Islands Trust

STAFF REPORT

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SUBJECT:	Islands Trust Area Precipitation Interception Potential

REPORT SUMMARY

The purpose of this report is to present *Precipitation Interception Potential* maps that represent real-world precipitation interception by terrestrial ecosystems in the Islands Trust area. These *Precipitation Interception Potential* surfaces are combined with groundwater recharge data, to create a comprehensive groundwater recharge potential of the terrestrial surface for the Islands Trust area. This product was created by Islands Trust staff to inform the Islands Trust Groundwater Recharge Mapping project on the role of ecosystems in the determination of groundwater recharge potential. The successful completion of this product in concert with the groundwater recharge potential mapping informs decision-makers on current and future water management strategies, supporting the Islands Trust mandate to preserve freshwater and protect watersheds.

BACKGROUND

Water shortage issues are an ever-present concern for many individuals in the Islands Trust area. In a survey conducted in 2016, more than 40% of residents indicated they have concerns about exhausting their household freshwater supply (Islands Trust, 2021). Furthermore, changing precipitation patterns are projected to result in longer drought periods during the summer, and more intense precipitation events in the wetter seasons, resulting in reduced freshwater quality (Pinna Sustainability, 2020). Climate change-related issues such as sea-level rise and storm surge flooding are also expected to worsen the saltwater intrusion issues found on the islands (Islands Trust, 2021). With freshwater concerns abound, actions must be taken to mitigate these water-related issues. Understanding how groundwater recharge potential and *Precipitation Interception Potential* influence the rate of groundwater and freshwater resource replenishment, is a logical step towards developing plans to ease some of these concerns.

Groundwater recharge is one of the primary factors controlling limits on groundwater withdrawal (Döll & Flörke, 2005, as cited in Mohan et al., 2018). To determine the groundwater recharge potential of the Islands Trust area, multiple variables, including ground and vegetation characteristics, need to be considered (Mohan et al., 2018). Forest canopies have been known to intercept as much as 10-40% of the total rainfall, reducing the amount of water that is available for groundwater recharge (Horman et al., 1996, as cited in Murakami, 2006). As such, quantifying and mapping *Precipitation Interception Potential* is important for assessing groundwater recharge potential.

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*This report was updated in June 2022 to reflect changes in the Islands Trust Area Groundwater Recharge Mapping report (GW Solutions, 2021)

The purpose of this investigation on *Precipitation Interception Potential* is to assess the spatial variability of interception potential in the Islands Trust area to develop a greater understanding of groundwater recharge potential. This will be done by combining the results of this analysis with other data pertinent to groundwater recharge.

Figure 1 describes the factors that will contribute to the overall groundwater recharge mapping. Once completed, a greater understanding of groundwater recharge variations will be developed allowing for appropriate water management strategies, based on this information, to be implemented. With more informed policies on freshwater management, freshwater can be more effectively, sustainably, and efficiently managed.

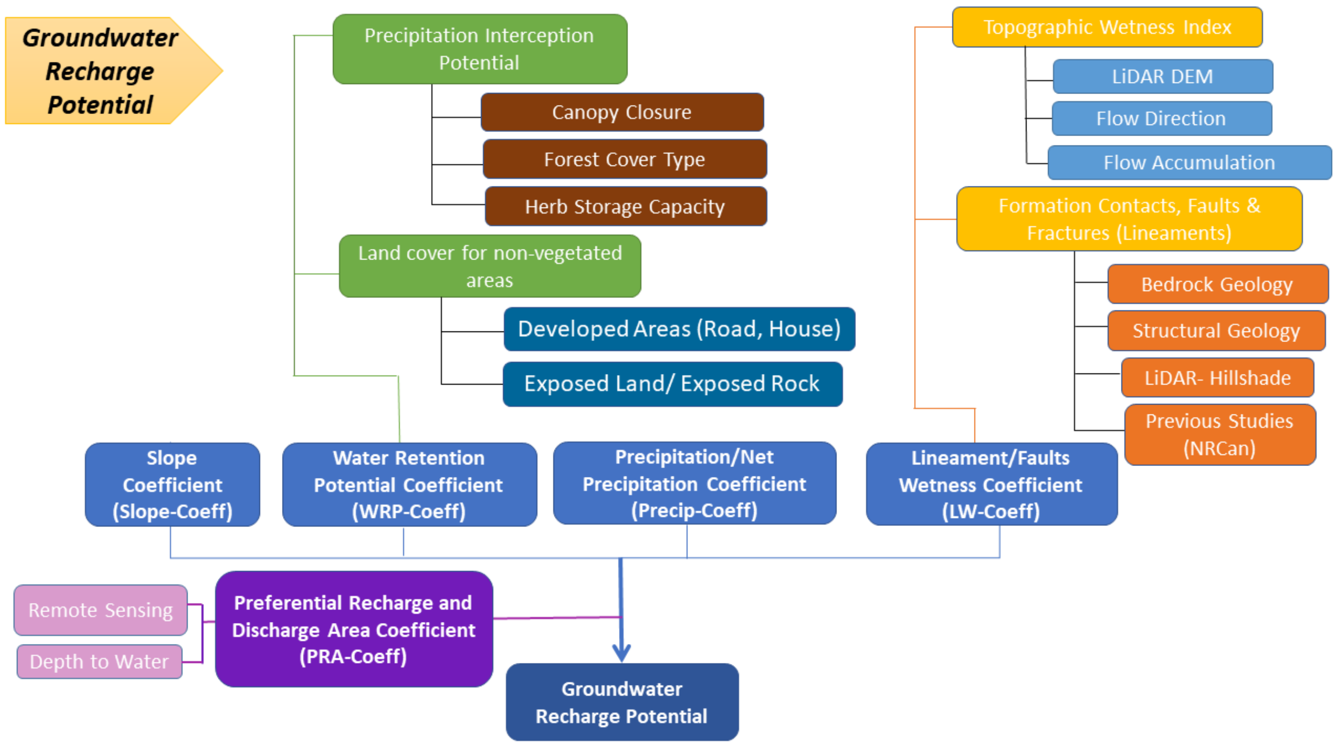

Figure 1. *Groundwater Recharge Potential methodology and contributing factors. Figure from Islands Trust Area Groundwater Recharge Mapping report, GW Solutions (2021).* https://islandstrust.bc.ca/document/islands-trust-groundwater-recharge-mapping-potential-project-report-ver-2021/

ANALYSIS

The *Precipitation Interception Potential* maps are developed with the successful execution of four key objectives.

1. Literature review to determine characteristics that significantly contribute to precipitation interception.
2. Vegetation Resource Inventory (VRI) that assesses which vegetation interception characteristics correspond to VRI attribute data that is available in the Islands Trust Area.
3. A weighting scheme, based on the literature review that assigns importance to the VRI attributes and attribute items deemed significant to precipitation interception.
4. VRI attributes, and associated attribute items inputted into a GIS model with assigned weights to create a geospatial surface representing *Precipitation Interception Potential* for the Islands Trust area.

Summary of Literature Review

The first phase of this report was to conduct a literature review to identify variables that significantly influence precipitation interception. Climatic variables were identified as having a strong influence on rainfall interception, due to findings by Crockford and Richardson (2000). These variables include amount of rainfall, intensity of rainfall, wind speed and direction, and air temperature and humidity (Crockford and Richardson, 2000). Canopy closure was found to be a significant variable in precipitation interception, as a more closed canopy structure has been linked to greater rainfall interception (Yan et al., 2015).

Additionally, Livesley et al. (2014) found that trees with greater canopy density intercepted a larger proportion of gross rainfall. Forest cover type was identified as important to interception potential, as Miralles et al. (2010) found that interception is responsible for the evaporation of ~13% of total rainfall in broadleaf evergreen forests, ~19% in broadleaf deciduous forests, and ~22% in needleleaf forests, in a study on global rain interception rates. Canopy storage capacity was also found to influence rainfall interception, as decreases in canopy storage have been associated with decreases in interception rates (Grunicke et al., 2020). Projecting crowns were identified as an influencing factor for precipitation interception, as projecting crowns can result in greater interception (Crockford and Richardson, 2000). Stemflow was also found to be a significant component of precipitation interception, as stemflow was found to account for 8.9% of gross rainfall in pine trees, in a study by Crockford and Richardson (1990) (as cited in Crockford and Richardson, 2000).

Primary Data: The Vegetation Resource Inventory

The primary dataset used for this analysis is the Vegetation Resource Inventory (VRI). The VRI is a government funded vegetation inventory dataset, developed primarily for forest management purposes (Ministry of Forests, Lands and Natural Resource Operations (FLNRO), n.d.). Inventories are conducted in two phases: 1) a photo interpretation phase, and 2) a ground sampling phase (FLNRO, n.d.). The dataset provides a large variety of data including, but not limited to, land cover types, stand age and density metrics, biogeoclimatic data, and species composition data. These data are contained in a spatial data layer, with polygons of varying size distributed across the entirety of British Columbia. Being a provincial dataset, the VRI is projected using the NAD 1983 BC Environment Albers projection (ESPG: 3005).

Study Area

The study area for this analysis was the islands in the Islands Trust Area. The primary focus was the larger islands, as groundwater recharge and interception potential information created for those locales is likely to benefit a greater number of people. Provided that the necessary VRI data is available and that there is adequate funding to support further analysis, *Precipitation Interception Potential* analyses will be conducted for the smaller islands.

Methodology

After determining interception variables found to significantly influence precipitation interception, the next step was to determine which VRI attributes could be used for quantifying these variables of interception. This narrowed down the number of interception variables for *Precipitation Interception Potential* to three: **1) Canopy Closure (CC), 2) Forest Cover Type (FCT), and 3) Herb Canopy Storage (HCS)**. *Variables of Interception* was the term given to the general forest features that were determined to be significant to rainfall interception.

Attributes are the VRI data categories that contribute to each of the three aforementioned *Variables of Interception*. The VRI attributes used include Label Line 4 Index Classes (for crown closure), Shrub Crown Closure, Shrub Cover Pattern, Land Cover Class Code 1, Land Cover Class Code 2, Land Cover Component Percentage 1, Land Cover Component Percentage 2, Herb Cover Type, and Herb Cover Percentage. These attributes were assigned a weight indicating their importance to the *Variable of Interception* they belong to.

Attribute items are the class codes or descriptors found within each attribute in the VRI. These include numeric and text characters which indicate the coverage or coverage type of attributes. Attribute item ratings are the interception values assigned to each of the attribute items found within the VRI. The attribute item ratings range between 1 and 0, with a precision of two decimal places, and were assigned based on the inferred interception potential of VRI attribute items. Ratings were originally assigned values which collectively added up to 1, for each individual attribute. To convert the ratings to a scale of 1 to 0 for each attribute item (1 = most interception, 0 = no interception), the ratings were normalized according to the greatest interception potential rating for each attribute. This resulted in the attribute item with the greatest interception potential receiving a rating of 1, while attribute items with lower estimated interception potential receiving lower ratings. This method allowed for ratings to keep their original proportionate relationships, but resulted in scaled rating values that were often odd numbers (refer to Tables 3, 4, 5, 7, 8, 10, and 11 for ratings). Refer to Figure 2 for a visualization of the relationship between the aforementioned contributors to *Precipitation Interception Potential*.

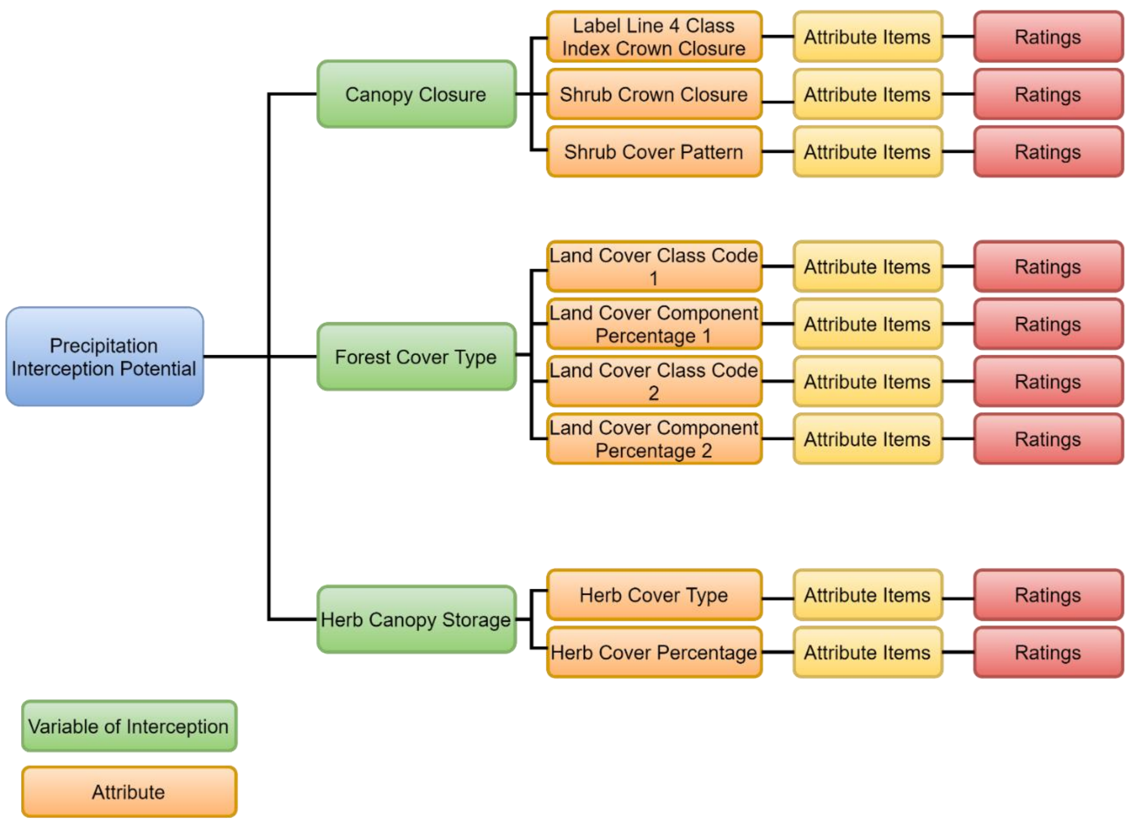

Figure 2. *Description of relationship between interception variables, attributes, attribute items, and ratings.*

To assign relative importance weighting schemes were developed for both the *Variables of Interception* and the VRI attributes. Weights were calculated using the analytical hierarchy process (AHP), which is a method that allows for pairwise comparisons between variables/attributes based on their relative importance (Aragon et al., 2012).

Values of 9 represent extreme importance relative to other variables or attributes, 7 indicates very strong importance, 5 indicates strong importance, 3 indicates moderate importance, and 1 indicates equal importance between variables or attributes. RStudio (RStudio Team, 2020) was used to perform the necessary calculations to determine the weighting assigned by the AHP scheme, using code developed by Aragon et al. (2012). The three *Variables of Interception* were assigned a weight determining the influence of different interception variables to precipitation interception, while VRI attributes were assigned weights to determining the influence of these attributes towards interception variables. The AHP tables used to determine interception variable weights are found in Table 1, while the AHP tables for VRI attribute weighting are found in Tables 2, 6, and 9.

***Table 1**. AHP table for weighting Variables of Interception.*

	Canopy Closure	Forest Cover Type	Herb Canopy Storage
Canopy Closure	1	3	5
Forest Cover Type	1/3	1	3
Herb Canopy Storage	1/5	1/3	1

1) Canopy Closure (CC) (Weight = 0.64)

Canopy Closure (CC) received a relatively heavy weight of 0.64 because of the strong importance level (5) it received relative to the least important variable in the AHP weighting scheme. This importance level was based on findings in the literature review that indicated CC was the most significant Variable of Interception out of the three used for this analysis.

Yan et al. (2015) and Livesley et al. (2014) both found that precipitation interception is related to CC characteristics. Yan et al. (2015) surmised that interception differences in a Chinese fir plantation, between trees of different age classes, were the result of CC differences, with more closed canopies having a greater interception potential. Similarly, by comparing two Eucalypt tree species, Livesley et al. (2014) found that trees with more sparse canopies intercepted less water. Moreover, forest canopies that are not fully closed allow water to reach the forest floor unimpeded, resulting in lower interception rates (Yan et al., 2015). This suggests that CC is the dominant determinant of precipitation interception, as closure needs to be present for interception to occur, regardless of the species present.

VRI Attributes and Weighting:

- Label Line 4 Index Classes – Crown Closure (Weight = 0.72)
- Shrub Crown Closure (Weight = 0.14)
- Shrub Cover Pattern (Weight = 0.14)

It was determined that Crown Closure, Shrub Crown Closure, and Shrub Cover Pattern were the most suitable available attributes for quantifying CC, after reviewing the literature and VRI attributes available in the areas of interest. Crown Closure was assigned a strong importance relative to Shrub Crown Closure and Shrub Cover Pattern, resulting in a weight of 0.72. Crown Closure received this importance level due to findings by Gash et al. (1980), who reported interception rates ranging from 26.7% to 42.4% in coniferous forests, and Carlyle-Moses and Price (1999), who reported interception rates of ~19.3% in deciduous broadleaf species, while Wang et al. (2005) reported interception losses of ~6.9 to ~11.7% for two different shrub species, and Zhang et al. (2018) and Magliano et al. (2019) reported average interception rates of 21.4% and 9.4% for shrubs.

Shrub Crown Closure and Shrub Cover Pattern were both assigned equal importance (strongly less important than Crown Closure) because these attributes both describe shrub closure characteristics, which, based on the previously mentioned interception values, are less significant towards precipitation interception than tree cover. Overall, Crown Closure contributes 0.72 to the CC interception variable, while shrub attributes contribute 0.28. The AHP table used to determine weights can be found in Table 2.

Table 2. *AHP table for weighting Canopy Closure VRI attributes.*

	Label Line 4 Index Classes – Crown Closure	Shrub Crown Closure	Shrub Cover Pattern
Label Line 4 Index Classes – Crown Closure	1	5	5
Shrub Crown Closure	1/5	1	1
Shrub Cover Pattern	1/5	1	1

Label Line 4 Index Classes – Crown Closure Attribute Items and Ratings:

The Crown Closure attribute items are represented as values ranging from 0 to 9, which represent Crown Closure percentage classes (Table 3). These attribute items were assigned ratings that increased linearly from lowest to highest closure. The relationship between Crown Closure and interception potential was assumed to be a positive linear relationship because as closure increases, the potential for precipitation to be obstructed by vegetation also increases.

Table 3. *Label Line 4 Index Classes (Crown Closure) attribute items and ratings table.*

Crown Closure %	Attribute Item	Rating
0-5	0	0.05
6-15	1	0.16
16-25	2	0.26
26-35	3	0.37
36-45	4	0.47
46-55	5	0.58
56-65	6	0.68
66-75	7	0.79
76-85	8	0.89
86-100	9	1.00

Shrub Crown Closure Attribute Items and Ratings:

Shrub Crown Closure attributes items are represented as a percentage, indicating the ground area covered by vertically projecting crowns in each polygon (FLNRO, 2019). The attribute items were categorized by intervals of 10% and assigned ratings that increased in a linear fashion (Table 4.). The positive, linear relationship between attribute items and ratings (interception potential) was assumed due to the logic that as coverage increases, so does the potential for water to be obstructed from freely reaching the ground.

Table 4. *Shrub Crown Closure attribute items and ratings table.*

Attribute Item (% Cover)	Rating
0-10	0.05
11-20	0.16
21-30	0.26
31-40	0.37
41-50	0.47
51-60	0.58
61-70	0.68
71-80	0.79
81-90	0.89
91-100	1.00

Shrub Cover Pattern Attribute Items and Ratings:

Shrub Cover Pattern attribute items are represented as values ranging from 1 to 9 (Table 5). Increases in these attribute item code values indicate a transition to a more continuous, homogeneous coverage pattern. Ratings for these attribute items start at 0.15 and increase linearly. The linear increase in ratings was used due to the progressive and regular increase in pattern continuity with attribute item value increases, which is likely to increase interception.

__Table 5__. Shrub Cover Pattern attribute items and ratings table

Pattern Description	Attribute Item	Rating
Single to very few (<4) occurrences of limited extent, circular to irregular shape	1	0.15
Single to very few (<4) occurrences of limited extent, linear or elongated shape	2	0.25
Several (>3) sporadic occurrences of limited extent, circular to irregular shape	3	0.35
Several (>3) sporadic occurrences of limited extent, linear or elongated shape	4	0.45
Intimately intermixed units, often with gradational transitions from one to the other	5	0.55
Discontinuous but extensive occurrences, parallel to sub-parallel elongated in shape	6	0.65
Limited continuous occurrence with few inclusions	7	0.75
Continuous occurrence with several inclusions	8	0.85
Continuous occurrence with very few inclusions	9	1.00

2) Forest Cover Type (FCT) (Weight = 0.26)

Forest Cover Type (FCT) was assigned moderate importance (3) relative to the least important variable, resulting in a weight of 0.26. This decision was made based on findings in the literature that indicated FCT is not as important as CC for precipitation interception.

Different cover types have different interception potentials (Miralles et al., 2010). In a study of global rainfall interception losses, Miralles et al. (2010) concluded that broadleaf evergreen forests intercept ~13% of rainfall, broadleaf deciduous forests intercept ~19%, and needleleaf forests intercept ~22%. These interception differences are significant, justifying the FCT interception variable as important for determining interception potential. While FCT is an important variable for interception, it is not as dominant as CC. For interception to occur, there needs to be CC. The FCT will then contribute to how much interception will occur for a given CC value. Consequently, FCT is considered secondary to CC, in terms of importance to interception potential.

VRI Attributes and Weighting:

- Land Cover Class Code 1 (Weight = 0.42)
- Land Cover Component Percentage 1 (Weight = 0.42)
- Land Cover Class Code 2 (Weight = 0.08)
- Land Cover Component Percentage 2 (Weight = 0.08)

Land Cover Class Codes describe the land cover type in each VRI polygon, with Code 1 representing the dominant land cover type and Code 2 representing the second most dominant land cover type (FLNRO, 2019). Land Cover Component Percentage 1 and 2 provide the percent area of land cover type in each polygon, with Land Cover Class Code 1 corresponding to Land Cover Component Percentage 1 and Land Cover Class Code 2 corresponding to Land Cover Component Percentage 2 (FLNRO, 2019). Together, these attributes describe the dominant and second most dominant land cover types, and percentages of these land cover types found within each polygon containing VRI data. The information on both land cover type and percentage makes these attributes appropriate for determining FCT.

A large percentage of VRI polygons had data for Land Cover Class Code 1 and Land Cover Component Percentage 1, but not for Land Cover Class Code 2 and Land Cover Component Percentage 2. This, in addition to Land Cover Class Code 1 and Land Cover Component Percentage 1 representing the dominant land cover type, resulted in Land Cover Class Code 1 and Land Cover Component Percentage 1 being assigned strong importance (5) compared to Land Cover Class Code 2 and Land Cover Component Percentage 2. Land Cover Class Code 1 and Land Cover Component Percentage 1 each received a weight of 0.42, while Land Cover Class Code 2 and Land Cover Component Percentage 2 received weights of 0.08. Thus, the FCT interception variable is primarily determined by dominant land cover type metrics (0.84), and receives a much smaller contribution from secondary land cover type metrics (0.16). The AHP table used to determine the weighting scheme for forest cover type attribute can be found in Table 6.

Table 6. *AHP table for weighting forest cover type VRI attributes*

	Land Cover Class Code 1	Land Cover Component Percentage 1	Land Cover Class Code 2	Land Cover Component Percentage 2
Land Cover Class Code 1	1	1	5	5
Land Cover Component Percentage 1	1	1	5	5
Land Cover Class Code 2	1/5	1/5	1	1
Land Cover Component Percentage 2	1/5	1/5	1	1

Land Cover Class Code 1 and 2 Attribute Items and Ratings:

Land Cover Class Codes 1 and 2 include attribute items describing a large variety of land cover types. Since these attributes are being used to evaluate the interception potential of forest cover, land cover that is not considered forest cover, or is unlikely to intercept water, was given a rating of 0.00. Cover types likely to contribute to interception were assigned ratings ranging from 0.19 to 1, and arranged in six rating classes (1.00, 0.90, 0.81, 0.43, 0.29, and 0.19) (Table 7). Treed Coniferous cover was given the highest rating value (1.00), based on findings by Miralles et al. (2010) that indicated needleaf forests intercept more water (interception rate = ~22%) than other forest types. Miralles et al. (2010) state that due to the coarse spatial resolution of their analysis the interception rate values are low; however, the study provides a valid comparison of the interception rates between cover types.

Treed Broadleaf was assigned a rating of 0.81, based on the Miralles et al. (2010) study which found that broadleaf cover types intercept less water (evergreen broadleaf = ~13%, deciduous broadleaf = ~19%) than coniferous cover types. The rating of 0.81 represents that broadleaf forests generally intercept less water than coniferous forest, but also that deciduous broadleaf tree cover (intercepts ~86% as much water as coniferous), which was determined to be more prevalent in the study area than evergreen broadleaf after reviewing the B.C. Tree Species Compendium Index, intercepts more water than evergreen broadleaf cover (intercepts ~59% as much water as coniferous) (Ministry of Forests, Lands and NRO, 2000; Miralles et al., 2010).

Treed Mixed received a rating of 0.90, as this attribute item is a mixed treed class and 0.90 falls in between the ratings of the other treed attribute item ratings. A rating of 0.43 was assigned to Shrub Tall based on findings by Zhang et al. (2018) and Magliano et al. (2019) that found average interception rates of shrub species in their studies to be 21.4% and 9.4%, respectively. In comparison, Gash et al. (1980) reported interception rates of 26.7%, 31.7% and 42.4% in coniferous forests, while Pypker et al. (2005) reported a mean interception rate of 31.1% for a young Douglas-fir.

Shrub Low was assigned a rating of 0.19 because Guo et al. (2017) indicate interception capability is dependant on height, meaning that shorter shrubs intercept less water than tall shrubs. Herbs, of all types, were assigned a rating of 0.29 based on findings by Yabin et al. (2018) who found that herbs have a similar interception capability to shrubs. This rating represents a middle ground between tall and low herbs, as there was no differentiation between tall and short herbs in the attribute item classes.

Instead, there are simply classes for herb types, all of which have the same rating. Information that could be used to differentiate the interception capabilities of fords and graminoids (herb types) was lacking, providing the reasoning for all herb types being assigned the same rating. The three bryoid attribute items were all assigned a rating of 0.19 (lowest cover type rating), based on a study of forest floor interception by Wang-Erlandsson et al. (2014) that found that floor interception, which the Bryoid classes are part of, contributes 10% to global evaporation, whereas vegetation interception contributes 21%.

Table 7. *Land Cover Class Code 1 and 2 attribute items and ratings table.*

Attribute Item	Rating
TB Treed Broadleaf	0.81
TC Treed Coniferous	1.00
TM Treed Mixed	0.90
ST Shrub Tall	0.43
SL Shrub low	0.19
HE Herb	0.29
HF Herb - Fords	0.29
HG Herb - Graminoids	0.29
BY Bryoid	0.19
BM Bryoid - Moss	0.19
BL Bryoid - Lichens	0.19
All Others	0.00

Land Cover Component Percentage 1 and 2 Attribute Items and Ratings:

Land Cover Component Percentages 1 and 2 describe the amount of the polygon occupied by the dominant and second most dominant land cover type (FLNRO, 2019). The attribute items organized the percentages into 10 classes that progressively increased by 10% (Table 8). Ratings assigned to each of these attribute item classes increased linearly, with a rating of 1 assigned to the highest attribute item cover class (91-100%). The increase in rating with increases in attribute item value was used because as the coverage of a cover type increases, it is assumed that the interception potential of that cover type also increases.

__Table 8.__ Land Cover Component Percentage 1 and 2 attribute items and ratings table.

Attribute Item (% Cover)	Rating
0-10	0.05
11-20	0.16
21-30	0.26
31-40	0.37
41-50	0.47
51-60	0.58
61-70	0.68
71-80	0.79
81-90	0.89
91-100	1.00

3) Herb Canopy Storage (HCS) (Weight = 0.10)

Herb Canopy Storage (HCS) was designated as the least important Variable of Interception, with CC being assigned a strong comparative importance and FCT being assigned as moderately more important, resulting in HCS receiving a light weight of 0.10. Generally, the literature indicates that storage capacity is of lesser importance to the FCT and CC variables, in regards to Precipitation Interception Potential. Being that the VRI did not provide data to adequately quantify canopy storage capacity, HCS was designated as an interception variable. Additionally, the HCS interception variable allows for precipitation interception to be further quantified in areas that do not have significant canopy closure. The inferred lesser importance of storage capacity, compared to CC and FCT, in addition to herbs not being found in a large majority of VRI polygons, guided the decision to classify HCS as less important than the other variables.

In a study of herbaceous canopy rainfall storage capacity, Yu et al. (2012) estimated storage capacities ranging from ~0.2 mm to ~0.9 mm. Pypker et al. (2005) indicate that for small precipitation events, higher storage capacity will result in greater interception because vegetation with higher storage capacities will not saturate as quickly. Though once saturated, interception rates do not differ significantly between vegetation with different storage capacities so long as they have a similar ratio of evaporation to rainfall intensity (Pypker et al., 2005). This suggests that for small precipitation events, storage capacity can be an important variable for Precipitation Interception Potential. However, this also suggests that storage capacity does not have a large influence on interception when large precipitation events occur, providing the reasoning for the lesser importance of HCS compared to CC and FCT.

VRI Attributes and Weighting:

- Herb Cover Type (Weight = 0.5)
- Herb Cover Percentage (Weight = 0.5)

The Herb Cover Type and Herb Cover Percentage VRI attributes were used for estimating HCS because of the strong availability of data for these attributes. These attributes provide information on the coverage of herbs within each polygon, which is assumed to influence storage capacity. The two HCS attributes were assigned equal importance since they both describe the presence of herbs. With equal importance, Herb Cover Type and Herb Cover Percentage each provided weights of 0.50 towards HCS. The AHP table used for the calculation of weights for HCS is found in Table 9.

Table 9. *AHP table for weighting Herb Canopy Storage VRI attributes.*

	Herb Cover Type	Herb Cover Percentage
Herb Cover Type	1	1
Herb Cover Percentage	1	1

Herb Cover Type Attribute Items and Ratings:

Herb Cover Type attribute items included three classes: Herb, Herb - Fords, and Herb - Graminoids (Table 10). Information differentiating the interception potential of these three attribute items was limited, resulting in these three herb types all receiving an interception potential rating of 1.00. This was not a limiting factor in the outputs, as the inclusion of Herb Cover Type was designed to boost the interception contribution from herbs rather than differentiating the interception potential of different herb types.

Table 10. *Herb Cover Type attribute items and ratings table.*

Attribute Item	Rating
HE Herb	1.00
HF Herb - Fords	1.00
HG Herb - Graminoids	1.00

Herb Cover Percentage Attribute Items and Ratings:

Herb Cover Percentage attribute item ratings range from 0% to 100%. For rating purposes, the attribute item values were organized into classes, starting from 0% to 10% and increasing by 10% each (Table 11). The ratings assigned to each of these attribute item classes increased almost linearly, from 0.05 to 1.00. The increases in rating associated with increases in Herb Cover Percentage were assigned to reflect the increase in interception potential by herbs, with greater coverage of herbs.

Table 11. *Herb Cover Percentage attribute items and ratings table.*

Attribute Item (% Cover)	Rating
0-10	0.05
11-20	0.16
21-30	0.26
31-40	0.37
41-50	0.47
51-60	0.58
61-70	0.68
71-80	0.79
81-90	0.89
91-100	1.00

Once the weighting and rating scheme had been determined, precipitation interception outputs could be created after completing necessary geospatial data work. To isolate the areas of interest for this analysis, ArcGIS Pro was used to clip the VRI data to the areas of interest. The ratings were then applied to their corresponding attribute items to create spatial datasets (shapefiles with ratings in attribute tables) that could be used to generate CC, FCT, HCS, and total Precipitation Interception Potential outputs. The CC, FCT, HCS, and Precipitation Interception Potential (weighted sum of CC, FCT, and HCS) outputs (rasters) were then created using R code, by performing weighted sums of the attribute rating shapefiles and converting them to raster format. At this stage, the outputs were ready to be included in the groundwater recharge potential mapping project.

For display purposes, the CC, FCT, HCS, and total Precipitation Interception Potential outputs were then classified with ArcGIS Pro in very low, low, moderate, high, and very high classes. Then, maps with these data were created for some of the more spatially prominent islands in the Islands Trust area.

Considerations

The weighting schemes and rating values contributing to *Precipitation Interception Potential* in this report were developed based on inferences guided by the literature review. The *Precipitation Interception Potential* of the three interception variables, and their associated attributes, attribute items, and ratings, were not determined by in-situ interception data and observations. Consequently, the precipitations interception potential surfaces generated by these data are an estimation and do not represent observed data. Additionally, the VRI dataset used to determine *Precipitation Interception Potential* does not have perfect coverage of all the attributes used in this analysis. As such, there may be larger error in interception potential values in areas where data coverage are not ideal. It is also important to consider that should any changes in coverage occur to any of the contributing attributes to precipitation interception, that interception could be dramatically altered. Also, assuming that the precipitation interception scheme accurately reflects real-world interception, the precipitation interception outputs are only as accurate as the VRI data used to create the outputs.

DELIVERABLES

The final deliverables include Canopy Closure, Forest Cover Type, Herb Canopy Storage, and overall Precipitation Interception Potential outputs. These outputs were generated with a 20m by 20m pixel resolution and displayed with a blue (low interception) to red (high interception) colour scheme. Canopy Closure maps can be found in Figures 3-13, Forest Cover Type maps can be found in Figures 14-24, Herb Canopy Storage maps can be found in Figures 25-35, and overall Precipitation Interception Potential maps can be found in Figures 36-46.

NEXT STEPS

Next steps were for a contractor to engage this methodology with a python script in R-Studio and generate the precipitation interception potential maps and GIS data. This data was be implemented into the methodology for the *Islands Trust Area Groundwater Recharge Mapping* project part of the Islands Trust Groundwater Sustainability Science Program, part of the Islands Trust Freshwater Sustainability Strategy. That report is available on the Islands Trust website.

https://islandstrust.bc.ca/document/islands-trust-groundwater-recharge-mapping-potential-project-report-ver-2021/

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**This report was updated in June 2022 to reflect changes in the Islands Trust Area groundwater recharge mapping methodology.*

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APPENDIXES

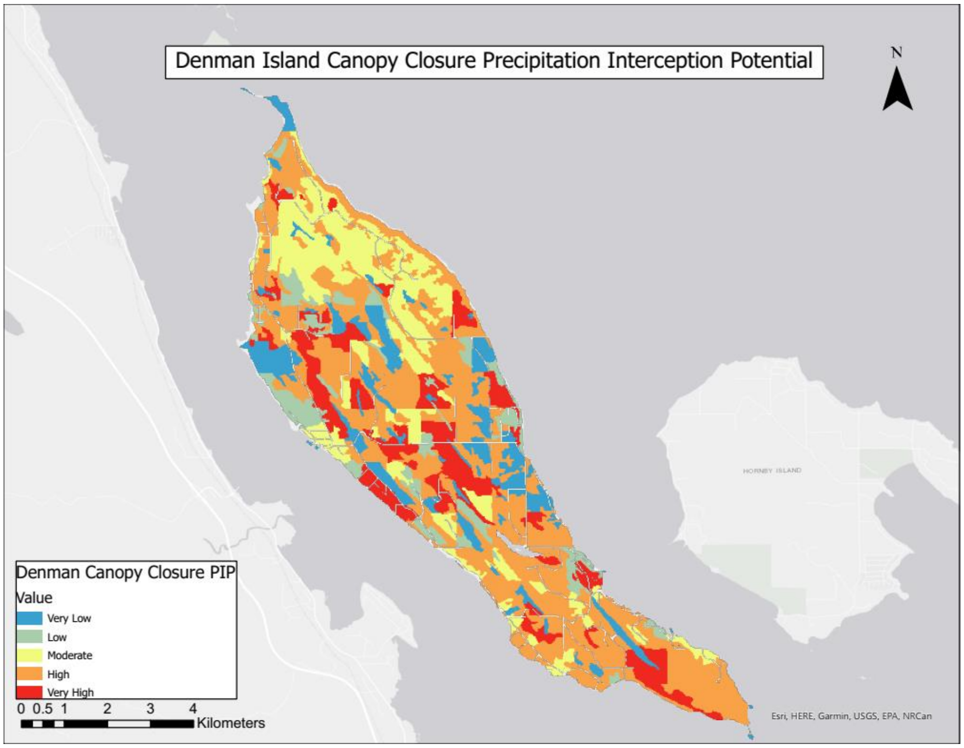
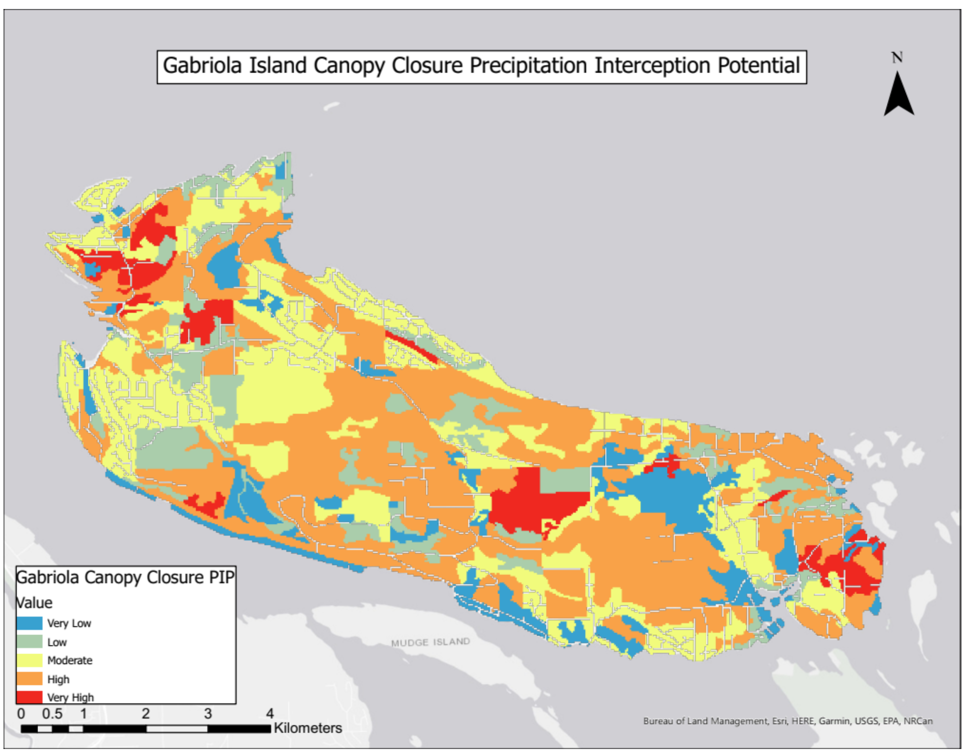


Figure 3. *Canopy Closure Precipitation Interception Potential map of Denman Island.*



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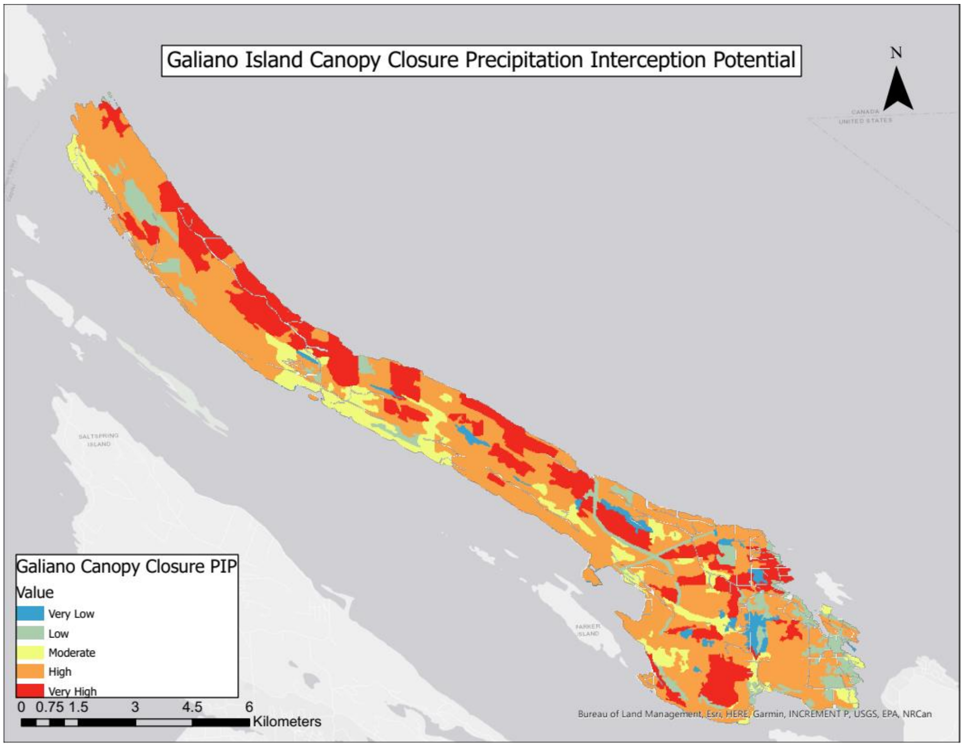

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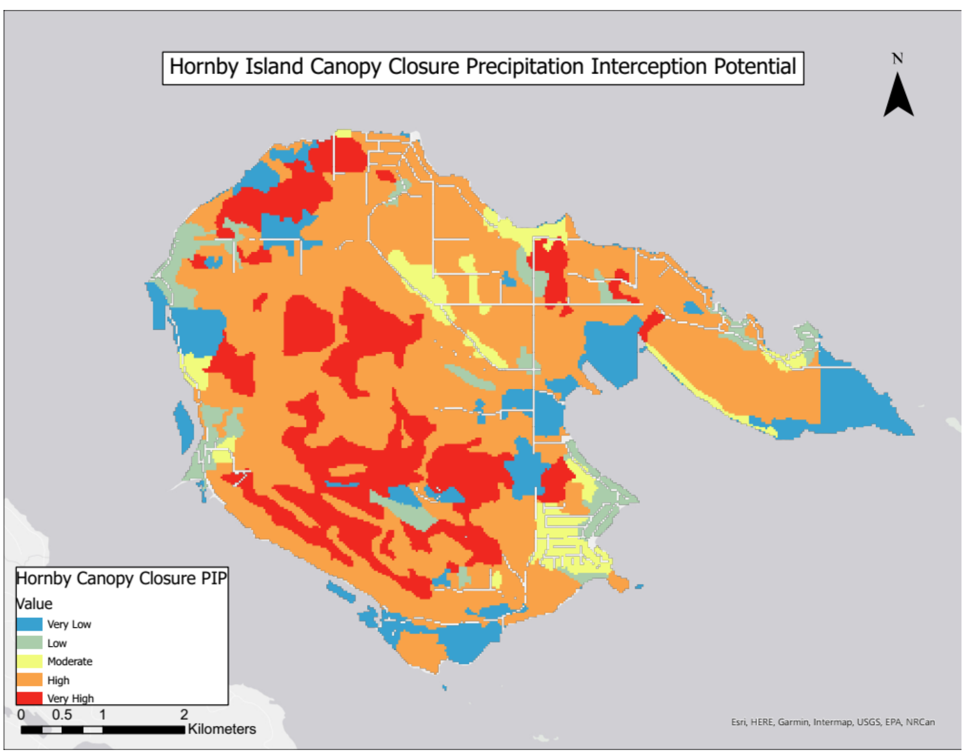

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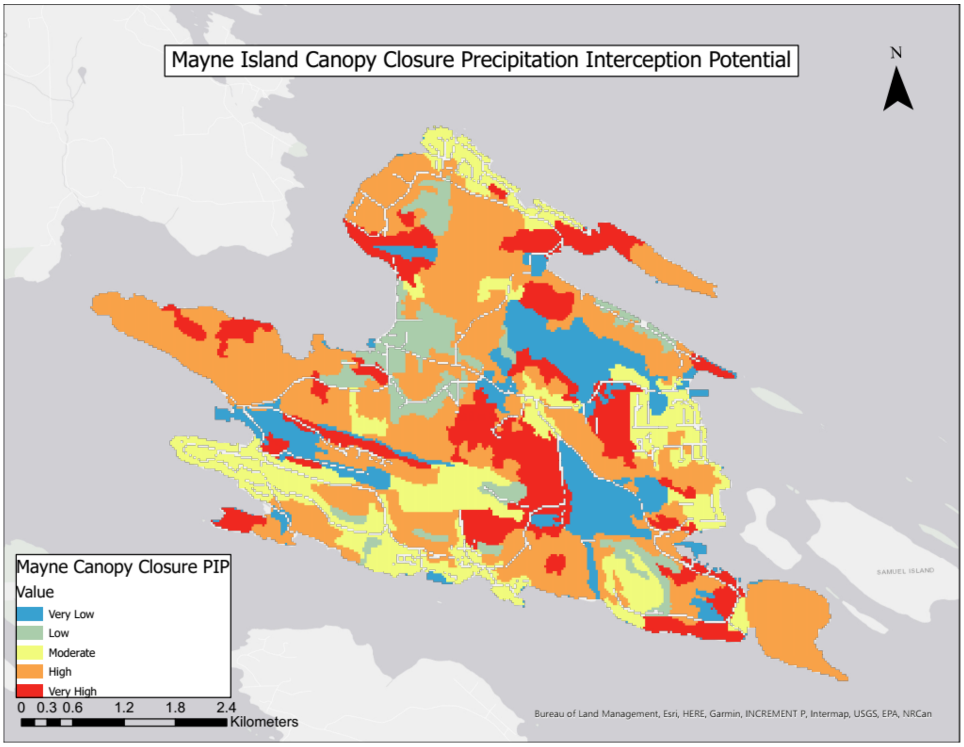

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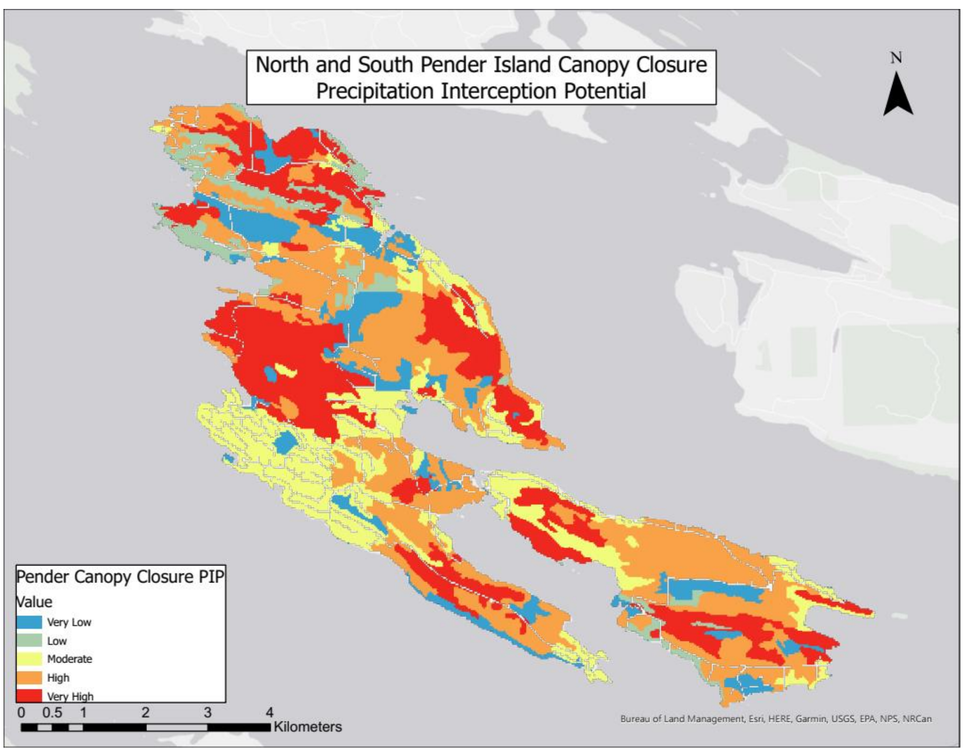
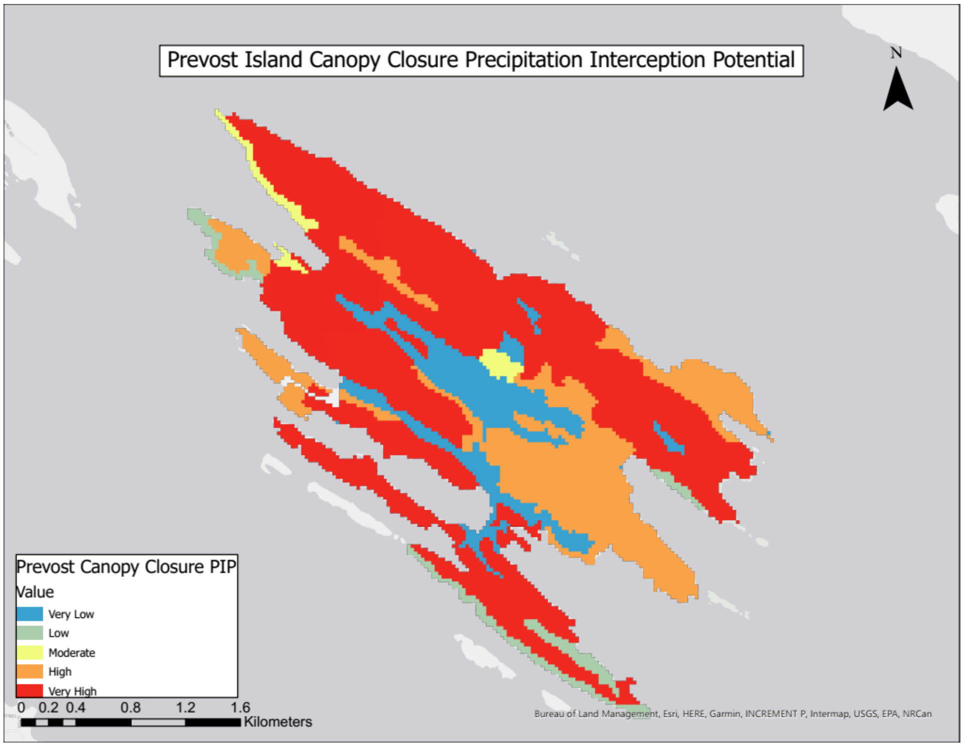


***Figure 8.** Canopy Closure Precipitation Interception Potential map of North and South Pender Island.*



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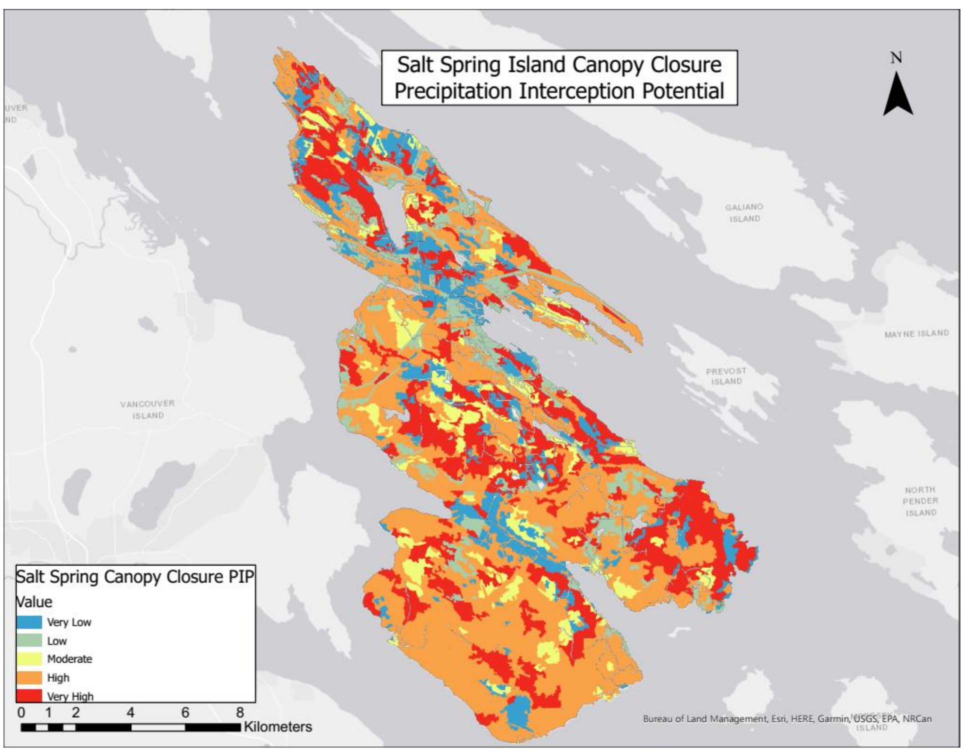

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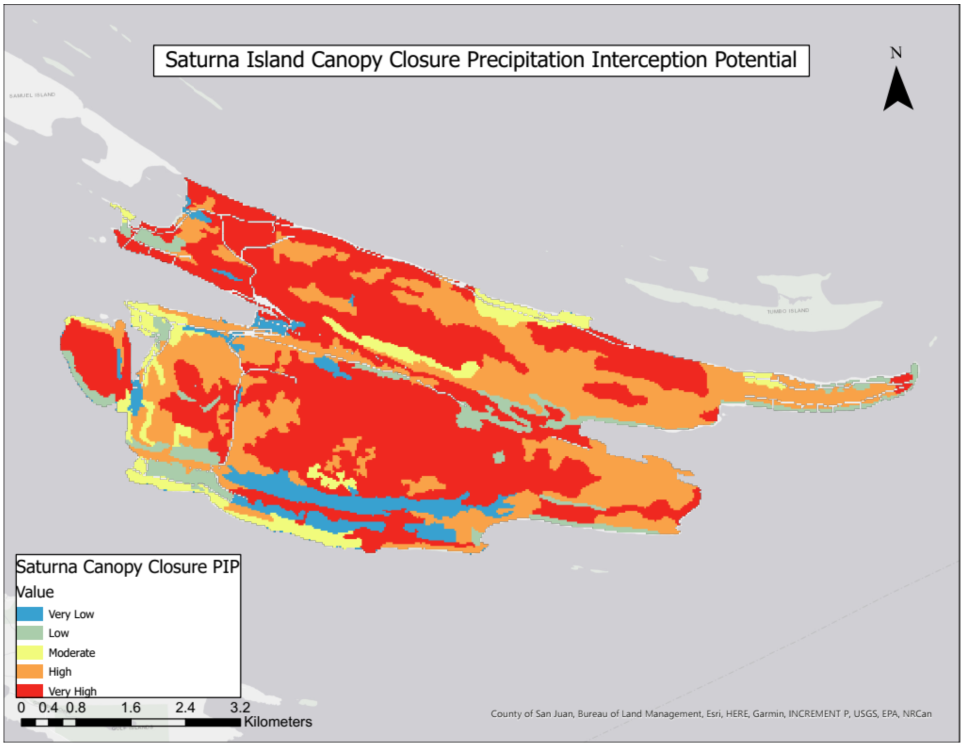


Figure 11. *Canopy Closure Precipitation Interception Potential map of Saturna Island.*

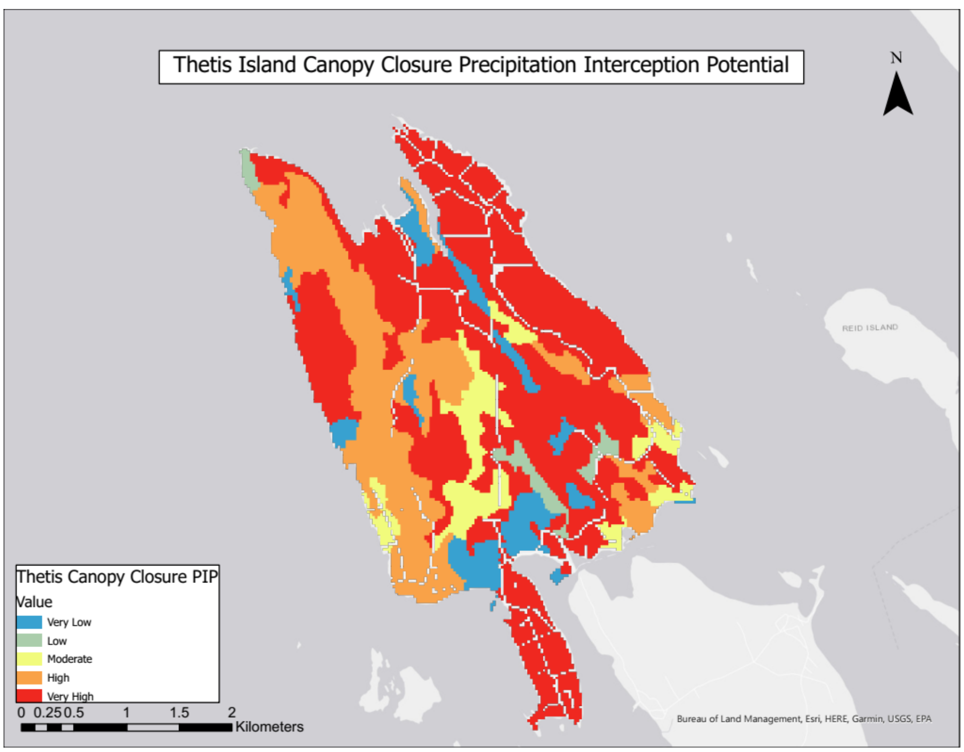
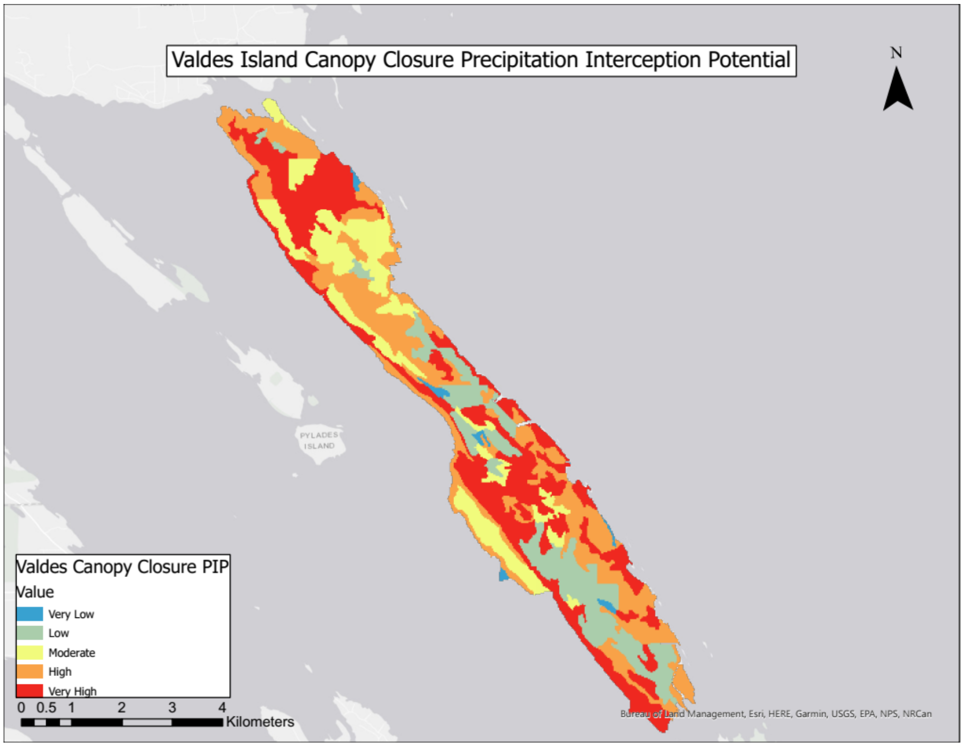


Figure 12. *Canopy Closure Precipitation Interception Potential map of Thetis Island.*



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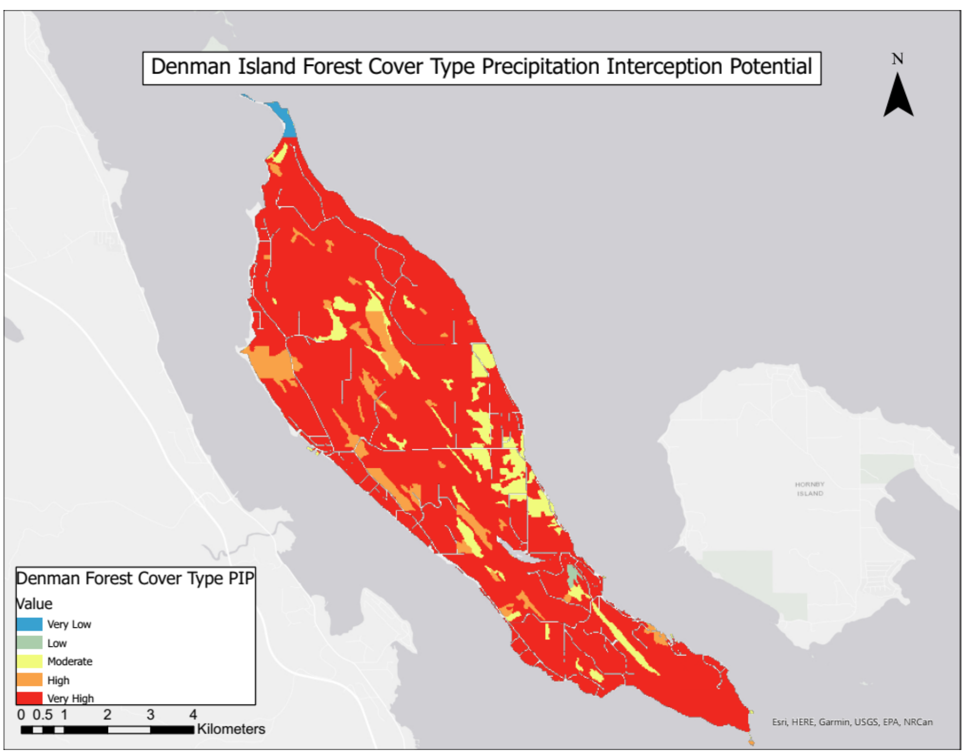
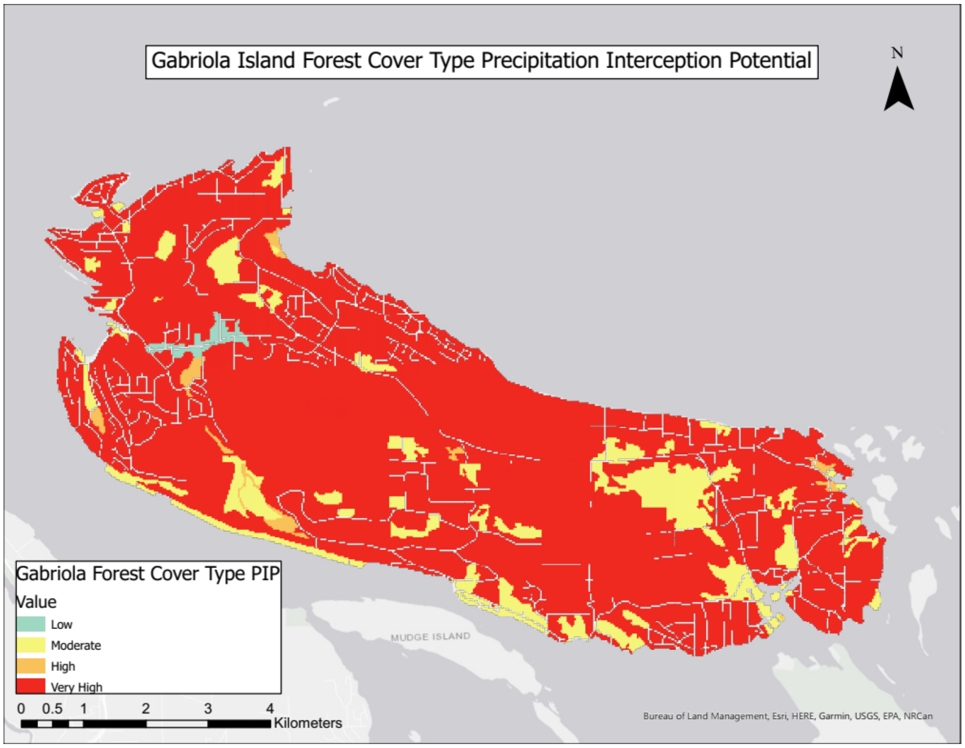


Figure 14. *Forest Cover Type Precipitation Interception Potential map of Denman Island.*



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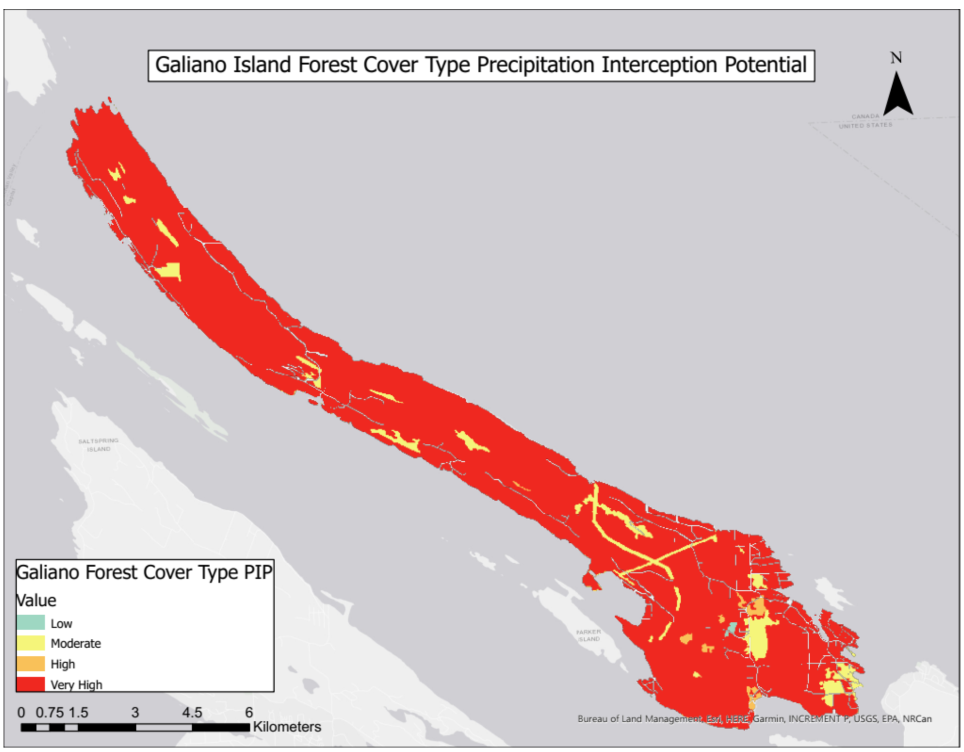

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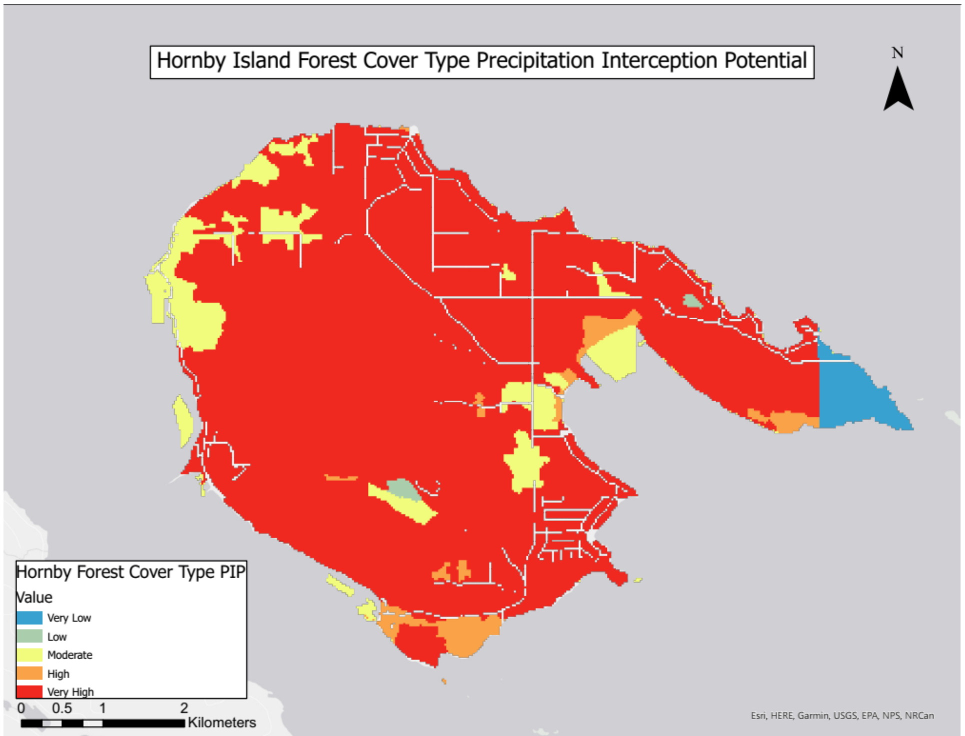

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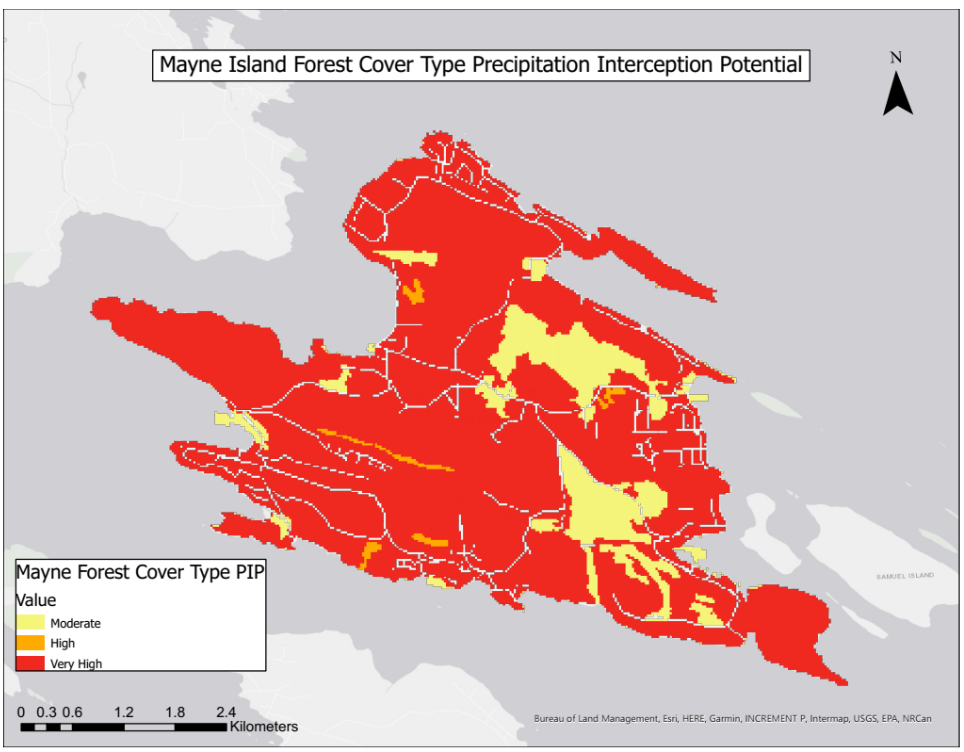

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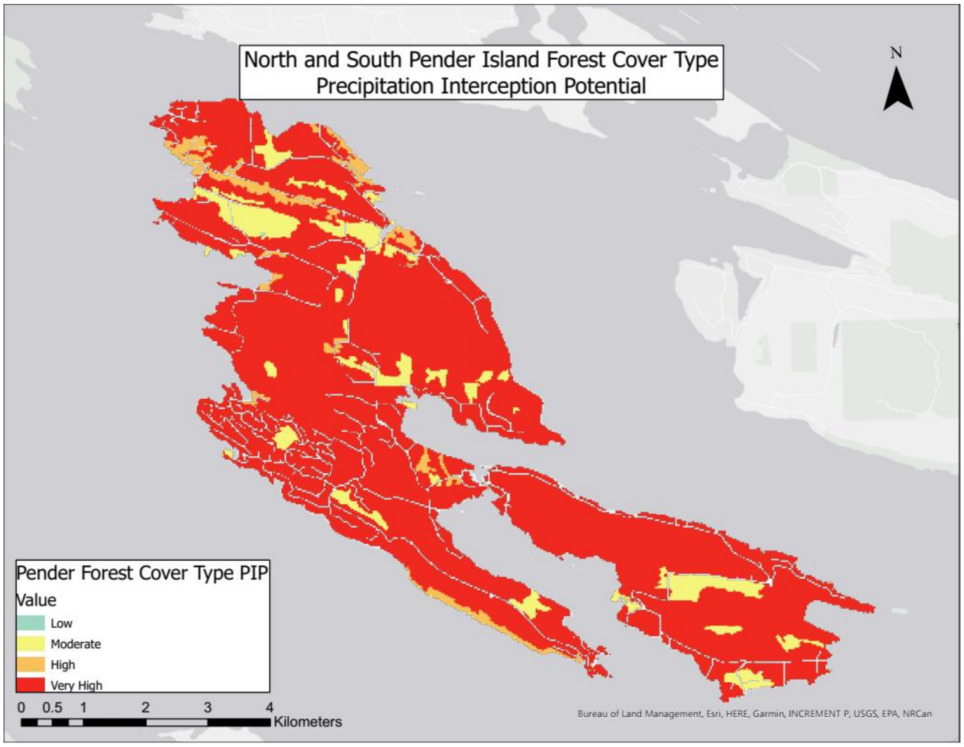

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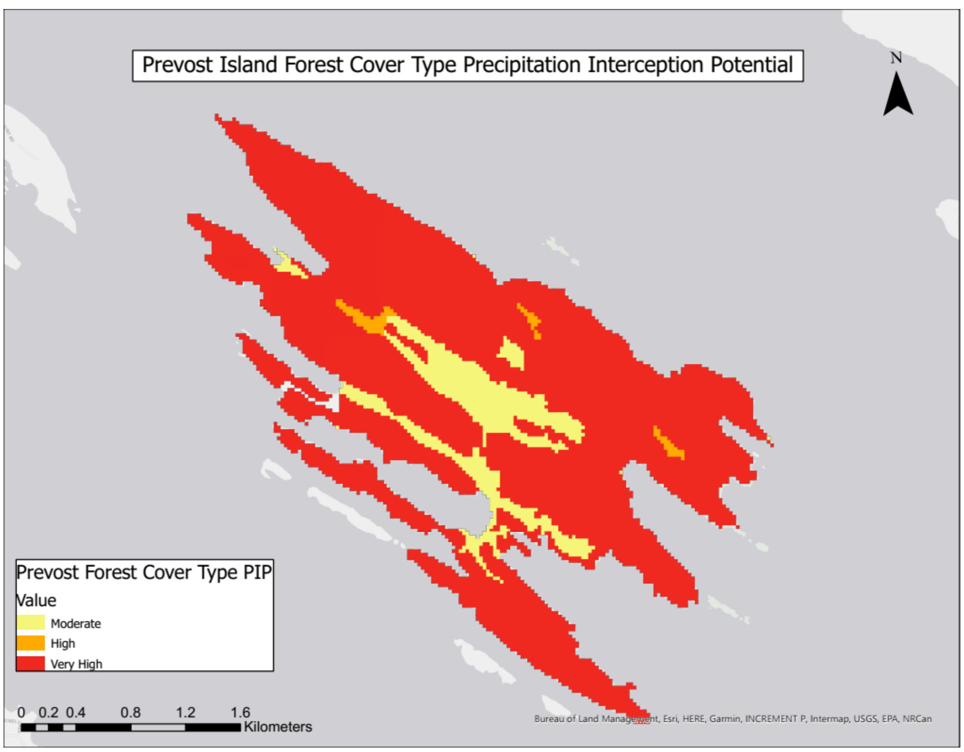

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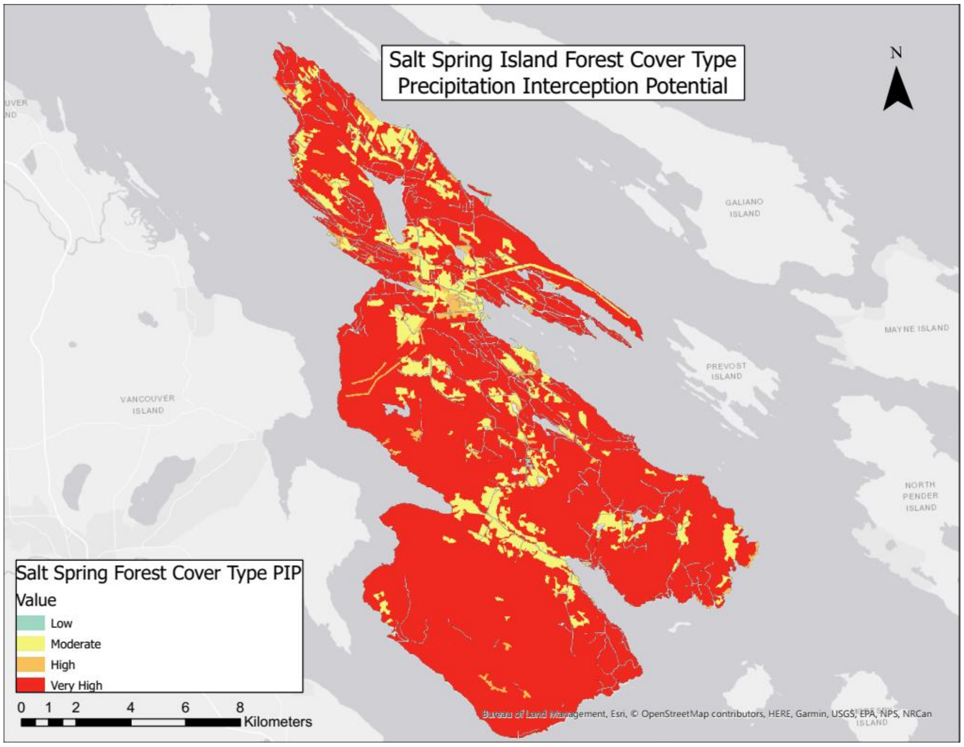

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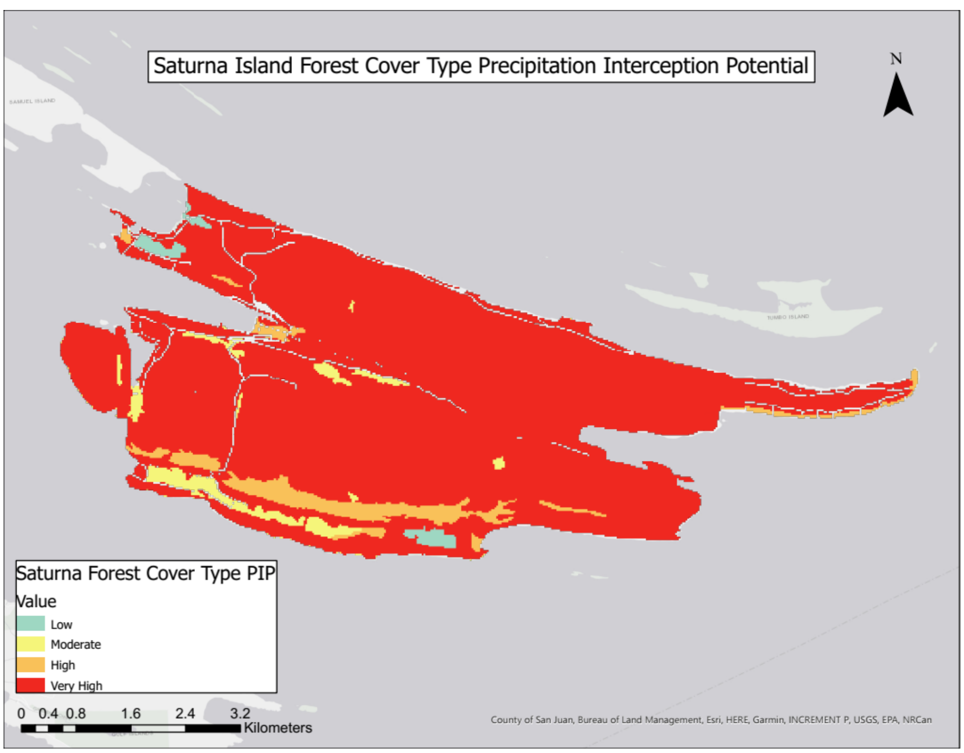

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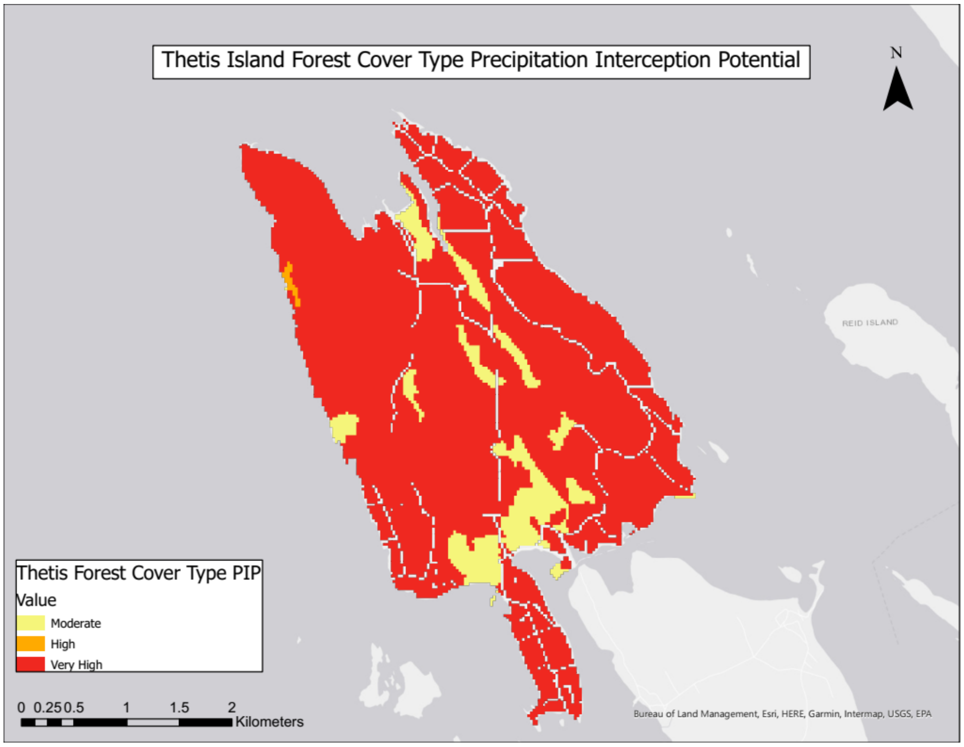

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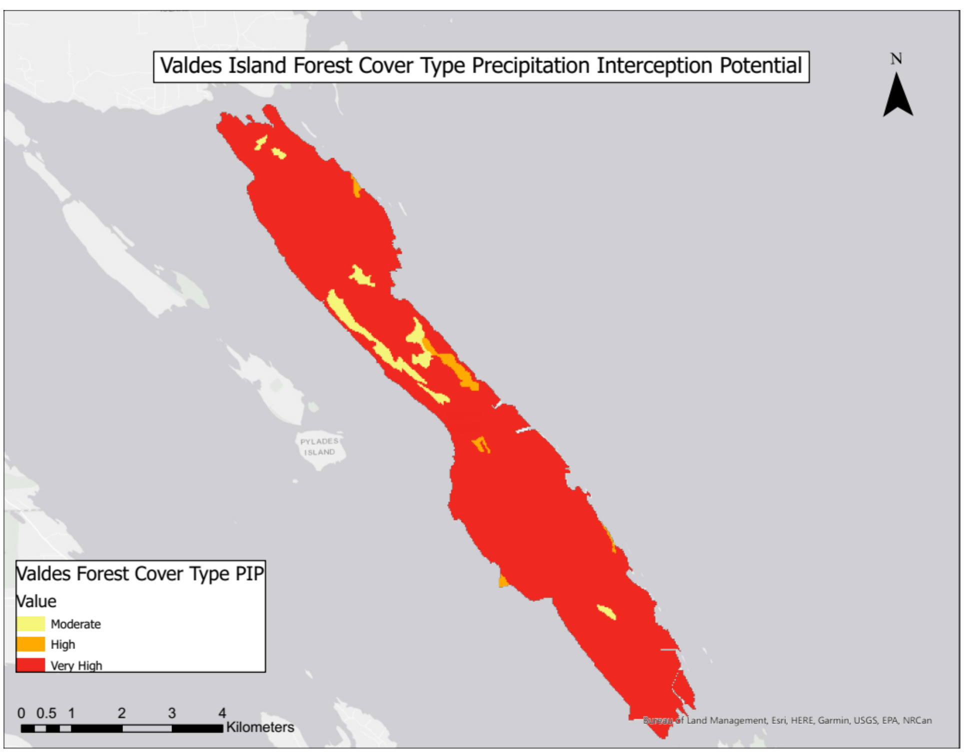

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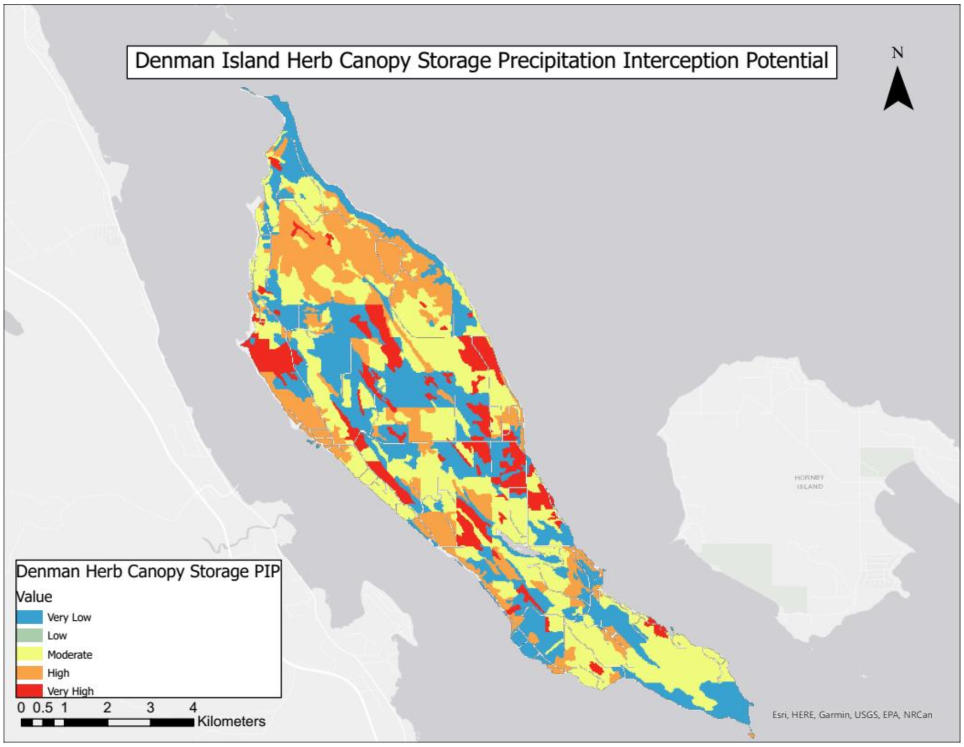
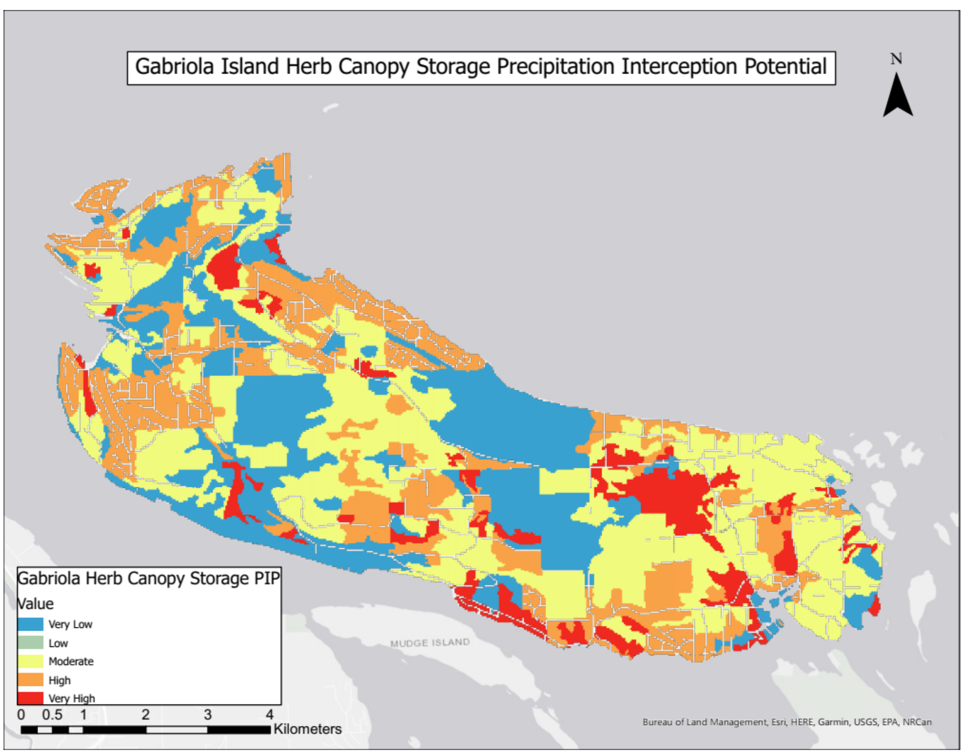


Figure 25. *Herb Canopy Storage Precipitation Interception Potential map of Denman Island.*



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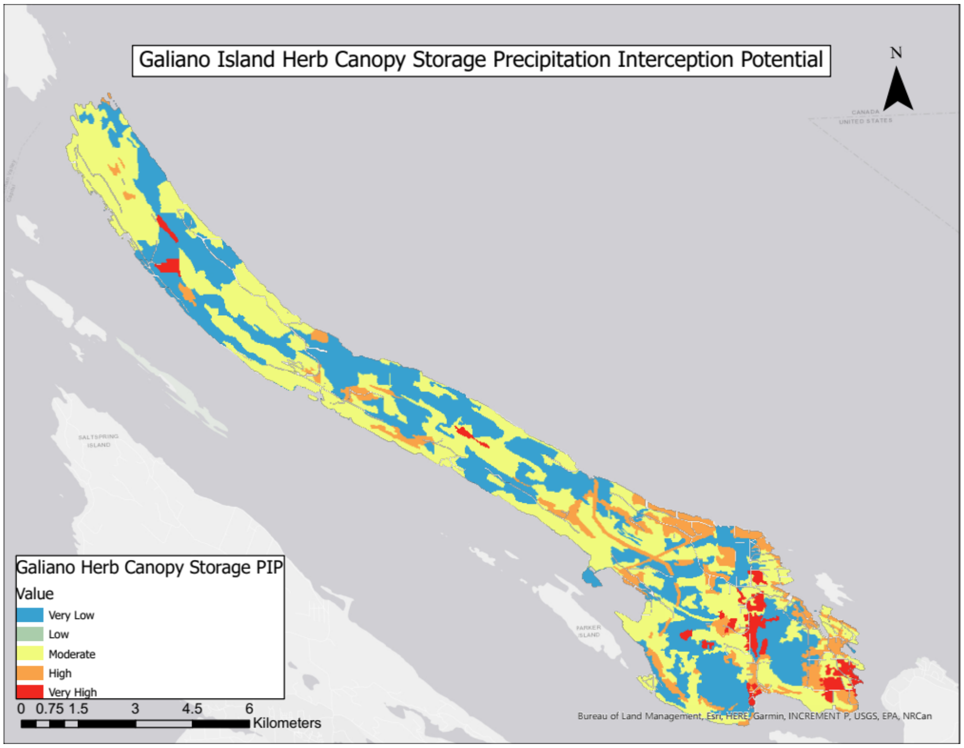

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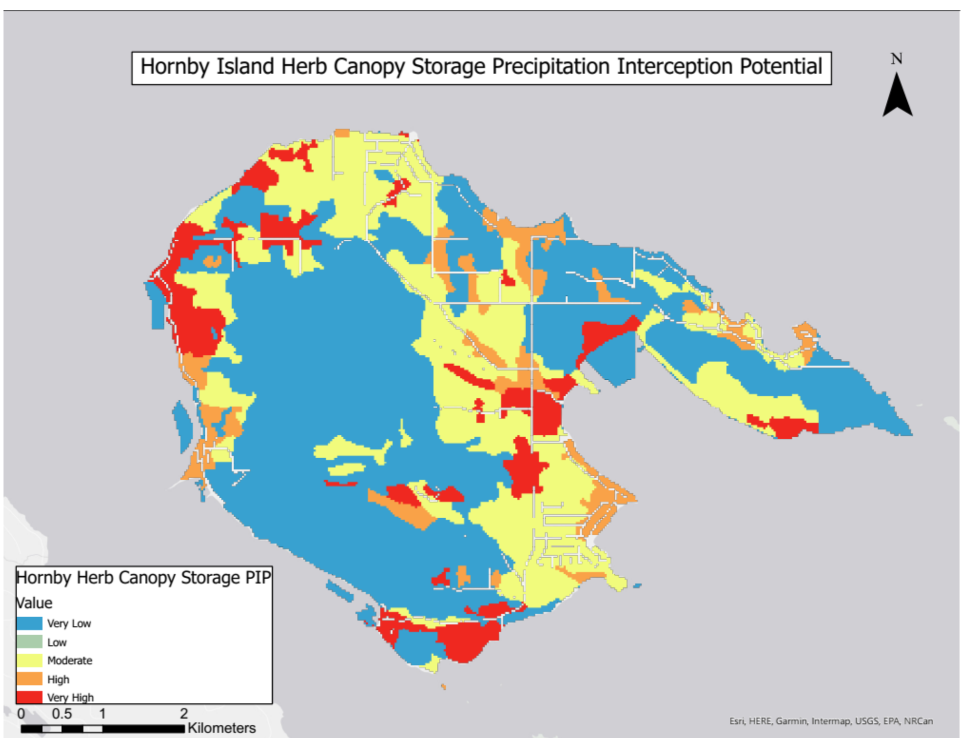

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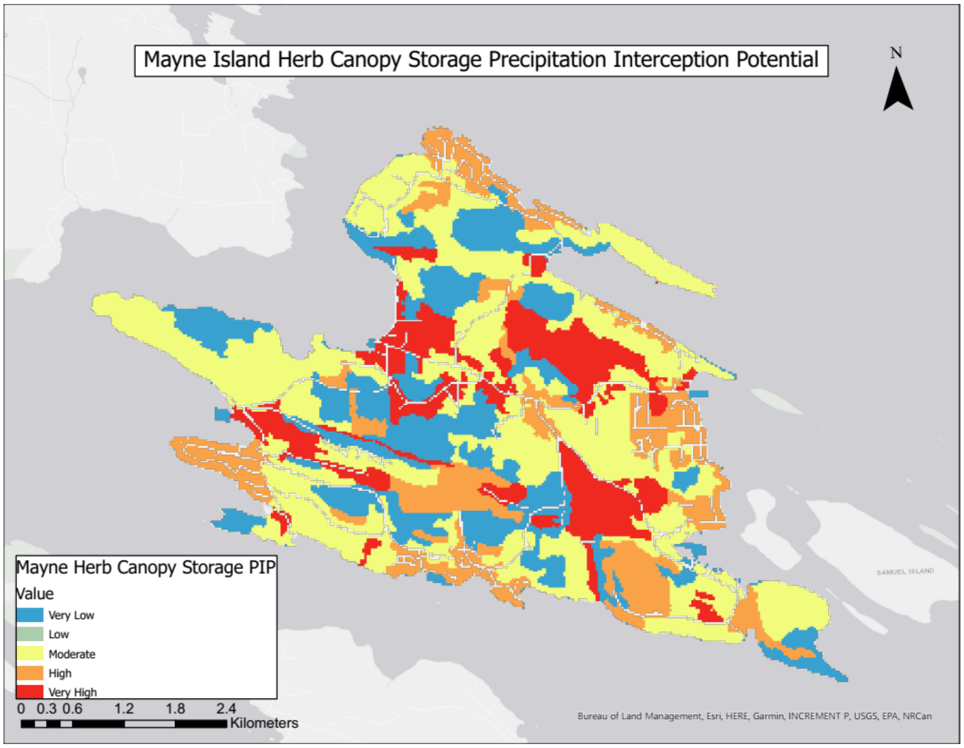

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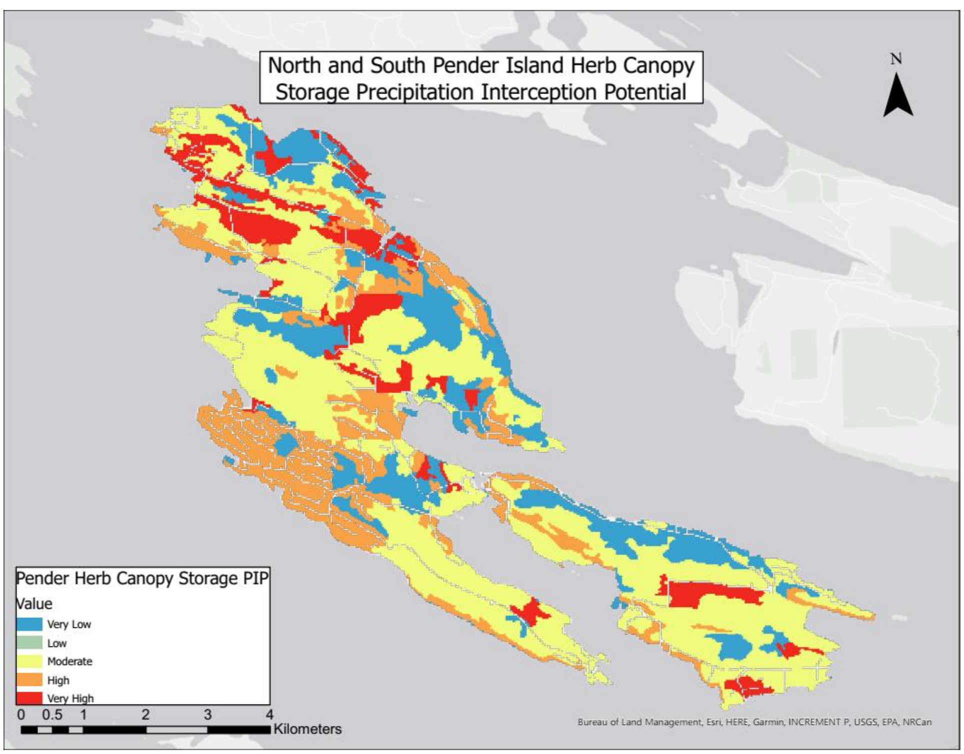
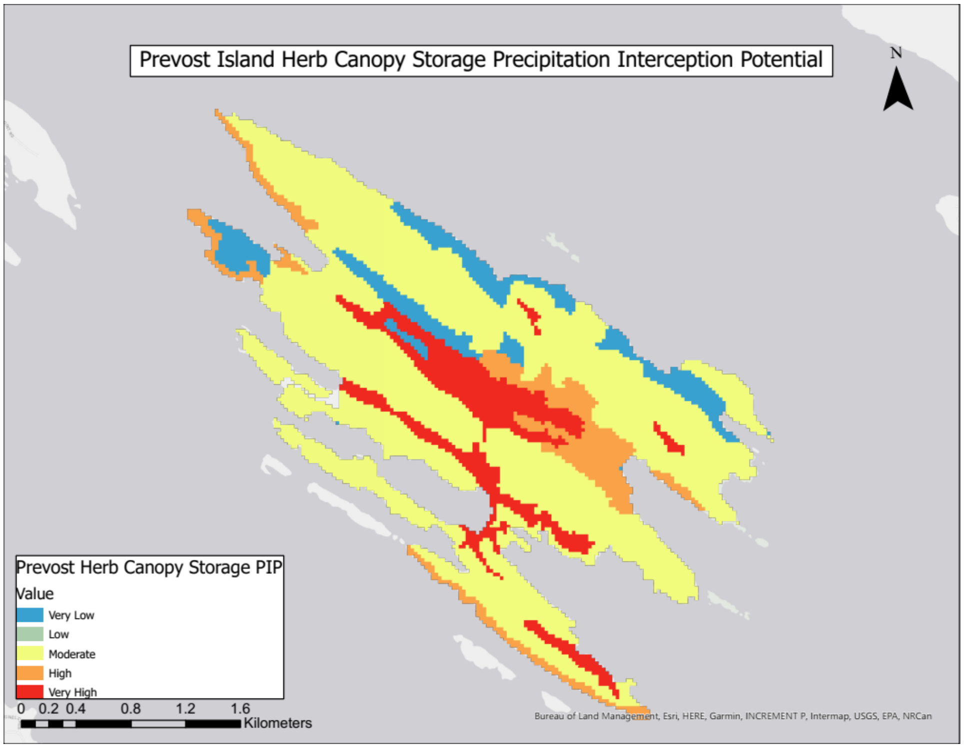


Figure 30. *Herb Canopy Storage Precipitation Interception Potential map of North and South Pender Island.*



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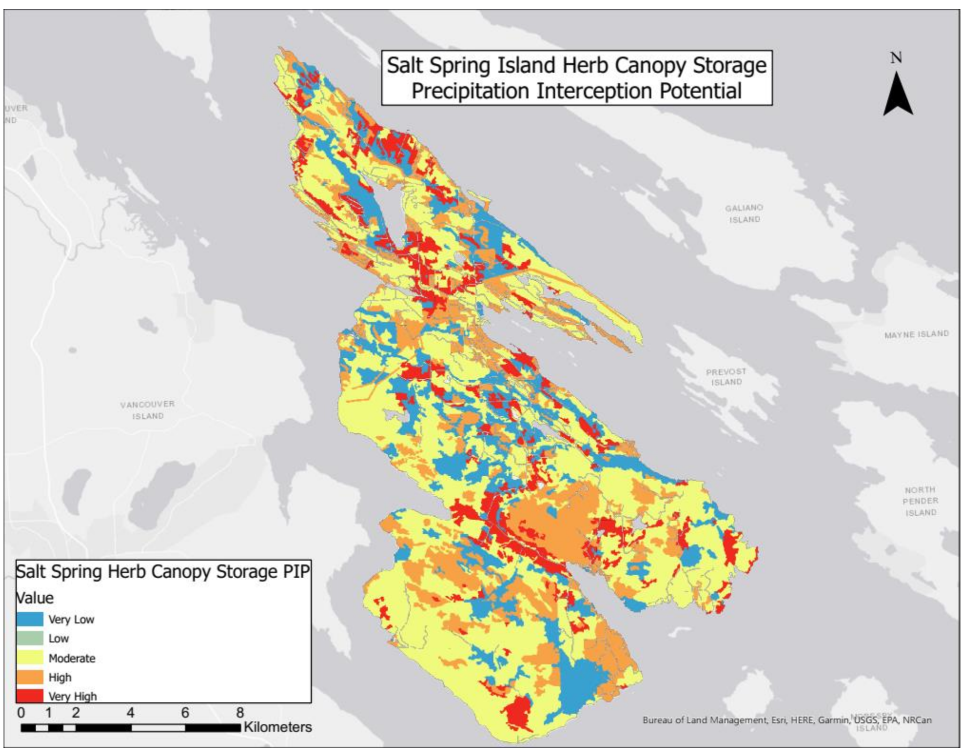

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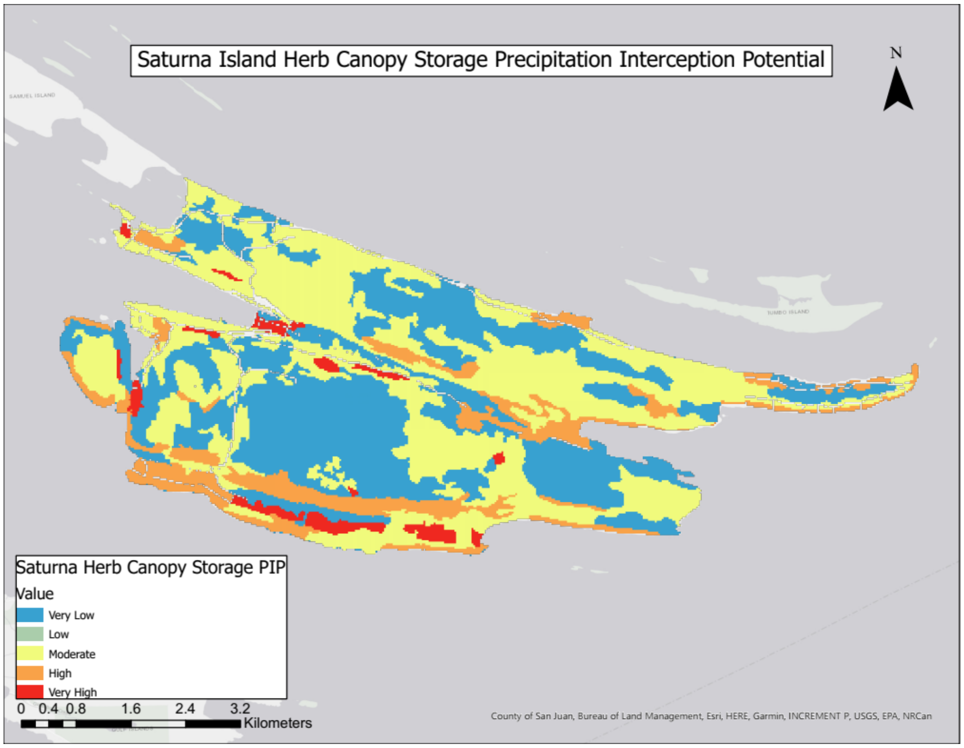

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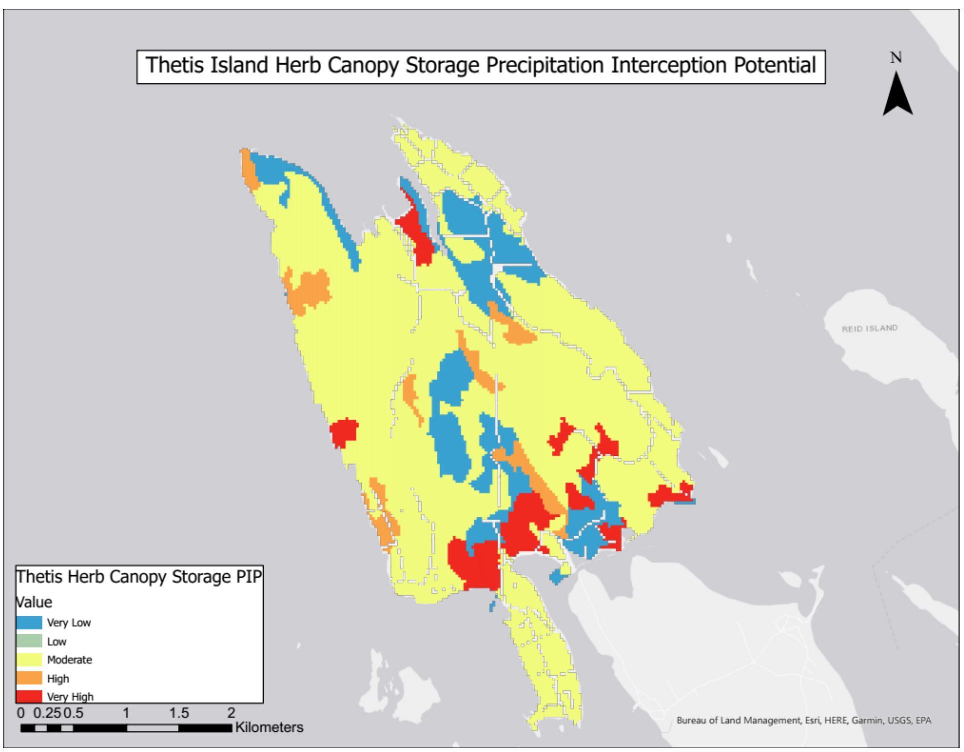

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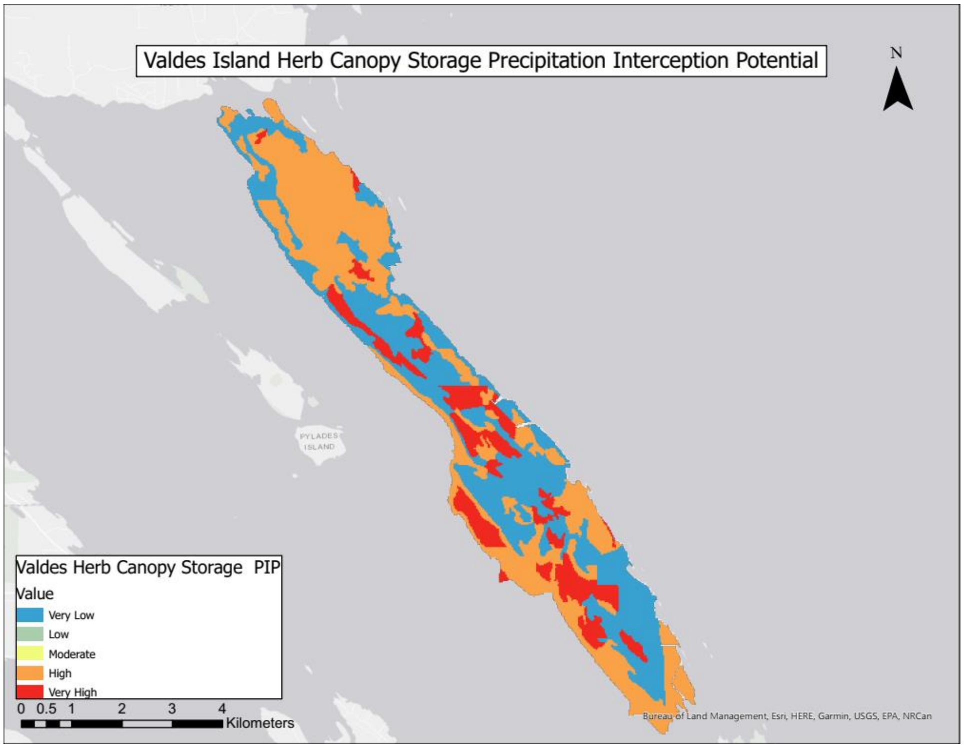

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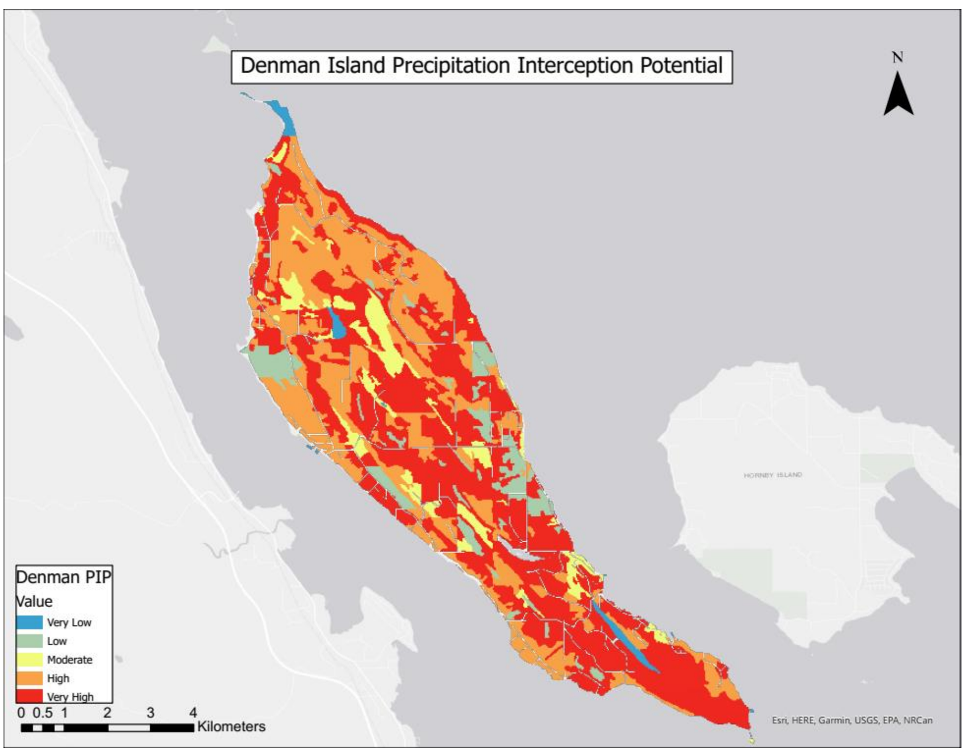

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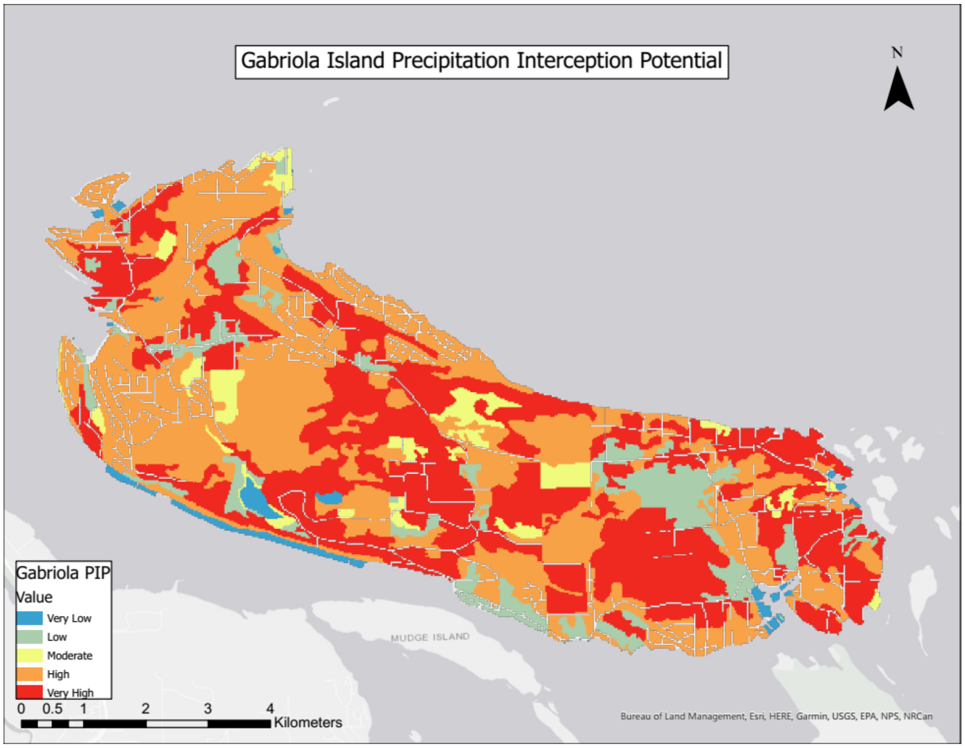


Figure 37. *Overall Precipitation Interception Potential map of Gabriola Island.*

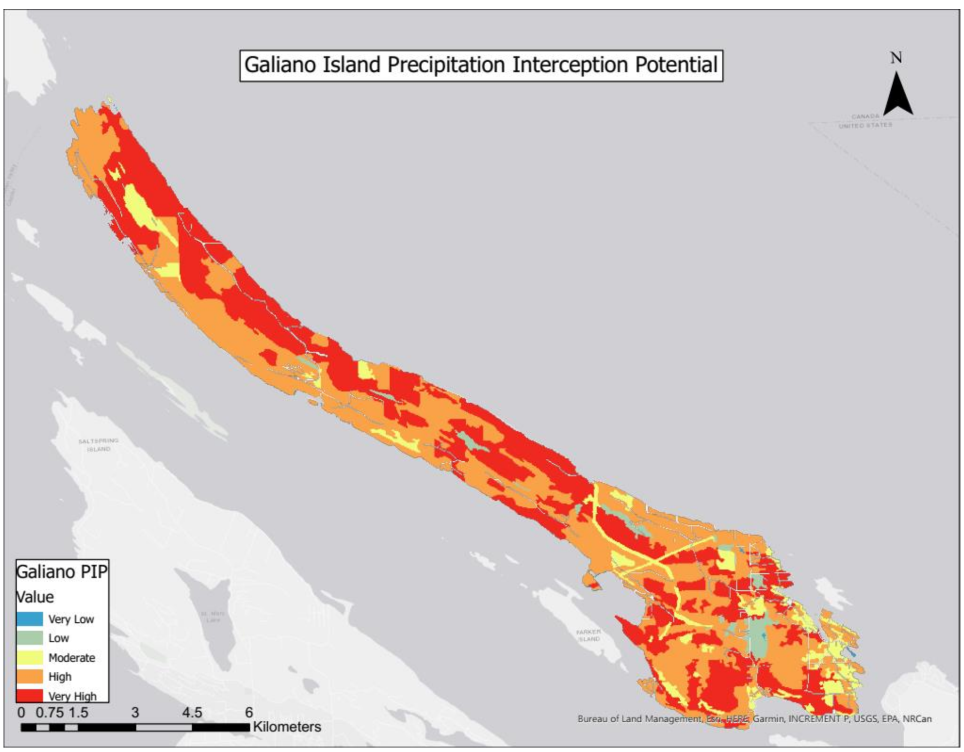
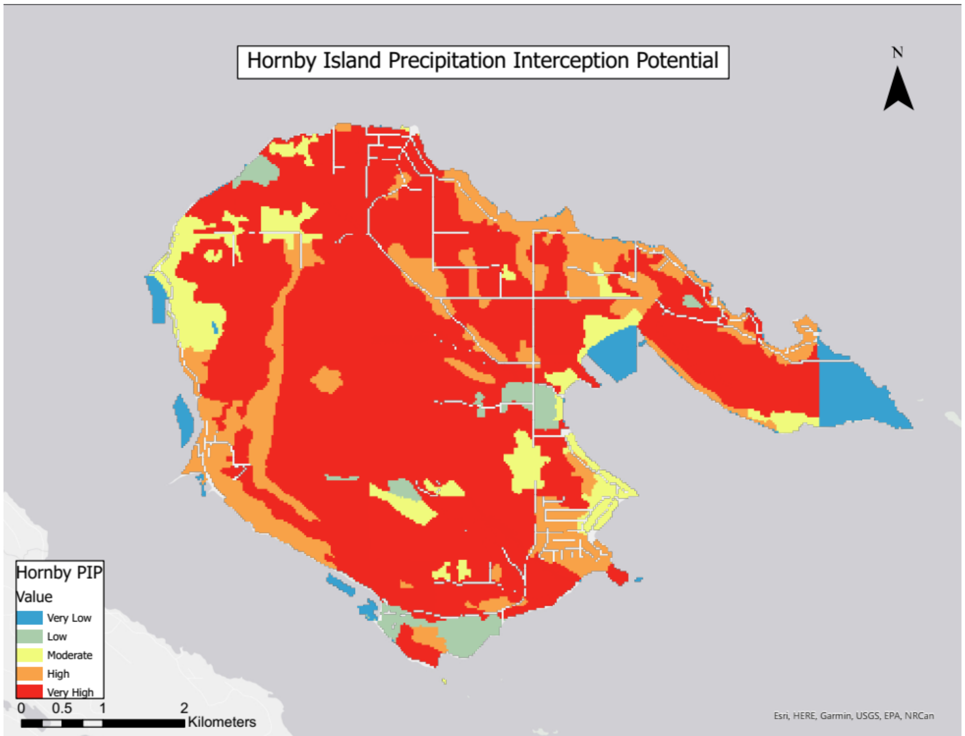


Figure 38. *Overall Precipitation Interception Potential map of Galiano Island.*



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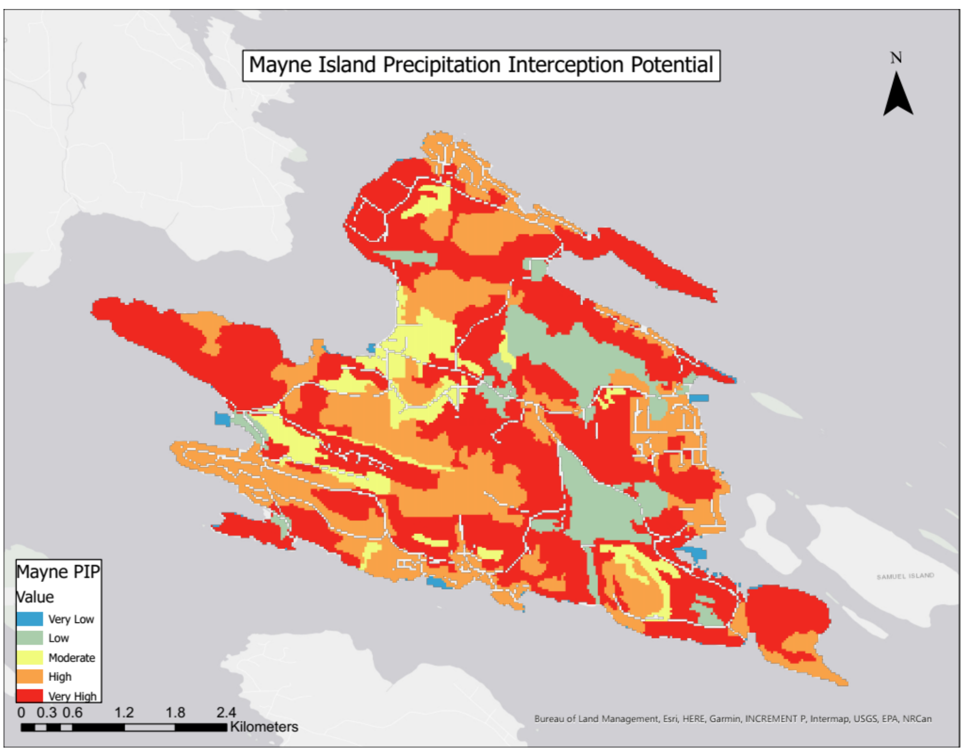

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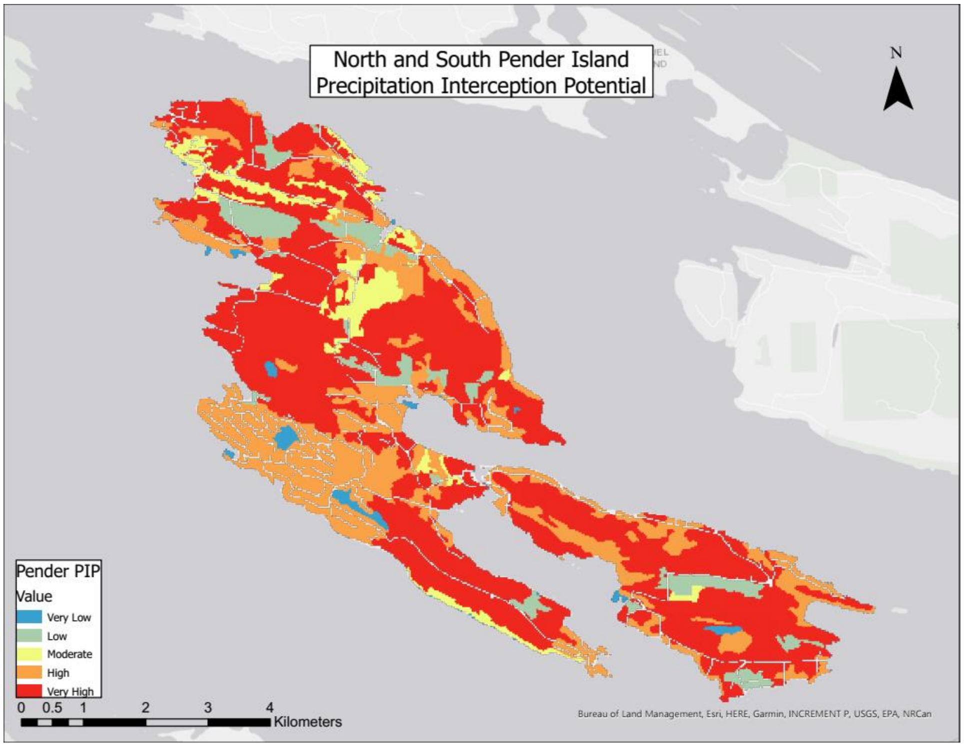


Figure 41. *Overall Precipitation Interception Potential map of North and South Pender Island.*

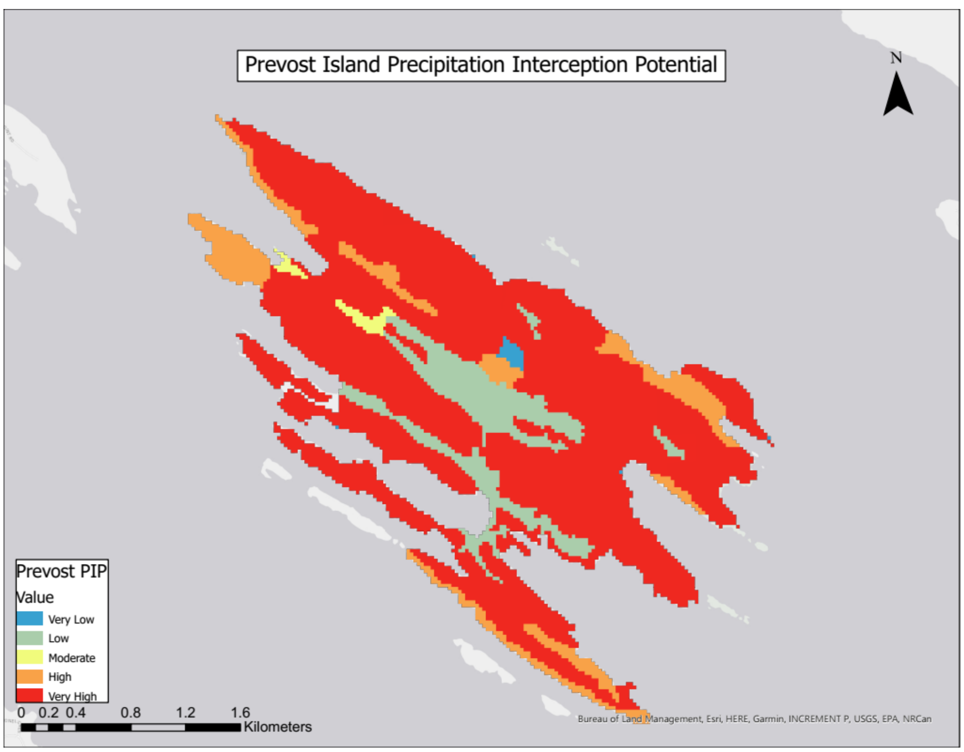
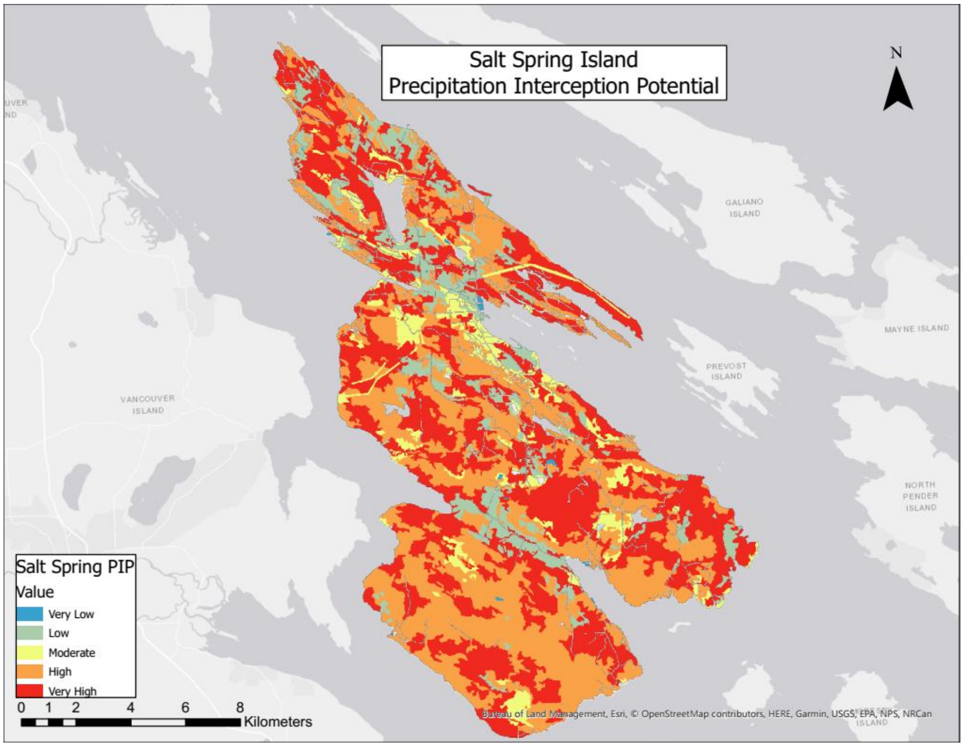


Figure 42. *Overall Precipitation Interception Potential map of Prevost Island.*



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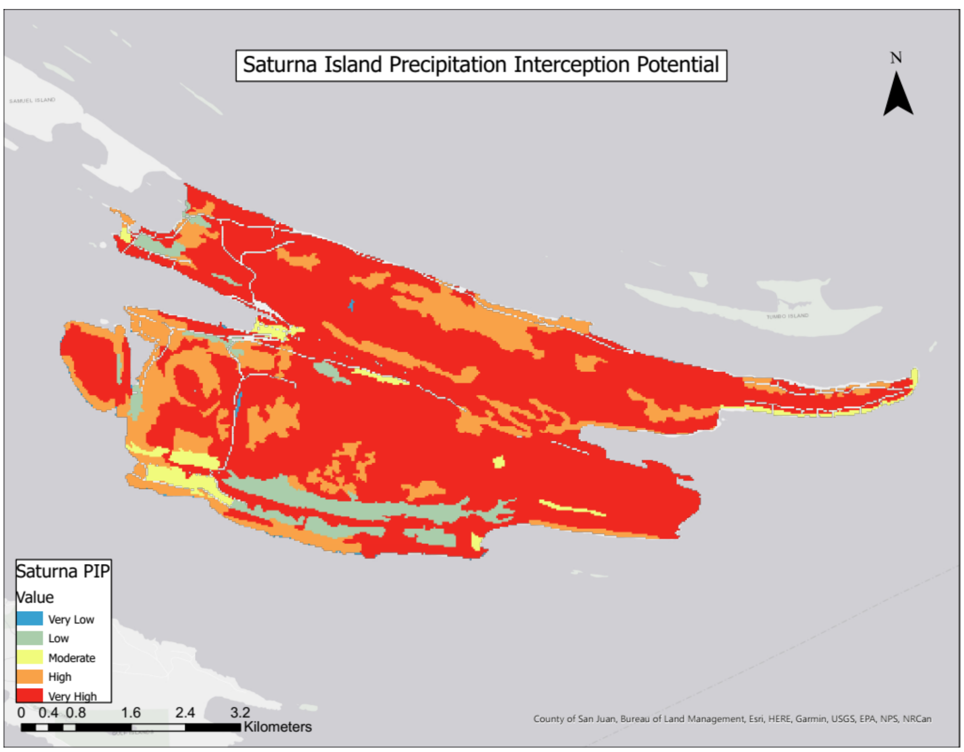

Figure 44. *Overall Precipitation Interception Potential map of Saturna Island.*

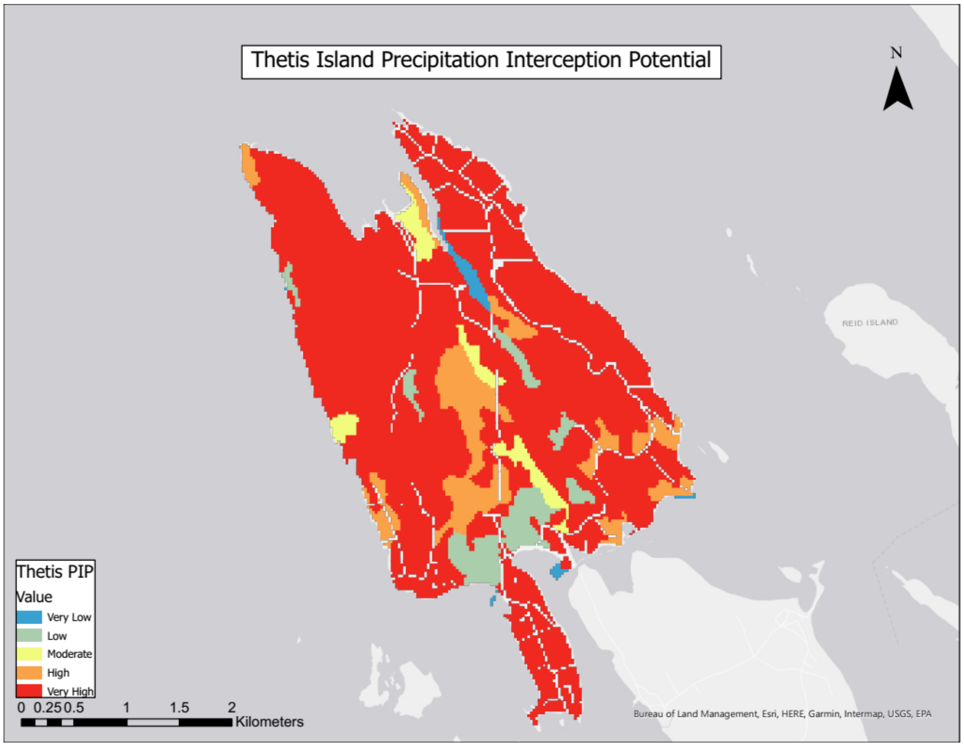

Figure 45. *Overall Precipitation Interception Potential map of Thetis Island.*

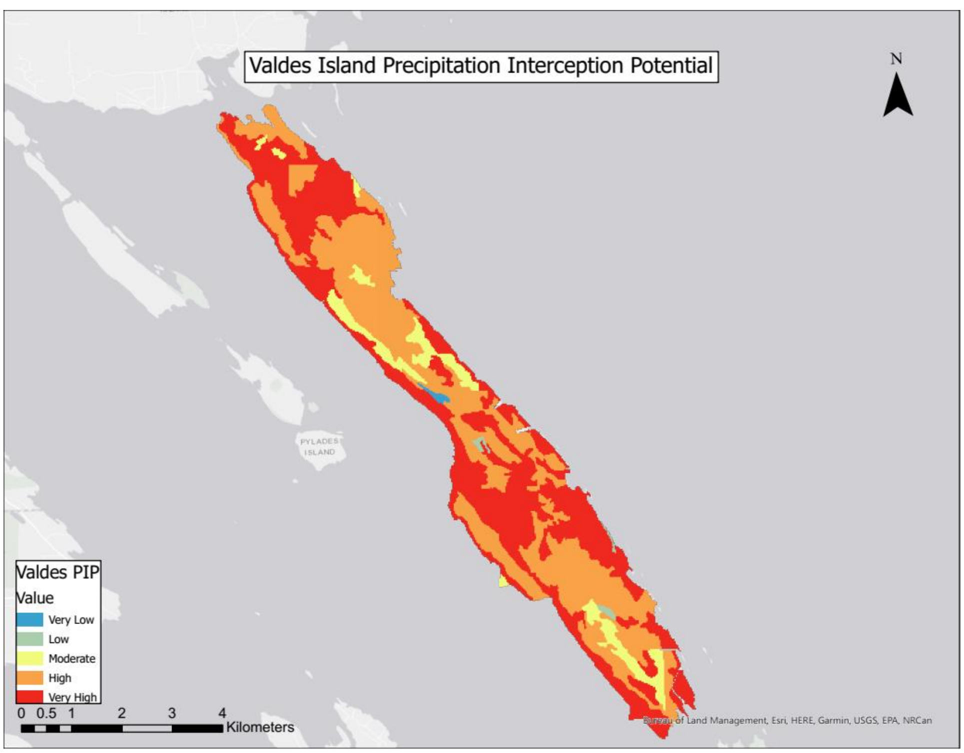

Figure 46. *Overall Precipitation Interception Potential map of Valdes Island.*