site was also given a series of "points", derived from the count of public access areas, to be able to make comparisons among the priority sites regarding public accessibility and to be able to compare travel distance landscape configurations to landscape compositions.

The data presented in Figures 15 and 16 is specific to four priority sites; however each of the thirty-six landscapes surrounding priority sites were analyzed to describe the terrestrial and marine components of public access over some travel distance. The number of public access sites within defined travel distances for both the terrestrial and marine environments was calculated from corresponding Washington State Department of Ecology data (Figure 16). The number of terrestrial and marine public access sites was converted directly into “points” (Figure 16) so that travel distance access configurations and landscape compositions could be readily compared.

Results

Composition – Land Cover

In general, landscapes were not heavily dominated by any particular type of land cover except forests (Figure 17). Dominance by any land cover type was less than 50% in nineteen of the thirty-six landscapes and natural land cover types were dominant in twenty-eight locations. Larger landscapes did have more developed land covers, but also more of other types of land cover, offsetting the impact of development. The overall lack of majority dominance and the amount of natural land cover dominance indicate that areas surrounding priority restoration sites retain appreciable amounts of undeveloped land with some habitat variety.

Almost half of the landscapes surrounding priority sites, fifteen of thirty-six, were dominated by forest land covers (Figure 17). Forest dominance in twelve of the landscapes was by a majority and at three locations was by greater than 80%. Eight landscapes displayed dominance by developed land covers, but at only two locations, Chambers Bay and the Deschutes River, both dense urban areas, was developed land cover majority dominant. Locations that were even slightly less urban, such as the suburban and industrial areas along the Snohomish River east of the city of Everett, were dominated by developed land covers, but only from the mid-30% to mid-40% range, implying a substantial amount of the landscape was still composed of natural land covers. Open and aquatic land covers were each dominant, albeit weakly, around six priority sites, mostly associated with river deltas, from the low-30% to mid-50% range. Many of the river deltas in the region are cleared landscapes hosting monoculture farmlands and as such dominance by open or aquatic land covers was unsurprising. More interesting was that even in river delta areas, open land cover was only majority dominant at one location, suggesting that even in these farmland areas other habitat types remain. Wetlands were the dominant land cover in only a single landscape, the Quilceda river delta, and only at 43%, yet another data point reinforcing the loss of wetlands in developed regions.

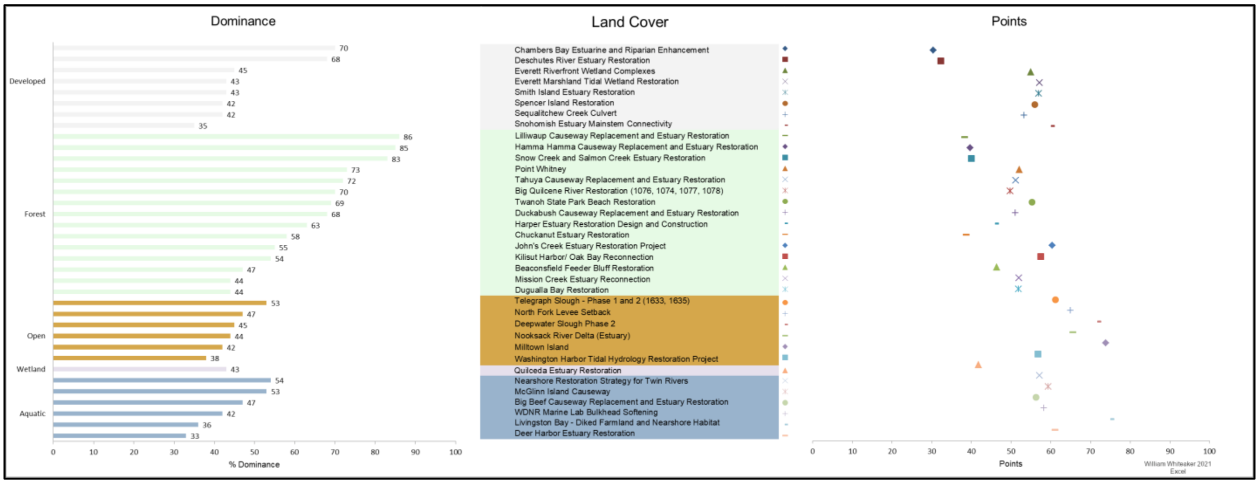


Figure 17 Dominance and Points: Land Cover. Left Panel: Five color coded land cover types and the percent to which that land cover type was dominant at a priority site. Each associated priority site is in the center panel, directly to the right of each percentage bar. Center Panel: Priority sites associated with dominance percentages in the left panel and points in the right panel. Background colors correspond with the left panel and indicate land cover type dominance. Symbols to the right of each site's name correspond with the right panel and identify each site in the points distribution. Right Panel: Points given to each site. Each associated priority site is in the center panel, directly to the left of each symbol.

Points were assigned to each of the thirty-six landscapes in relation to percentage of land cover type (Figure 17). Higher point values indicate greater amounts of undeveloped land and equal distribution of that undeveloped land among the cover types. Twenty-seven of the thirty-six sites received more than fifty points, including six development dominant sites, indicating at least one half the landscape was undeveloped and divided between at least two natural land cover groups. None of the landscapes received points in the lowest 30% or highest 20% of the point range. This distribution suggests that most landscapes retained some amount of natural habitat, with multiple types of habitat present, but no landscape escaped development and even the most natural of landscapes did not contain an equal distribution of land cover types.

The two lowest point totals occurred in the two most developed landscapes, Chamber's Bay and the Deschutes River. Development and mono-culture farming of undeveloped lands combined to limit points at many river delta restoration sites. However, other developed landscapes had mid-range point values, indicating significant and varied amounts of undeveloped land remained. Some landscapes with little development were so heavily dominated by forest that few other land covers were present and point values were correspondingly low. Compounding the extent of forest, a number of priority sites were causeways over streams or tidal inlets. Much of the surrounding terrain was therefore water rather than land. These sites also tended to be fairly small, with smaller proportionally sized surrounding landscapes. With such limited terrestrial terrain, a single land cover type, such as forest, could easily dominate. The low point values seen at the heavily forested Lilliwaup and Hamma Hamma causeway sites demonstrate this compounded effect.

Landscapes dominated by open land cover types received many of the highest point values and were mostly associated with priority sites just upstream of a river mouth, such as Deepwater Slough and Milltown Island. These sites tended to be encompassed by smaller scale farming with little development present. Open cover types were frequently only slightly dominant, with significant amounts of forest and wetland covers remaining in the landscape, leading to generally higher point totals. The only landscape dominated by wetland, around the Quilceda Estuary site, received relatively few points. Wetland cover types were only slightly dominant at this site, with the rest of the area being heavily developed, and few other natural habitat types present.

Sites where aquatic land cover types were dominant tended to be toward the upper range of point values. These sites were generally smaller relative to other priority areas, were located along rural shorelines, and were spatially arranged so that dominant aquatic cover types shoreward of a site were complimented by multiple terrestrial cover types landward of the site.

This lack of development and fortunate distribution of cover types created the specific elements required to generate higher point totals. One of the aquatic dominant sites, Livingston Bay, received the highest point total in the land cover analysis. The landscape surrounding the Livingston Bay site is almost equally divided into thirds, with about a third of the land cover being aquatic and shoreward of the site, about a third being open and landward of the site, about a quarter being forest and landward of the site, and the remainder developed. Surprisingly, of the thirty-six sites, only three, the aquatic dominant Livingston Bay and the open dominant Deepwater Slough and Milltown Island, displayed the spatial composition, lack of development and multiple evenly distributed habitats, necessary to receive more than 70 points in the land cover analysis.

Composition – Impervious Surface

All thirty-six landscapes were dominated by the 0-20% impervious surface group (Figure 18). In other words, the least intense amount of impervious surface was dominant at every site. At two priority sites all impervious surfaces were in the 0-20% range, resulting in 100% dominance. Impervious surface was between 0-20% in so much of so many landscapes that few, sub 10%, other densities of impervious surface were recorded in eighteen of the thirty-six landscapes. Dominance was so pronounced that the 0-20% grouping was majority dominant in thirty-four of the thirty-six landscapes. Even in the most densely developed landscapes, where the 0-20% group was not majority dominant, it was still dominant by over 40%. Unfortunately, the excessive dominance of the 0-20% group appears directly related to methodology. When the groupings were established, undeveloped lands were bunched with some light impervious surface. This was done as a way to account for farm roads, parking lots at trail heads, etc. In hindsight, it would have been preferable to create a 0% group followed by a 1-20% group. Such a method may have accounted for farms and forests where no impervious surface existed, while accounting for areas where light development occurred, creating more realistic dominance results. It is interesting to note however that in all thirty-six landscapes, even the most developed, the dominant form of impervious surface was little to none. This reinforces the findings from the land cover analysis that even priority sites in the most urban areas are surrounded by landscapes which retain some natural habitat.

The areas where dominance occurred at 100% (Figure 18), Point Whitney and Hamma Hamma, are both small sites surrounded by proportionally smaller landscapes limiting the extents of any surface type. These areas are also heavily forested with few roads or structures. Since the data for impervious surface was divided into 30 x 30 m cells, even if a paved road or small roof structure appeared in a data cell, the relatively small impervious surface area could be obscured by forest canopy or offset by natural surfaces in the remainder of the cell. This combination of limited extent, forest, and few small built environments created near perfect conditions for 0-20% density to be 100% dominant at these two sites. Many other sites had similar surrounding environments and displayed high levels of dominance by the 0-20% category. However, as the sites became larger, the surrounding landscapes became proportionally larger and more complex and the level of 0-20% dominance decreased. Larger sites, such as areas along the Snohomish River near the city of Everett, Chambers Bay, and the Deschutes River, also tended to have more development, distributing impervious surface through multiple densities and mitigating dominance. The trend of decreasing dominance with increasing size and development is apparent in the data (Figure 18) but is not exact. Some smaller sites, like Beaconsfield Feeder Bluff, were located in dense urban areas and also exhibited relatively lower dominance due to surrounding development. Chambers Bay and the Deschutes River were the two largest and most developed sites and were the only two sites where 0-20% was not the majority dominant density of impervious surface.

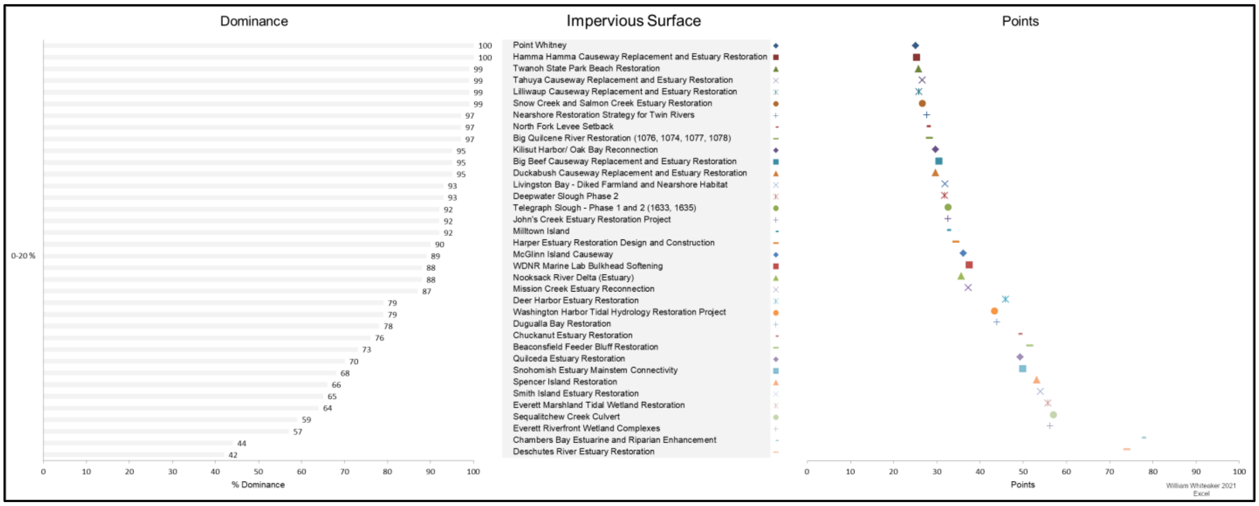


Figure 18 Dominance and Points: Impervious Surface. Left Panel: One color coded impervious surface density and the percent to which that density was dominant at a priority site. Since only one group of impervious surface density (0-20%) was dominant at all sites, only that group appears along the y-axis. Each associated priority site is in the center panel, directly to the right of each percentage bar. Center Panel: Priority sites associated with dominance percentages in the left panel and points in the right panel. Background color corresponds with the left panel and indicates the dominance of the 0-20% impervious surface group. Symbols to the right of each site's name correspond with the right panel and identify each site in the points distribution. Right Panel: Points given to each site. Each associated priority site is in the center panel, directly to the left of each symbol.

Points were assigned to each of the thirty-six landscapes in relation to percentage of impervious surface (Figure 18). Higher point values indicate greater amounts of less developed land and distribution of that land among impervious surface densities. The concept behind this methodology was to assign points in a manner similar to the land cover analysis, with the various groups of impervious surface percentage representing various habitats. It was originally thought that the least dense impervious surface group, 0-20%, would represent mostly undeveloped land. The next group, 21-40%, would represent more rural areas with some development. The 41-60% group would reflect suburban areas with plentiful yards and tree lined streets. Urban housing with small yards and some trees and shrubbery might retain some natural habitat and be classed as the 61-80% group. The 81-100% group was considered dense development, analogous to developed areas in the land cover analysis, so no points would be assigned. This idealized methodology proved to be a misinterpretation of the data and actually produced results contradictory to both the original intent and to the land cover analysis.

While land cover data separated development into a specific category, impervious surface data actually characterized a scaling level of development. These important distinctions were conflated in a good faith attempt to account for multiple habitat types in the impervious surface data. The outcome was a methodology where the more developed landscapes, with greater variation in impervious surface density, were awarded more points. The results of the impervious surface analysis were effectively reversed from the original intent, which was to account for the amount and variety of natural habitat. Acknowledging these shortcomings, the results can still be used to describe habitat, with the recognition that the habitat being described is that which remains in the built environment.

Smaller, less developed sites such as Point Whitney and Hamma Hamma received points for having more natural habitats. However, points were limited as variety within that natural habitat could not be determined from impervious surface data. As sites became larger and more developed, more gradations within the impervious surface data occurred and additional points for habitat variety in the built environment were assigned. The trend in points was the inverse of the trend in dominance but just as apparent. The Beaconsfield site again stands out, as although it is a fairly small site it is surrounded by substantial development and therefore received a fairly high point total. Some of the more developed river delta sites such as Chuckanut and Quilceda marked an inflection point where enough variation in impervious surface density occurred that at least half the points were assigned. Large heavily developed landscapes along the Snohomish River near the city of Everett received many of the higher point totals. In fact, six of the nine sites that received more than 50 points were along the Snohomish River. The largest and most developed landscapes of Chambers Bay and the Deschutes River received the most points. These two sites each received more than 70 points while no other site received greater than 57 in the impervious surface analysis. This was a distinct increase in points, revealing just how much larger and more developed those two landscapes were.

Composition – Land Use

Dominance by land use was generally more pronounced than dominance by land cover. Only three of the thirty-six landscapes were not majority dominated by a land use type (Figure 19). Dominance by development was significant in the landscapes where it occurred, but was only seen in ten sites. Higher parcel numbers correlated closely with increased development and development dominance. Comparatively, natural land use dominance was observed in twenty-six of the thirty-six sites. Site size did not appear to be closely correlated with development dominance. Many of the smaller sites were forest dominated but others were in landscapes zoned for residential use and dominated by development. The largest sites however, were also development dominated. Most of the mid-sized sites with urban areas were dominated by open land use categories. Dominance was strong in all usage groups. The extent of dominance was seen as an indicator of zoning uniformity and subsequent limits on variability of land use. The number of sites where natural land uses were dominant, along with the intensity of that dominance, suggests that many landscapes were composed of significant amounts of natural and somewhat varied habitat.

Open type land uses were dominant at the highest number of locations, eighteen of the thirty-six (Figure 19). Five sites were greater than two-thirds open dominated, three sites approached two-thirds open dominance and sixteen sites were majority open dominate. The dominance of open land use types was not necessarily indicative of completely natural habitats. Many of the landscapes where open land use was dominant were river deltas, such as Deepwater Slough or the Nooksack Delta. Flood plains just upstream of a river mouth, such as the Everett Marshlands or Everett Riverfront were open dominant as well. Agriculture and associated monoculture were present in many of these areas, creating a considerable amount of undeveloped but unnaturally uniform habitat. Forest land uses, dominant at eight sites, displayed the highest dominance variability. The Hamma Hamma site was 97% designated forest, the highest dominance of all land uses, while the Point Whitney site was only 43% designated forest, the least dominance of all land uses. Many of the forest dominant sites were relatively small and the land use classification of a single parcel had outsized effect, magnifying dominance. Developed land uses were dominant at ten sites and more than two-thirds dominant at nine of those sites. The largest and most urban sites, Chambers Bay and Deschutes River, were development dominated, but so were a number of smaller sites. Inspecting these smaller sites revealed that only one, Beaconsfield, was in an urban area. Most of the others were fairly rural bridging structures. The causeways at sites like Big Beef, Kilisut Harbor, and Dugualla Bay cross waterways, establishing transportation corridors with residential housing at either end and creating small pockets of development in otherwise rural settings. Surprisingly, the spatial arrangement and limited size of these sites created some of the most development dominant landscapes. The rural Big Beef site, a fraction of the size of the densely urban Chambers Bay site, is the most heavily development dominant site, with 91% developed land use.

Points were assigned to each of the thirty-six landscapes in relation to percentage of land use (Figure 19). Higher point values indicate greater amounts of undeveloped land and equal distribution of that undeveloped land between forest and open land uses. Twenty-five of the thirty-six sites received more than fifty points, indicating at least one half the landscape was undeveloped and divided between the two natural land cover groups. Development was recorded in almost all landscapes but even in areas where development was the most dominant land use, some natural habitat remained and some points were awarded. None of the landscapes received points in the highest 20% of the range, meaning that even the most natural setting did not contain an equal distribution between forest and open land use and maximum habitat variety was not observed.

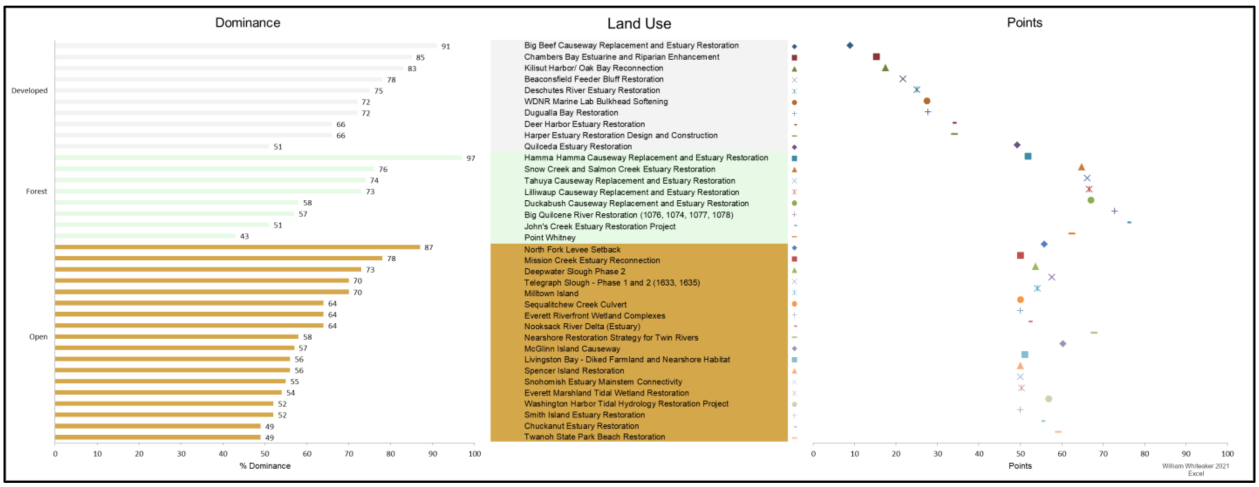


Figure 19 Dominance and Points: Land Use. Left Panel: Three color coded land uses and the percent to which that land use was dominant at a priority site. Each associated priority site is in the center panel, directly to the right of each percentage bar. Center Panel: Priority sites associated with dominance percentages in the left panel and points in the right panel. Background colors correspond with the left panel and indicate land use dominance. Symbols to the right of each site's name correspond with the right panel and identify each site in the points distribution. Right Panel: Points given to each site. Each associated priority site is in the center panel, directly to the left of each symbol.

The lowest point totals were seen in the developed land use category. The largest and most densely urban landscapes, Chambers Bay and the Deschutes River, were in this category, but they did not receive the lowest points. Instead smaller sites, many of which involved causeway restorations bounded by residential neighborhoods, like Big Beef and Kilisut Harbor, received fewer points than the large urban areas. Even though these sites were not as densely developed, waterways and limited size meant that what development was present occupied much of the terrestrial landscape, reducing or eliminating opportunities for forest or open land uses and resulting points.

Interestingly, small causeway sites also received many of the highest point totals. In these instances little development was present and the sites were surrounded by forest land uses. In places like Duckabush and Tahuya, residential construction had not taken place near the causeway and the surrounding terrestrial landscapes consisted mostly of forest and river flood plain. The limited size of the sites meant that the landscapes did not extend to the point where development began. With plentiful natural land uses and little development, corresponding points were fairly high. The highest point value calculated for a land use site was also in a forested landscape, but was an ideal case. John’s Creek is a moderately sized site set back just slightly from a river mouth. The site is surrounded by dense forest, floodplain, and a golf course. Due to this rather perfect spatial arrangement, the landscape surrounding the John’s Creek site has little development and slightly more forest than open space, giving the site 76 land use points.

Landscapes dominated by open land uses all received between 50 and 60 points, except the tiny, coastal Twin Rivers site, which received 68 due to being bounded on the landward side by a forest and clear-cut. Many of the sites surrounded by open land uses were surprisingly developed, including six sites along the Snohomish River near Everett. The open dominant land use sites tended to be along rivers just upstream from the mouth and surrounding landscapes displayed substantial amounts of cleared agricultural lands or river floodplain. The mid-range point distribution for these sites in the land use analysis reflects the presence of open space but limited forest.

Configuration – Public Access: Immediate

Public access along the terrestrial border of the priority sites was generally limited (Figure 20). Publicly accessible areas did border at least some landward portion of twenty-eight sites, but in only four cases was the accessible border greater than 50%. At only a single site was the terrestrial border completely accessible to the public, although a second site was 96% accessible. Public access at three sites was less than 5% of the landward perimeter and at eight sites none of the landward perimeter allowed access. Marine access contrasted starkly with terrestrial access. Public marine shorelines were seen at twenty-eight sites, with twenty-four being more than 66% accessible and eighteen being completely accessible to the public. Due to the accessibility of marine shorelines, the total publicly accessible border was >50% at twenty-one sites and >20% at an additional four sites.

Two sites, Deepwater Slough and Milltown Island, were far more immediately accessible than the others (Figure 20). These two sites are adjacent to each other, just upstream from the mouth of the Skagit River, and almost completely surrounded by public nature areas. Numerous sites had moderate levels of immediate access, between 37% and 77%, and all shared the common characteristics of limited terrestrial access but substantial marine access. Some of these sites such as Livingston Bay, Quilceda, and the Everett Riverfront, were surrounded by residential areas, industry, or public works on one side and open waterfront on the other. Additional moderately accessible sites like Duckabush and Harper Estuary were causeways with little to no terrestrial access but considerable shoreline. Sites associated with causeways were also among the least immediately accessible areas. Big Beef, Lilliwaup, and Hamma Hamma were all small causeways with scarce public accessibility from either terrestrial or marine environments.

The immediate access analysis provided one perspective of a sites public accessibility, but that view was not comprehensive. Twanoh State Park is a medium sized site completely accessible to the public from the surrounding landscape, but was considered to only have 4% terrestrial public border in the immediate access analysis (Figure 20). An inspection of the site revealed a promontory shoreline park with a two lane road immediately inland, isolating the shoreward park from an associated landward parking lot. To account for situations where the immediate access lens gave an erroneous impression of public accessibility at a priority site, the travel distance methodology was developed.

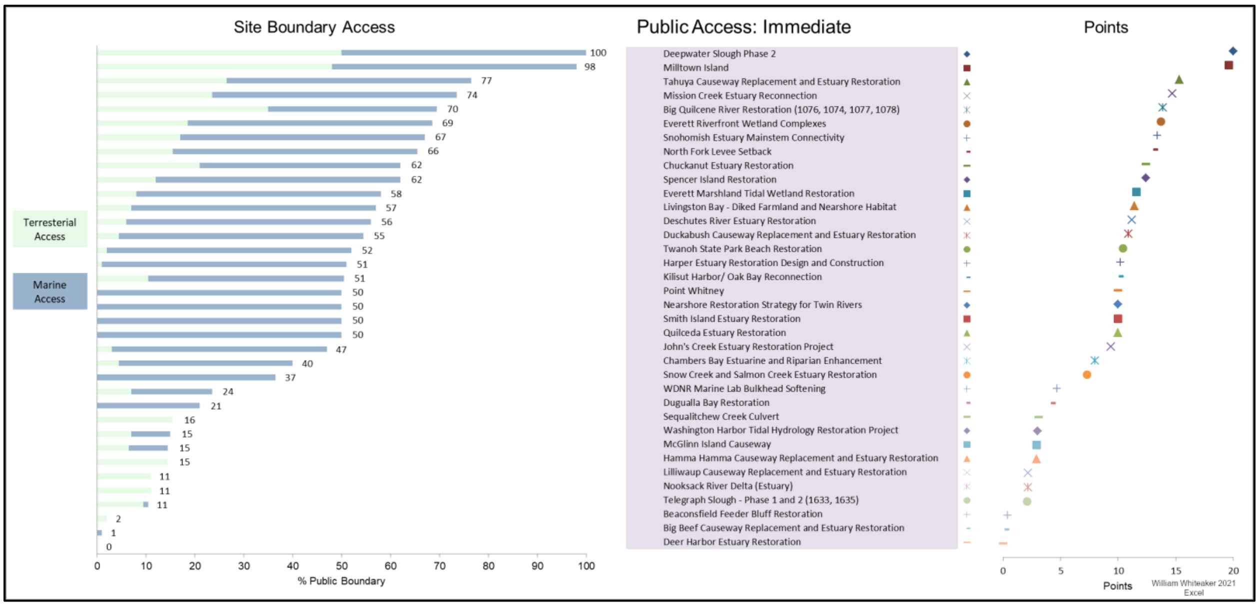


Figure 20 Site Boundary Access and Points: Public Access: Immediate. Left Panel: Terrestrial and marine perimeters and the percent to which those perimeters were accessible to the public at a priority site. Each associated priority site is in the center panel, directly to the right of each percentage bar. Center Panel: Priority sites associated with boundary access in the left panel and points in the right panel. Background color used only to create visual separation of the panels. Symbols to the right of each site's name correspond with the right panel and identify each site in the points distribution. Right Panel: Points given to each site. Each associated priority site is in the center panel, directly to the left of each symbol.

Deepwater Slough received maximum points and Milltown Island received near maximum. These were the only two sites to be awarded points at the high end of the range and represent a distinct increase compared to the next highest value (Figure 20). Both sites are surrounded by a public nature area and are completely, or almost completely accessible to the public. Twenty priority sites received between 10 and 15 points, indicating the majority of the sites were at least moderately accessible to the public, even if that accessibility was predominantly from the shore, not the upland. Big Quilcene and Tahuya were the only sites other than Deepwater Slough and Milltown Island to have a majority of the terrestrial border publicly accessible. Landward accessibility combined with mostly or completely public shoreline resulted in two of the highest point totals from the group of moderately accessible sites. Conversely, the shoreline was completely public at Point Whitney, Smith Island, Twin Rivers, and Quilceda but none had any immediate terrestrial access and all four received 50% maximum points as a result, the lowest points of the moderately accessible group.

Hamma Hamma and Lilliwaup were both small causeway replacements with no public shoreline and minimal terrestrial access and both received few points (Figure 20). Unexpectedly, the Nooksack River Delta, one of the largest priority sites, exhibited the same access configuration as the much smaller Lilliwaup site and was award the same number of points. The Nooksack site, even though considerable in size, was a delta dominated by farmland. As such, little public land adjoined the site and what waterways were present flowed through private agricultural areas. The marine shoreline of the site was nearly bifurcated by private land to the north and a private aquaculture facility to the south, eliminating any public shoreline. The Beaconsfield, Big Beef, and Deer Harbor sites received the least amount of points, with Deer Harbor being the only site to receive zero points. Beaconsfield is a bluff backed beach in a dense urban area where “piano key” residential parcels prevent access to almost the entire site. The small Big Beef and Deer Harbor causeways support two lane roads with no availability or necessity of public access, except for a sliver of shoreline at the Big Beef site.

Configuration – Public Access: Travel

As with immediate access, travel distance access was generally limited, more so in the terrestrial environment than the marine (Figure 21). However, all sites had some type of public access within the travel extent, although one site had only terrestrial access and two sites only marine access.

Parks, designated open spaces, and other classifications of publicly accessible areas could be found within the defined walking distance of 2500 feet at thirty-four of thirty-six priority sites. At eight sites, five or more such public areas were present within the specified walking distance. Only a single site was observed to have ten or more public areas within the defined walking distance. Public water access, including boat launches, marinas, and moorings, was found to be within the defined marine travel distance of five miles at thirty-five of the thirty-six priority sites. Thirteen sites had five or more marine public access areas within five miles. At only one site were ten or more access areas within the defined five mile marine travel distance.

The number of public access locations requiring travel to reach a priority site did not appear to be correlated with either development density or site size (Figure 21). Two small rural causeways, Duckabush and McGlinn Island, had the highest and the third highest numbers of public access areas respectively. Telegraph Slough, a substantially larger but still rural site, had the second highest amount of travel based public access. However, the fourth highest number of public access areas was around one of the largest and most developed sites, Deschutes River. The other large and densely developed site, Chambers Bay, had the tenth most amount of public access. Sites along the Snohomish River, such as Everett Riverfront and Everett Marshland, both large sites with substantial development in the surrounding landscape, were seen to have moderate to limited amounts of public access. Two small sites, Beaconsfield, in the center of dense development, and Hamma Hamma, a rural causeway similar to the high access

Duckabush, not only shared some of the lowest amounts of public access, but were also the only two sites to have no terrestrial public access. Twin Rivers, along the southern coast of the Strait of Juan de Fuca, was the only site with no marine access locations. Only two terrestrial access areas were seen near Twin Rivers, giving this small, rural, former barge loading facility, the least amount of public access when considering travel distance.

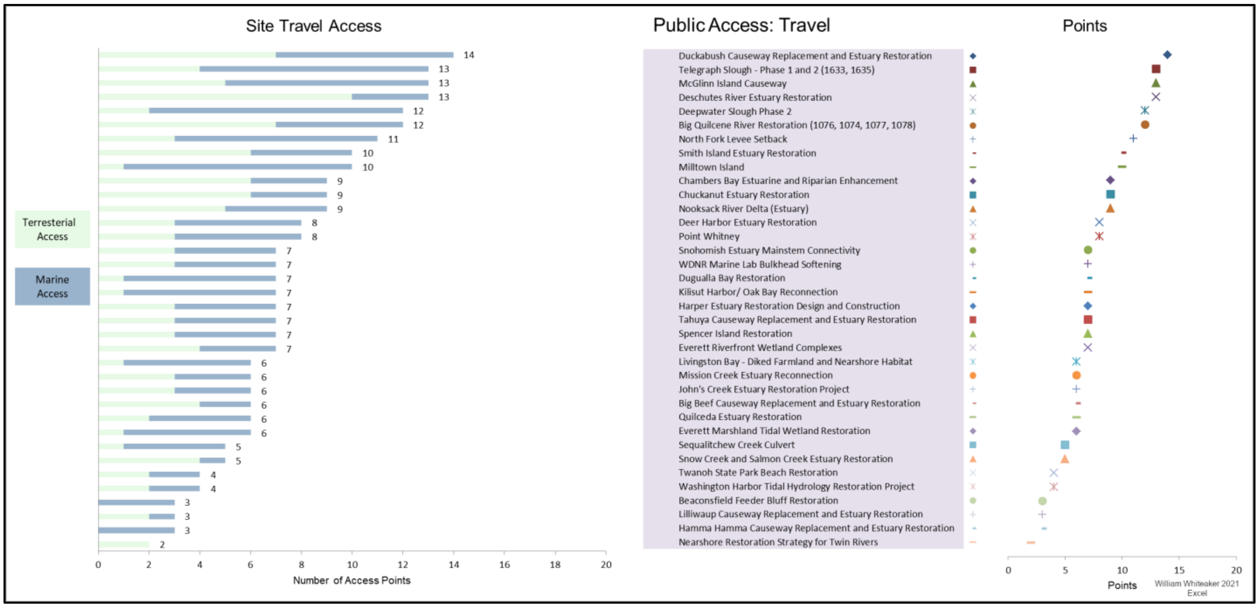


Figure 21 Site Travel Access and Points: Public Access: Travel. Left Panel: The number of terrestrial and marine access areas available to the public within the specified travel distance of a priority site. Each associated priority site is in the center panel, directly to the right of each number bar. Center Panel: Priority sites associated with travel access in the left panel and points in the right panel. Background color used only to create visual separation of the panels. Symbols to the right of each site's name correspond with the right panel and identify each site in the points distribution. Right Panel: Points given to each site. Each associated priority site is in the center panel, directly to the left of each symbol.

Points for public access with travel were assigned on a one to one ratio with the number of access locations. As such, point totals represent the sum of publicly accessible terrestrial and marine access areas within defined distances of a priority site, rather than the interpretations of percentages seen in the previous four analysis lenses (Figure 21). No site received maximum points, as no site had ten or more access locations in both the terrestrial and marine environments. Conversely, no site received zero points, as all sites had some type of public access if some amount of travel took place to reach the site. Twenty-seven priority sites had fewer than ten public access locations and received fewer than ten points. Nine sites had ten or more nearby public access areas and were assigned ten or more points.

The Duckabush causeway was located over a braided stream delta, just inland of the river mouth junction with Hood Canal, a long narrow marine channel. A number of public forest areas, parks, and a campground were within walking distance of the site. Public boat launches, a marina, and numerous boat houses were located along either side of the channel near the site. Due to this level of access, the Duckabush site received the highest number of points, fourteen (Figure 21). All nine sites that received ten or more points were located near river mouths and had multiple nearby parks or other public areas that seemed to be located to specifically take advantage of the river meets ocean setting. All nine sites also had multiple marine access areas, with a number of boat launches upstream from the site, increasing the total access and associated number of points.

Small sites where access was limited to either the terrestrial or marine environs received the fewest points. Of the four sites with the fewest points, Beaconsfield was located in dense urban shoreline development southwest of Seattle, with little publicly owned land available. Hamma Hamma and Lilliwaup were both small rural causeways surrounded by private timberland and limited to no public marine access within the defined travel distance. Twin Rivers was another small remote location; this time along the open coast of the Strait of Juan de Fuca where no public marine access was nearby and little of anything was within walking distance.

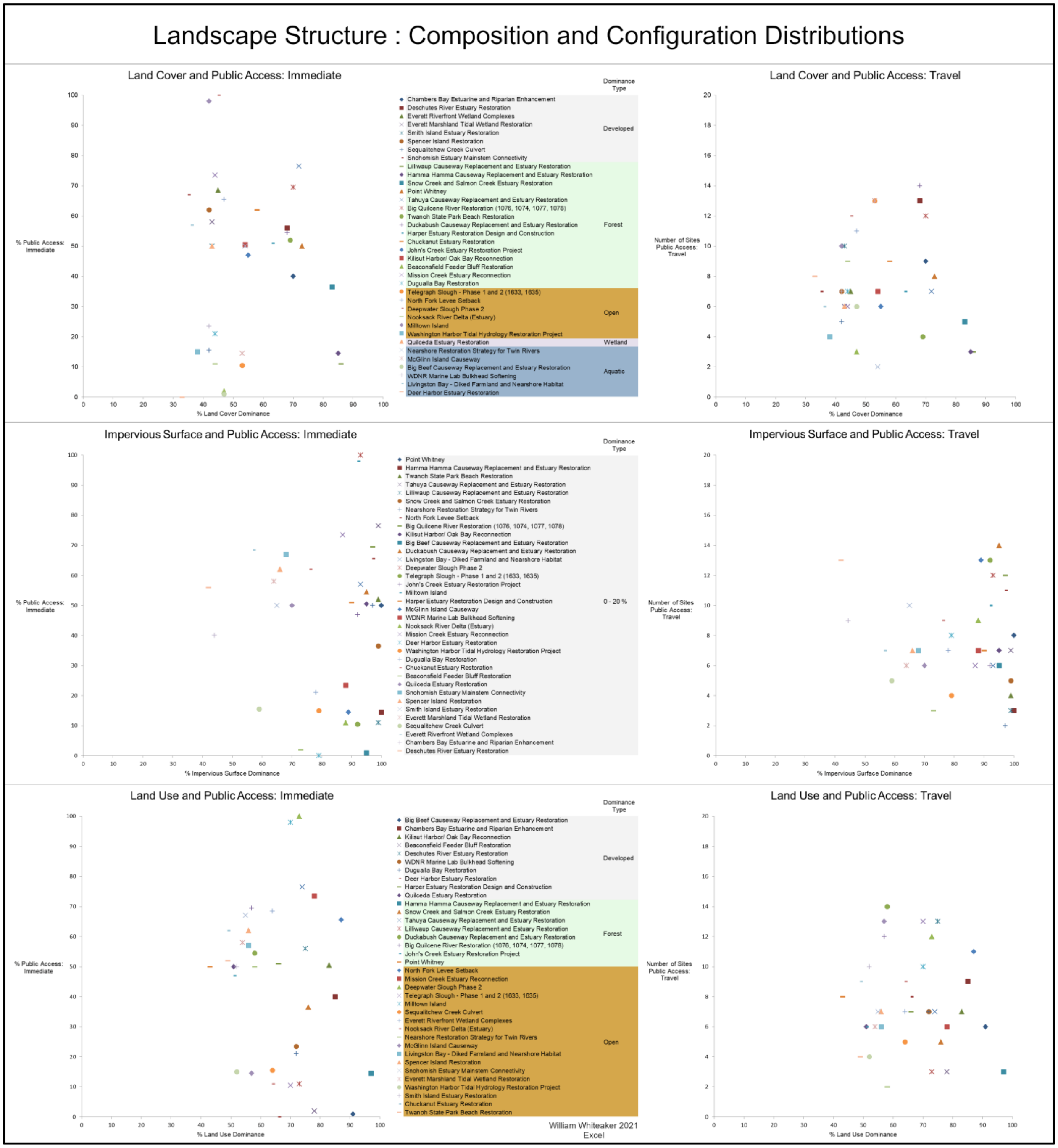


Figure 22 Overview of dominance in the three landscape composition lenses when compared to each of the two landscape configuration lenses. Composition appears along the x-axis and configuration along the y-axis in all six plots. For each composition lens (upper: land cover, middle: impervious surface, lower: land use), a configuration lens is compared on the left (immediate access) and right (access with travel), with the priority sites listed in the center, in order of decreasing dominance by category. Dominance categories are colored coded and labeled to the right of the priority site names. Symbols to the left of the priority sites are used to identify each site in the associated plots to the left and right.

Five lenses for analyzing the landscapes surrounding priority sites were employed. The three composition lenses were then each compared to the two configuration lenses, generating six descriptions of landscape structure (Figure 22). Individually, each of the six descriptions presents a different perspective concerning the landscape extents neighboring the priority sites. Independent discussion of each perspective occurs in the following sections. Taken as a whole, the six independent views should reveal the common narrative regarding the composition and configuration of the landscape structure. Finally, the point values representing natural and varied habitat were compared to the point values representing public access, for all of the landscapes. The individualized lenses of landscape structure combined with the aggregate of points should significantly increase the understanding of the landscape extents surrounding the thirty-six PSNERP priority sites.

Landscape Structure – Land Cover and Public Access: Immediate

Landscapes were distributed into four general groupings in this comparison; a large group with middling dominance and access, a group of two displaying high dominance and low access, another group of two with moderate dominance and high access, and a small group with moderate dominance and low access (Figure 23). The majority of landscapes, twenty-two of the thirty-six, were in the large mid-range group. Most of these had approximately 35-80% dominance and around the same percentage of access. The most noticeable outlier from this central group was the Snow and Salmon creek site, which was heavily dominated by forest land covers, but had no terrestrial access, substantially reducing overall accessibility. Only two sites displayed greater dominance in the surrounding landscape than the Snow and Salmon Creek site. Both, Hamma Hamma and Lilliwaup, were small sites whose proportionally small landscape extents were also dominated by forest land covers. In addition, these sites were causeways with limited terrestrial access and no marine access.

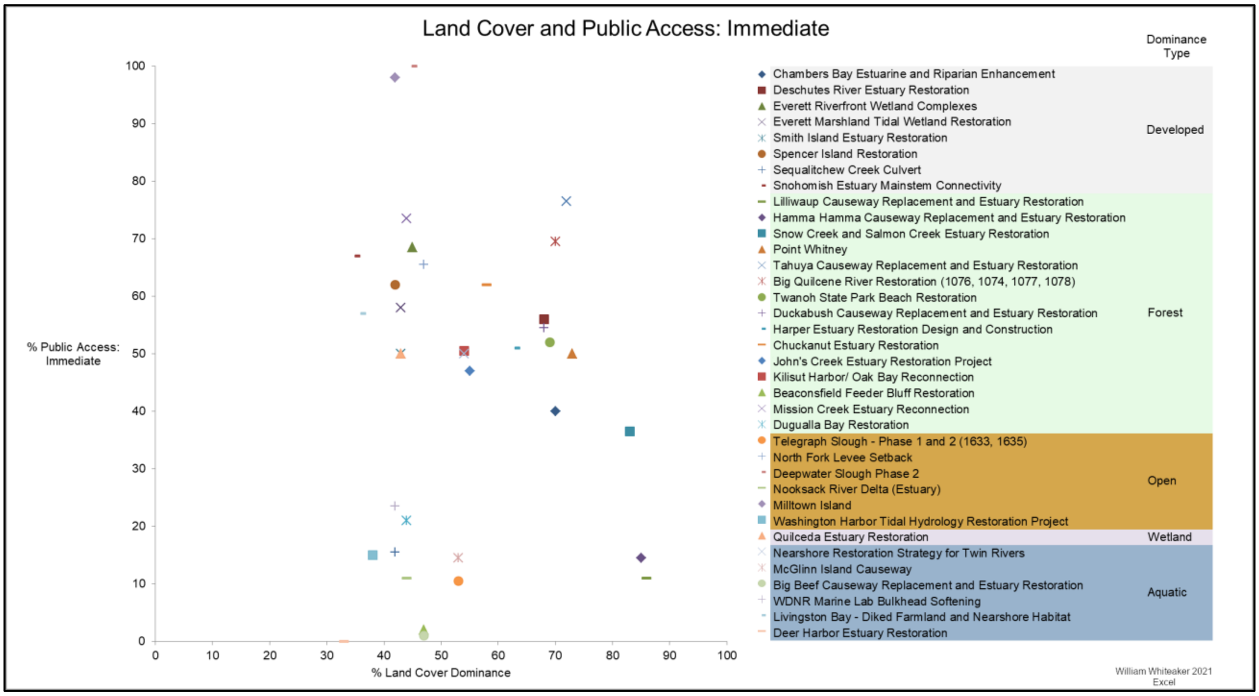


Figure 23 Land cover dominance compared to immediate public access. The dominant percentage of land cover in the landscape extent surrounding each priority site is plotted along the x-axis. The percentage of the site boundary which was immediately accessible to the public is plotted along the y-axis. Priority sites are listed to the right, in order of descending dominance percentage by category. Dominance categories are colored coded, with labels on the far right. Symbols to the left of the priority sites are used to identify each individual site in the plot.

Deepwater Slough and Milltown Island exhibited the highest amounts of immediate access, with both having almost the entire boundary of the site available to the public (Figure 23). These sites are adjacent to each other on the Skagit River delta, just upstream from the mouth. The landscapes surrounding these sites were dominated by open land covers, principally agriculture. However, the sites were also near public areas managed to maintain something of the natural state of the delta. The nature areas allowed a wide variety of forest, wetland, and aquatic land covers to flourish, so agricultural lands were only moderately dominant.

The smaller grouping consisted of ten landscapes, all observed to have moderate dominance but little access (Figure 23). Of these, three had exceptionally low access.

Beaconsfield, Big Beef, and Deer Harbor were all small sites, with the latter two being causeways. None of the three had encompassing landscapes heavily dominated by specific land cover. Beaconsfield is surrounded by a developed, forested bluff, while the Big Beef and Deer Harbor landscapes are tidally influenced, resulting in moderate dominance by aquatic land covers. Due to the steep topography of the bluff and private beach, only 2% of the Beaconsfield terrestrial site boundary was open to the public. Big Beef had no public terrestrial access and only 1% of the shoreline of the site was public. The tiny Deer Harbor was the only priority site without any public perimeter, although the roadway itself could be walked along.

Landscape Structure – Land Cover and Public Access: Travel

The majority of the landscapes in this comparison, twenty-nine of the thirty-six, were in the lower half of the access range (Figure 24). Twenty-three of those sites had between five and ten access locations, approximately 30-70% dominance, and formed a central distribution. Six landscapes had noticeably lower access, and seven noticeably higher. Thirty-three of the sites had landscapes where dominance occurred in the 30-75% range. Only three landscapes demonstrated greater than 75% dominance, and all three had low access. The three sites associated with landscapes that had high dominance but low accessibility were Hamma Hamma, Lilliwaup, and Snow and Salmon Creek. These sites were distinct from the majority of the distribution due to the sheer magnitude of dominance by forest land cover types and the remote nature of the sites severely limiting access. All three sites are located in narrow river valleys enclosed by forested hills. Hamma Hamma had no terrestrial access within the defined walking distance, while Lilliwaup and Snow and Salmon Creek had some type of terrestrial access nearby, but each only had a single marine access location with five miles.

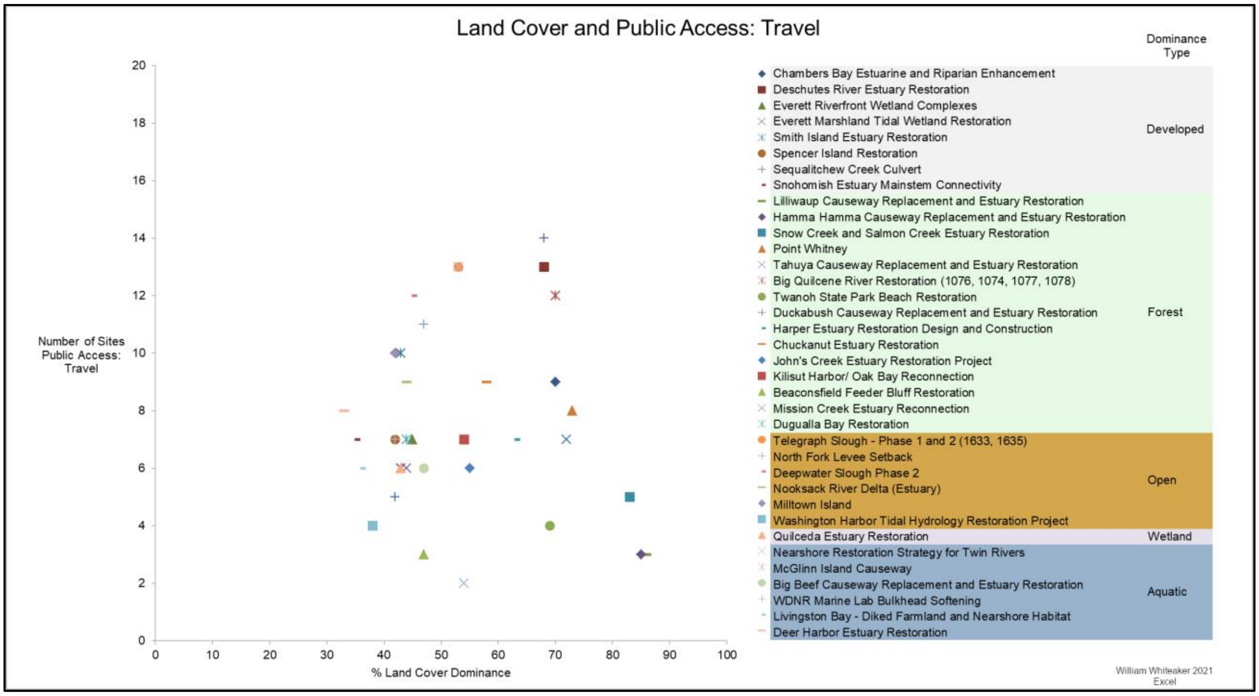


Figure 24 Land cover dominance compared to public access if travel was required to reach the site. The dominant percentage of land cover in the landscape extent surrounding each priority site is plotted along the x-axis. The number of public access locations within specified travel distances is plotted along the y-axis. Priority sites are listed to the right, in order of descending dominance percentage by category. Dominance categories are colored coded, with labels on the far right. Symbols to the left of the priority sites are used to identify each individual site in the plot.

Three additional sites with noticeably lower access than the central distribution, Twin Rivers, Washington Harbor, and Twanoh, were all fairly remote (Figure 24). Twin Rivers is an aquatically dominated coastal site with only two public timberlands within walking distance and no marine access locations. Washington Harbor, located on a spit backed by farmland, was marginally dominated by open land covers and had limited public accessibility from either the terrestrial or marine environments. Twanoh was located on a promontory surrounded by dominant forest land cover, with few nearby locations providing either terrestrial or marine access. However, one of the locations providing access to the Twanoh site, which is a state park, is an adjacent public parking lot. As such, the terrestrial access to Twanoh was certainly undervalued by this analysis' methodology. A final site with lower access, Beaconsfield, was not remote and was moderately dominated by neighboring development. The development was primarily single family residential, yet no public parks or other terrestrial access locations were within defined walking distance. A few public boat launches did grant marine access to the Beaconsfield site.

The seven sites with noticeably higher access than the central distribution were all located on river deltas (Figure 24). Four with moderate dominance, Deepwater Slough, McGlinn Island, North Fork, and Telegraph Slough were all associated with the Skagit River delta. This delta supports considerable agriculture but also hosts public nature areas which preserve forest, wetland, and aquatic land covers, mitigating dominance. These four sites each had moderate numbers of terrestrial public access locations, but some locations were large and may have increased access beyond what was evaluated. Numerous public boat launches near the delta created plentiful marine access as well. Two of the remaining three sites with greater dominance, Big Quilcene and Duckabush, were surrounded by forest cover and had multiple public terrestrial and marine access locations within defined travel distances. At the final site with greater access, Deschutes River, the encompassing landscape was dominated by developed land covers, but still maintained some natural habitat. A number of public parks within walking distance gave Deschutes River the highest number of terrestrial access locations, although few marine access locations were nearby.

Landscape Structure – Impervious Surface and Public Access: Immediate

The distribution for this comparison was concentrated into five clusters of sites, three large, two small, and four sites unassociated with any cluster (Figure 25). The largest cluster contained twelve sites with 87-100% dominance and 47-77% access. These were all smaller sites with minor development, leading to the marked dominance of the least dense classification of impervious surface. Little of these sites terrestrial boundaries were publicly accessible but all had

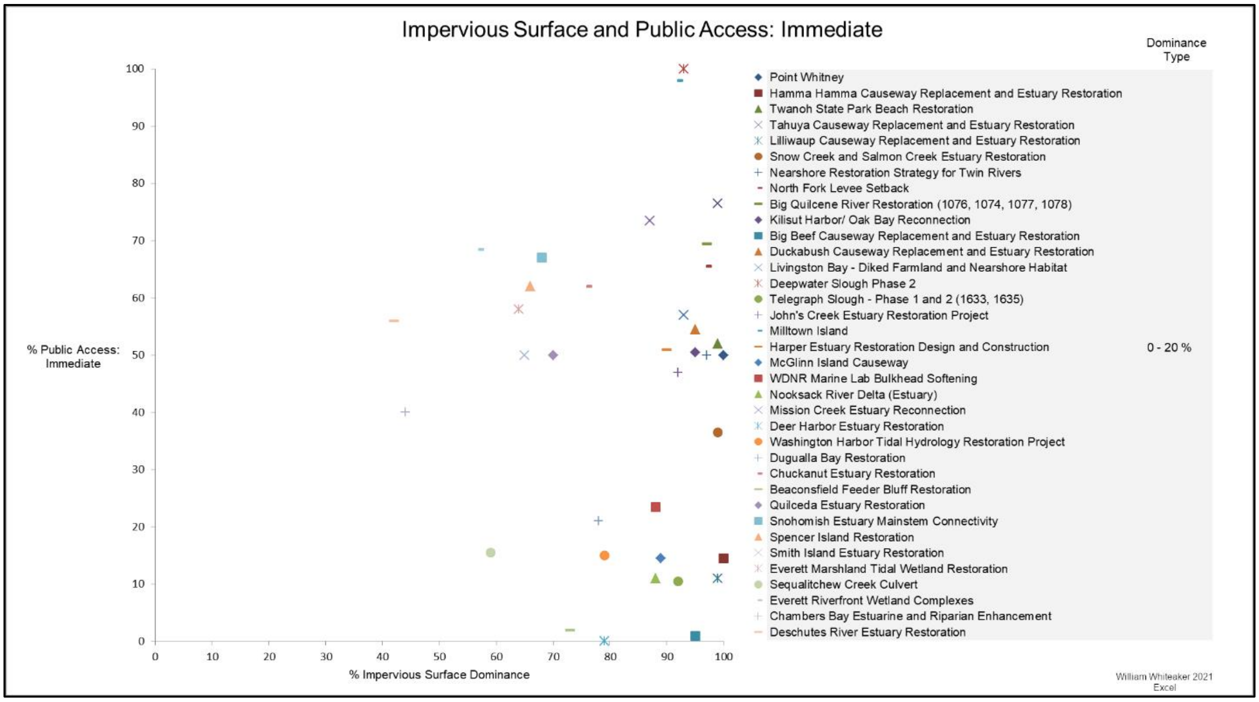


Figure 25 Impervious surface dominance compared to immediate public access. The dominant percentage of impervious surface in the landscape extent surrounding each priority site is plotted along the x-axis. The percentage of the site boundary which was immediately accessible to the public is plotted along the y-axis. Priority sites are listed to the right, in order of descending dominance percentage. All impervious surfaces were dominant in the 0-20% range, so all sites are the same color code, and the 0-20% label appears to the far right. Symbols to the left of the priority sites are used to identify each individual site in the plot.

predominantly public shorelines, characteristics which yielded moderately high amounts of immediate access. Eight sites were found in the next largest cluster, with dominance between 77-100% and access between 11-21%. These sites were again small, with minor development in the surrounding landscape underlying least dense impervious surface dominance. In an almost reversed pattern from the sites in the larger cluster, a small amount of the terrestrial boundary at these sites was publicly accessible, but little to no public shoreline was present. Between these two clusters of high dominance was one of the four non-clustered sites, Snow and Salmon Creek. Like the other high dominance sites, this site was small with little development in the surrounding landscape. None of the terrestrial border of Snow and Salmon Creek was publicly accessible, but almost three-quarters of the shoreline was public, giving the site moderately low accessibility.

Seven sites, all between 57-76% dominance and 50-60% access, were in the third large cluster (Figure 25). Six of the sites were associated with the Snohomish River Delta and the nearby expanding cites of Everett and Marysville. The seventh site, Chuckanut, was similarly close to the rapidly developing city of Bellingham. The increased amounts of development seen in the landscapes surrounding these sites correspondingly increased impervious surface densities, dampening the dominance of the lowest intensity classification. The terrestrial borders of all seven sites displayed limited public accessibility, but the marine shorelines were almost completely public.

Two neighboring sites, Deepwater Slough and Milltown Island, were again noticeably isolated from the majority distribution and created a small cluster with high dominance and high access (Figure 25). These two sites on the Skagit River delta were surrounded by sparse development, so the least dense impervious surface group was quite dominant, and the perimeters of both were almost entirely accessible to the public. Showing similarly high dominance but miniscule accessibility were three small sites that formed the final cluster. Beaconsfield had the least dominance of these three, as encircling development introduced multiple types of impervious surface. Big Beef and Deer Harbor were both remote causeways with little impervious surface other than the roadways being investigated for removal or relocation. Nearly non-existent immediate access clearly differentiated these three sites from the other groupings.

Three sites in heavily developed landscapes were distinctly independent of any of the clusters (Figure 25). Deschutes River and Chambers Bay were both large sites surrounded by urban landscapes. Impervious surface was abundant in all five density groupings, which moderated the dominance of any one group. Surprisingly, even though both sites were situated in city type environments, little of the terrestrial border of either site was publicly accessible. However, the marine shoreline of both sites was almost entirely public. Sequalitchew Creek was comparatively smaller than the other urban sites, with less development established in the surrounding landscape. As such, dominance by the least dense impervious surface classification was slightly increased. About one third of the terrestrial boundary at the Sequalitchew Creek site was open to the public. However, an active railway passed through the site, parallel to the beach face and the shoreline was subsequently private. Therefore public access was only available terrestrially and was limited relative to the other urban sites.

Landscape Structure – Impervious Surface and Public Access: Travel

The distribution of impervious surface compositions with travel based access configurations seemed straight forward, as most of the landscapes surrounding priority sites were heavily dominated by the 0-20% impervious surface group and had limited public access (Figure 26). Further examination hinted that more complex relationships were present. Fourteen landscapes formed a high dominance, low access grouping. Six others displayed high dominance and moderately high access. Between those two groups were two sites, Nooksack and Milltown Island, which displayed high dominance but moderate access. Both sites were associated with river deltas, copious agriculture, and limited development, the driving factor in the dominance of least dense impervious surfaces. A number of terrestrial and marine access locations were in the vicinity of either site, although Milltown Island had fewer terrestrial locations, more marine locations, and overall increased accessibility in comparison with Nooksack.

Another group of six sites demonstrated moderate dominance and low access. Between this group and the group of fourteen sites with high dominance and low access was a small group

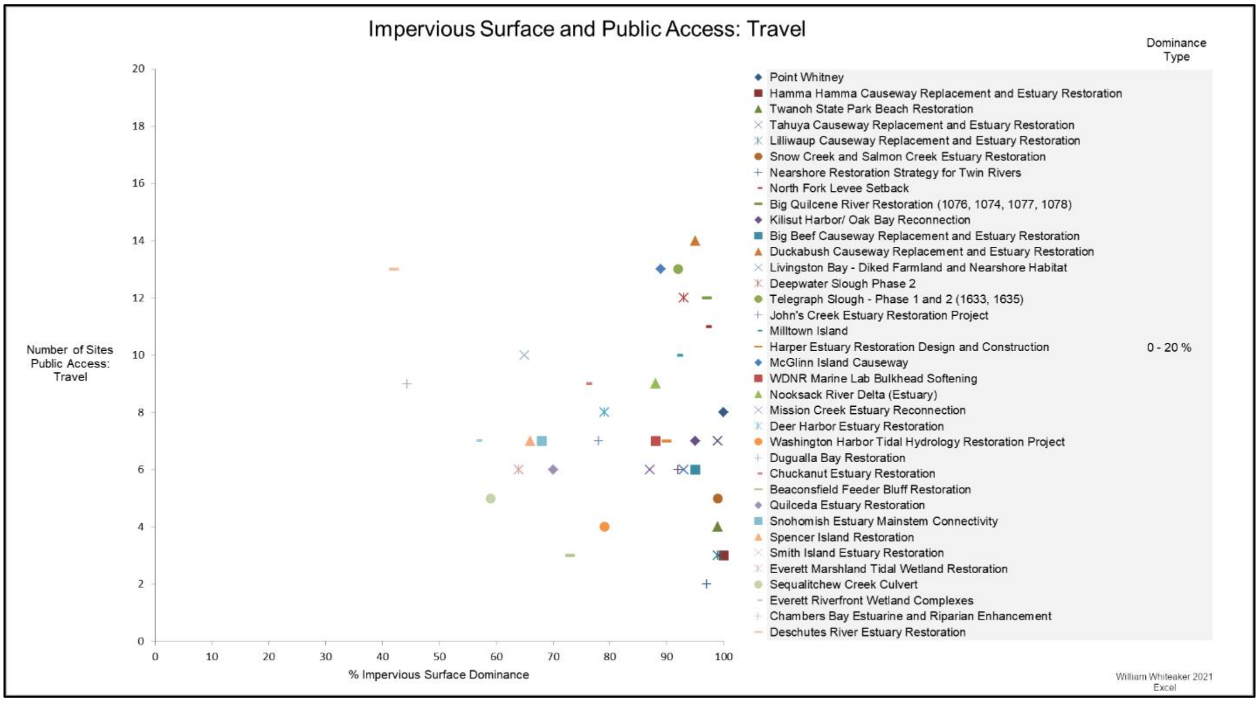


Figure 26 Impervious surface dominance compared to public access if travel was required to reach the site. The dominant percentage of impervious surface in the landscape extent surrounding each priority site is plotted along the x-axis. The number of public access locations within specified travel distances is plotted along the y-axis. Priority sites are listed to the right, in order of descending dominance percentage. All impervious surfaces were dominant in the 0-20% range, so all sites are the same color code, and the 0-20% label appears to the far right. Symbols to the left of the priority sites are used to identify each individual site in the plot.

of three sites with moderately high dominance and moderate access (Figure 26). The three sites in this group, Chuckanut, Deer Harbor, and Dugualla Bay were all associated with tidal embayments, but at three vastly different scales. Deer Harbor was the smallest of the three and the proportionally smaller surrounding landscape had just enough minor development to slightly reduce the intensity of impervious surface dominance. Surprisingly, this tiny site had a number of terrestrial and marine public access locations nearby. Chuckanut was a much larger site, south of the city of Bellingham, and outlying sprawl introduced more impervious surface densities, decreasing dominance. Even with considerably increased site size and proximity of urban development, Chuckanut had nearly the same travel access as Deer Harbor. The Dugualla Bay site was larger still, near both an urban center and military base, and enclosed by suburban development. Oddly, this large site had only a single location of terrestrial travel access, but strong marine travel access gave the site nearly as much overall accessibility as Deer Harbor and Chuckanut.

Two sites were observed to have moderately high dominance and very low access (Figure 26). Beaconsfield, surrounded by urban development, resulting varieties of impervious surface, and lessened dominance, had no terrestrial travel access. Only a few marine access locations could be used to reach the site. Washington Harbor, although fairly remote, was large enough that the proportionally sized landscape incorporated some outlying development, mitigating the dominance of the least dense form of impervious surface. Public access to the Washington Harbor site could be achieved from two terrestrial and two marine locations in the surrounding landscape.

Three sites of lower dominance and greater access clearly stood out from the majority distribution. Smith Island was a large site located on the Snohomish River delta, just north of the city of Everett. Many types of impervious surface were present in the associated landscape and dominance was moderate. A number of public parks and boat launches were close to the site and public access was also moderate. The other two outliers were Chambers Bay and Deschutes River. The urban density and matching reduction in impervious surface dominance at these two sites was quite noticeable. Both sites could be reached from multiple terrestrial or marine access locations. Deschutes River was one of the most publicly accessible sites in terms of travel. The site was located in the state capitol of Olympia, was surrounded by public parks and open spaces, and possessed the highest number of terrestrial public access locations of any priority site.

Landscape Structure – Land Use and Public Access: Immediate

Fifteen sites were surrounded by landscapes which saw land use dominance between 43-66% and publicly accessible border between 47-70% (Figure 27). Of the fifteen, only Harper Estuary, a small site with suburban development bunched at either end of a causeway providing access over a tidal inlet was dominated by development. These fifteen sites were the largest grouping in the land use and immediate access distribution. Two sites, Mission Creek and Tahuya, had slightly higher dominance and higher access than the large central grouping. Mission Creek was a very small site with a public shoreline adjoining the southern edge of a public park. The park was categorized as open land use, although it was maintained as forest. The park's parcel designation combined with the open space designation for the wide tide lands near the priority site gave the impression the landscape was heavily dominated by open land uses, even though much of the surrounding land was forested. Tahuya was a causeway in a narrow river valley with forested slopes on either side. The forest was public land and granted appreciable, if difficult, public access. Three additional sites had higher dominance but similar access as the majority grouping. Sandwiched between a river to the north and farm fields to the south, the North Fork site on the Skagit delta demonstrated the highest open land use dominance, and the third highest land use dominance overall. Nearly isolated terrestrially by the neighboring agriculture, the site was still fairly accessible due to a completely public riverine shoreline. The urban Deschutes River site was development dominated yet had comparable access configuration to the North Fork site, with little public terrestrial boundary but a fully public shoreline. The rural Kilisut Harbor causeway was also development dominated, but in a wildly different configuration. Large water bodies occupied much of the landscape to the north and south of the site. Light suburban development clustered at the east end of the causeway; at the west end was the forested perimeter of Naval Magazine Indian Island, a United States naval facility whose parcel designation of "government services" was responsible for an appreciable amount of developed land use dominance in the landscape. Kilisut Harbor had little terrestrial access, but an unexpected amount of marine access for a causeway.

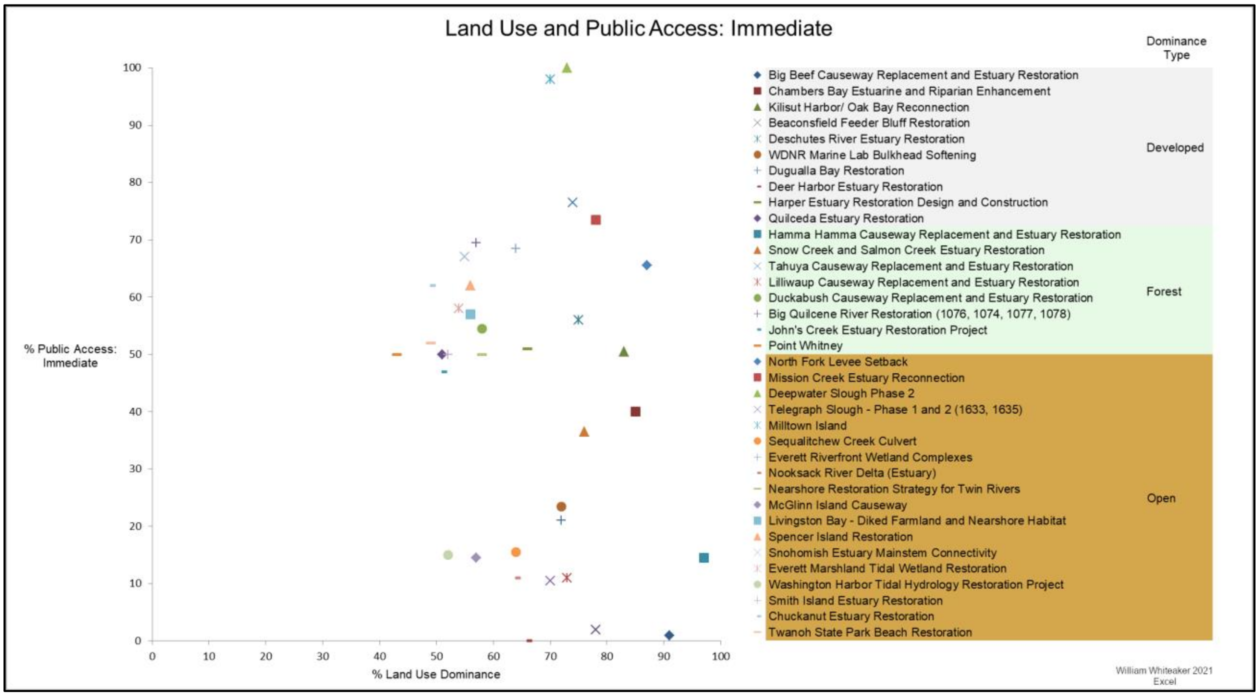


Figure 27 Land use dominance compared to immediate public access. The dominant percentage of land use in the landscape extent surrounding each priority site is plotted along the x-axis. The percentage of the site boundary which was immediately accessible to the public is plotted along the y-axis. Priority sites are listed to the right, in order of descending dominance percentage by category. Dominance categories are colored coded, with labels on the far right. Symbols to the left of the priority sites are used to identify each individual site in the plot.

The Chambers Bay and Snow and Salmon Creek sites had nearly identical dominance to Deschutes River and Kilisut Harbor, but slightly less public access (Figure 27). The urban surroundings of Chambers Bay made it the second most dominated landscape by developed land uses and the fourth most overall. Dense housing abutted a good portion of the site perimeter with much of the remaining perimeter shared with a private golf course. Little of the terrestrial perimeter was publicly accessible, which was not surprising as the priority site itself was a regional wastewater treatment facility, an unlikely location to find unrestricted public access. Oddly, 71% of the marine shoreline was open to the public. However, an active railway just shoreward of a narrow or non-existent beach face would probably deter much public use. The Snow and Salmon Creek site was nestled between large forests on either side of a river valley floor and as such landscape dominance by forest land uses was high. All lands adjoining the site were private so none of the terrestrial perimeter was available to the public, although much of the marine perimeter was publicly accessible.

Eight sites formed a second grouping of between 52-73% dominance and 10-24% publicly accessible border (Figure 27). The physical characteristics of these sites and the landscapes around them were quite varied. Dominance occurred in all three land use types. The common attribute among these sites seemed to simply be the lack of access, as six of the eight had limited to no marine access and one had no terrestrial access. The only sites with less access than this group of eight were the three sites discussed previously as having little to no perimeter access, Beaconsfield, Big Beef, and Deer Harbor. The Hamma Hamma causeway site, with no marine and little terrestrial access, still appeared as an outlier from the low access sites due to the dominance of forested parcels in the landscape. At the opposite end of the access measurement, Deepwater Slough and Milltown Island, the adjacent sites on the Skagit River delta encircled by public nature areas, were noticeable as an outlying group of two with nearly open boundaries. The landscape extent in which these priority sites were nestled was a patchwork of farm fields, predictably dominated by open land uses.

Landscape Structure – Land Use and Public Access: Travel

In the comparison between land use and travel access, thirty-five of the thirty-six landscapes were found in a single large scattered grouping (Figure 28). The only outlier to this group was the landscape around the Hamma Hamma site, which was again distinct due to the magnitude of dominance. Two large parcels made up the vast majority of the terrain around

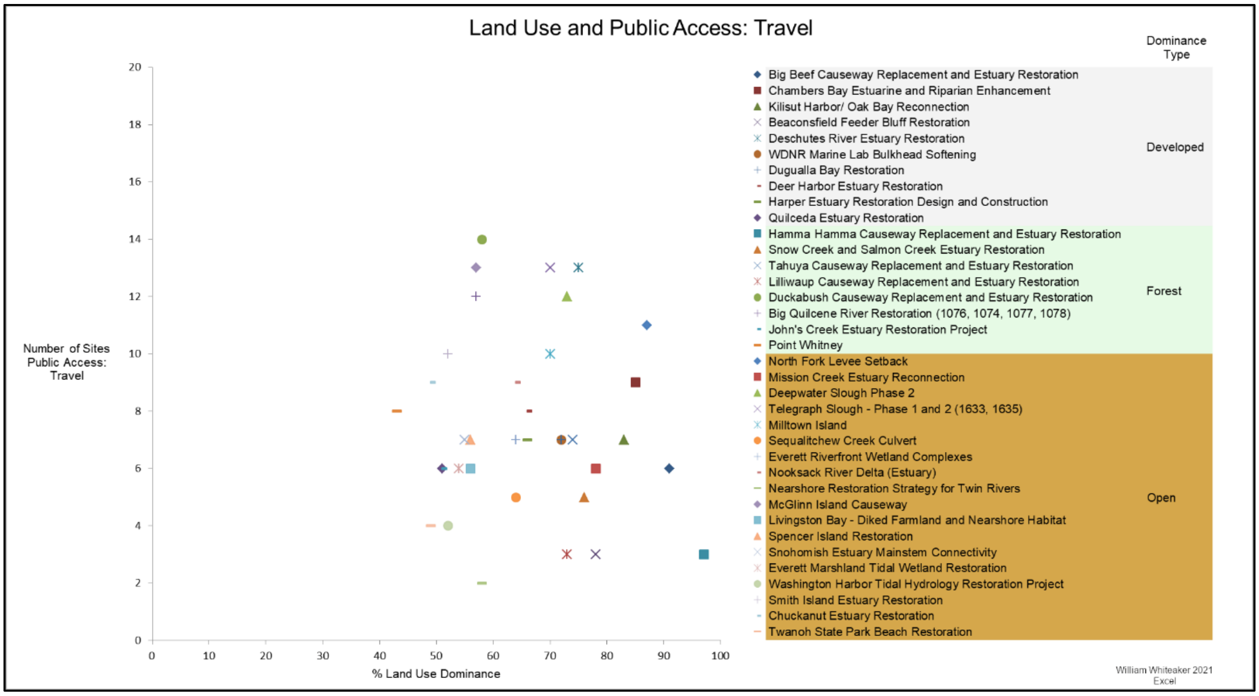


Figure 28 Land use dominance compared to public access if travel was required to reach the site. The dominant percentage of land use in the landscape extent surrounding each priority site is plotted along the x-axis. The number of public access locations within specified travel distances is plotted along the y-axis. Priority sites are listed to the right, in order of descending dominance percentage by category. Dominance categories are colored coded, with labels on the far right. Symbols to the left of the priority sites are used to identify each individual site in the plot.

Hamma Hamma and both were designated as some type of timberland, leading to 97% dominance by forest land use types. Hamma Hamma was the second least accessible site when considering travel access, with only three marine public access locations and no terrestrial public access locations nearby. The only landscape which approached the dominance observed at Hamma Hamma was Big Beef. There residential homes clustered at either end of a causeway separating Beef Harbor to the south from Puget Sound to the north. The absence of land amplified the effects of land use on what terrain was present, generating 91% development dominance. Big Beef also had greater access than Hamma Hamma, with both terrestrial and marine public access locations within defined travel distances.

The least dominance in this comparison existed in the landscape surrounding the Point Whitney site (Figure 28). The spit and lagoon at this site were in a fairly rural area with dense forest. However, roadways present on either side of the lagoon granted access to multiple narrow residential lots along with the spit itself. A portion of the spit, and ponds cut from the lagoon, were home to a public-private shellfish research and rearing operation. The presence of the residential and industrial development, even though many of the residential lots were well forested, dramatically reduced the dominance of forest land use designations. Point Whitney was fairly accessible from both terrestrial and marine perspectives, with multiple nearby public access locations in both environments.

The only other sites that were appreciably different from the majority distribution possessed the highest and lowest access, although they had identical dominance intensity (Figure 28). The landscape around the Duckabush site was forested, although patches of open lands were apparent along the river valley leading to the proposed causeway restoration area. Two large forest designated parcels dwarfed all other parcels in the landscape, but upland forest canopies also concealed an unexpected number of small residential parcels. Shoreward of the causeway is a wide grassland delta covered with braided stream channels. The open lands and deceptive amount of development curtailed the dominance of forest land use, with only 58% by area of the parcels classified as timberland. Duckabush was the most accessible of any site in the comparison, with seven terrestrial and seven marine public access locations. The landscape surrounding the tiny Twin Rivers site only contained ten parcels. Even though nine of the ten parcels were observed to have forest, the tenth was a highway, five parcels comprising the majority of the area of the landscape were classified as open land use, and the site was open land use dominant by 58%. Twin Rivers had the fewest number of locations from where the public might travel to the site, with only two nearby terrestrial locations and nothing in the marine environment.

Landscape Structure – Composition and Configuration

The points assigned to all three composition analyses were summed, as were the points assigned to the two configuration analyses. The composition analyses were land cover, impervious surface, and land use. Points in the composition analyses represented an attempt to account for the amount of natural habitat remaining in the landscape extent around each site and variability in that natural habitat. Higher composition points indicated greater amounts of natural habitat and increased variation of that natural habitat. The configuration analyses were public access: immediate and public access: travel. The suggested restoration activities at some of the priority sites would remove bridges, parking lots, or roads, reducing or eliminating public access. Points in the configuration analyses represented an attempt to account for the public's ability to use a site if restoration occurred at the site. Higher configuration points indicated more of the perimeter of the site was open to the public and that there were a greater number of locations in the surrounding landscape from which the public could travel to the site. The total points each site received in terms of composition and configuration were compared (Figure 29).

All of the landscapes, even those that were intensely developed, had some amount of natural habitat remaining. Further, while most landscapes were observed to have only moderate diversity of natural habitat, every single landscape possessed some diversity. No landscape extent analyzed was seen to have only forest, or only agriculture, etc., as the remaining natural habitat. The status of public access was similar to that of habitat. Every priority site had some amount of public access. Many of the sites had moderate levels of public access, but no site was completely isolated or unavailable to the public.

Examining the composition and configuration distribution, the vast majority of the landscapes, twenty-seven of the thirty-six, appeared in an elongated central group (Figure 29). All of the sites, including those in the central group, had at least moderate amounts and diversity

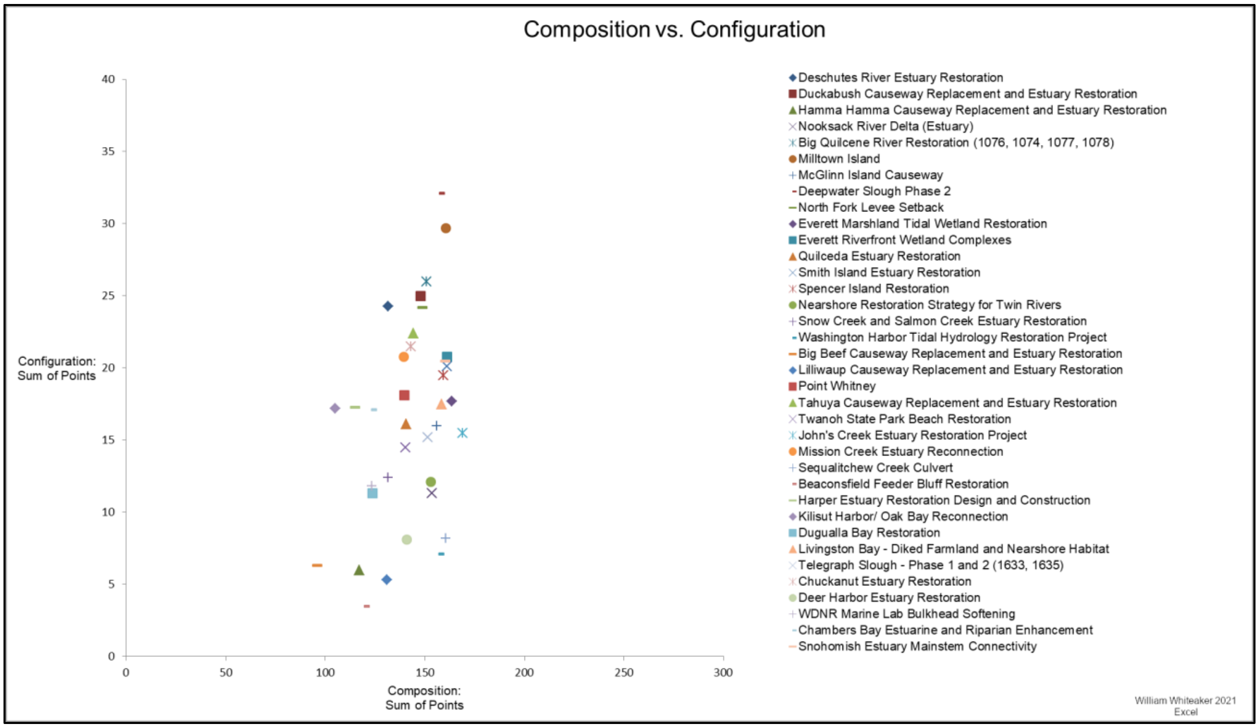


Figure 29 Structure observed in the landscape extent surrounding each of the thirty-six priority sites. The sum of points awarded to the three composition analyses, land cover, impervious surface, and land use, is plotted along the x-axis. The sum of points awarded to the two configuration analyses, immediate and travel based public access, is plotted along the y-axis. The priority sites are listed on the right, matching the order of appearance in PSNERP's documentation. Symbols to the left of the priority sites are used to identify each site in the plot.

of natural habitat, and the narrowness of the composition distribution expressed those traits. Greater variation occurred in the accessibility of a site, with some being mostly inaccessible while others had substantial amounts of public access. The Kilisut Harbor landscape stands out from the central group due to low composition, the second lowest of any site. Kilisut Harbor was a small causeway with Scow Bay to the north and Oak Bay to the south. The predominately marine surroundings left little landscape extent to analyze. Forest dominated what terrain was present, although limited tide lands appeared where the bays joined under the causeway. Access to the Kilisut Harbor site was moderate and present in terrestrial and marine environments, both immediately and with travel. As such, accessibility at Kilisut Harbor was representative of average access among the priority sites. Similar access but markedly different composition was seen at the John's Creek site, across the central distribution from Kilisut Harbor and at the opposite end of the composition range. The landscape encompassing John's Creek had the highest amount of remaining natural habitat and the greatest diversity of habitat seen around any of the priority sites. Forest was predominant, extensive shellfish beds lay north and south of the site, tidelands to the east, and scant wetlands were also present.

Two sites had noticeably higher access than those in the central group (Figure 29). Unsurprisingly, Deepwater Slough and Milltown Island were visibly separate from the other sites in the access distribution. Both sites boundaries were almost fully publicly accessible and this had caused the sites to be distinct in previous immediate access analysis as well. These two adjacent Skagit River delta sites were surrounded by mostly undeveloped agricultural lands. Neighboring public nature reserves assured significant wetlands were also present, along with some tide lands and scattered forest, creating a fairly diverse natural habitat.

Three sites with moderate compositions and low access appeared just below the central distribution (Figure 29). Deer Harbor, a small causeway on Orcas Island, was surrounded by enough development to eliminate some natural habitat. Some habitat diversity was present as open space, tidelands, and some scattered forest remained. Dear Harbor was not immediately accessible, although some of the nearby development included marinas and moderate public access via travel was possible. The Sequalitchew Creek landscape extent retained some natural habitat, although diversity was low as the habitat was mostly forest, but a few tidelands and a small valley floor with grasses were also present. Sequalitchew Creek had no public shoreline, little of the terrestrial border was public, and only limited access via travel was available. The landscape around Washington Harbor was mostly agricultural land. A thick strip of forest separated the spit at the center of the suggested restoration effort from the upland farms. Some tidelands were present near the mouth of the spit and some scarce wetlands were also observed. A small amount of the Washington Harbor site perimeter was publicly accessible and few access locations were nearby if the public wished to reach the site.

Finally, four sites were apparent in the distribution as having not only some of the least amounts of natural habitat and habitat variety, but also the least amounts of access (Figure 29). Big Beef, Hamma Hamma, and Lilliwaup were all causeways where water made up a significant portion of the surrounding landscape. The limited terrestrial extents tended to be heavily forested with some development clustered at either end of the causeway. The dense forestation reduced habitat diversity. The relatively small site sizes had proportionally small landscapes where even small amounts of development had outsized effect in reducing the appearance of remaining natural habitat. Due to the shape and location of a causeway, a narrow strip of pavement over water, the perimeter of all three sites was mostly inaccessible. However, some public access locations were present in the landscapes surrounding all three sites. The Beaconsfield site seemed quite different compositionally from the causeways, but further examination revealed unexpected similarities. The landscape extent around the Beaconsfield site was proportionally sized to the small site, developed, and what natural habitat remained was predominately forest. Beaconsfield had less remaining natural and varied habitat than most other sites. Public access was extremely limited, with hardly any of the perimeter of the site publicly accessible and only three marine public access locations nearby. Beaconsfield had the least access of any priority site.

Landscape Structure – Summary

As an organization, PSNERP's overarching goal was to protect, restore, and enhance a diverse ecosystem (Fresh et al. 2004). Diversity was described by PSNERP as one of the key components of a healthy and sustainable natural system (Schlenger et al. 2011, Greiner et al. 2010, Clancy et al. 2009). Examination of the landscape settings of PSNERP's prioritized restoration projects indicates that most are surrounded by complex social-ecological systems. Human factors are certainly present at all sites; otherwise restoration would be unnecessary. Yet even with substantial development, the composition and configuration of the landscapes retain a significant natural and varied component. This composition of surrounding area should serve as a complement to restoration at the priority sites. The restoration efforts being considered seem likely to alter the fairly modified land of priority areas into something more akin to the surrounding environment. It would appear that PSNERP has avoided a scenario whereby islands of rejuvenated habitat were created within vast swaths of pavement (Puget Sound Nearshore Ecosystem Restoration Project 2014) as no site was entirely dominated by development and some variation within the remaining natural habitat existed at all sites.

Another consideration in restoring Puget Sound's nearshore was reconnecting habitat. Since most of the priority sites were positioned in ecological surroundings which retained an assortment of natural biophysical compositions, restoration of these sites offered the potential to re-establish long severed ecosystems. This renewed association would not necessarily be limited to the priority site and adjoining lands, but might also see the priority site acting as a bridge, enabling habitat continuity throughout a formerly disconnected landscape (Pimm and Jenkins 2019, Briscoe et al. 2017). In essence, restoration would re-integrate priority sites into the landscape from which they were removed. Since recreating linkages among separated habitats was another primary PSNERP objective (Greiner et al. 2010), it is reassuring that priority site restoration appears to have the potential to satisfy habitat reconnection goals as well as habitat diversity goals.

While the landscapes surrounding the priority sites tend to retain some natural composition, a general dearth of public access is typical, both along the site perimeter and with some travel distance. As has been noted, PSNERP's framework did not include issues of public accessibility (Cereghino et al. 2012) and assessing the project via such criteria may seem unfair. However, PSNERP was funded with public money and the relationship between public funding and public access should at least be considered. Public access to restoration areas is of significant debate, with vigorous discussion and diversity of opinion evident regarding the amount, necessity, and impacts, both positive and negative, of said access (Vining et al. 2000, Woolley and McGinnis 2000, Coke and Brown 1976). Interestingly, debates concerning public access are frequently interwoven with debates over general public knowledge. Public knowledge may also have spatial context, as the public cannot access restoration without knowing of said restoration (Weinstein 2007, Petts 2006, Connelly et al. 2002). Public access and public knowledge concerning the use of public funds may lead to restoration efforts being perceived as more successful, although increased access and knowledge is not a guarantee of more positive perception (Gans and Murray 2010, Evans and Durant 1995). Unfortunately, knowledge factors, such as signage, public outreach, or media exposure, all of which could have interesting interactions with public awareness and use of public lands, were simply beyond the extent of this study. The objective of this study was purposefully constrained to describing the public's interaction with restoration sites from the spatial perspective of access. In addition, this study attempted to remain neutral with respect to whether public access to restoration sites was beneficial or detrimental, either in terms of physical restoration, or in the perception of restoration. Within this defined spatial context, public access to the priority sites was generally moderate to low, but some type of access existed at every site. Even if PSNERP did not intend to include more social concerns, the accessibility of priority sites would undoubtedly influence public perception, perhaps creating a more positive opinion of PSNERP and associated restoration efforts.

Conclusion

When PSNERP began in 2001, the effort was focused on trying to understand the historical background of the regional landscape of Puget Sound. What documented morphology existed was used to provide insight into the natural bio-geophysical processes which created the landscape and how both the processes and landscape changed through time. By understanding recorded natural processes and resulting change, the potential for the landscape to sustain modern restoration could be gauged. Traditionally restoration in the region had been opportunistic, taking place where and when an area, and necessary restoration funds, became available. The knowledge of landscape behavior PSNERP developed allowed restoration locations to be chosen purposefully, prioritized to areas where maximum impact would be achieved. PSNERP's framework evaluated not just the degradation of a site, but the sustainability of a restored site and the benefits restoring a specific site might provide to the surrounding environment. Restoration benefits were considered to be how much natural setting would be returned, whether that natural setting would be diverse, and if that natural setting would be reconnected to surrounding habitats. PSNERP appears to have mostly achieved the goals related to habitat, as the landscapes surrounding many of the priority sites appear to compliment and support restoration. In general, landscapes around priority sites have moderately high amounts of natural habitat and some habitat diversity. At a number of sites, restored habitat would be reconnected to ample and diverse natural landscapes in the surrounding environment.

It is difficult to critique PSNERP in regards to public use. Public use was not included in PSNERP's methodology and significant debate exists as to whether public use of restoration is even desirable. Supporters of public parklands or other public recreation areas would likely approve of more public access to restoration sites. Supporters of non-public conservation lands, or private property owners whose lands abut restoration sites, might oppose more public access to those restoration sites. Yet, much of PSNERP's funding was public, and PSNERP presented transparency and public accountability as a necessary component of restoration. PSNERP's framework was touted as transparent, allowing stakeholders to follow and to a limited extent participate in the decision making process. However, much of the restoration that may take place as a result of the framework might be difficult for the public to observe or interact with, reducing accountability. Public access to restoration will eventually be debated by the public, who will decide whether the social effects of this restoration were desirable, or worth the cost, or neither. While public access may not have been considered by PSNERP, public access seems a worthy consideration in future restoration frameworks, due to the eventual and unavoidable reckoning with what the public determine is desirable and worthwhile. What can be said is that all PSERNP priority sites have some level of public access, but few have much of it.

Having thoroughly examined the landscapes surrounding PSNERP's priority sites, in terms of the amount and diversity of remaining natural habitat, and in terms of public accessibility, my hypothesis can be supported or disproven and the research questions answered.

The hypothesis was:

PSNERP selected priority restoration sites which are moderately degraded, dissimilar from the surrounding landscapes, and which have limited opportunities for public interaction.

The hypothesis is partially true. PSNERP did select moderately degraded sites that in many cases incorporated or were surrounded by development. However, while some development and associated degradation of natural systems appeared in the landscapes around the priority sites, substantial amounts of natural habitat and a good deal of habitat diversity remained near many sites. Further, while public access to restoration sites was generally limited, some type of access existed at all sites.

The first research question asked:

If restored, would PSNERP priority sites be similar or dissimilar in landscape structure to their adjacent landscapes?

The answer to the first research question is that if restored, PSNERP priority sites would appear to be mostly similar in landscape structure with the surrounding landscapes. Restoration at even the most heavily altered sites would be surrounded by natural habitats with some diversity.

The second research question asked:

If restored, would PSNERP's priority sites be accessible to the public?

The answer to the second research question is that if restored, PSNERP priority sites would have limited public access. While every site has some type of access, the amount of access at most sites is low enough to limit public interaction with the site.

Limitations to this analysis

The regrouping of impervious surface data was the most significant limitation in this study. Although the data was regrouped multiple times, the grouping used in this analysis unfortunately still measured levels of development, rather than separating development from natural habitat. The effect of grouping in this manner was apparent in the dominance of the least intense impervious surface group. Even so, some variability in potential natural habitats, such as rural and urban, could be detected. Any future work would benefit by considering all impervious surface as development, regardless of intensity, creating clear distinctions between developed and natural habitats.

A regrouping limitation was also seen with land use data. Only two natural land use groups could be created, rather than the four groups seen with land cover and impervious surface. Since only two groups were present, points per group were rescaled to fifty. Minimum and maximum points per landscape remained the same so points were still comparable between compositions.

Landscape configuration was initially examined as the publicly accessible perimeter of a priority site, calculated through a shared boundary with immediately adjacent public parcels. Only upon discovery of priority site associated, but non-adjacent parcels, was the need for a travel distance metric understood. The intention of incorporating a travel component into the description of configuration was to acknowledge landscape features obviously connected to priority sites, but not captured by the shared perimeter method. Data regarding recreational marine travel distances was scarce, but a good faith effort was made to incorporate this data nonetheless. The resulting measures of travel distance, while imperfect, do create a more robust account of landscape configuration.

The inclusion of the point metric was a two-fold attempt to account for variety within natural habitats while also providing a means to directly compare composition and configuration among priority sites. The points system worked well with composition data, especially land cover, but was poor when used with configuration data. The points system therefore produced measures of natural and varied habitats, while simply reiterating travel access data, adding marginal value to that component of the study. Since the point metric provided some insight into composition, future use might be worthwhile if paired with land cover data. A stronger accounting methodology should be considered if examining landscape configuration.

The methods chosen to pursue answers to the research questions are well defined in literature, but represent only one aspect of what can be measured regarding landscape structure. For example, this analysis used public accessibility as an indicator of human value, but did not purposefully select components of landscape structure demonstrably connected to public acceptance of restoration. As such, the results of this analysis may appear abstract, lacking the definitive conclusions alternate measures may have provided. However, the results do successfully describe the spatial context surrounding priority sites, highlighting substantial variety in terms of both habitat and access.

Closing

PSNERP was of course about more than restoration. It was about the decision making process that leads to restoration. The strategic process PSNERP developed was not just about deciding which sites to restore, but how to decide which sites to restore. As the process progressed, PSNERP thoroughly evaluated thirty-six sites, eleven of which were forwarded for funding, with three granted funding. However, that was just the primary PSNERP effort. The development of the decision making framework, and processing of potential areas through that framework, brought additional attention to many of the locations. A number of the smaller sites have found restoration funding through other sources and have either been completed, such as Beaconsfield, or are in progress. This additional restoration may not have taken place without the identification and evaluation of the sites provided by PSNERP's strategic framework. If the restoration efforts undertaken by PSNERP are judged in isolation, success may appear marginal, as to date only three of thirty-six sites have undergone restoration. A broader interpretation would be that while PSNERP has only received funding to restore three fairly large complex sites, the strategic framework developed by PSNERP and the conceptual design work completed by PSNERP has increased attention to a number of smaller sites, which are now also receiving restoration funding, albeit through non-PSNERP funding mechanisms.

When appraising a project the size of PSNERP, it is helpful to take a step back and view the project from greater scope. In her 2008 book “Natural Experiments” Judith Layzer examined a series of regional case studies concerning ecosystem based management. Some of the cases achieved a fair amount of success; others were plagued by poor decisions, cultural resistance, and lack of strategic vision. It seems likely that PSNERP will eventually be looked back on as a case study by some future examiner. That examiner may well conclude that PSNERP found some success in habitat restoration and reconnection, and that the project created additional restoration opportunities, but that the public was mostly unaware of said restoration or PSNERP’s role in it. PSNERP will probably be viewed as more successful than not, but with some areas where significant improvement was possible.

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Appendix A

Summary Tables and GIS Imagery

Appendix A Table 1. The percentage dominance, type of dominance, and number of points calculated for each composition lens for all thirty-six PSNERP priority sites.

PSNERP ID	Project Name	Land Cover			Impervious Surface			Land Use		
		% : Dominance	Type : Dominance	Points	% : Dominance	Type : Dominance	Points	% : Dominance	Type : Dominance	Points
1003	Deschutes River Estuary Restoration	68	Developed	32	42	0-20	74	75	Developed	25
1012	Duckabush Causeway Replacement and Estuary Restoration	68	Forest	51	95	0-20	30	58	Forest	67
1047	Hamma Hama Causeway Replacement and Estuary Restoration	85	Forest	40	100	0-20	25	97	Forest	52
1055	Nooksack River Delta (Estuary)	44	Open	66	88	0-20	36	64	Open	52
1076	Big Quilcene River Restoration (1076, 1074, 1077, 1078)	70	Forest	50	97	0-20	28	57	Forest	73
1091	Milltown Island	42	Open	74	92	0-20	32	70	Open	54
1092	McGlinn Island Causeway	53	Aquatic	59	89	0-20	36	57	Open	60
1101	Deepwater Slough Phase 2	45	Open	72	93	0-20	32	73	Open	54
1102	North Fork Levee Setback	47	Open	65	97	0-20	28	87	Open	56
1126	Everett Marshland Tidal Wetland Restoration	43	Developed	57	64	0-20	56	54	Open	50
1127	Everett Riverfront Wetland Complexes	45	Developed	55	57	0-20	56	64	Open	50
1136	Quilceda Estuary Restoration	43	Wetland	42	70	0-20	49	51	Developed	49
1142	Smith Island Estuary Restoration	43	Developed	57	65	0-20	54	52	Open	50
1149	Spencer Island Restoration	42	Developed	56	66	0-20	53	56	Open	50
1190	Nearshore Restoration Strategy for Twin Rivers	54	Aquatic	57	97	0-20	28	58	Open	68
1230	Snow Creek and Salmon Creek Estuary Restoration	83	Forest	40	99	0-20	26	76	Forest	65
1237	Washington Harbor Tidal Hydrology Restoration Project	38	Open	57	79	0-20	43	52	Open	57
1256	Big Beef Causeway Replacement and Estuary Restoration	47	Aquatic	56	95	0-20	30	91	Developed	9
1346	Lilliwaup Causeway Replacement and Estuary Restoration	86	Forest	38	99	0-20	26	73	Forest	67
1379	Point Whitney	73	Forest	52	100	0-20	25	43	Forest	62
1404	Tahuya Causeway Replacement and Estuary Restoration	72	Forest	51	99	0-20	27	74	Forest	66
1421	Twanoh State Park Beach Restoration	69	Forest	55	99	0-20	26	49	Open	59
1447	John's Creek Estuary Restoration Project	55	Forest	60	92	0-20	32	51	Forest	76
1457	Mission Creek Estuary Reconnection	44	Forest	52	87	0-20	37	78	Open	50
1467	Sequalitchew Creek Culvert	42	Developed	53	59	0-20	57	64	Open	50
1499	Beaconsfield Feeder Bluff Restoration	47	Forest	46	73	0-20	51	78	Developed	22
1505	Harper Estuary Restoration Design and Construction	63	Forest	46	90	0-20	34	66	Developed	34
1552	Kilisut Harbor/ Oak Bay Reconnection	54	Forest	58	95	0-20	30	83	Developed	17
1609	Dugualla Bay Restoration	44	Forest	52	78	0-20	44	72	Developed	28
1618	Livingston Bay - Diked Farmland and Nearshore Habitat	36	Aquatic	75	93	0-20	32	56	Open	51
1633	Telegraph Slough - Phase 1 and 2 (1633, 1635)	53	Open	61	92	0-20	32	70	Open	58
1642	Chuckanut Estuary Restoration	58	Forest	39	76	0-20	49	49	Open	55
1648	Deer Harbor Estuary Restoration	33	Aquatic	61	79	0-20	46	66	Developed	34
1684	WDNR Marine Lab Bulkhead Softening	42	Aquatic	58	88	0-20	37	72	Developed	28
1801	Chambers Bay Estuarine and Riparian Enhancement	70	Developed	30	44	0-20	77	85	Developed	15
1805	Snohomish Estuary Mainstem Connectivity	35	Developed	60	68	0-20	50	55	Open	50

Appendix A Table 2. The percentage of the terrestrial, marine, and total perimeters which are publicly accessible, points for immediate access, the terrestrial, marine, and total number of public access areas, and points for travel access, calculated for each configuration lens for all thirty-six PSNERP priority sites.

PSNERP ID	Project Name	Public Access : Immediate				Public Access : Travel			
		% : Terresterial Boundary	% : Marine Boundary	% : Total Boundary	Points	# : 2500ft Access	# : 5mi Access	# : Total Access	Points
1003	Deschutes River Estuary Restoration	12	100	56	11.2	10	3	13	13
1012	Duckabush Causeway Replacement and Estuary Restoration	9	100	55	10.9	7	7	14	14
1047	Hamma Hama Causeway Replacement and Estuary Restoration	29	0	15	2.9	0	3	3	3
1055	Nooksack River Delta (Estuary)	22	0	11	2.2	5	4	9	9
1076	Big Quilcene River Restoration (1076, 1074, 1077, 1078)	70	69	70	13.9	7	5	12	12
1091	Milltown Island	96	100	98	19.6	1	9	10	10
1092	McGlinn Island Causeway	13	16	15	2.9	5	8	13	13
1101	Deepwater Slough Phase 2	100	100	100	20.0	2	10	12	12
1102	North Fork Levee Setback	31	100	66	13.1	3	8	11	11
1126	Everett Marshland Tidal Wetland Restoration	16	100	58	11.6	1	5	6	6
1127	Everett Riverfront Wetland Complexes	37	100	69	13.7	4	3	7	7
1136	Quilceda Estuary Restoration	0	100	50	10.0	2	4	6	6
1142	Smith Island Estuary Restoration	0	100	50	10.0	6	4	10	10
1149	Spencer Island Restoration	24	100	62	12.4	3	4	7	7
1190	Nearshore Restoration Strategy for Twin Rivers	0	100	50	10.0	2	0	2	2
1230	Snow Creek and Salmon Creek Estuary Restoration	0	73	37	7.3	4	1	5	5
1237	Washington Harbor Tidal Hydrology Restoration Project	14	16	15	3.0	2	2	4	4
1256	Big Beef Causeway Replacement and Estuary Restoration	0	2	1	0.2	4	2	6	6
1346	Lilliwaup Causeway Replacement and Estuary Restoration	22	0	11	2.2	2	1	3	3
1379	Point Whitney	0	100	50	10.0	3	5	8	8
1404	Tahuya Causeway Replacement and Estuary Restoration	53	100	77	15.3	3	4	7	7
1421	Twanoh State Park Beach Restoration	4	100	52	10.4	2	2	4	4
1447	John's Creek Estuary Restoration Project	6	88	47	9.4	3	3	6	6
1457	Mission Creek Estuary Reconnection	47	100	74	14.7	3	3	6	6
1467	Sequalitchew Creek Culvert	31	0	16	3.1	1	4	5	5
1499	Beaconsfield Feeder Bluff Restoration	4	0	2	0.4	0	3	3	3
1505	Harper Estuary Restoration Design and Construction	2	100	51	10.2	3	4	7	7
1552	Kilisut Harbor/ Oak Bay Reconnection	21	80	51	10.1	1	6	7	7
1609	Dugualla Bay Restoration	0	42	21	4.2	1	6	7	7
1618	Livingston Bay - Diked Farmland and Nearshore Habitat	14	100	57	11.4	1	5	6	6
1633	Telegraph Slough - Phase 1 and 2 (1633, 1635)	19	2	11	2.1	4	9	13	13
1642	Chuckanut Estuary Restoration	42	82	62	12.4	6	3	9	9
1648	Deer Harbor Estuary Restoration	0	0	0	0.0	3	5	8	8
1684	WDNR Marine Lab Bulkhead Softening	14	33	24	4.7	3	4	7	7
1801	Chambers Bay Estuarine and Riparian Enhancement	9	71	40	8.0	6	3	9	9
1805	Snohomish Estuary Mainstem Connectivity	34	100	67	13.4	3	4	7	7

PNSERP ID
1003

Site Name
Deschutes River Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 12 Marine: 100

Public Access Areas (#)
Terresterial: 10 Marine: 3

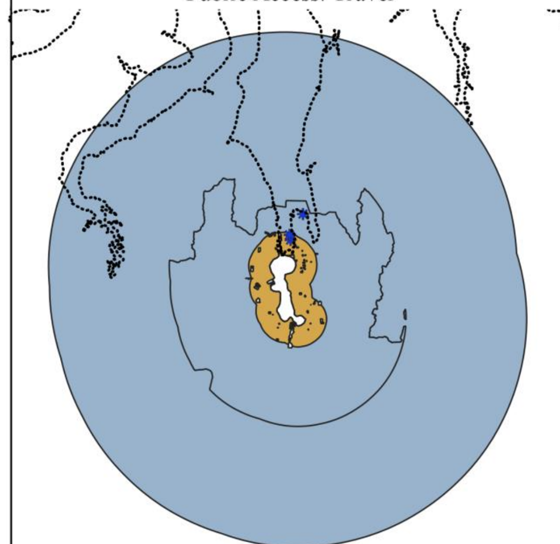
Land Cover Dominance
Developed 68%

Impervious Surface Dominance
0-20% Density 42%

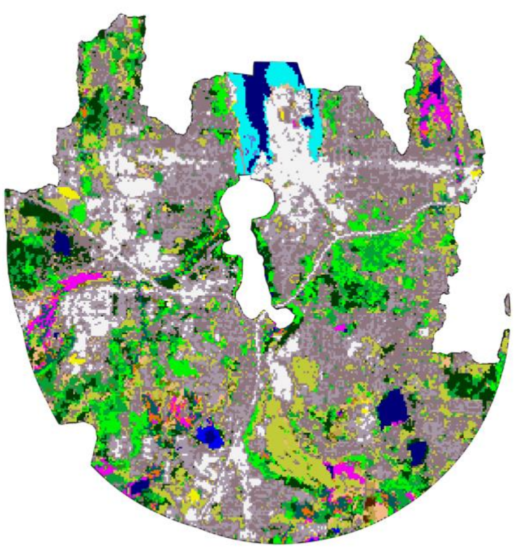
Land Use Dominance
Developed 75%

Public Access: Immediate

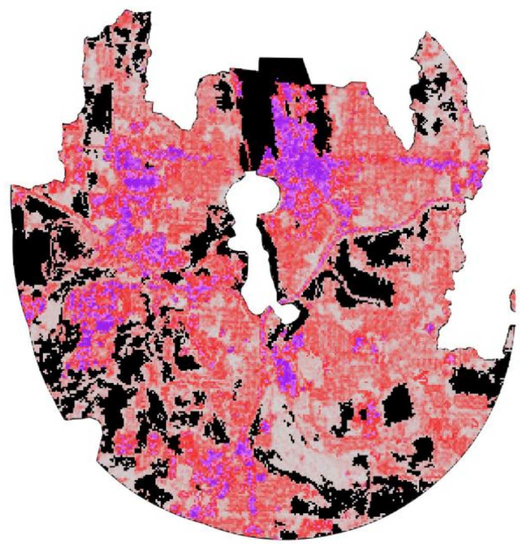
Public Access: Travel



Land Cover



Impervious Surface



Land Use

PNSERP ID
1012

Site Name
Duckabush Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 9 Marine: 100

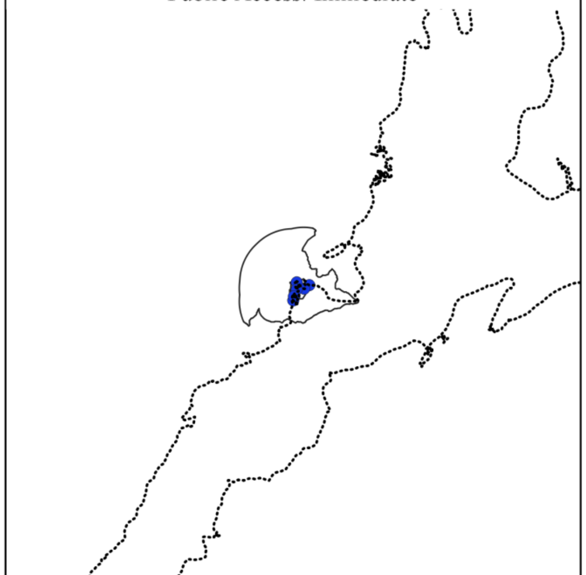
Public Access Areas (#)
Terresterial: 7 Marine: 7

Land Cover Dominance
Forest 68%

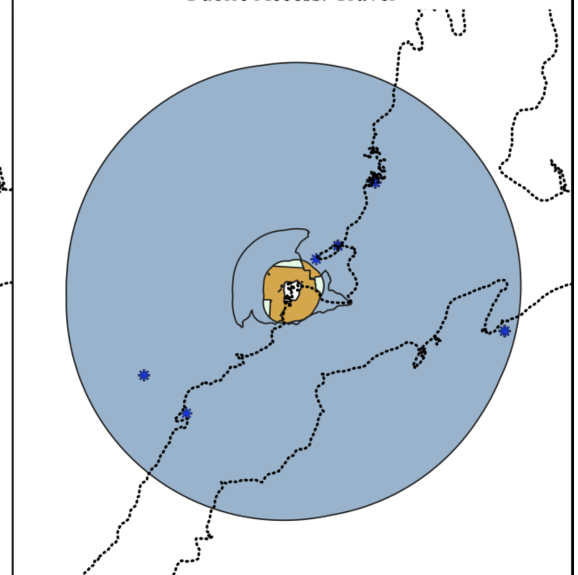
Impervious Surface Dominance
0-20% Density 95%

Land Use Dominance
Forest 58%

Public Access: Immediate

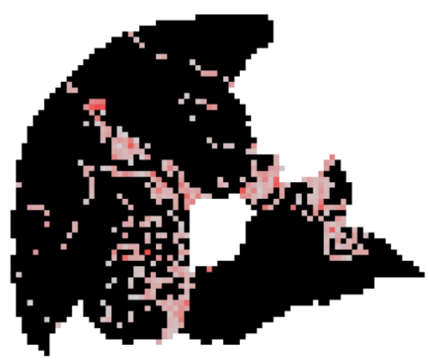


Public Access: Travel

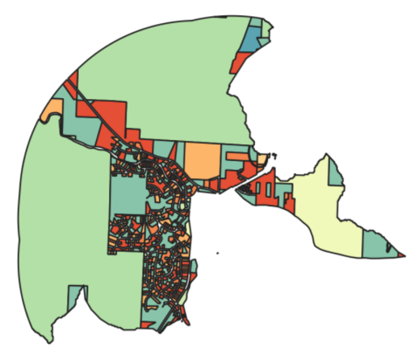


Land Cover

Impervious Surface



Land Use



PNSERP ID
1047

Site Name
Hamma Hamma Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 29 Marine: 0

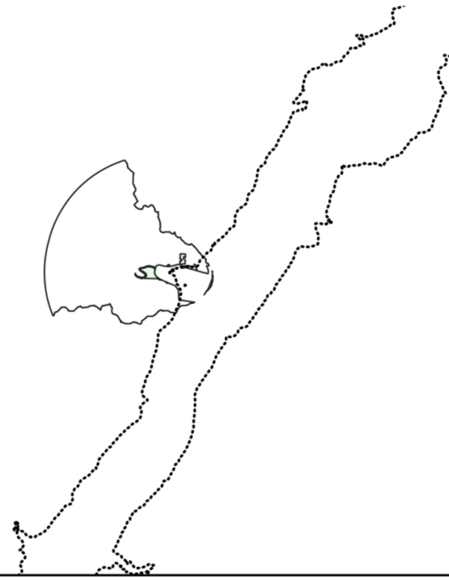
Public Access Areas (#)
Terresterial: 0 Marine: 3

Land Cover Dominance
Forest 85%

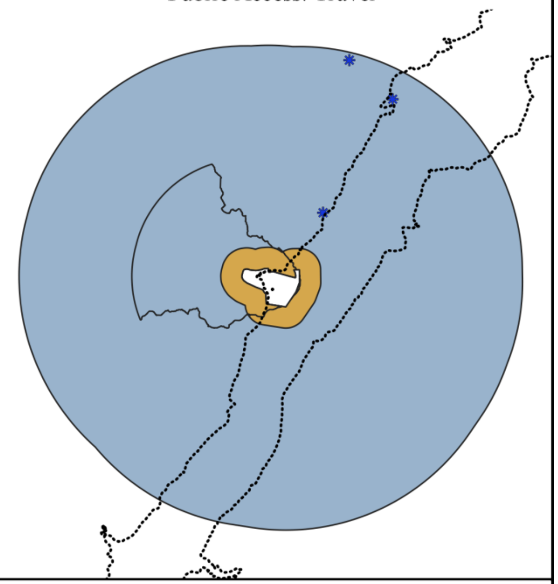
Impervious Surface Dominance
0-20% Density 100%

Land Use Dominance
Forest 97%

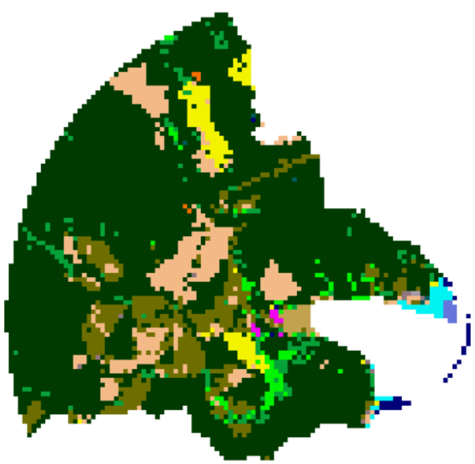
Public Access: Immediate



Public Access: Travel

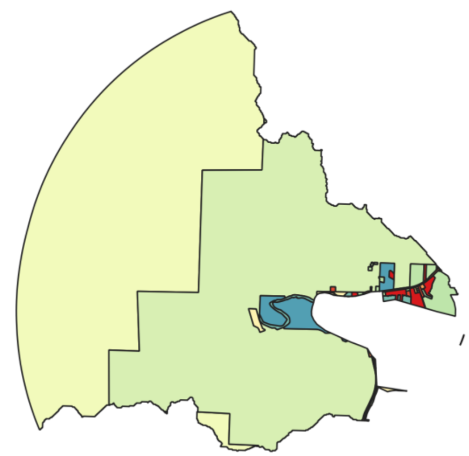


Land Cover



Impervious Surface

Land Use



PNSERP ID
1055

Site Name
Nooksack River Delta

Publicly Accessible Perimeter (%)
Terresterial: 22   Marine: 0

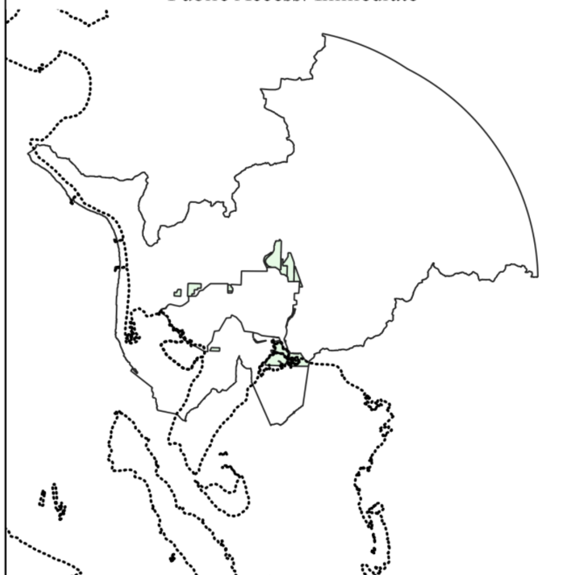
Public Access Areas (#)
Terresterial: 5   Marine: 4

Land Cover Dominance
Open   44%

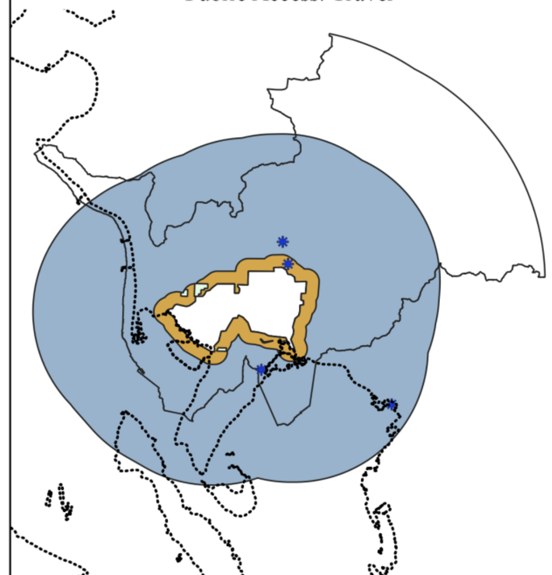
Impervious Surface Dominance
0-20% Density   88%

Land Use Dominance
Open   64%

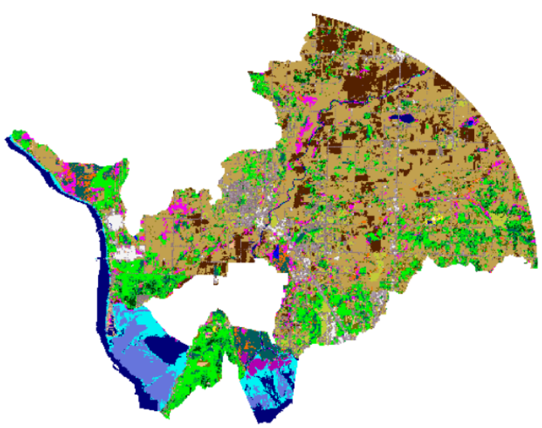
Public Access: Immediate



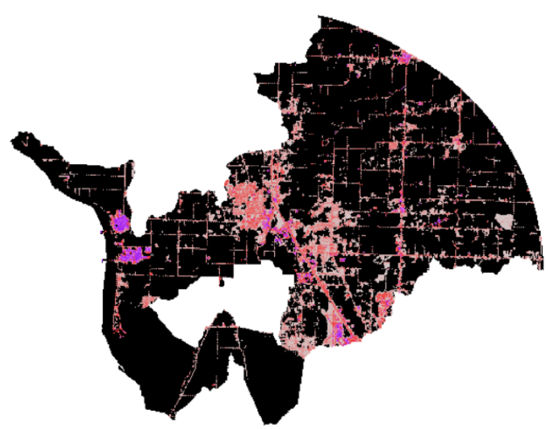
Public Access: Travel



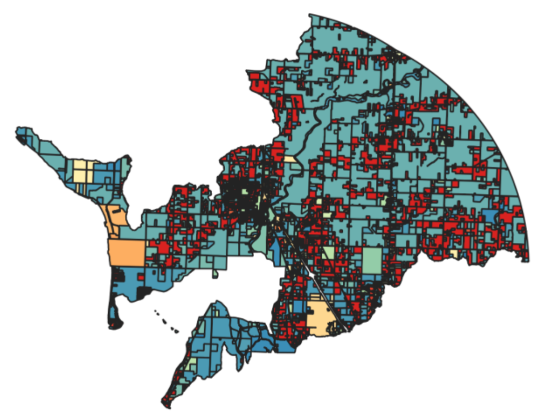
Land Cover



Impervious Surface



Land Use



PNSERP ID
1076

Site Name
Big Quilcene River Restoration

Publicly Accessible Perimeter (%)
Terresterial: 70 Marine: 69

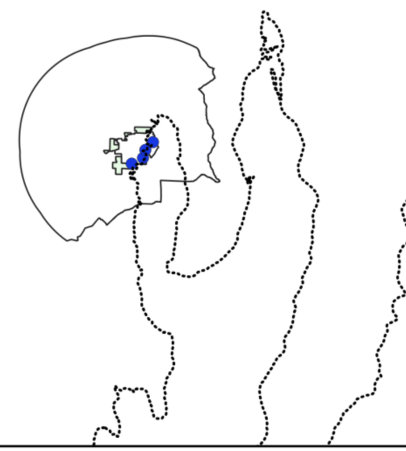
Public Access Areas (#)
Terresterial: 7 Marine: 5

Land Cover Dominance
Forest 70%

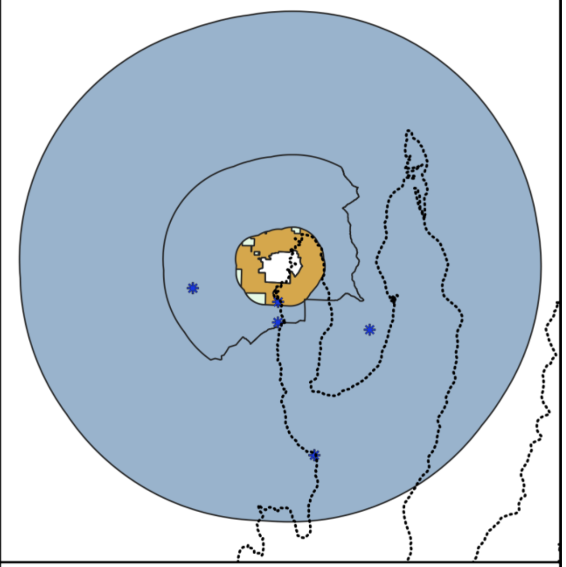
Impervious Surface Dominance
0-20% Density 97%

Land Use Dominance
Forest 57%

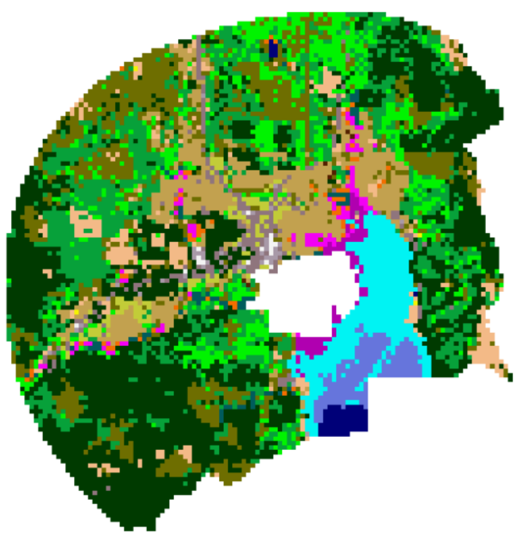
Public Access: Immediate



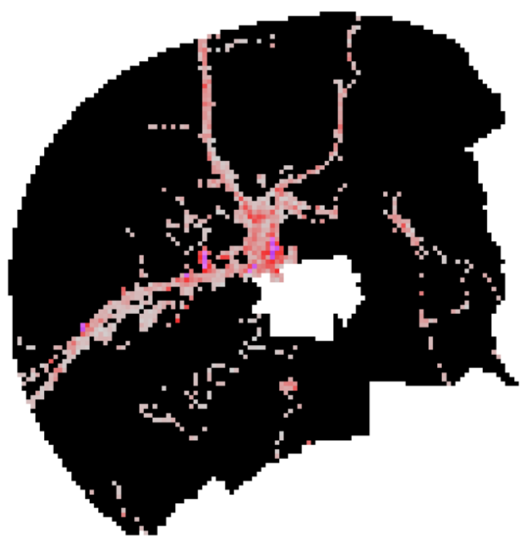
Public Access: Travel



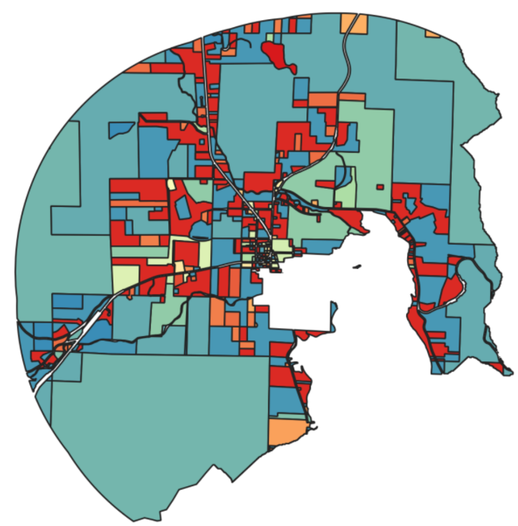
Land Cover



Impervious Surface



Land Use



PNSERP ID
1091

Site Name
Milltown Island

Publicly Accessible Perimeter (%)
Terresterial: 96 Marine: 100

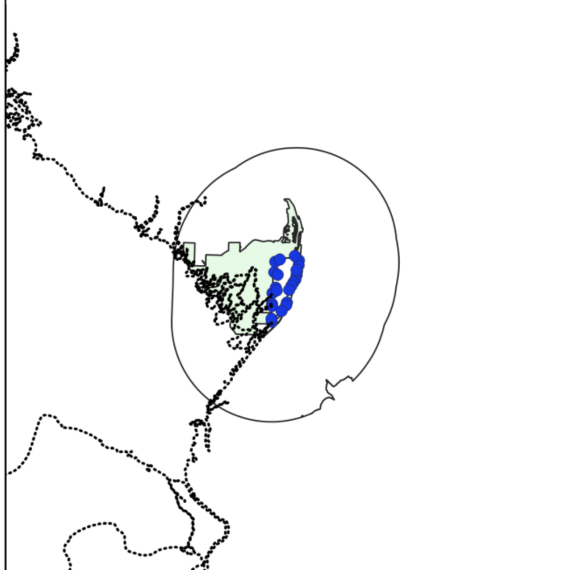
Public Access Areas (#)
Terresterial: 1 Marine: 9

Land Cover Dominance
Open 42%

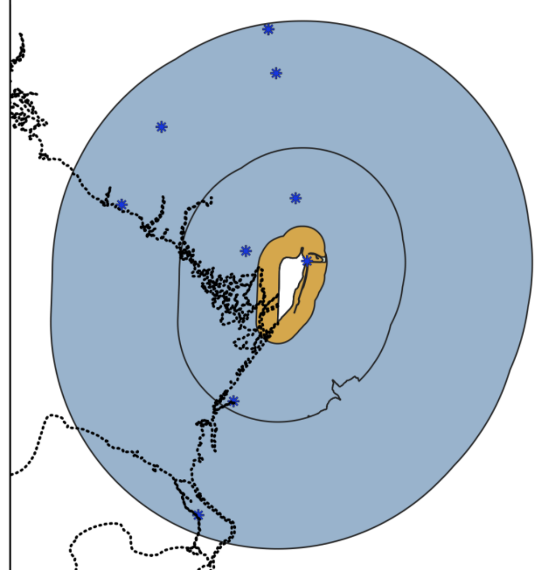
Impervious Surface Dominance
0-20% Density 92%

Land Use Dominance
Open 70%

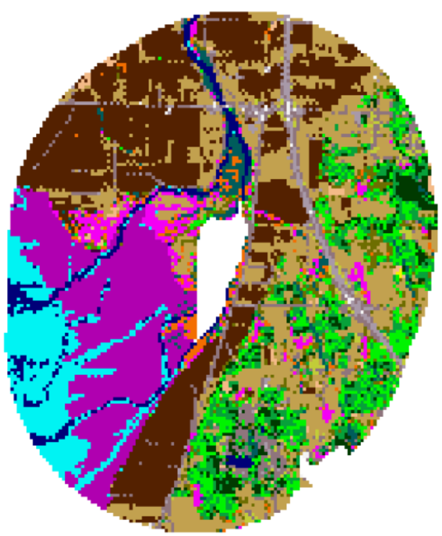
Public Access: Immediate



Public Access: Travel

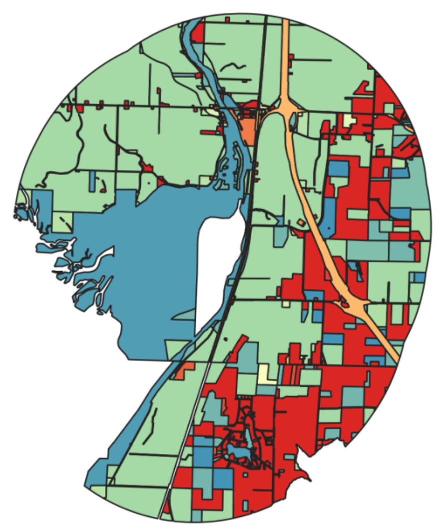


Land Cover



Impervious Surface

Land Use



PNSERP ID
1092

Site Name
McGlinn Island

Publicly Accessible Perimeter (%)
Terresterial: 13 Marine: 16

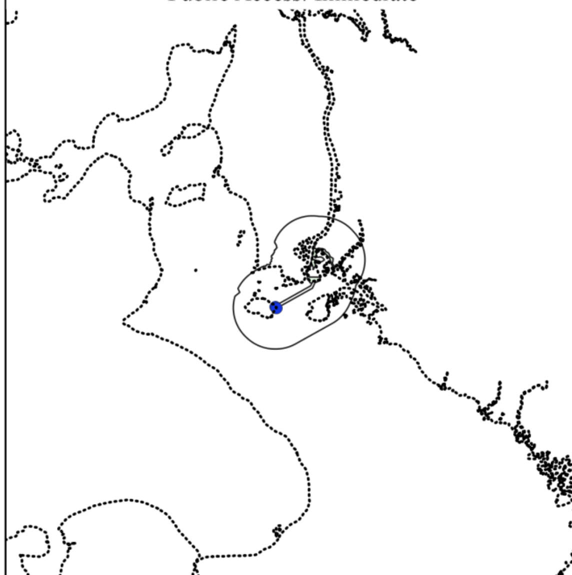
Public Access Areas (#)
Terresterial: 5 Marine: 8

Land Cover Dominance
Aquatic 53%

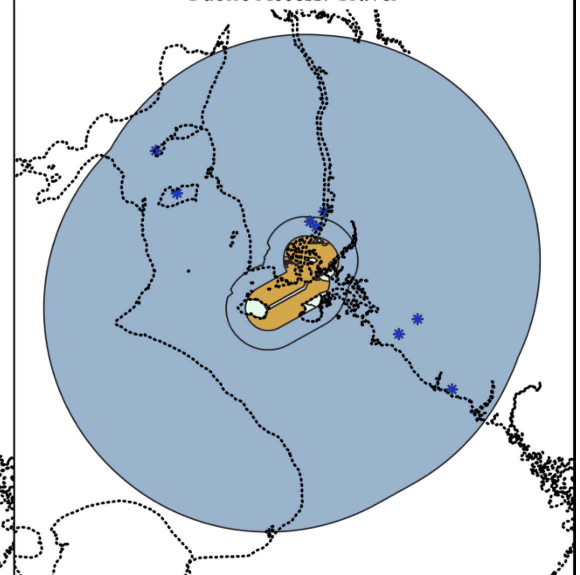
Impervious Surface Dominance
0-20% Density 89%

Land Use Dominance
Open 57%

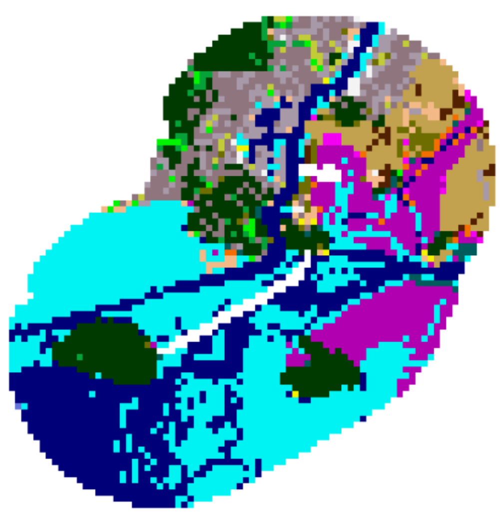
Public Access: Immediate



Public Access: Travel



Land Cover



Impervious Surface

Land Use

PNSERP ID
1101

Site Name
Deepwater Slough

Publicly Accessible Perimeter (%)
Terresterial: 100   Marine: 100

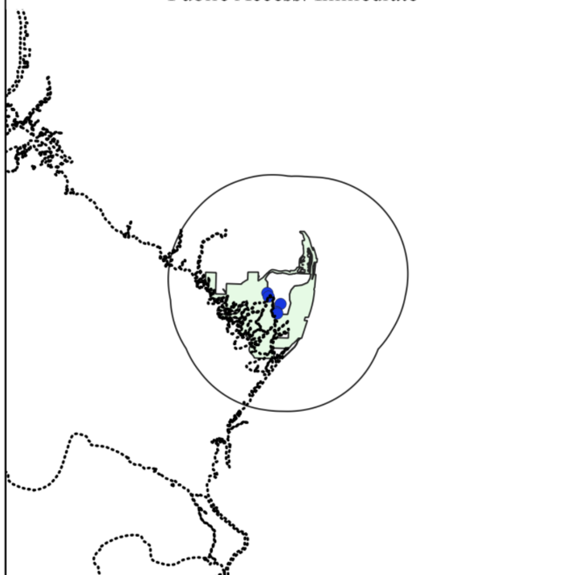
Public Access Areas (#)
Terresterial: 2   Marine: 10

Land Cover Dominance
Open   45%

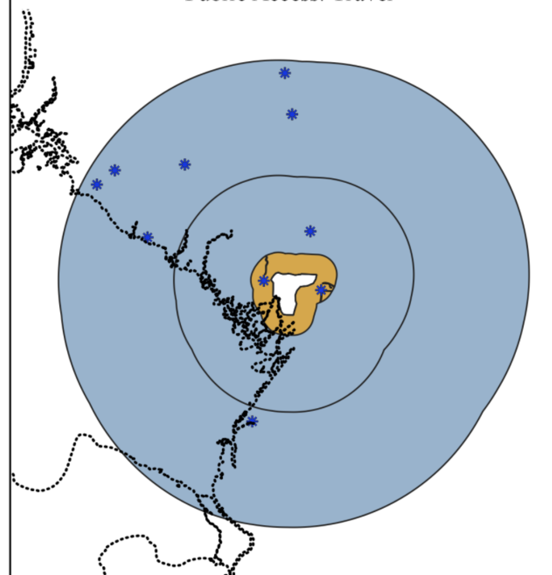
Impervious Surface Dominance
0-20% Density   93%

Land Use Dominance
Open   73%

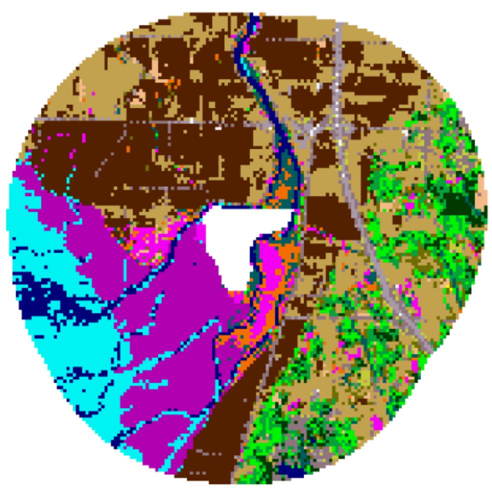
Public Access: Immediate



Public Access: Travel



Land Cover



Impervious Surface

Land Use

PNSERP ID
1102

Site Name
North Fork Levee Setback

Publicly Accessible Perimeter (%)
Terresterial: 31 Marine: 100

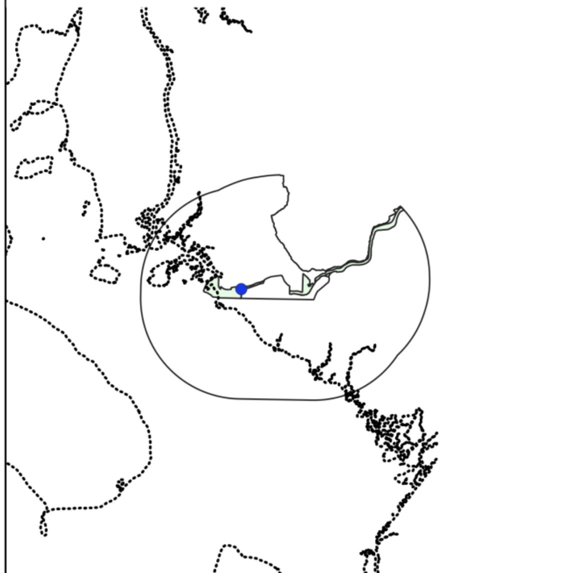
Public Access Areas (#)
Terresterial: 3 Marine: 8

Land Cover Dominance
Open 47%

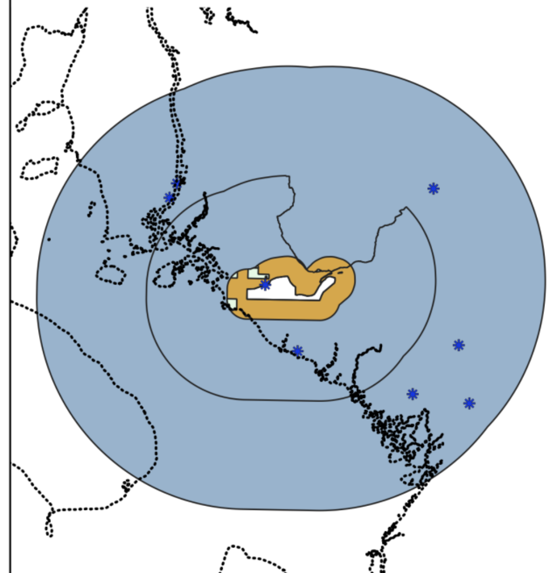
Impervious Surface Dominance
0-20% Density 97%

Land Use Dominance
Open 87%

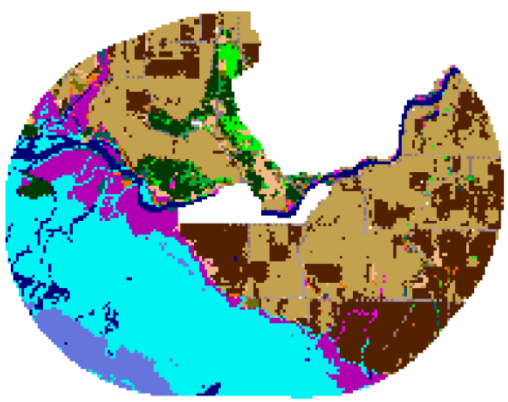
Public Access: Immediate



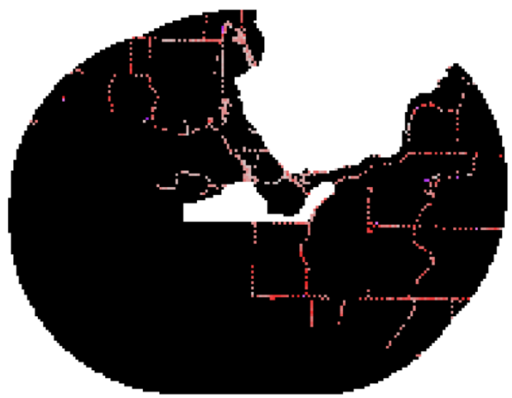
Public Access: Travel



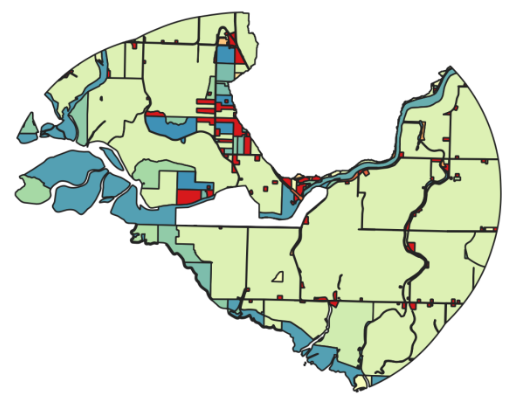
Land Cover



Impervious Surface



Land Use



PNSERP ID
1126

Site Name
Everett Marshland Tidal Wetland

Publicly Accessible Perimeter (%)
Terresterial: 16 Marine: 100

Public Access Areas (#)
Terresterial: 1 Marine: 5

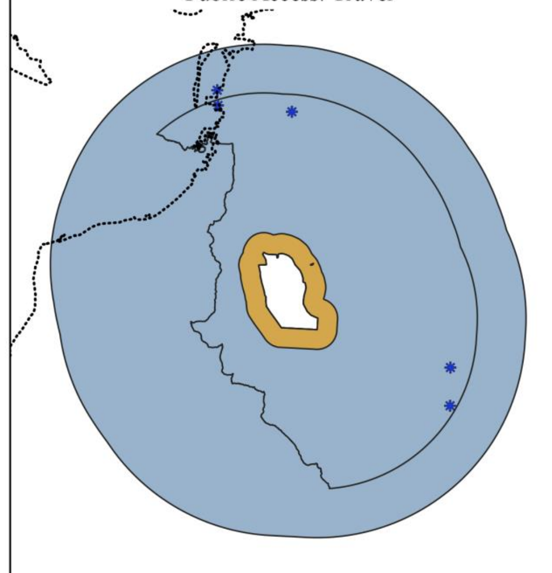
Land Cover Dominance
Developed 43%

Impervious Surface Dominance
0-20% Density 64%

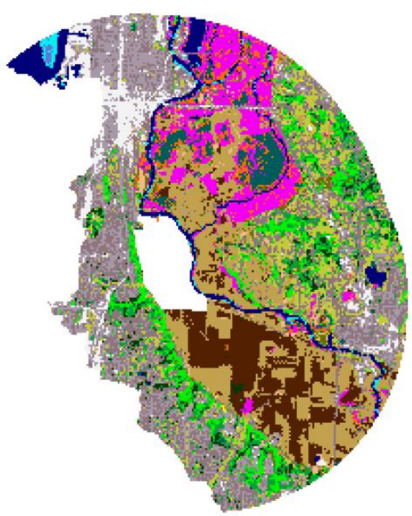
Land Use Dominance
Open 54%

Public Access: Immediate

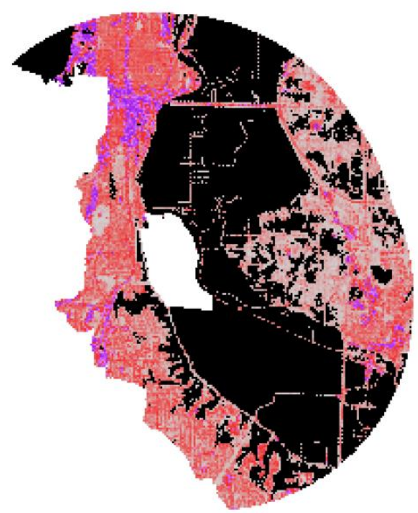
Public Access: Travel



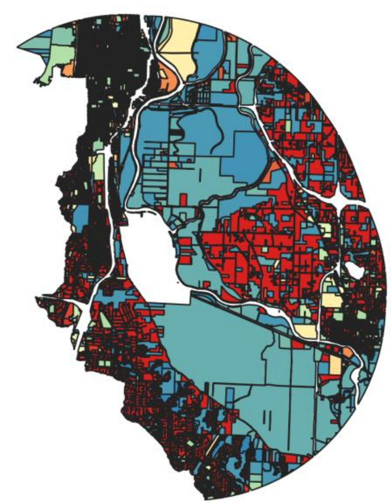
Land Cover



Impervious Surface



Land Use



PNSERP ID
1127

Site Name
Everett Riverfront Wetland Complexes

Publicly Accessible Perimeter (%)
Terresterial: 37 Marine: 100

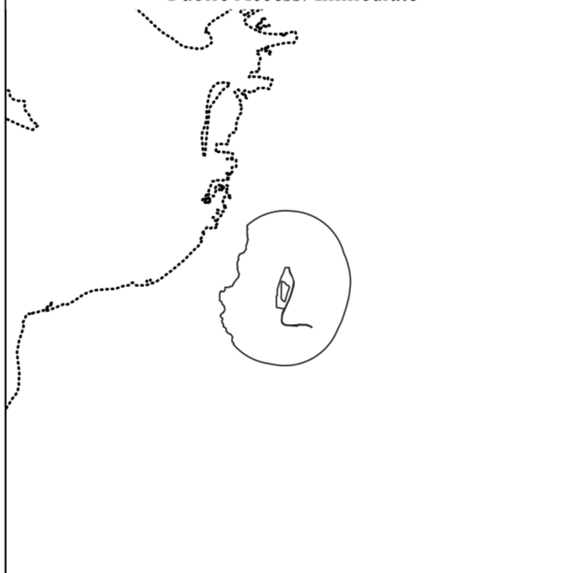
Public Access Areas (#)
Terresterial: 4 Marine: 3

Land Cover Dominance
Developed 45%

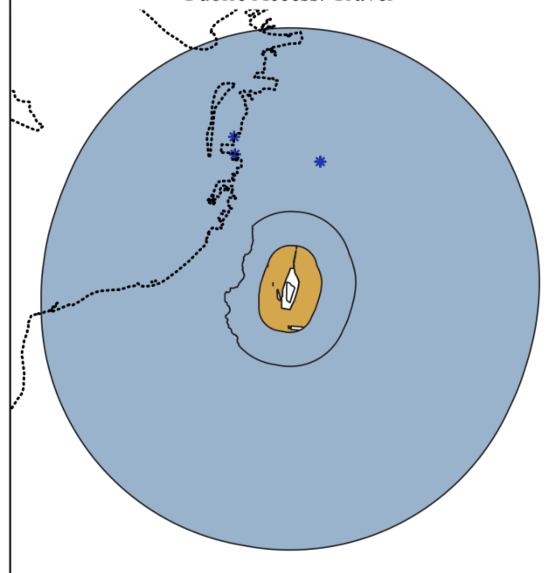
Impervious Surface Dominance
0-20% Density 57%

Land Use Dominance
Open 64%

Public Access: Immediate

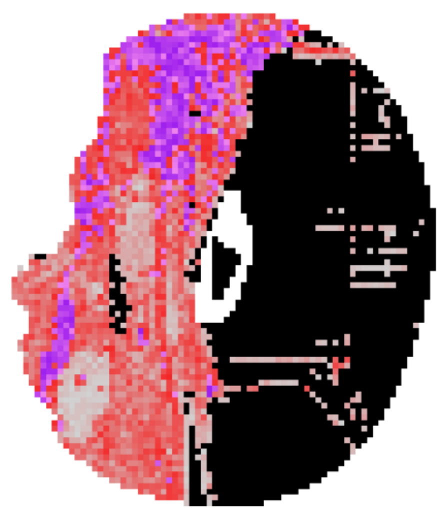


Public Access: Travel

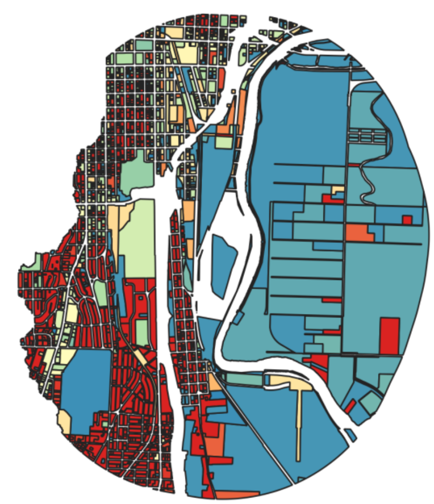


Land Cover

Impervious Surface



Land Use



PNSERP ID
1136

Site Name
Quilceda Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 0 Marine: 100

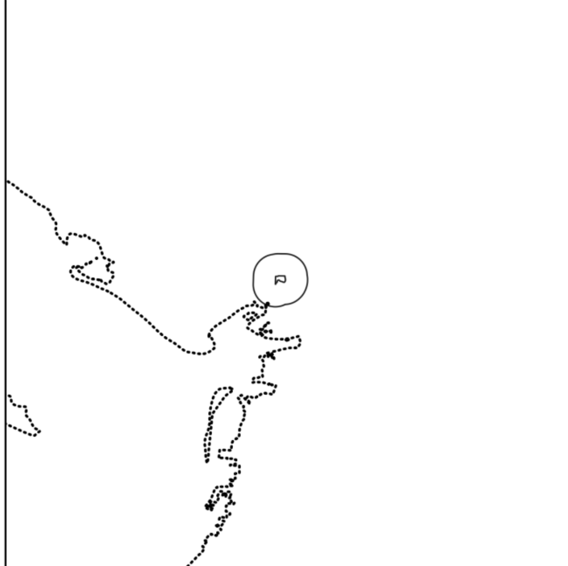
Public Access Areas (#)
Terresterial: 2 Marine: 4

Land Cover Dominance
Wetland 43%

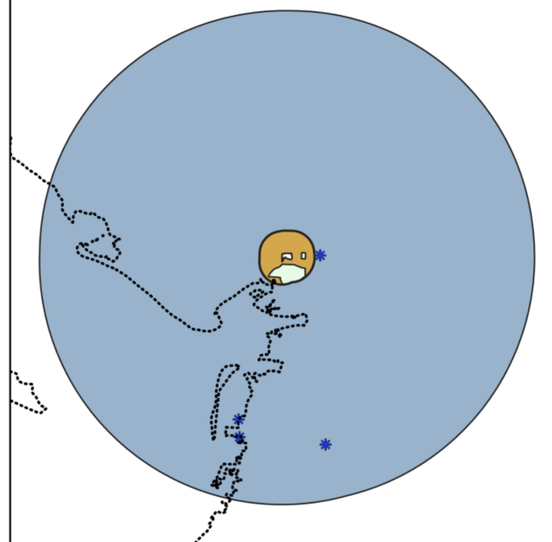
Impervious Surface Dominance
0-20% Density 70%

Land Use Dominance
Developed 51%

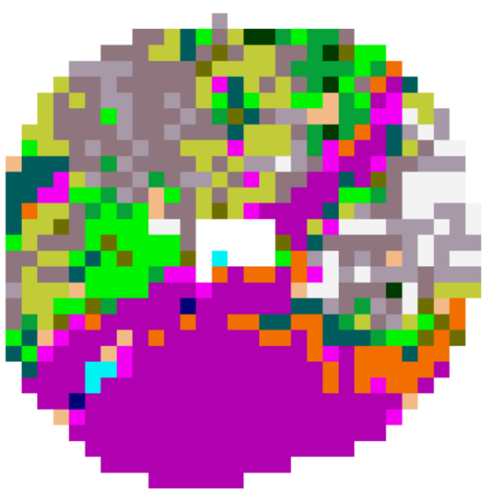
Public Access: Immediate



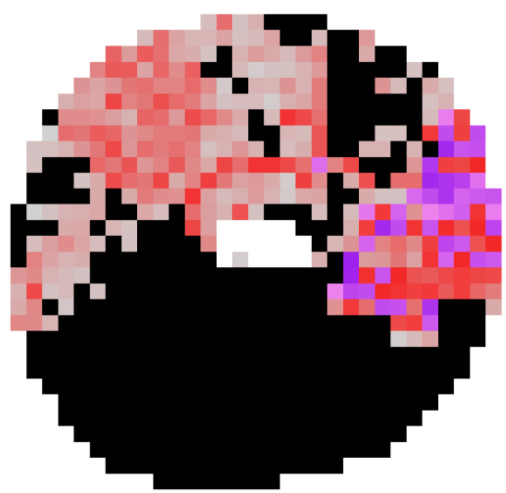
Public Access: Travel



Land Cover



Impervious Surface



Land Use

PNSERP ID
1142

Site Name
Smith Island Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 0 Marine: 100

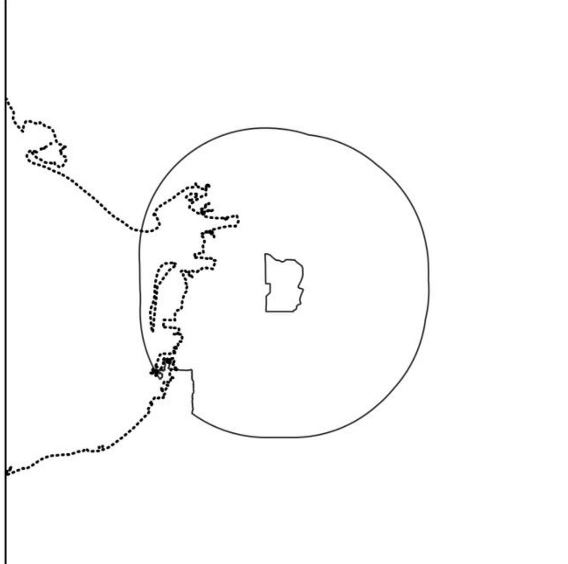
Public Access Areas (#)
Terresterial: 6 Marine: 4

Land Cover Dominance
Developed 43%

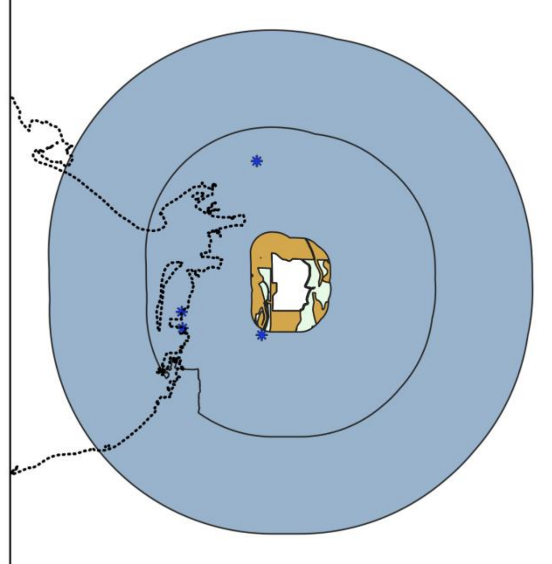
Impervious Surface Dominance
0-20% Density 65%

Land Use Dominance
Open 52%

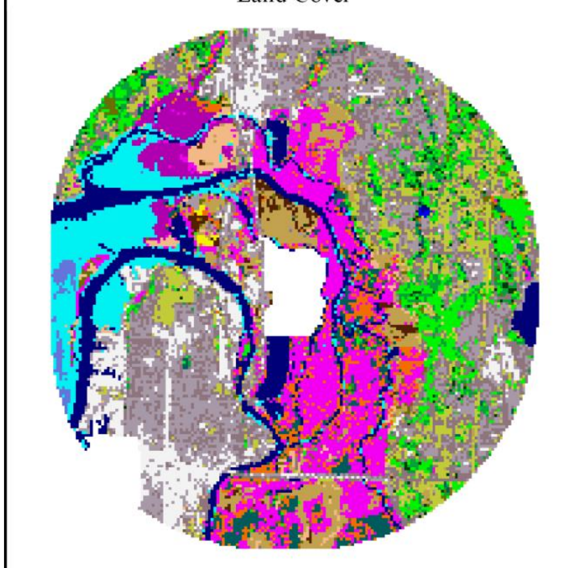
Public Access: Immediate



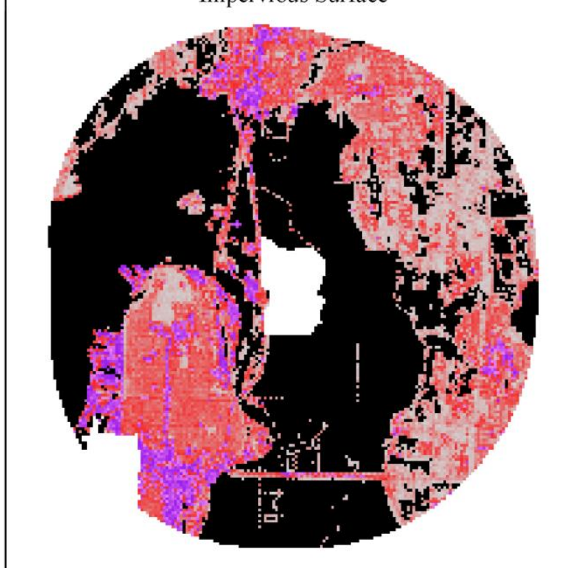
Public Access: Travel



Land Cover



Impervious Surface



Land Use

PNSERP ID
1149

Site Name
Spencer Island Restoration

Publicly Accessible Perimeter (%)
Terresterial: 24 Marine: 100

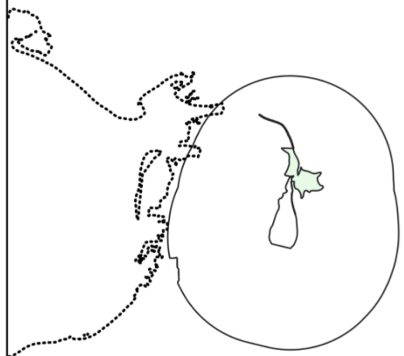
Public Access Areas (#)
Terresterial: 3 Marine: 4

Land Cover Dominance
Developed 42%

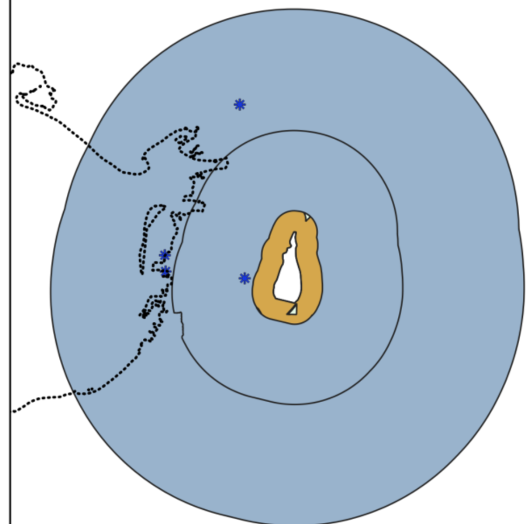
Impervious Surface Dominance
0-20% Density 66%

Land Use Dominance
Open 56%

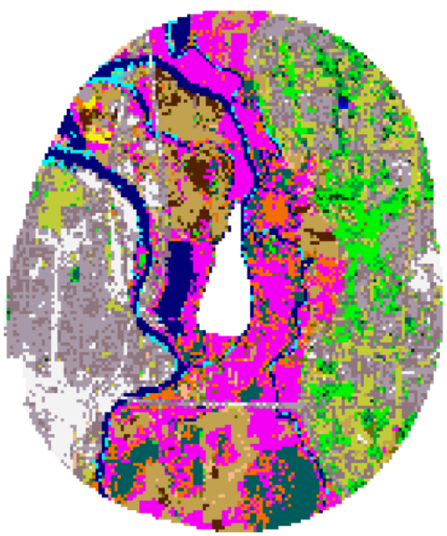
Public Access: Immediate



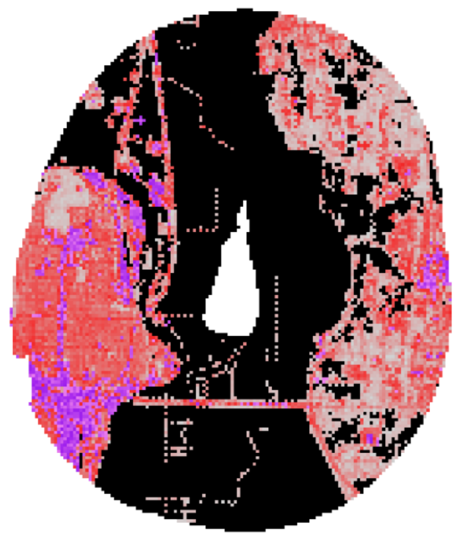
Public Access: Travel



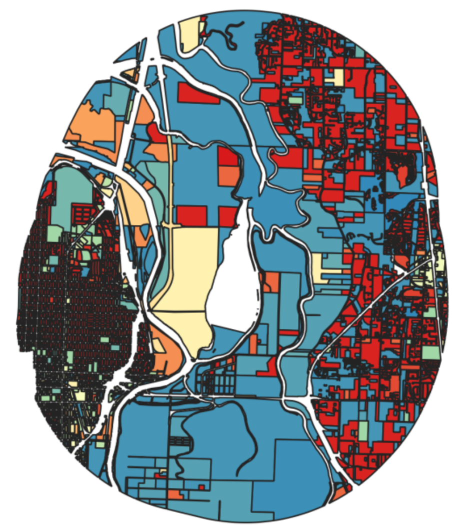
Land Cover



Impervious Surface



Land Use



PNSERP ID
1190

Site Name
Nearshore Restoration for Twin Rivers

Publicly Accessible Perimeter (%)
Terresterial: 0 Marine: 100

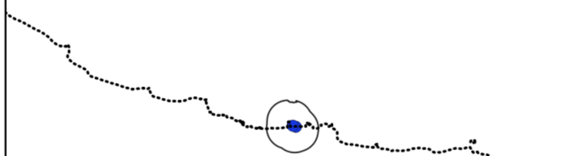
Public Access Areas (#)
Terresterial: 2 Marine: 0

Land Cover Dominance
Aquatic 54%

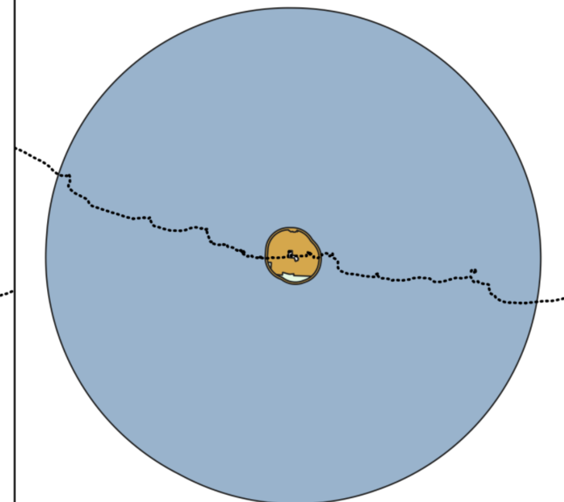
Impervious Surface Dominance
0-20% Density 97%

Land Use Dominance
Open 58%

Public Access: Immediate



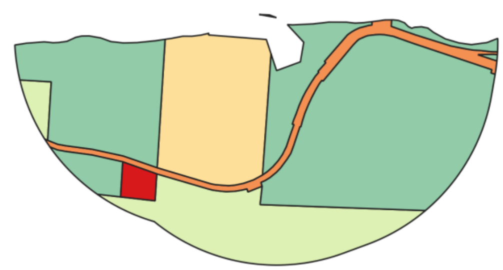
Public Access: Travel



Land Cover

Impervious Surface

Land Use



PNSERP ID
1230

Site Name
Snow Creek and Salmon Creek Estuary

Publicly Accessible Perimeter (%)
Terresterial: 0 Marine: 73

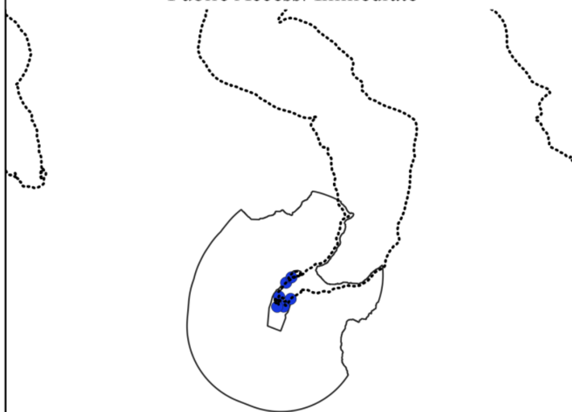
Public Access Areas (#)
Terresterial: 4 Marine: 1

Land Cover Dominance
Forest 83%

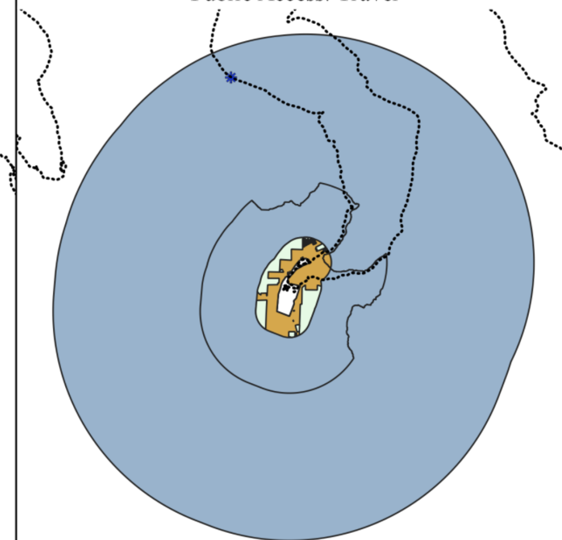
Impervious Surface Dominance
0-20% Density 99%

Land Use Dominance
Forest 76%

Public Access: Immediate



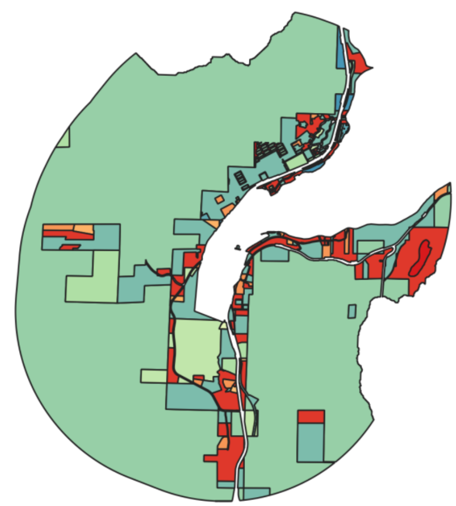
Public Access: Travel



Land Cover

Impervious Surface

Land Use



PNSERP ID
1237

Site Name
Washington Harbor Tidal Hydrology

Publicly Accessible Perimeter (%)
Terresterial: 14 Marine: 16

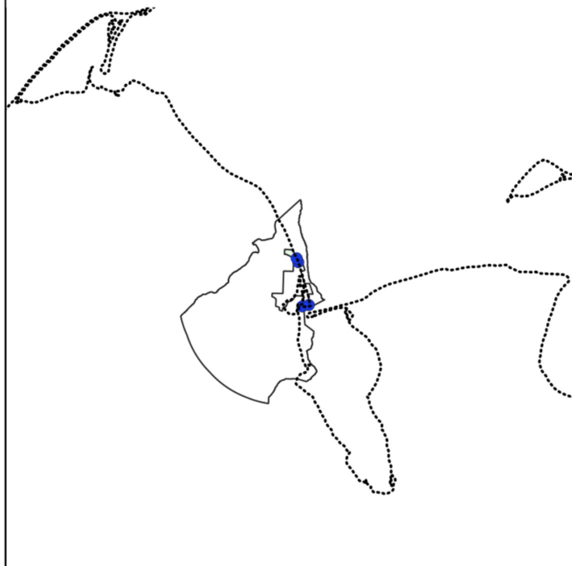
Public Access Areas (#)
Terresterial: 2 Marine: 2

Land Cover Dominance
Open 38%

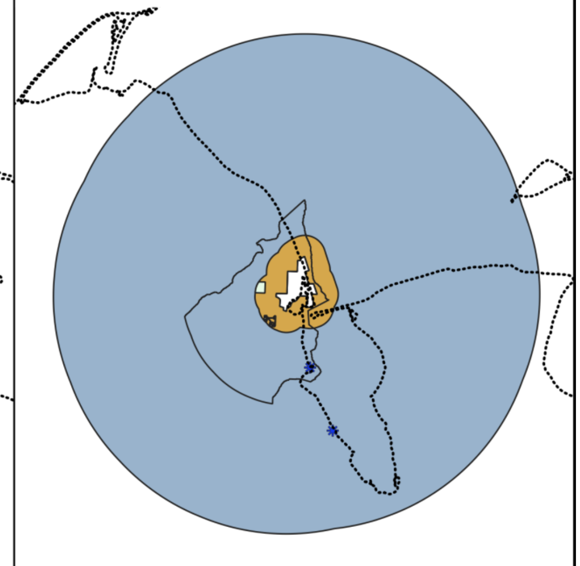
Impervious Surface Dominance
0-20% Density 79%

Land Use Dominance
Open 52%

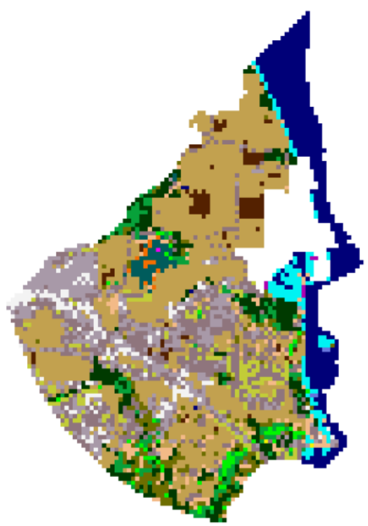
Public Access: Immediate



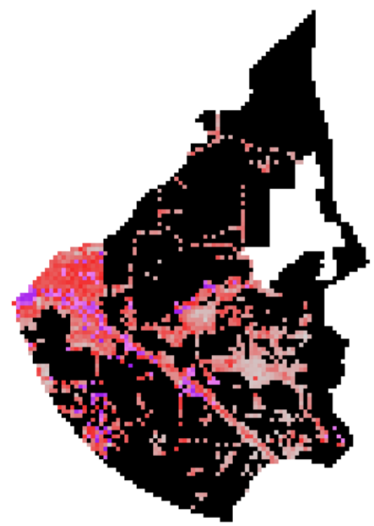
Public Access: Travel



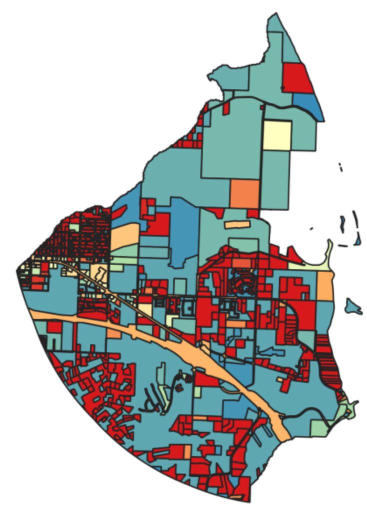
Land Cover



Impervious Surface



Land Use



PNSERP ID
1256

Site Name
Big Beef Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 0 Marine: 2

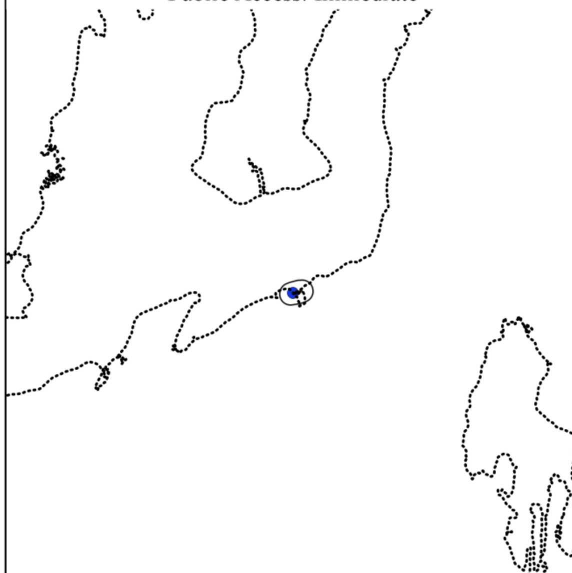
Public Access Areas (#)
Terresterial: 4 Marine: 2

Land Cover Dominance
Aquatic 47%

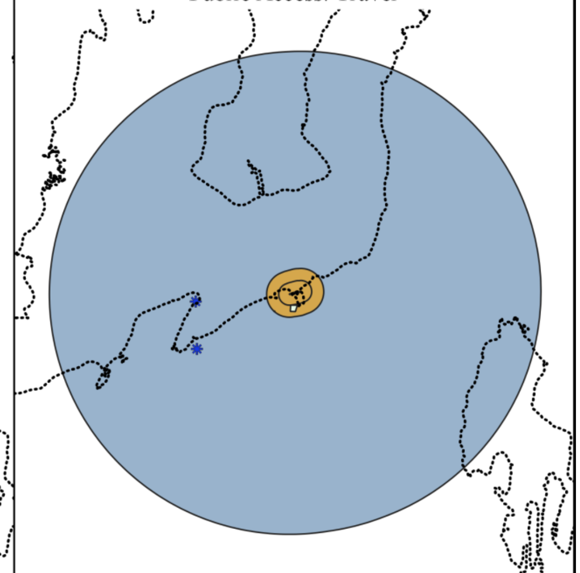
Impervious Surface Dominance
0-20% Density 95%

Land Use Dominance
Developed 91%

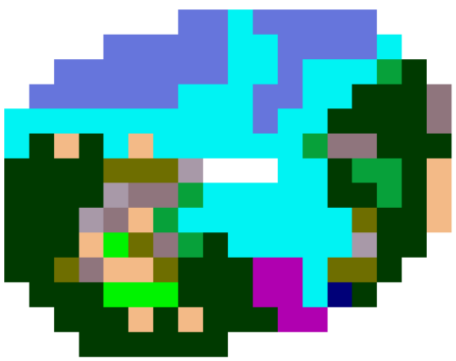
Public Access: Immediate



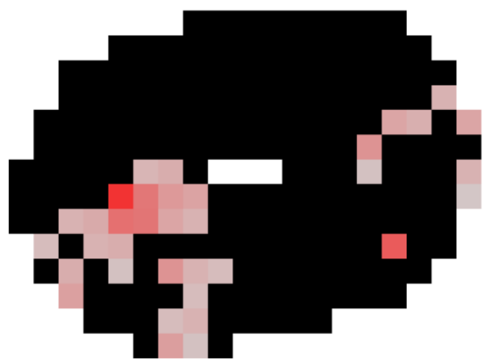
Public Access: Travel



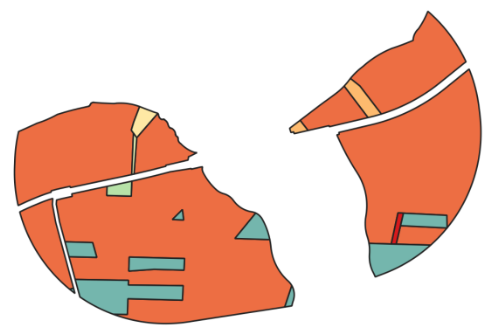
Land Cover



Impervious Surface



Land Use



PNSERP ID
1346

Site Name
Lilliwaup Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 22 Marine: 0

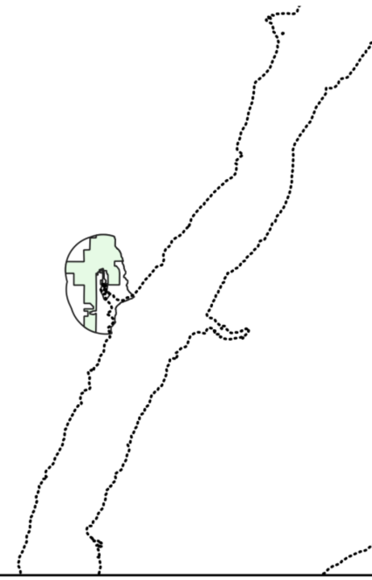
Public Access Areas (#)
Terresterial: 2 Marine: 1

Land Cover Dominance
Forest 86%

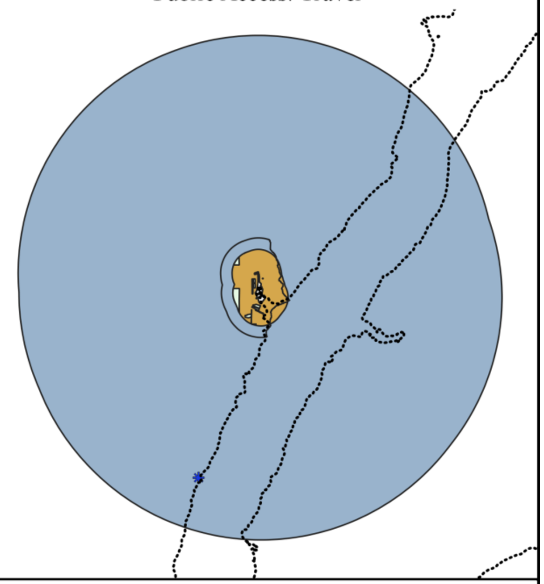
Impervious Surface Dominance
0-20% Density 99%

Land Use Dominance
Forest 73%

Public Access: Immediate



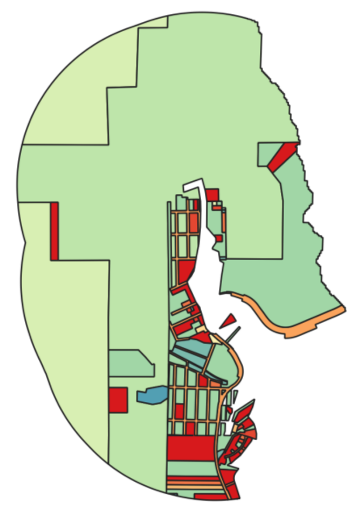
Public Access: Travel



Land Cover

Impervious Surface

Land Use



PNSERP ID
1379

Site Name
Point Whitney

Publicly Accessible Perimeter (%)
Terresterial: 0 Marine: 100

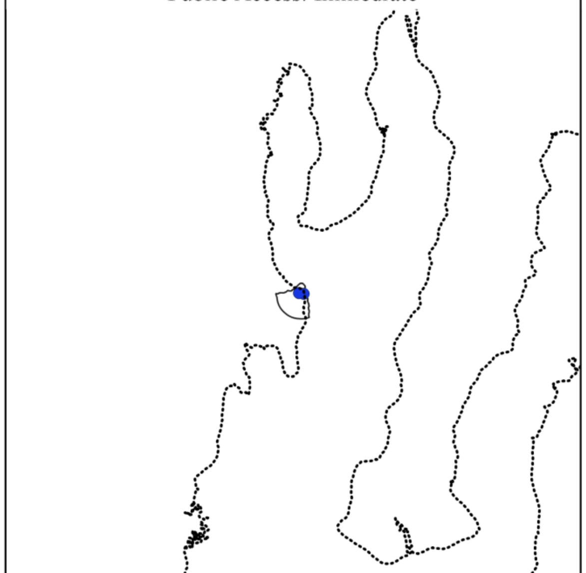
Public Access Areas (#)
Terresterial: 3 Marine: 5

Land Cover Dominance
Forest 73%

Impervious Surface Dominance
0-20% Density 100%

Land Use Dominance
Forest 43%

Public Access: Immediate



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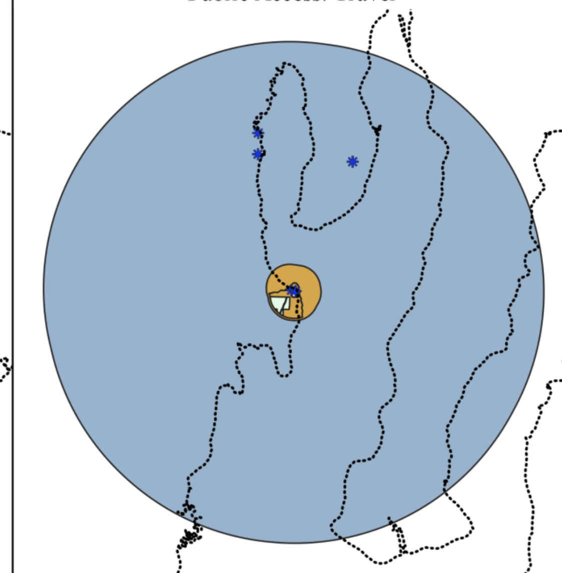
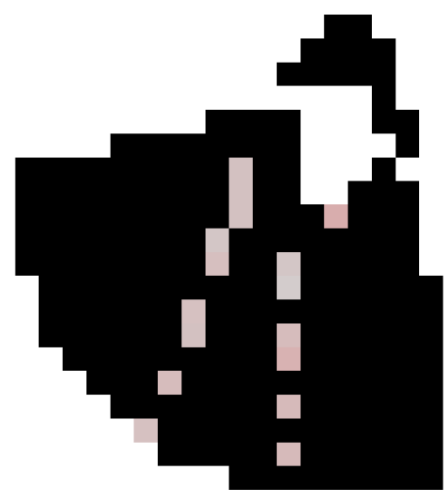
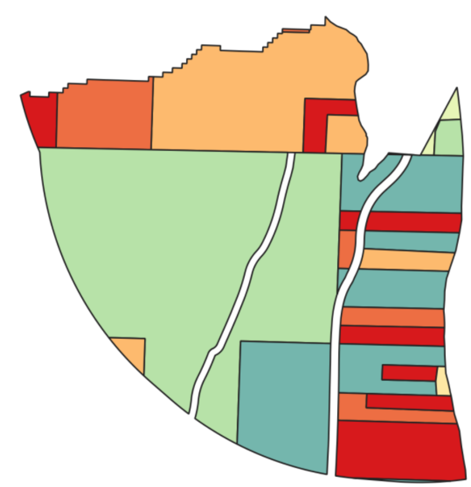


Land Cover

Impervious Surface



Land Use



PNSERP ID
1404

Site Name
Tahuya Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 53 Marine: 100

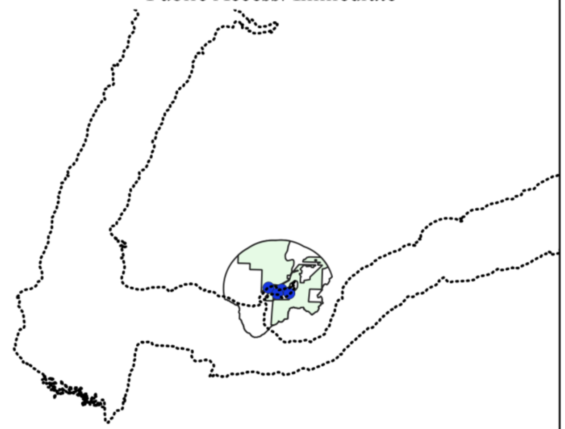
Public Access Areas (#)
Terresterial: 3 Marine: 4

Land Cover Dominance
Forest 72%

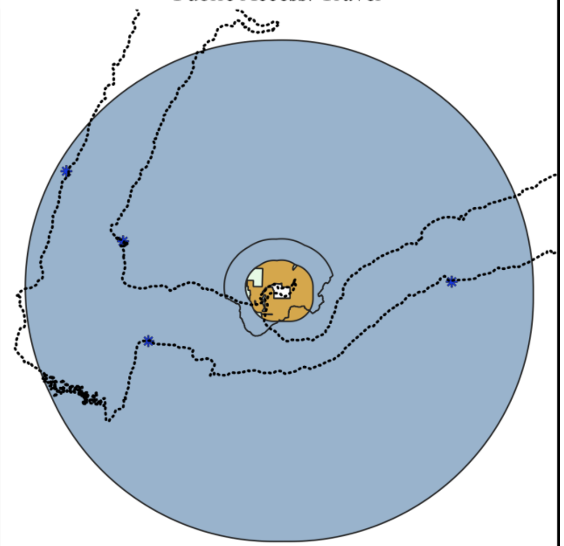
Impervious Surface Dominance
0-20% Density 99%

Land Use Dominance
Forest 74%

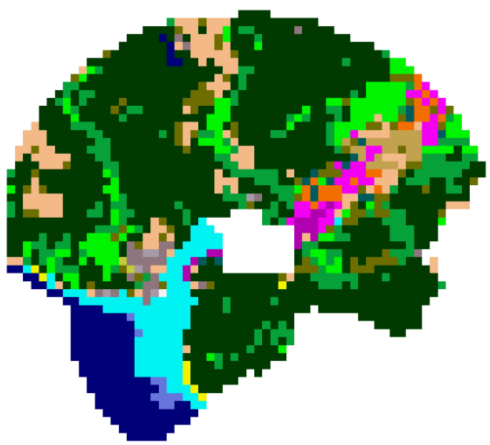
Public Access: Immediate



Public Access: Travel

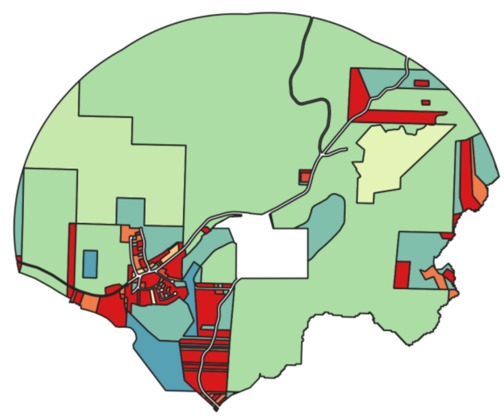


Land Cover



Impervious Surface

Land Use



PNSERP ID
1421

Site Name
Twanoh State Park Beach Restoration

Publicly Accessible Perimeter (%)
Terresterial: 4 Marine: 100

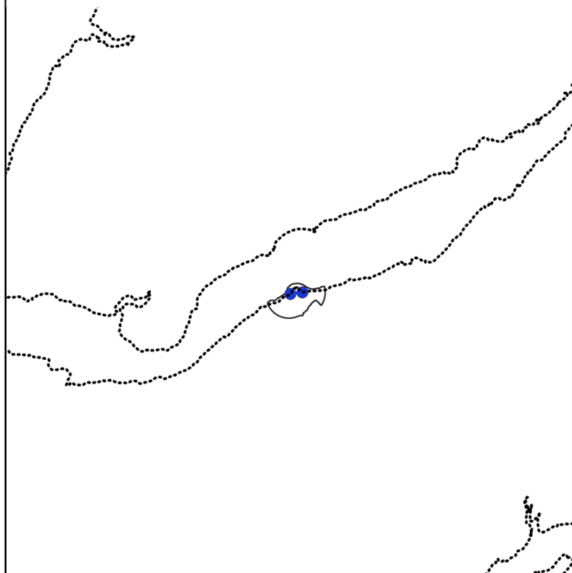
Public Access Areas (#)
Terresterial: 2 Marine: 2

Land Cover Dominance
Forest 69%

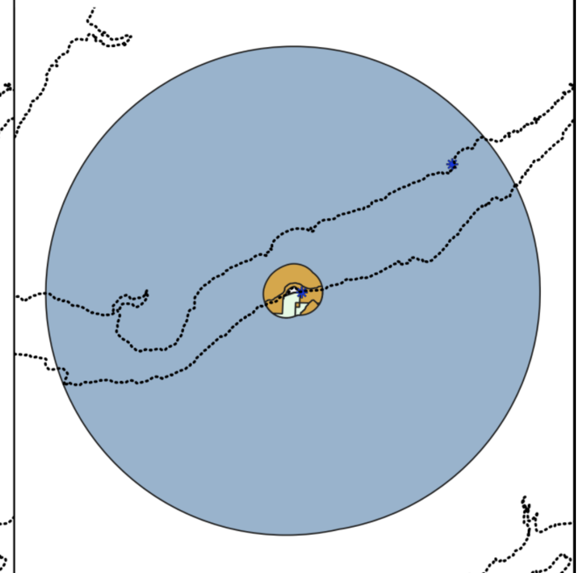
Impervious Surface Dominance
0-20% Density 99%

Land Use Dominance
Open 49%

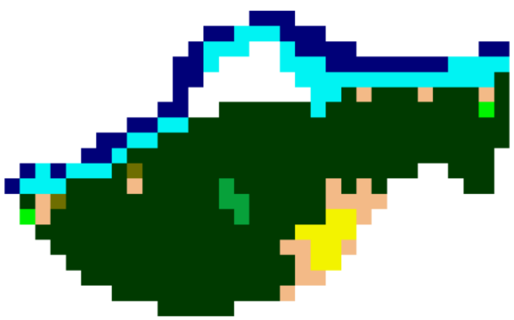
Public Access: Immediate



Public Access: Travel



Land Cover



Impervious Surface

Land Use

PNSERP ID
1447

Site Name
John's Creek Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 6 Marine: 88

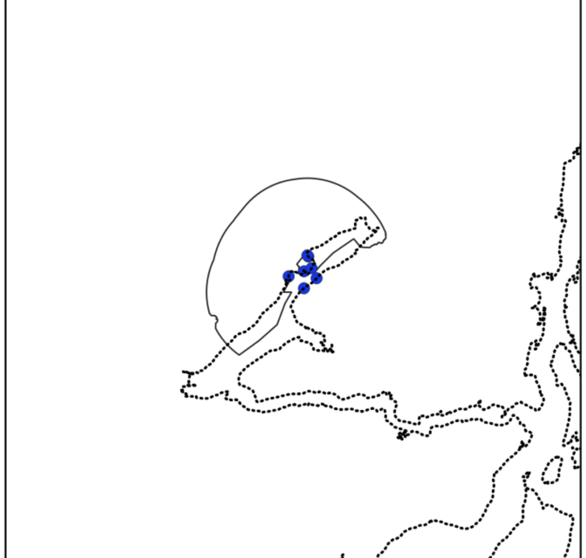
Public Access Areas (#)
Terresterial: 3 Marine: 3

Land Cover Dominance
Forest 55%

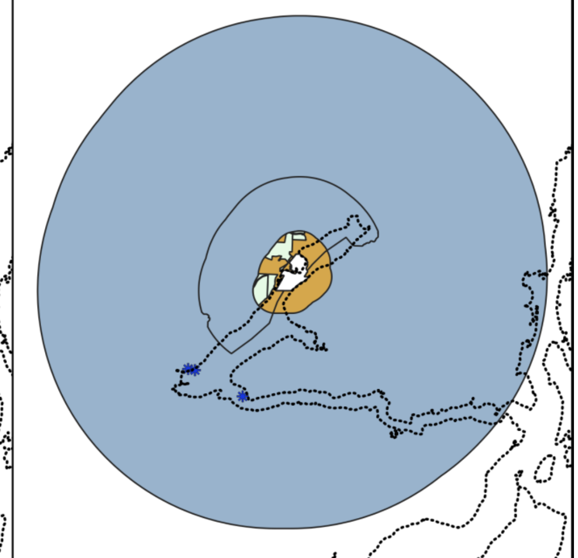
Impervious Surface Dominance
0-20% Density 92%

Land Use Dominance
Forest 51%

Public Access: Immediate



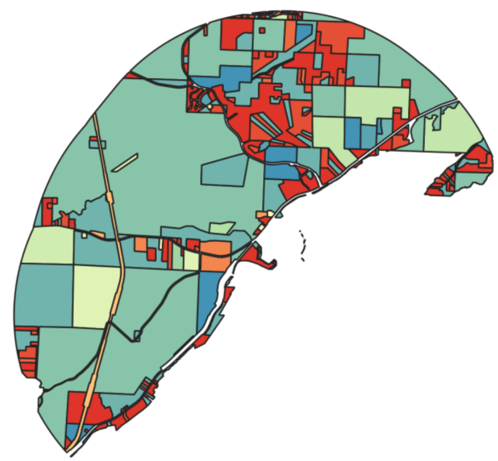
Public Access: Travel



Land Cover

Impervious Surface

Land Use



PNSERP ID
1457

Site Name
Mission Creek Estuary Reconnection

Publicly Accessible Perimeter (%)
Terresterial: 47 Marine: 100

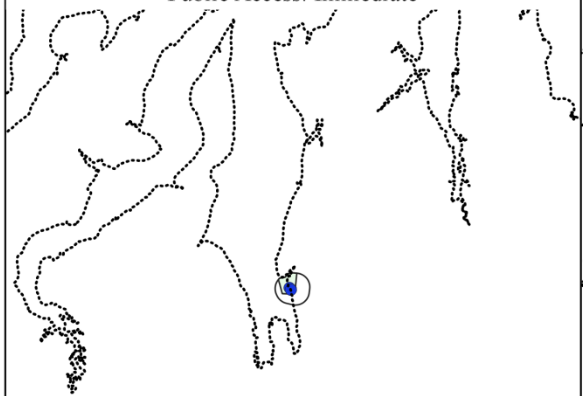
Public Access Areas (#)
Terresterial: 3 Marine: 3

Land Cover Dominance
Forest 44%

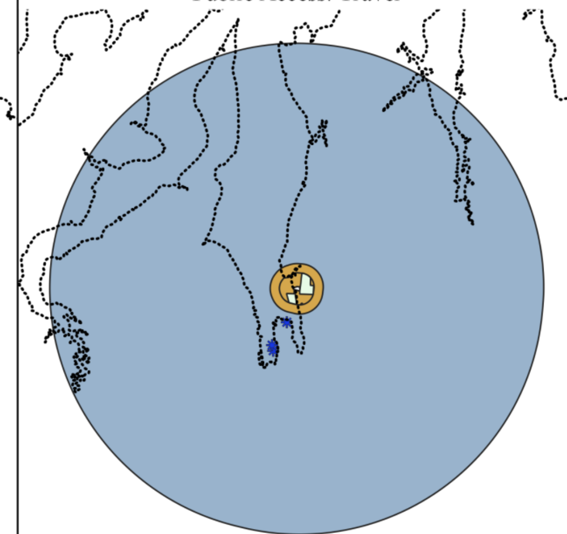
Impervious Surface Dominance
0-20% Density 87%

Land Use Dominance
Open 78%

Public Access: Immediate

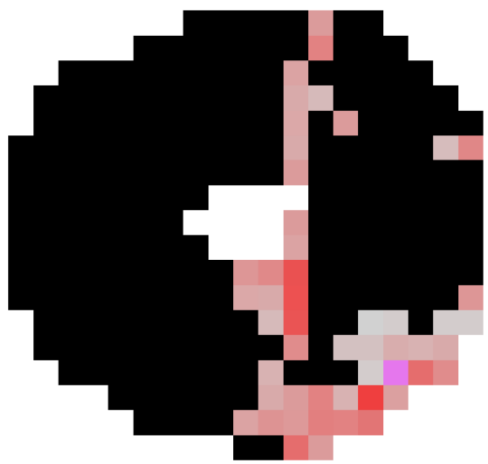


Public Access: Travel

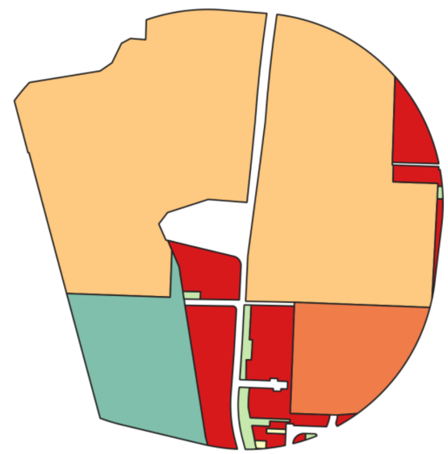


Land Cover

Impervious Surface



Land Use



PNSERP ID
1467

Site Name
Sequalitchew Creek

Publicly Accessible Perimeter (%)
Terresterial: 31 Marine: 0

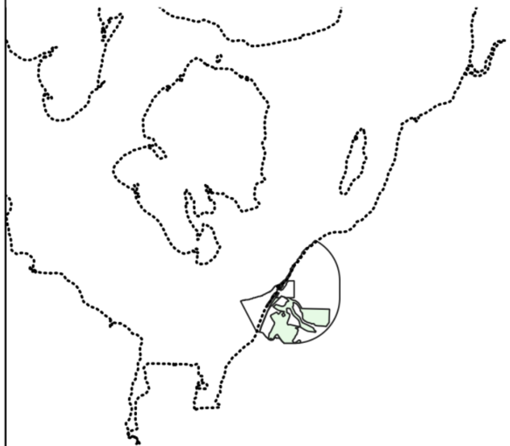
Public Access Areas (#)
Terresterial: 1 Marine: 4

Land Cover Dominance
Developed 42%

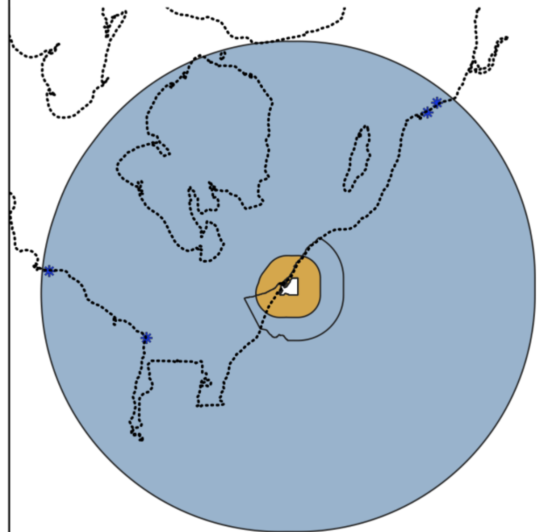
Impervious Surface Dominance
0-20% Density 59%

Land Use Dominance
Open 64%

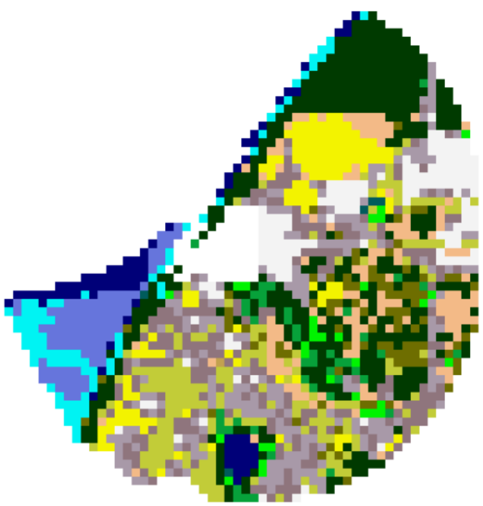
Public Access: Immediate



Public Access: Travel

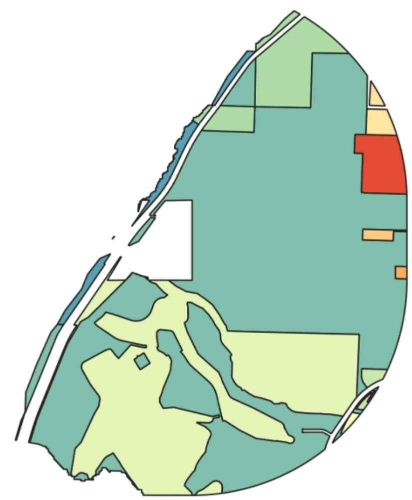


Land Cover



Impervious Surface

Land Use



PNSERP ID
1499

Site Name
Beaconsfield Feeder Bluff Restoration

Publicly Accessible Perimeter (%)
Terresterial: 4   Marine: 0

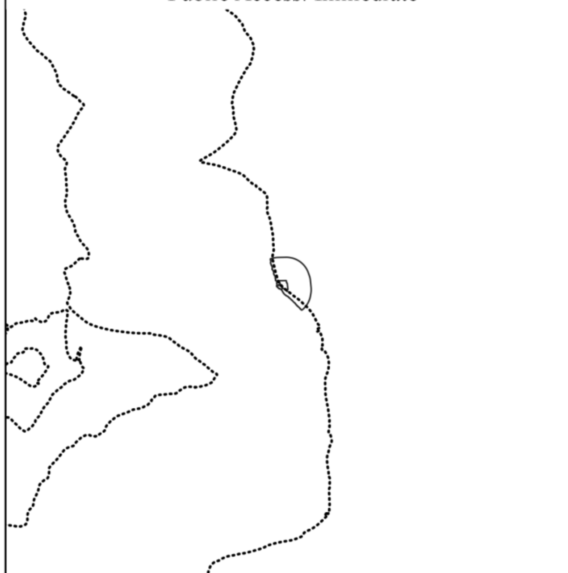
Public Access Areas (#)
Terresterial: 0   Marine: 3

Land Cover Dominance
Forest   47%

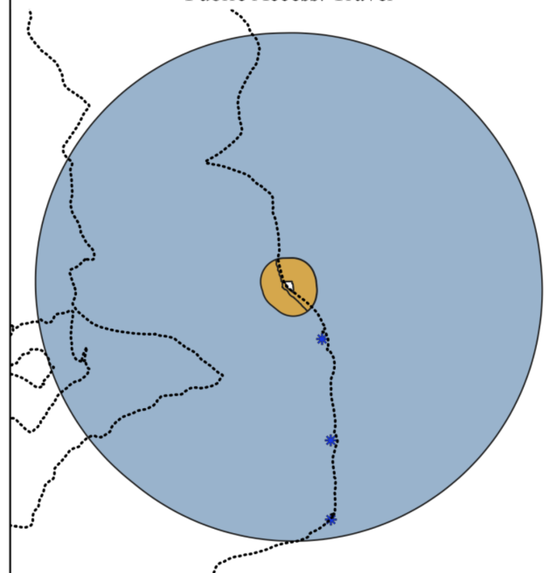
Impervious Surface Dominance
0-20% Density   73%

Land Use Dominance
Developed   78%

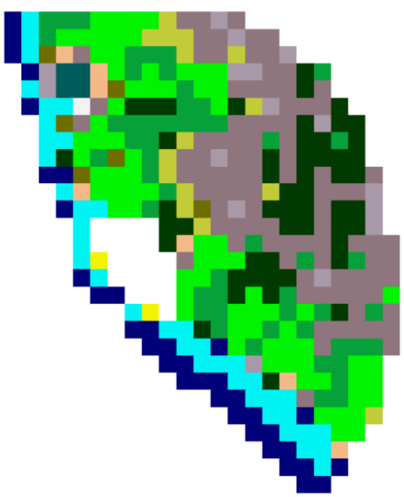
Public Access: Immediate



Public Access: Travel

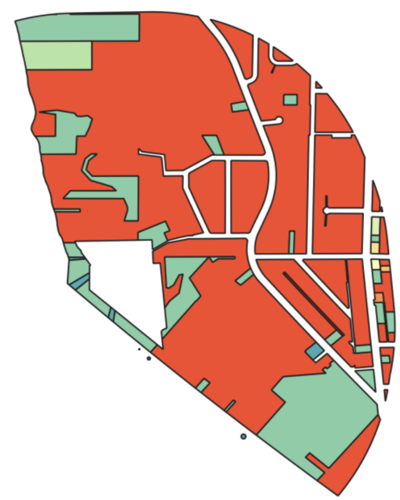


Land Cover



Impervious Surface

Land Use



PNSERP ID
1505

Site Name
Harper Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 2   Marine: 100

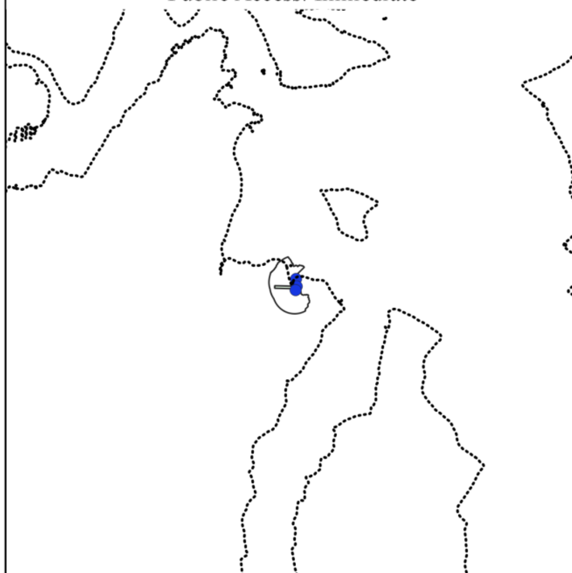
Public Access Areas (#)
Terresterial: 3   Marine: 4

Land Cover Dominance
Forest   63%

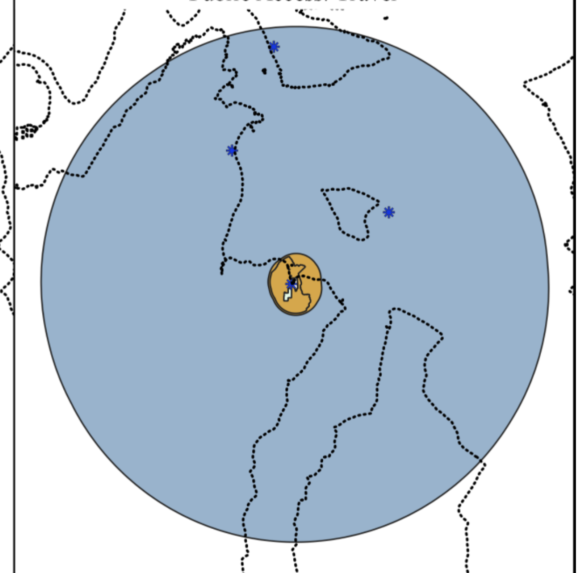
Impervious Surface Dominance
0-20% Density   90%

Land Use Dominance
Developed   66%

Public Access: Immediate



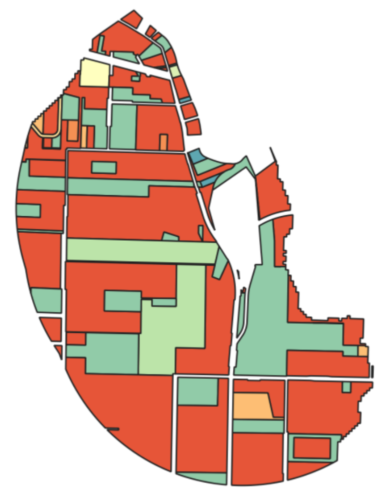
Public Access: Travel



Land Cover

Impervious Surface

Land Use



PNSERP ID
1552

Site Name
Kilisut Harbor / Oak Bay Reconnection

Publicly Accessible Perimeter (%)
Terresterial: 21 Marine: 80

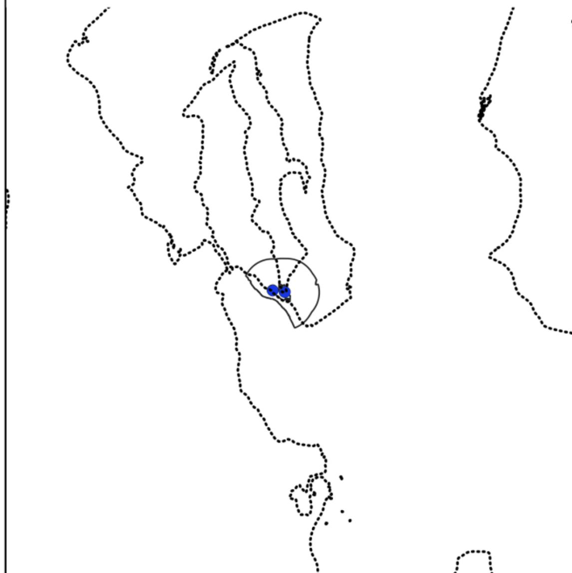
Public Access Areas (#)
Terresterial: 1 Marine: 6

Land Cover Dominance
Forest 54%

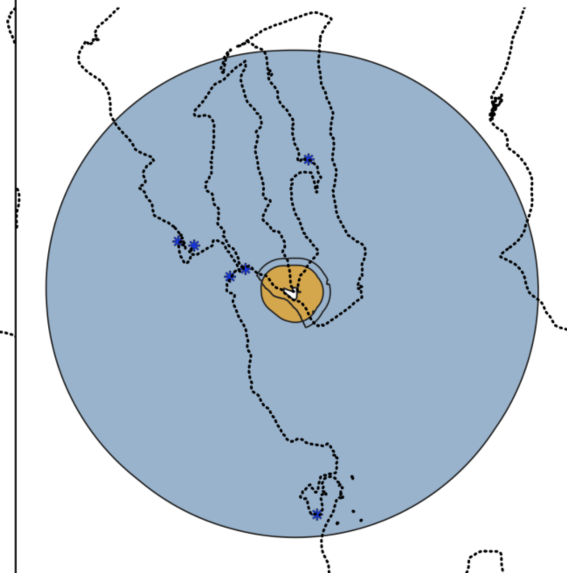
Impervious Surface Dominance
0-20% Density 95%

Land Use Dominance
Developed 83%

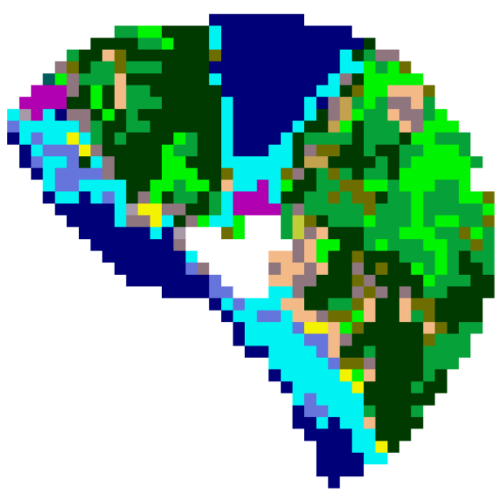
Public Access: Immediate



Public Access: Travel

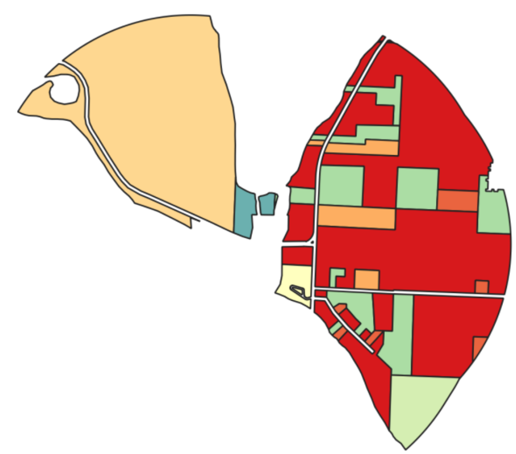


Land Cover



Impervious Surface

Land Use



PNSERP ID
1609

Site Name
Dugualla Bay Restoration

Publicly Accessible Perimeter (%)
Terresterial: 0 Marine: 42

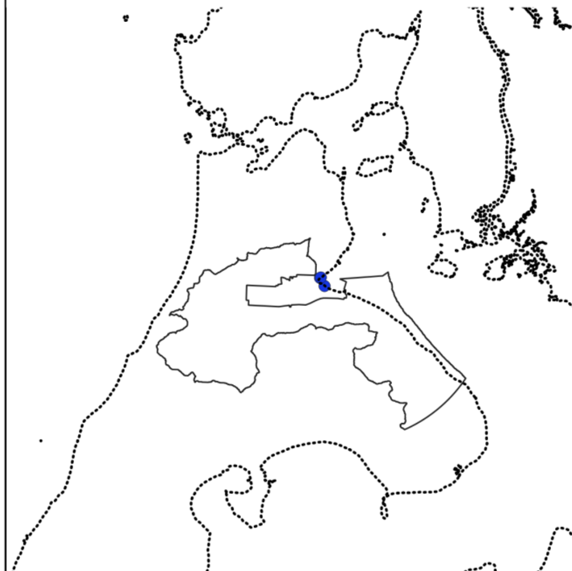
Public Access Areas (#)
Terresterial: 1 Marine: 6

Land Cover Dominance
Forest 44%

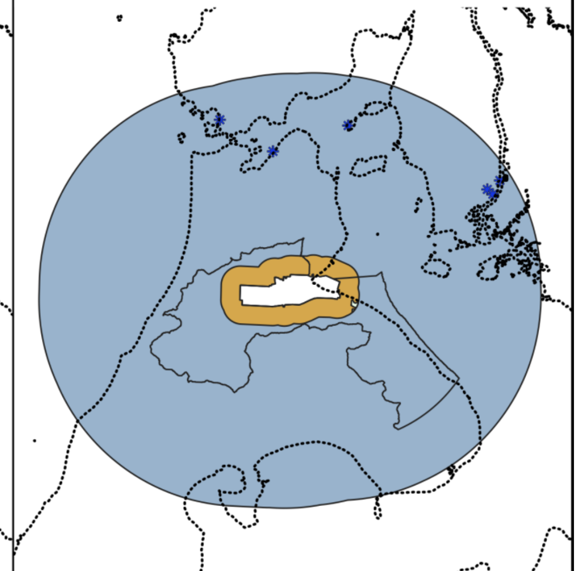
Impervious Surface Dominance
0-20% Density 78%

Land Use Dominance
Developed 72%

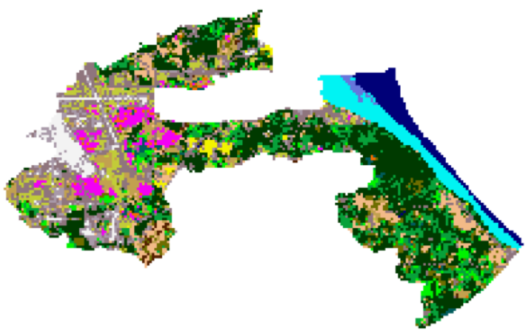
Public Access: Immediate



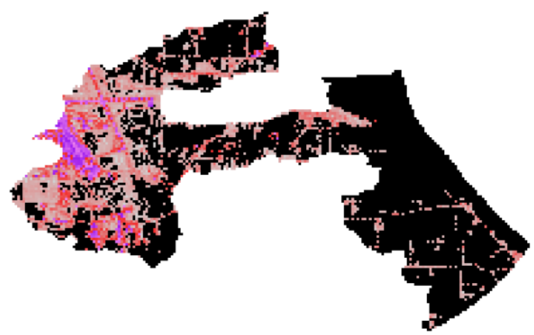
Public Access: Travel



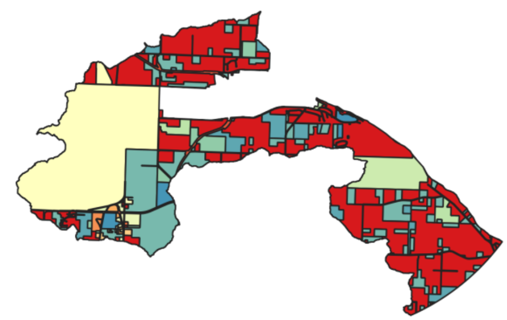
Land Cover



Impervious Surface



Land Use



PNSERP ID
1618

Site Name
Livingston Bay

Publicly Accessible Perimeter (%)
Terresterial: 14 Marine: 100

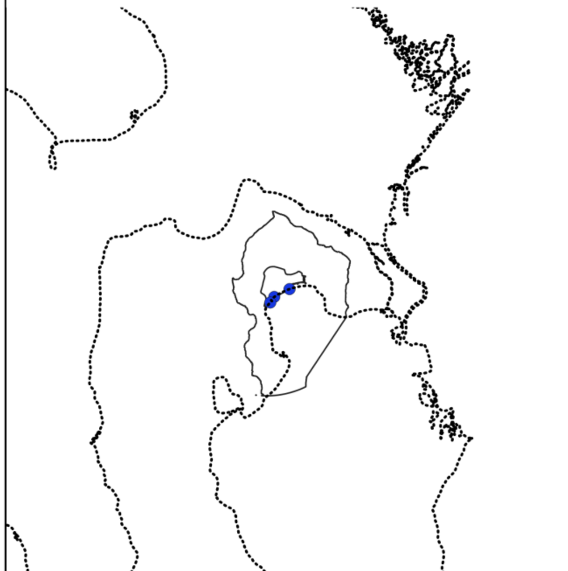
Public Access Areas (#)
Terresterial: 1 Marine: 5

Land Cover Dominance
Aquatic 36%

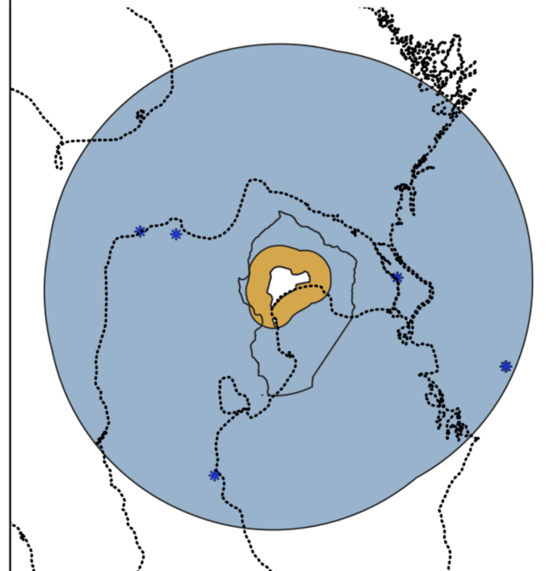
Impervious Surface Dominance
0-20% Density 93%

Land Use Dominance
Open 56%

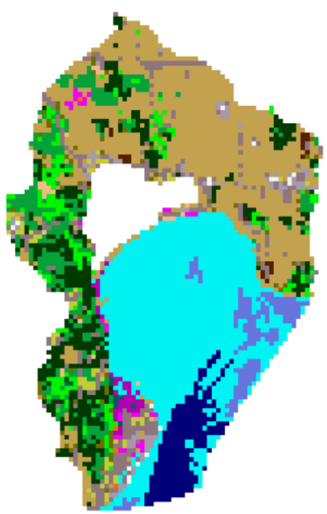
Public Access: Immediate



Public Access: Travel

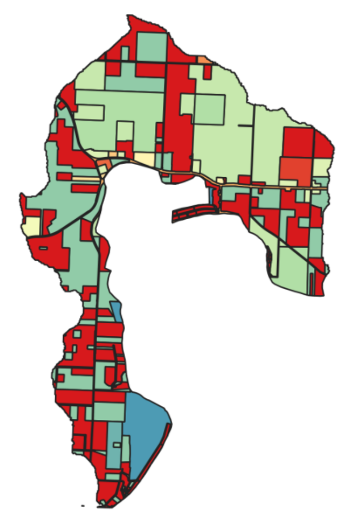


Land Cover



Impervious Surface

Land Use



PNSERP ID
1633

Site Name
Telegraph Slough

Publicly Accessible Perimeter (%)
Terresterial: 19 Marine: 2

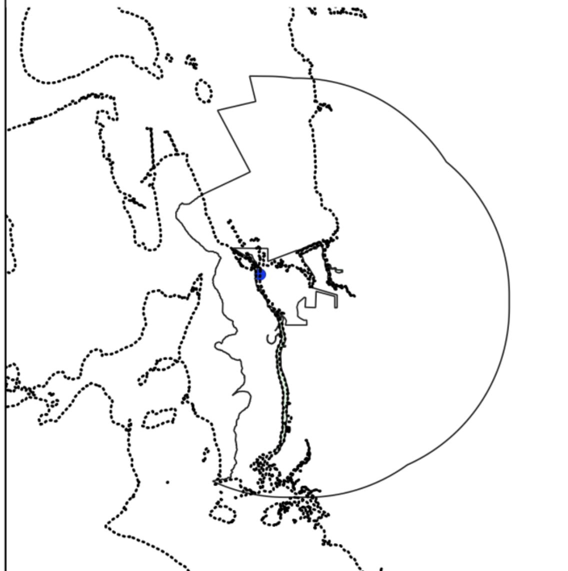
Public Access Areas (#)
Terresterial: 4 Marine: 9

Land Cover Dominance
Open 53%

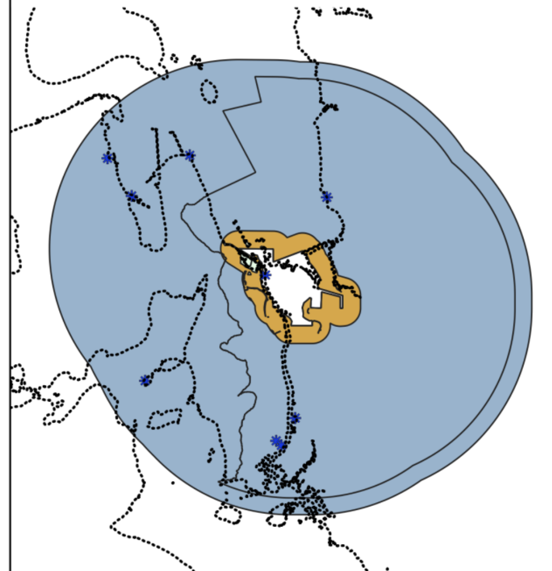
Impervious Surface Dominance
0-20% Density 92%

Land Use Dominance
Open 70%

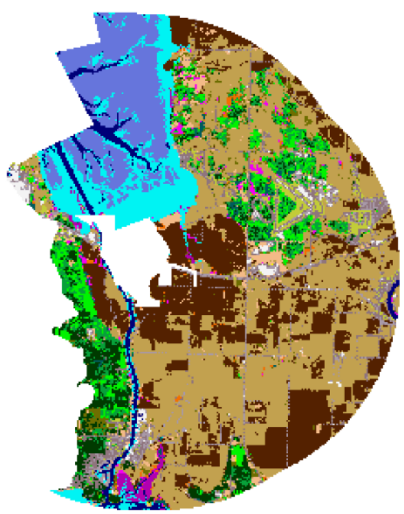
Public Access: Immediate



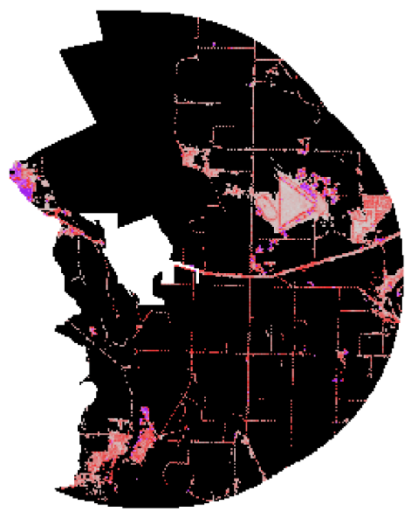
Public Access: Travel



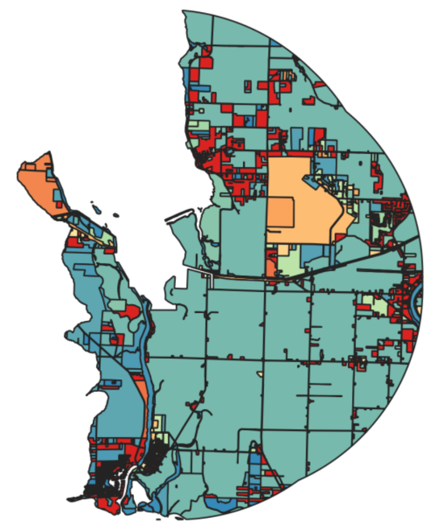
Land Cover



Impervious Surface



Land Use



PNSERP ID
1642

Site Name
Chuckanut Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 42 Marine: 82

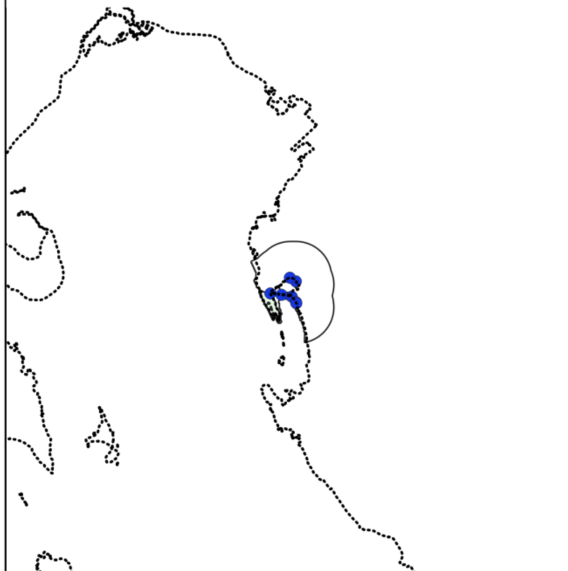
Public Access Areas (#)
Terresterial: 6 Marine: 3

Land Cover Dominance
Forest 58%

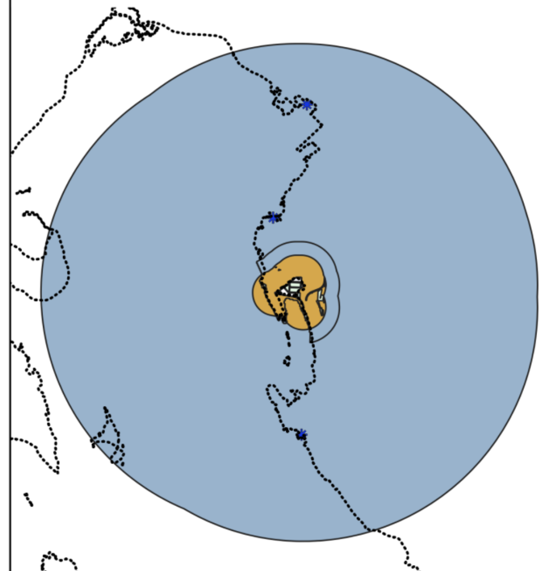
Impervious Surface Dominance
0-20% Density 76%

Land Use Dominance
Open 49%

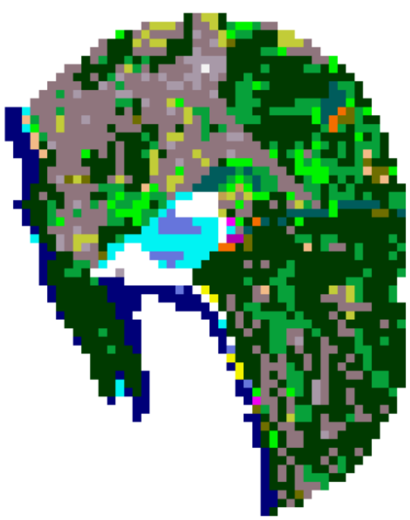
Public Access: Immediate



Public Access: Travel



Land Cover



Impervious Surface

Land Use

PNSERP ID
1648

Site Name
Deer Harbor Estuary Restoration

Publicly Accessible Perimeter (%)
Terresterial: 0 Marine: 0

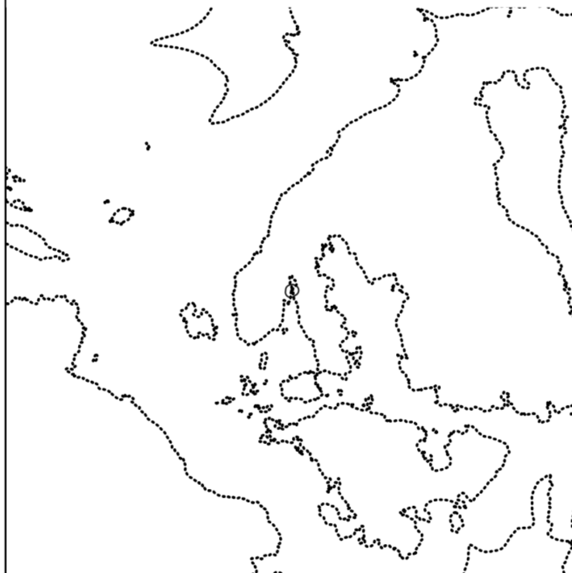
Public Access Areas (#)
Terresterial: 3 Marine: 5

Land Cover Dominance
Aquatic 33%

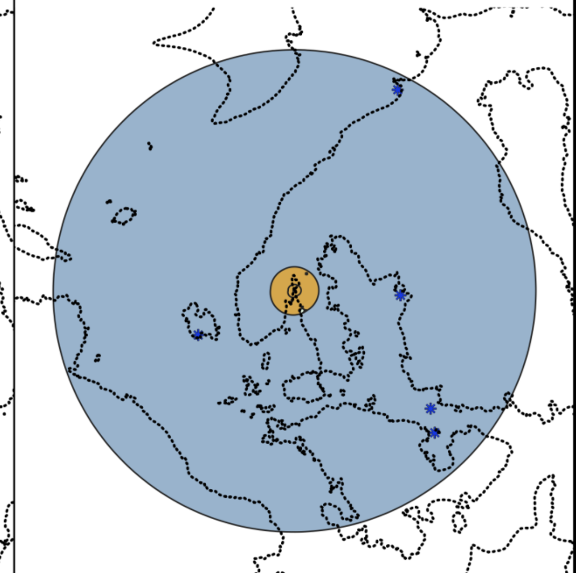
Impervious Surface Dominance
0-20% Density 79%

Land Use Dominance
Developed 66%

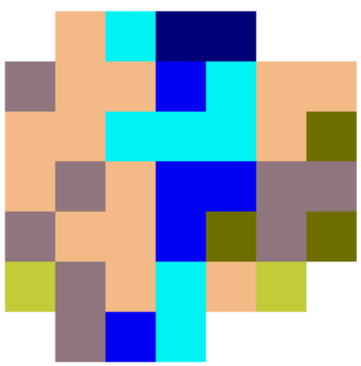
Public Access: Immediate



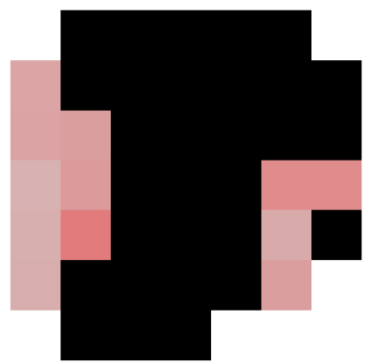
Public Access: Travel



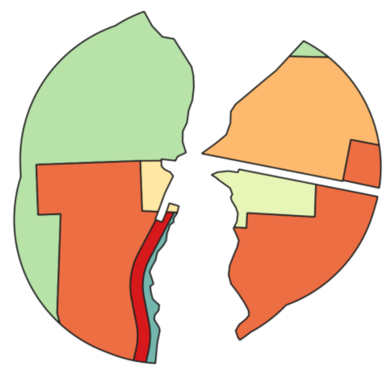
Land Cover



Impervious Surface



Land Use



PNSERP ID
1684

Site Name
WDNR Marine Lab

Publicly Accessible Perimeter (%)
Terresterial: 14 Marine: 33

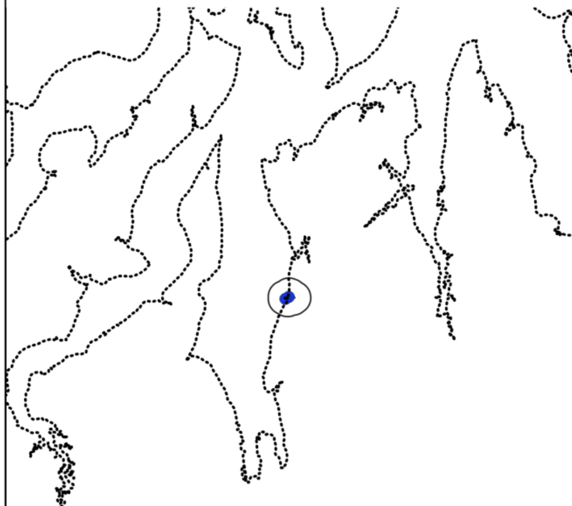
Public Access Areas (#)
Terresterial: 3 Marine: 4

Land Cover Dominance
Aquatic 42%

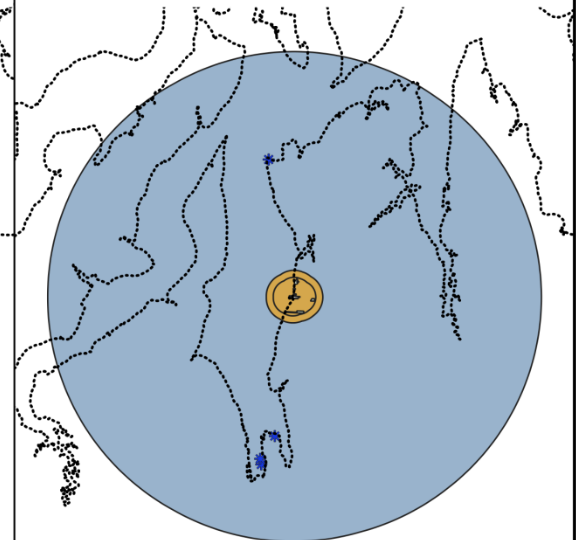
Impervious Surface Dominance
0-20% Density 88%

Land Use Dominance
Developed 72%

Public Access: Immediate



Public Access: Travel



Land Cover

Impervious Surface

Land Use

PNSERP ID
1801

Site Name
Chambers Bay

Publicly Accessible Perimeter (%)
Terresterial: 9 Marine: 71

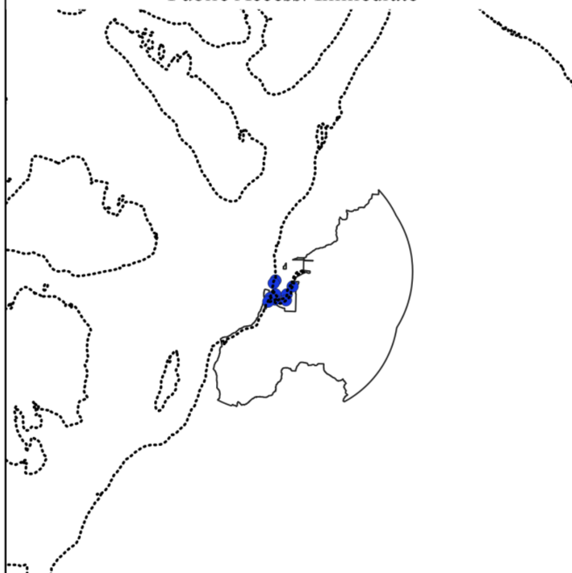
Public Access Areas (#)
Terresterial: 6 Marine: 3

Land Cover Dominance
Developed 70%

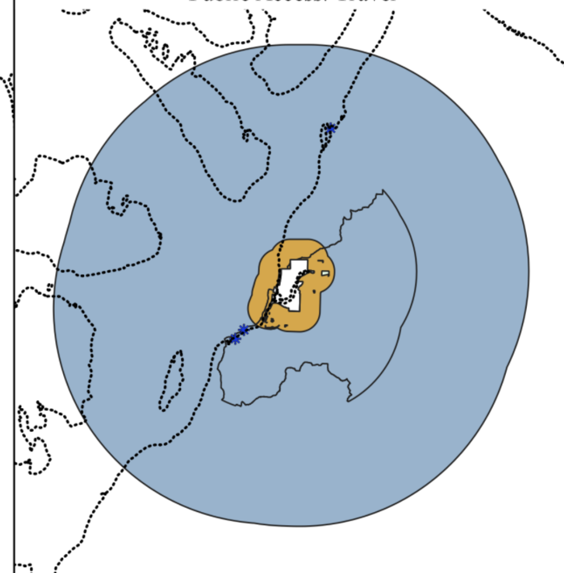
Impervious Surface Dominance
0-20% Density 44%

Land Use Dominance
Developed 85%

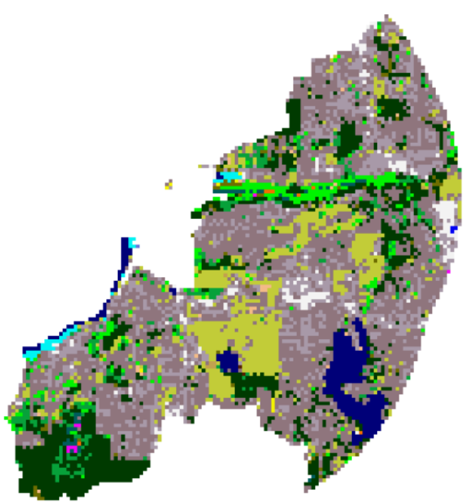
Public Access: Immediate



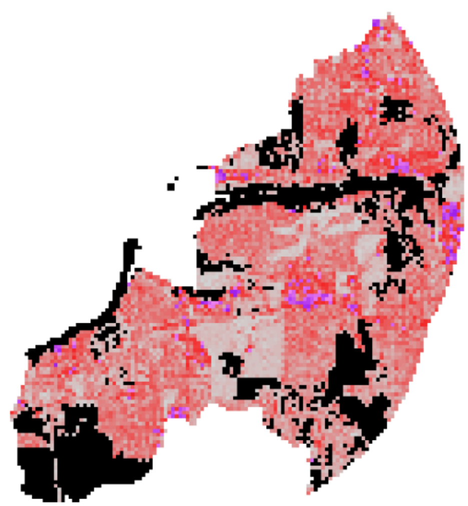
Public Access: Travel



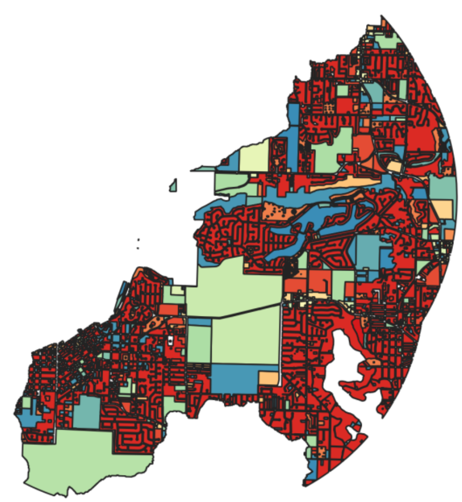
Land Cover



Impervious Surface



Land Use



PNSERP ID
1805

Site Name
Snohomish Estuary

Publicly Accessible Perimeter (%)
Terresterial: 34 Marine: 100

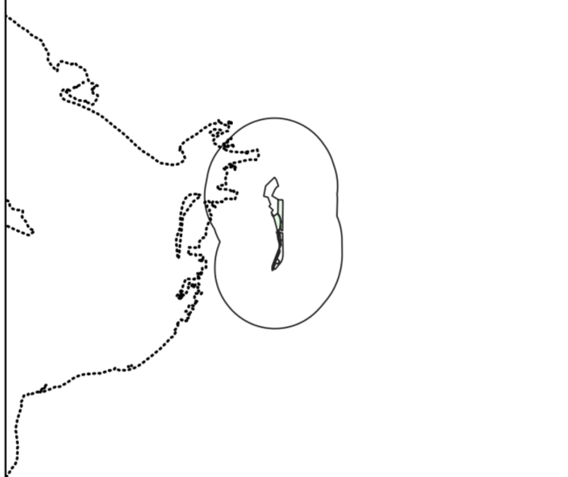
Public Access Areas (#)
Terresterial: 3 Marine: 4

Land Cover Dominance
Developed 35%

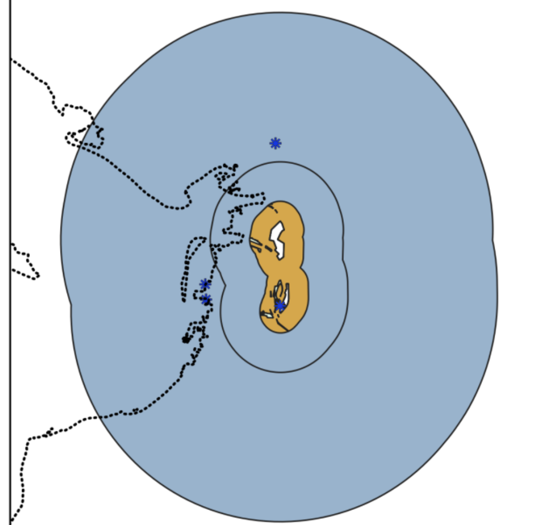
Impervious Surface Dominance
0-20% Density 68%

Land Use Dominance
Open 55%

Public Access: Immediate

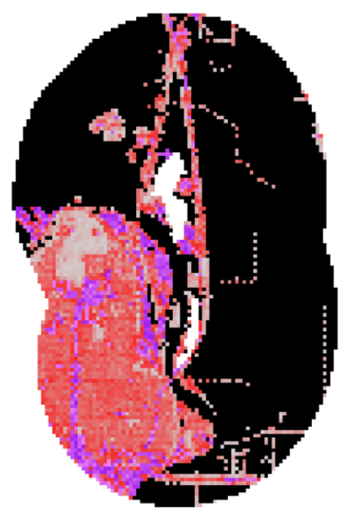


Public Access: Travel



Land Cover

Impervious Surface



Land Use