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TECHNICAL MEMORANDUM

Date: June 22, 2022

To: Zack Holt, City of Port Orchard

From: Mindy Fohn and Katie Wingrove, Herrera Environmental Consultants, Inc.

Subject: City of Port Orchard—Watershed Prioritization

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TABLES

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BACKGROUND

The purpose of this technical memorandum is to document the watershed prioritization process developed for the City of Port Orchard (City) to meet the requirements of S5.C.1.d.ii of the Western Washington Phase II NPDES Stormwater Permit. The approach taken to complete this prioritization process generally follows Ecology's Stormwater Management Action Planning (SMAP) Guidance (Ecology 2019) with modifications that reflect city priorities, stakeholder feedback, and the landscape.

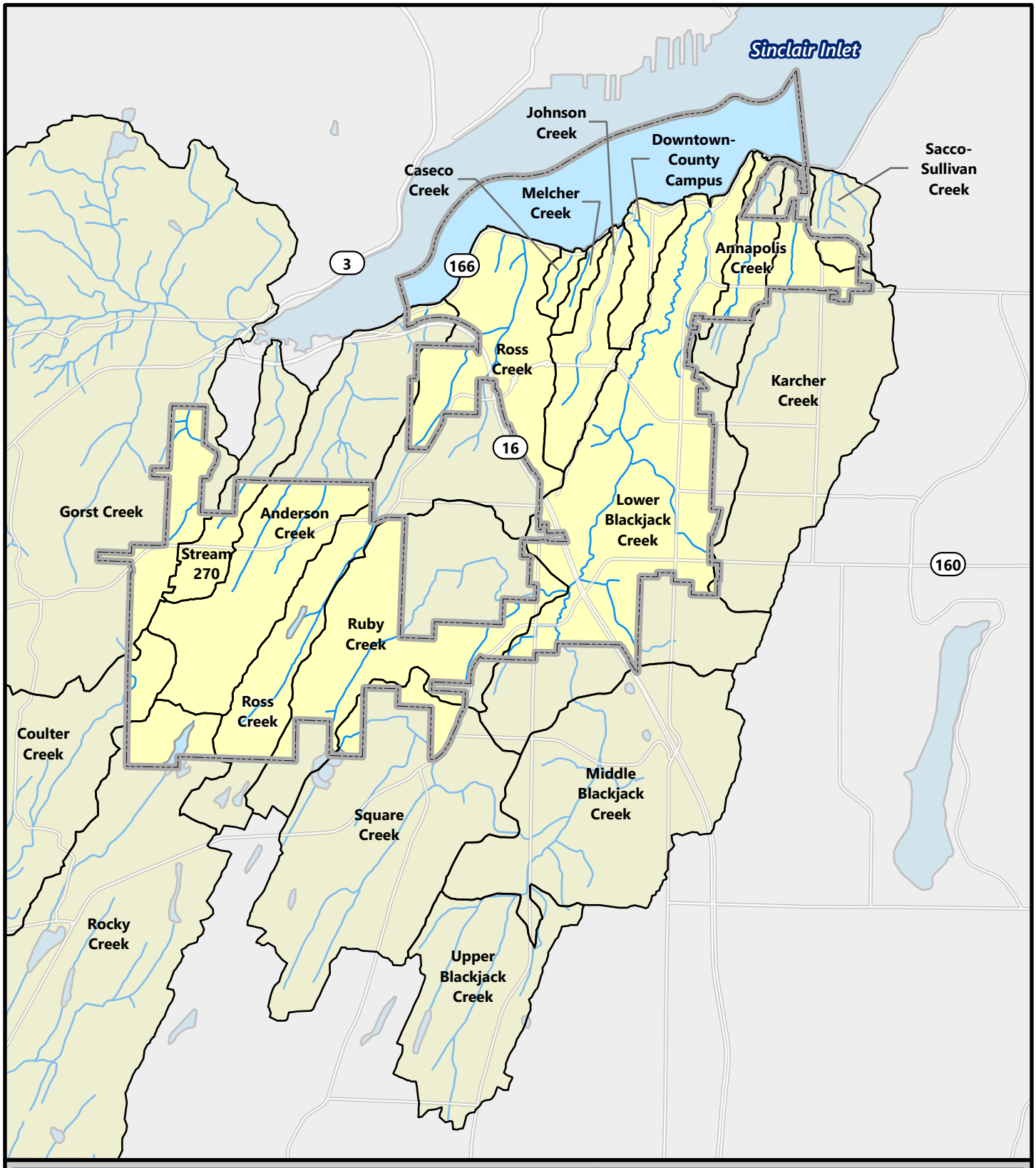
The City's watershed inventory and assessment submitted to Ecology March 31, 2022, delineated watersheds and collated existing information and data for the 18 watersheds that exist within City boundaries (Herrera 2022). Figure 1 depicts the City of Port Orchard SMAP watersheds.

The intent of this prioritization is to select one watershed for development of a SMAP Plan.

Prioritization involves the following steps:

- Refine the list of 18 City watersheds based upon stormwater influence, jurisdiction control and basin size.
- Evaluate candidate watersheds using selected metrics from the watershed inventory and develop a scoring, ranking and rating procedure. Ratings are used to assign watershed management goals of *Restoration* or *Development*.
- Evaluate *Restoration* watersheds for jurisdiction control, social equity, and promotes existing projects and plans.
- Select the highest priority watershed.

Finally, catchments were delineated in the highest priority watershed and a 400-600 acre catchment selected for development of the SMAP Plan.



Legend

- Watersheds
- Port Orchard City Limits
- Waterbodies
- Streams
- Roads

Figure 1.
City of Port Orchard SMAP Watersheds.

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PRIORITIZATION

Prioritization was conducted in four steps. Figure 2 depicts the steps for the prioritization process.

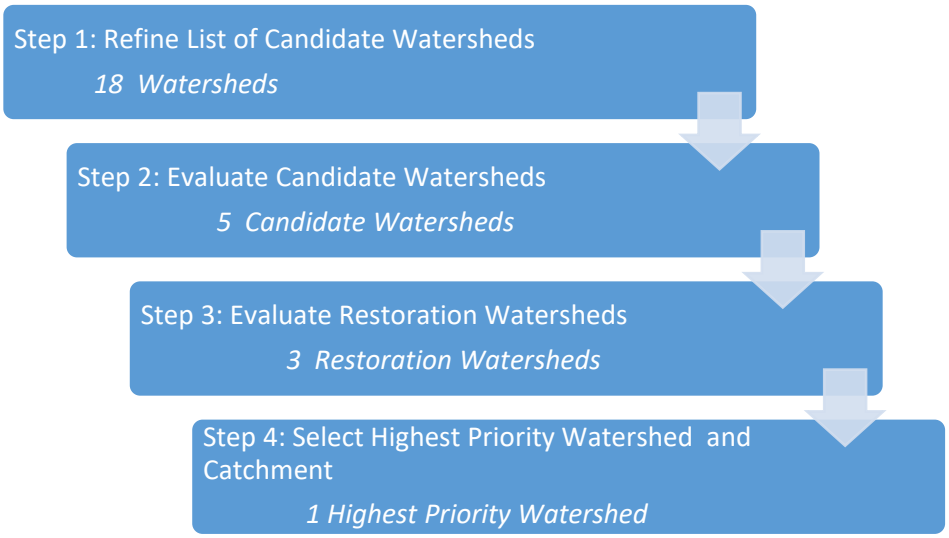


Figure 2. Watershed Prioritization Process for the City of Port Orchard.

Step 1: Refine List of Candidate Watersheds

Step 1 refines the list of all 18 City influenced watersheds in two steps. City of Port Orchard watersheds are depicted in Figure 1. First, watersheds were eliminated based upon stormwater influence (Herrera 2022). Second, the remaining watersheds were evaluated for appropriate catchment size.

Six watersheds were removed from this prioritization process during the Receiving Water Conditions Assessment (Herrera 2022) due to low or no stormwater influence or jurisdiction control less than 5 percent by the City:

- Middle Blackjack Creek
- Upper Blackjack Creek
- Square Creek
- Coulter Creek
- Rocky Creek
- Gorst Creek

Next, for the remaining 12 watersheds, acre size was evaluated. Future annexation by the City was incorporated into the watershed size. Table 1 summarizes current City watershed percentage control and acres, and potential future City control and total acres.

Table 1. Watershed Size Evaluation.

Watershed Name	% City	Acres	% City + UGA	Total City +UGA Acres
Annapolis Creek	54.6%	174	100.0%	318
Johnson Creek	100.0%	326	100.0%	326
Karcher Creek	11.4%	125	100.0%	1,433
Ross Creek	64.7%	1,142	66.4%	1,161
Anderson Creek (Gorst)	59.4%	758	59.9%	763
Lower Blackjack Creek	67.9%	1,685	86.6%	2,156
Ruby Creek	53.5%	758	54.5%	833
Sacco/Sullivan Creek	21.8%	41	100.0%	186
Downtown-County Campus	100.0%	178	100.0%	178
Melcher Creek	100.0%	61	100.0%	61
Caseco Creek	100.0%	56	100.0%	56
Stream 270	44.9%	162	44.9%	162

Annapolis Creek and Karcher Creek watersheds, currently within City control, are below the lower threshold recommended catchment size of 400 acres; however, annexation would result in the watersheds increasing in size near or above the threshold. The City does not anticipate annexing these areas in the near future, so these watersheds were removed from prioritization.

Seven watersheds were removed from this prioritization process due to their size well below the 400-acre threshold:

- Annapolis Creek
- Karcher Creek
- Downtown County Campus
- Sacco/Sullivan Creek
- Melcher Creek
- Caseco Creek
- Stream 270

Johnson Creek watershed size is slightly less than the 400-acre threshold but was retained for prioritization.

The following five watersheds are carried forward to Step 2 of the prioritization process:

- Anderson Creek
- Johnson Creek
- Lower Blackjack Creek
- Ross Creek
- Ruby Creek

Step 2: Evaluate Candidate Watersheds

Next, the five watersheds were scored and ranked for three evaluation categories:

- Receiving Water Use Support
- Development and Future Growth
- Water and Habitat Conditions

Select Metrics for Evaluation

Metrics were selected with input from City staff and review of Ecology guidance (Ecology 2019). Table 2 summarizes the category, purpose of each category and the selected metrics.

Table 2. Description of Evaluation Category, Purpose and Metrics.

Category	Purpose	Metric
Receiving Water Use Support	Determine extent the receiving water supports use by aquatic species and the community. Higher scores denote a greater number of species, habitat presence and community access.	• Forage Fish Nearshore Species Use • Pocket Estuary Presence • Freshwater Salmon and Trout Species Presence • Public Recreation Access
Development and Future Growth	Determine extent of development and potential future development. Higher scores denote a higher level of development and future development.	• Percent Total Impervious Area • Percent of Impervious Area in Stream Riparian Zone • Vacant Buildable Lands
Water and Habitat Conditions	Determine existing level of impairment of water quality and habitat conditions. Higher scores denote better conditions.	• B-IBI Habitat Condition of: • Nearshore Marine • Salmonid Rearing • Salmonid Spawning • Salmonid Migration Support • Refuge and Riparian Function

Receiving Water Use Support Evaluation

Receiving Water Use Support was scored for nearshore forage fish species presence, nearshore juvenile salmon (assumed) due to presence of a pocket estuary, number of salmonid and trout species, and public access for recreation. Scoring method for receiving water use support is shown in Table 3. Scoring results and rankings are shown in Table 4.

The highest potential score is 7. Scores range from 7 to 2. Lower Blackjack Creek was the top ranked watershed with the greatest support of receiving water uses.

Table 3. Scoring Method to Assess Receiving Water Use Support.

Metric	Method
Forage Fish Nearshore Species Use	Watersheds were scored based upon Washington State Forage Fish Mapping representing use of the nearshore habitat use by surf smelt and/or herring for spawning. ● **Score of 0:** No data or no presence of forage fish spawning ● **Score of 1:** Presence of one species ● **Score of 2:** Presence of both species
Presence of Pocket Estuary	Watersheds were scored based upon Washington State Ecology Coastal Atlas Mapping representing presence of marine nearshore pocket estuary use by juvenile salmonids and other species. ● **Score of 0:** No pocket estuary ● **Score of 1:** Pocket estuary
Freshwater Salmon and Trout Species Presence	Watersheds were scored based upon Statewide Salmon Distribution Database and NOAA Critical Habitat Mapping for ESA listed species representing presence and diversity of salmonid species. ● **Score of 0:** No species ● **Score of 1:** One to two species presence ● **Score of 2:** Three to four species presence ● **Score of 3:** Five or more species presence
Public Recreation	Watersheds were scored based upon Washington State Ecology Coastal Atlas representing public recreation access and use. ● **Score of 0:** No public access ● **Score of 1:** One public access area

Table 4. Receiving Water Use Support Scoring and Ranking for City of Port Orchard Candidate Watersheds.

	Forage Fish Spawning		Nearshore Aquatic Habitat		Diversity of Salmonid and Trout Species		Public Recreation Access		Result	
Watershed	Species	Score	Presence of Pocket Estuary	Score	Species Presence	Score	Number of Access Points	Score	Total Score	Ranking
Lower Blackjack Creek	Surf smelt, sand lance	2	Yes	1	Coho, fall chum, winter steelhead, resident trout, fall chinook, summer chum	3	1	1	**7**	**1**
Ross Creek	Surf smelt, sand lance	2	Yes	1	Coho, fall chum	2	1	1	**6**	**2**
Ruby Creek	Surf smelt, sand lance	2	Yes	1	Coho, fall chum, resident trout, summer chum	2	None	0	**5**	**3**
Anderson Creek	None	0	No	0	Coho, fall chum, winter steelhead, resident trout	2	None	0	**2**	**4**
Johnson Creek	Surf smelt	1	No	0	Resident trout	1	None	0	**2**	**4**

Development and Future Growth Evaluation

Development and Future Growth was assessed using metrics for total watershed impervious surface, impervious surface within City riparian buffer, and vacant lands within the City.

The scoring method applied to assess Development and Future Growth is shown in Table 5. Scoring and ranking is shown in Table 6.

Table 5. Scoring Method Used to Assess Development and Future Growth.

Metric	Method
Development	
Percent Total Impervious Area	Watersheds were scored based upon total (watershed-wide) impervious area as a measure of the degree to which existing development may be contributing pollutants and flow. ● **Score of 0:** Less than 10 percent impervious area ● **Score of 1:** 10.1 to 15 percent ● **Score of 2:** 15.1 to 25 percent ● **Score of 3:** Greater than 25.1 percent
Percent of Impervious Area in Stream Riparian Zone (200 foot buffer)	City stream buffer areas were scored for impervious surface within the regulated riparian stream buffer. ● **Score of 1:** Less than 5 percent ● **Score of 2:** Between 5.1 and 15 percent ● **Score of 3:** Greater than 15.1 percent
Future Development	
Percent Vacant Land	Percent of City watershed areas identified for development activity. ● **Score of 0:** 0 to 10 percent vacant lands ● **Score of 1:** 10.1 to 20 percent vacant lands ● **Score of 2:** 20.1 to 30 percent vacant lands ● **Score of 3:** 30.1 and greater vacant lands

Table 6. Development and Future Growth Scoring and Ranking for City of Port Orchard Candidate Watersheds.

Watershed	Percent Impervious Surface		Percent Impervious Surface in Stream Riparian Buffer		Future Growth		Result	
	Watershed Percent Impervious Area	Score	Percent Impervious Area in City	Score	Percent Vacant Lands in City	Score	Total Score	Rank
Johnson Creek	29	3	19	3	11	1	7	1
Anderson Creek	9	1	6	2	35	3	6	2
Lower Blackjack Creek	22	2	15	2	29	2	6	2
Ross Creek	13	1	10	2	28	2	5	4
Ruby Creek	5	0	6	2	55	3	5	4

The highest potential score is 9. Scores range from 5 to 7. Johnson Creek was the top ranked watershed with the highest level of development. Ruby Creek and Anderson Creek were the top scoring watersheds for vacant lands indicating greatest potential of future growth.

Water and Habitat Condition Evaluation

Water and Habitat Condition was evaluated using metrics for Benthic Index of Biotic Integrity (B-IBI) and habitat condition scores previously developed and described in Appendix B of the Watershed Inventory (Herrera 2022). Habitat condition scores were developed for nearshore marine habitat, salmonid rearing, salmonid spawning, salmonid migration, and condition of the riparian area providing refuge.

Scoring for Water and Habitat Condition are shown in Table 7. Scoring and rankings are shown in Table 8.

The highest potential score is 18. Scores ranged from a high of 16 and low of 7. Water and Habitat Condition are highest for Lower Blackjack Creek (score of 16), with Anderson Creek, Ross Creek, and Ruby Creek within 2 points (14, 13, and 12, respectively).

Table 7. Scoring Method to Assess Water and Habitat Condition.

Metric	Method
B-IBI	Watersheds were scored based upon the most recent B-IBI scores. No data was available for Johnson Creek, Karcher Creek or Ruby Creek. Scores from a watershed with similar percent impervious surface was used. ● **Score of 1:** Poor/Very Poor ● Score of 2: Fair ● Score of 3: Good
Nearshore Marine Habitat Condition	Watersheds were scored based upon the habitat condition evaluation described in Appendix B (Herrera, 2022). ● Score of 0: <1.0 ● Score of 1: 1.1-4.0 ● Score of 2: 4.1-10.0 ● Score of 3: >10.1
Salmonid Rearing Habitat	Watersheds were scored based upon salmonid rearing habitat condition evaluation described in Appendix B (Herrera, 2022) . ● Score of 0: 0-0.25 ● Score of 1: 0.26-0.50 ● Score of 2: 0.51-0.75 ● Score of 3: 0.76-1.00
Salmonid Spawning Habitat	Watersheds were scored based upon salmonid spawning habitat condition evaluation described in Appendix B (Herrera, 2022). ● Score of 0: 0-0.25 ● Score of 1: 0.26-0.50 ● Score of 2: 0.51-0.75 ● Score of 3: 0.76-1.00
Salmonid Migration Support	Watersheds were scored based upon salmonid migration habitat condition evaluation described in Appendix B (Herrera, 2022). ● Score of 0: 0-0.25 ● Score of 1: 0.26-0.75 ● Score of 2: 0.76-1.25 ● Score of 3: >1.26
Stream Refuge and Riparian Function	Watersheds were scored based upon stream refuge and riparian function evaluation described in Appendix B (Herrera, 2022). ● Score of 0: 0 to 0.25 ● **Score of 1:** 0.26 to 0.50 ● Score of 2: 0.51-0.75 ● **Score of 3:** >0.76-1.00

Table 8. Water and Habitat Condition Scoring and Ranking for City of Port Orchard Candidate Watersheds.

Watershed	B-IBI		Nearshore Marine Habitat Conditions		Salmonid Rearing Habitat		Salmonid Spawning Habitat		Salmonid Migration Support		Stream Refuge and Riparian Function		Results	
	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Total Score	Ranking
Lower Blackjack Creek	Good	3	20.9	3	0.88	3	1.00	3	2.31	3	0.38	1	**16**	**1**
Anderson Creek	Fair	2	1.2	1	1.00	3	0.97	3	0.98	2	0.77	3	**14**	**2**
Ross Creek	Fair	2	20.6	3	0.67	2	0.67	3	0.64	1	0.53	2	**13**	**3**
Ruby Creek	Fair[a]	2	20.9	3	0.15	0	0.67	3	0.83	2	0.53	2	**12**	**4**
Johnson Creek	Poor[b]	1	0.2	0	0.73	2	0.97	3	0.03	0	0.34	1	**7**	**5**

[a] No data available for Ruby Creek. B-IBI score from Anderson Creek, a similar watershed impervious percentage, is substituted.

[b] No data available for Johnson Creek. B-IBI score from Annapolis Creek (Herrera, 2022), a similar watershed impervious percentage, is substituted.

Watershed Management Goals and Retrofit Strategies

Evaluation results were used to apply a rating and corresponding with the level of Receiving Water Use Support (high, moderate, low), Development and Future Growth (high, moderate, low) and Water and Habitat Condition (good, fair, poor). Ratings were applied based upon the total score for each category. Results are summarized in Table 9.

Table 9. Rating Evaluation Categories for Watershed Management Goals.

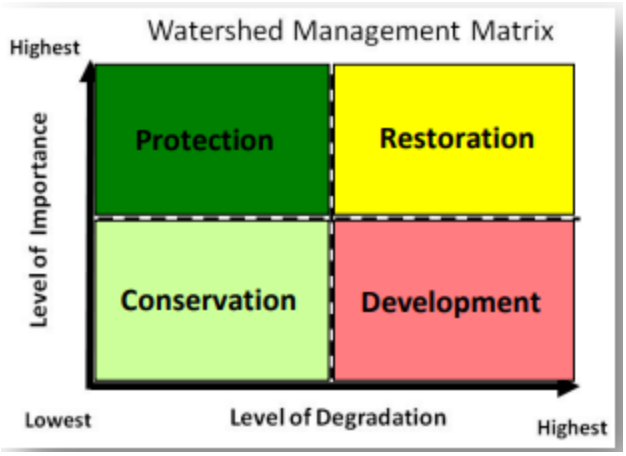
Watershed	Receiving Water Use Support		Water and Habitat Condition		Development and Growth	
	Total Score	Rating[a]	Total Score	Rating[b]	Total Score	Rating[c]
Anderson Creek	2	Low	14	Good	6	Moderate
Johnson Creek	2	Low	7	Fair	7	High
Lower Blackjack Creek	7	High	16	Good	6	Moderate
Ross Creek	6	High	13	Good	5	Moderate
Ruby Creek	5	Moderate	12	Fair	5	Moderate

[a] Highest score achievable is 7. Scores 6-7=High, 3-5=Moderate, ≤2=Low

[b] Highest score achievable is 18. Scores 13-18=Good, 7-12=Fair, ≤6=Poor

[c] Highest score achievable is 9. Scores of 7-9=High, 4-6=Moderate, ≤3=Low

Watersheds were placed in one of four management categories (Figure 2) based on watershed prioritization guidance provided by the Washington Department of Commerce (Commerce, 2016) and Ecology Puget Sound Watershed Characterization Project (Ecology, 2016).



Ecology, 2016

Figure 3. Watershed Management Goal Framework.

The framework is based upon a y-axis from lowest to highest for "Level of Importance" and an x-axis from lowest to highest for "Level of Degradation". For this analysis "Level of Importance" is translated to greater Receiving Water Use Support. "Level of Degradation" is translated to the level of watershed Development and Future Growth. The above framework does not incorporate Water and Habitat Condition; however, the results developed in this analysis are included to better understand receiving water conditions.

Both *Protection* and *Restoration* watersheds are characterized by high and moderate Receiving Water Use Support. *Protection* and *Restoration* watersheds differ where *Protection* is the watershed with lower levels of development and *Restoration* is the watershed with higher levels of development.

Conservation and *Development* watersheds are characterized by low Receiving Water Use Support, but different levels of development. *Development* is the watershed with higher levels of development and, by assumption, receiving waters with poorer conditions.

Retrofit strategies are applied to watersheds with moderate development placed into the *Restoration* or *Development* watershed management goal. *Restoration* watersheds are optimum candidates for stormwater retrofits and additional stormwater management actions due to higher receiving water support. However, stormwater retrofits should not be ruled out in *Development* watersheds, and can provide environmental benefits when opportunities are available.

The results from assessment of the three evaluation categories described above were used to determine watershed management goals and retrofit strategy for each candidate watershed (Table 10).

Table 10. Watershed Management Goals and Retrofit Strategy Results for City of Port Orchard Candidate Watersheds.

Watershed	Receiving Water Use Support	Water and Habitat Condition	Development and Growth	Management Goal	Retrofit Strategy
Lower Blackjack Creek	High	Good	Moderate	**Restoration**	**Proactive**
Ross Creek	High	Good	Moderate	**Restoration**	**Proactive**
Ruby Creek	Moderate	Fair	Moderate	**Restoration**	**Proactive**
Anderson Creek	Low	Good	Moderate	**Development**	**Opportunity**
Johnson Creek	Low	Fair	High	**Development**	**Opportunity**

Color indicates the watershed management matrix as shown in Figure 2.

It is important to note Ruby Creek is designated as *Restoration* due to potential for growth, and not for level of existing development (5 percent watershed impervious cover); whereas Lower Blackjack Creek and Ross Creek have higher levels of existing development with 22 and 13 percent watershed impervious cover, respectively.

The following *Restoration* watersheds were evaluated in Step 3:

- Lower Blackjack Creek
- Ross Creek
- Ruby Creek

Step 3: Evaluate Restoration Watersheds

The three *Restoration* watersheds were evaluated for:

- Jurisdiction control
- Social Equity
- Supports existing plans or projects

Jurisdiction Control

The greater area of a watershed that a jurisdiction has control over, the more likely the city's stormwater management actions will have meaningful benefit to the affected receiving water (Ecology, 2019). Table 11 summarizes the percentage of three priority watersheds within City or UGA boundaries. Based on this data, Lower Blackjack Creek and Ross Creek are the largest percentage of City area. Lower Blackjack Creek, if all UGA is annexed, increases from 68 percent to 87 percent area.

Table 11. Jurisdiction Control of City of Port Orchard Restoration Watersheds.

Watershed	Percentage in City	Percentage in UGA	Percentage Total City and UGA
Lower Blackjack Creek	68	19	87
Ross Creek	65	2	67
Ruby Creek	54	1	55

Social Equity

Characteristics of human populations in the watersheds were evaluated to identify potential benefits of addressing stormwater water issues upon overburdened communities. Equity metrics were calculated using data from the Washington Environmental Health Disparities Map and database and the Kitsap Overburdened Communities Assessment. Scores for socioeconomic factors and sensitive populations are used to identify level of vulnerable populations. The combined score is both threat from environmental exposures and vulnerability of populations.

Higher combined scores indicate a greater burden to that community. Table 12 is summary information for these metrics for the three watersheds.

Table 12. Social Equity Score and Rankings for City of Port Orchard Candidate Watersheds.

Watershed	Combined Score	Socioeconomic Factors	Sensitive Populations
Lower Blackjack Creek	5.91	5.35	5.38
Ross Creek	4.75	6.13	3.56
Ruby Creek	4.00	4.00	3.00

Scores are ranked from 0 to 10. All watersheds were similar and fell within the mid-range of values, indicating minimal difference in equity between them. Lower Blackjack Creek did have the highest combined score.

Promotes Other Plans and Projects

The final consideration for selecting the highest priority watershed was to review the watersheds in light of promoting existing plans and projects.

Lower Blackjack Creek

Blackjack Creek Watershed Assessment Plan and Protection and Restoration Plan

The plan was completed for the Suquamish Tribe in 2017. The plan divides Blackjack Creek watershed into five subwatersheds; including two of the five watersheds that have been prioritized through this process, i.e.,, Lower Blackjack and Ruby Creek.

The plan emphasizes the high value of the Blackjack Creek watershed for salmon and identified Lower Blackjack Creek as impaired for hydrology and sediment. The plan identifies stormwater retrofits as a key strategy in tributary areas.

City of Port Orchard Capital Improvement Projects:

The City is in the process of developing their Stormwater Capital Improvement Projects list as part of development of the City's first Stormwater and Watersheds Stormwater Comprehensive Plan. Higher priority projects located within the Lower Blackjack Creek watershed include SE Salmonberry Road Culvert Replacement, Blackjack Creek Floodplain Restoration and Stormwater Management, and the South Sidney Regional Facility. Lower priority projects include Silver Creek Rehabilitation and South Blackjack Creek Culvert Removal and Bridge Installation.

Ross Creek

City of Port Orchard Capital Improvement Projects:

Two potential projects have been identified in this watershed: Ross Creek Estuary Restoration and Beach Recreation Area and Ross Creek Beaver Dam Analogs Installation.

Ruby Creek

Blackjack Creek Watershed Assessment Plan and Protection and Restoration Plan

As presented above, the plan identified the Ruby Creek subwatershed at risk of degradation due to development; specifically it identified the lower reaches of the stream in the City controlled area as important. The analysis indicated that development potential was highest in this subwatershed. The plan recommends stormwater retrofits for existing developed areas.

City of Port Orchard Capital Improvement Projects

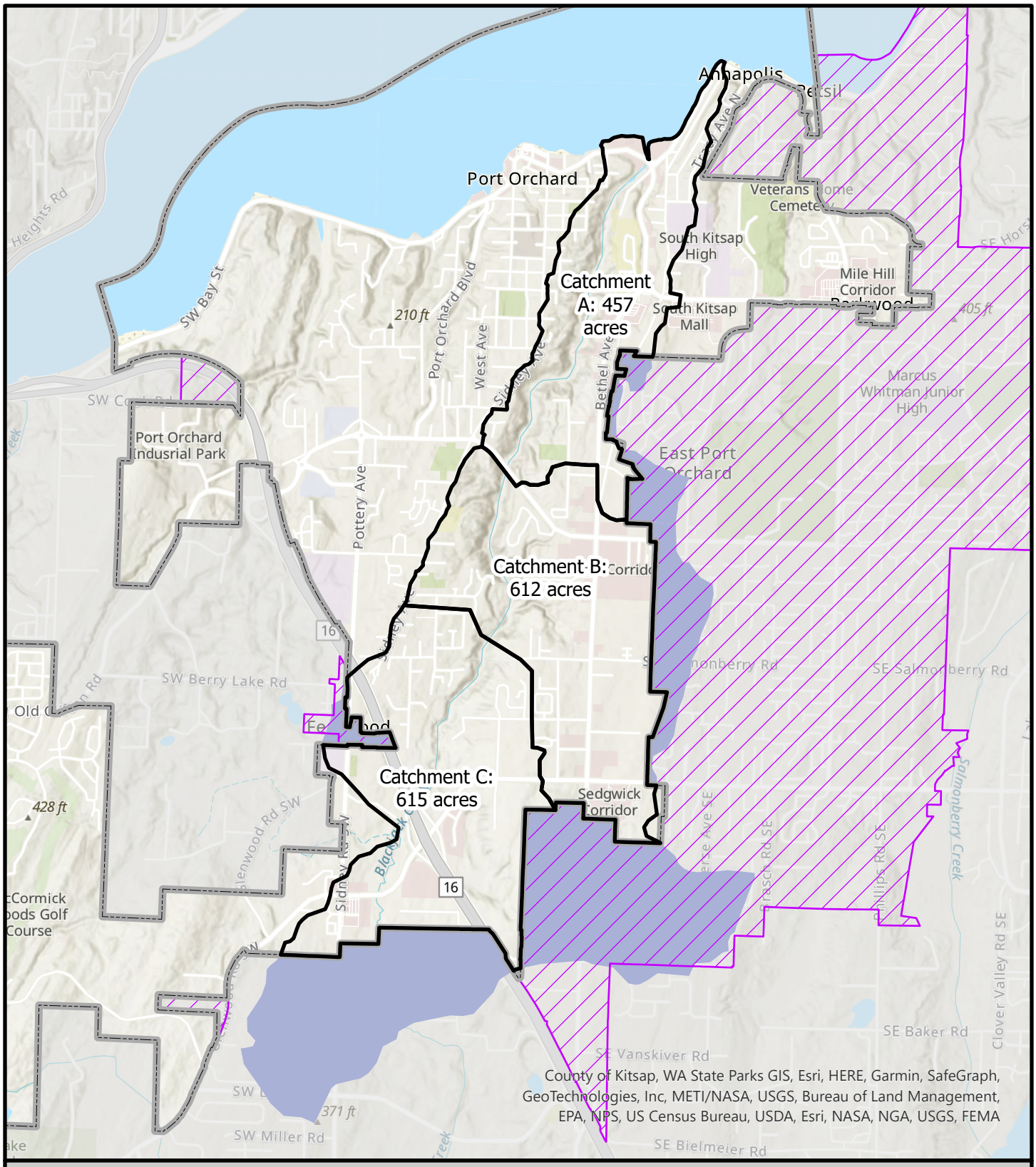
One potential planned capital project is located in this watershed, the Sidney Road SW Ruby Creek Culvert Replacement and Bridge Installation.

Step 4: Select Highest Priority Watershed and Catchment

Lower Blackjack Creek Watershed was selected as the City of Port Orchard SMAP Highest Priority Watershed based on the following characteristics:

- Designated as a *Restoration* watershed
- High Receiving Water Use Support
- Moderate level of Development and Future Growth
- Good Water and Habitat Condition
- Highest Jurisdiction Control of *Restoration* watersheds
- Promotes other plans and projects, most notably the *Blackjack Creek Watershed Assessment Plan and Protection and Restoration Plan.*

Upon review with City staff, catchment C (Figure 4) in the watershed is selected for developing the SMAP Plan. The selected catchment has a greater concentration of older development for retrofit opportunities.



Legend

- Lower Blackjack SMAP Catchment Areas
- Lower Blackjack Watershed (Outside City)
- Port Orchard UGA
- Port Orchard City Limits

Figure 4.
City of Port Orchard SMAP Catchments.

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