



STATE OF WASHINGTON
WATER RESEARCH CENTER

Overview of the Skagit Basin Water Mitigation Feasibility Assessment



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Approach

- Allocate a majority of our research time towards mitigation scenarios that would allow for homeowners to use their wells.
- Focus on the extension of pipelines to supply water for mitigation.
 - Would allow homeowners to use their wells.
 - Would take advantage of existing public water system pipelines and inchoate rights.
 - Would avoid the problems associated with hauling water for potable use.
- Only considered non-mitigation options to see if they could provide water at a significantly lower cost for some properties/locations.

Approach

- For the piping and trucking for mitigation we estimated costs for the all properties, not just select subbasins.
- We estimated ranges of cost estimates (low, middle, high) for these scenarios.
- Following the most recent stakeholder meeting we are focusing on the more conservative (higher cost) approaches.
- Just finished updated analysis, but haven't incorporated those results in yet.

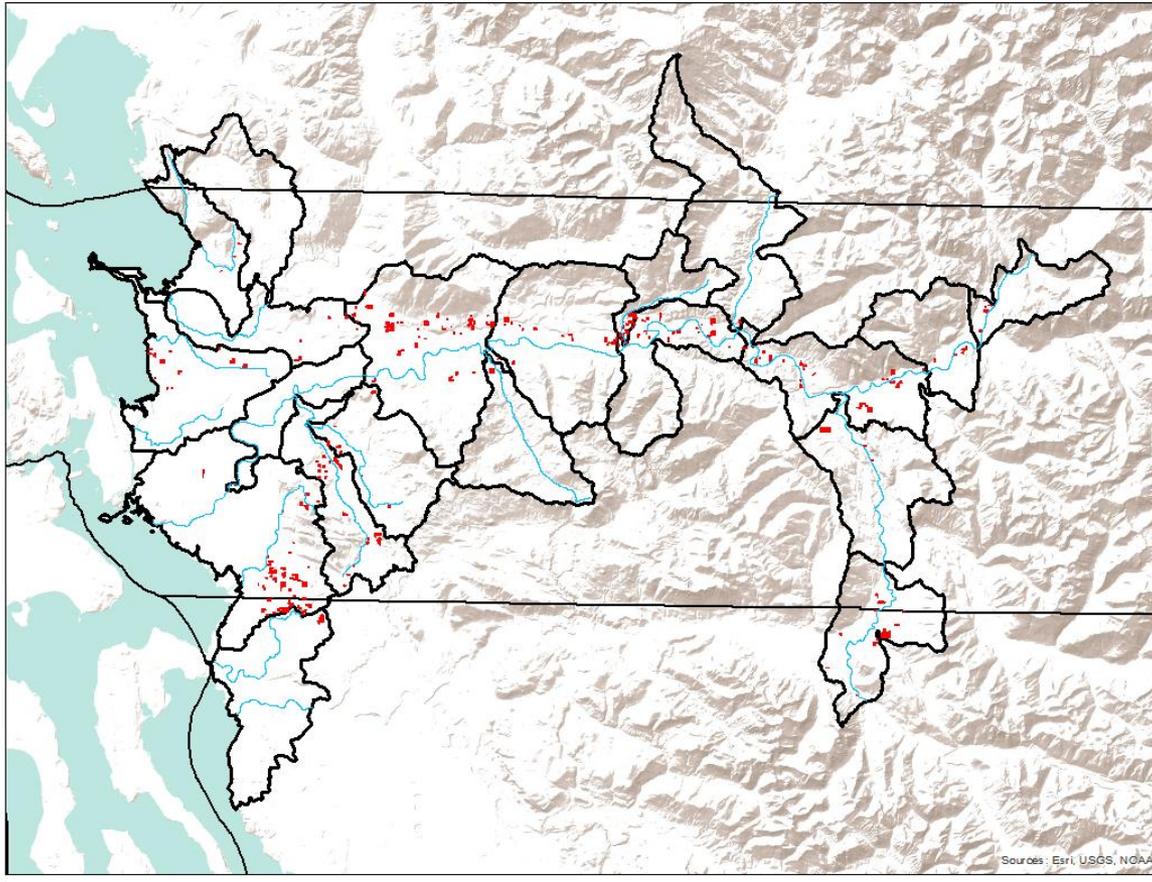
Flow Mitigation Scenarios

- Mitigation quantity assumption (follow previous reports by Ecosystem Economics and Golder Associates).
 - In scenarios that include outdoor use it was assumed that 0.08 af is consumptively used per year
 - Indoor consumptive water use was assumed to be 15 gallons per day, or 0.0168 ac-ft/year
 - Therefore, in the indoor+outdoor scenarios it was assumed that 0.1 af/year is used

Flow Mitigation: Piping

- Previous studies had considered extending public water systems to directly provide water.
- We modeled extending lines for flow augmentation to provide mitigation water for wells → idea is that small gauge pipes for augmentation are much cheaper than mains for direct connections.
- Pipes can be extended to an infinite number of points near the river.
 - Following previous analyses, assumed mitigation to be ‘in-place’ if mitigation point is in the same subbasin as the property (HUC-12 watersheds).
 - Least cost
 - Highest elevation
 - Most upstream – for some subbasins the highest elevation and most upstream leads to the same point.
 - **New scenario that will be focus of final report – follow road routes to headwaters of each subbasin.**

Subbasin boundaries with properties (red)
and tributaries (blue)



GIS based
analysis finds
“best” path to
each of the three
points within
each subbasin.

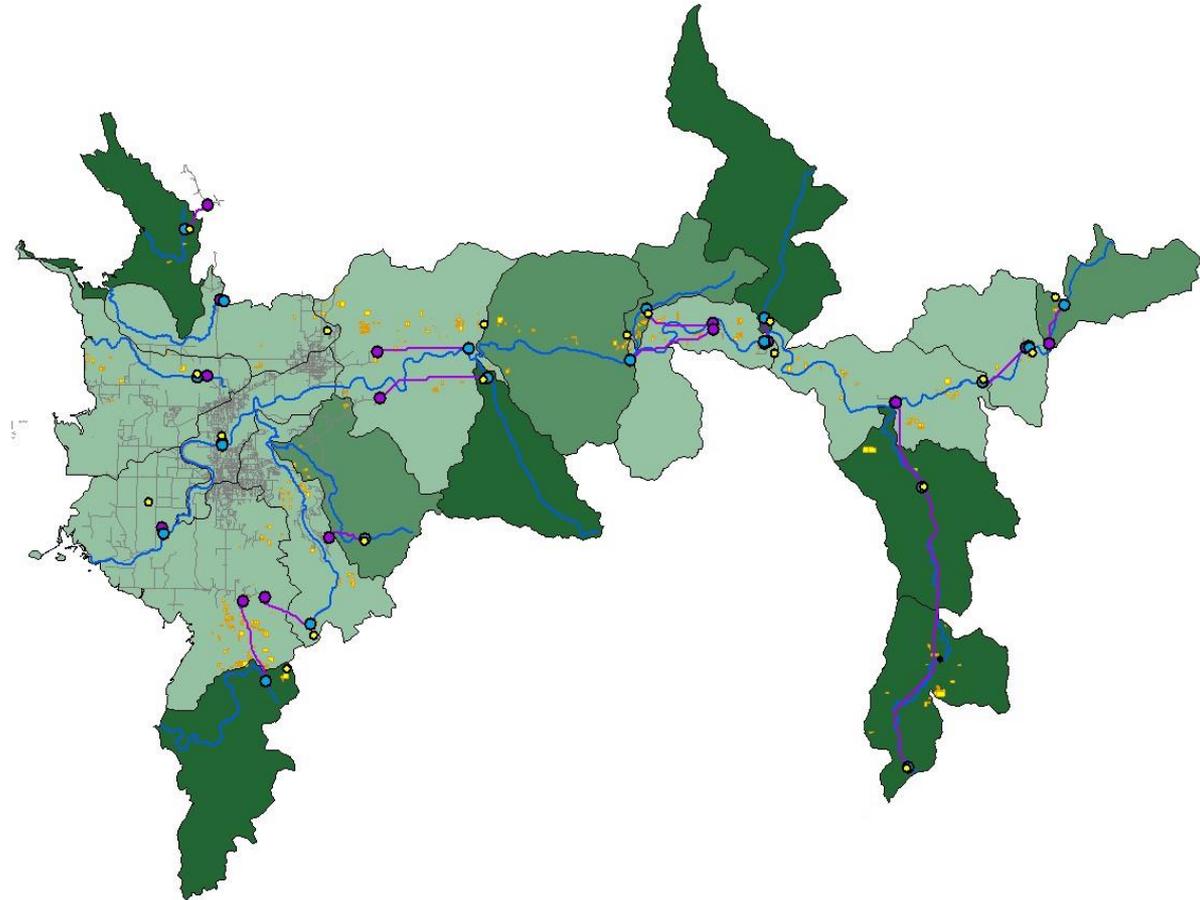
Results: Most Upstream Augmentation Point – Indoor Use Only

Legend

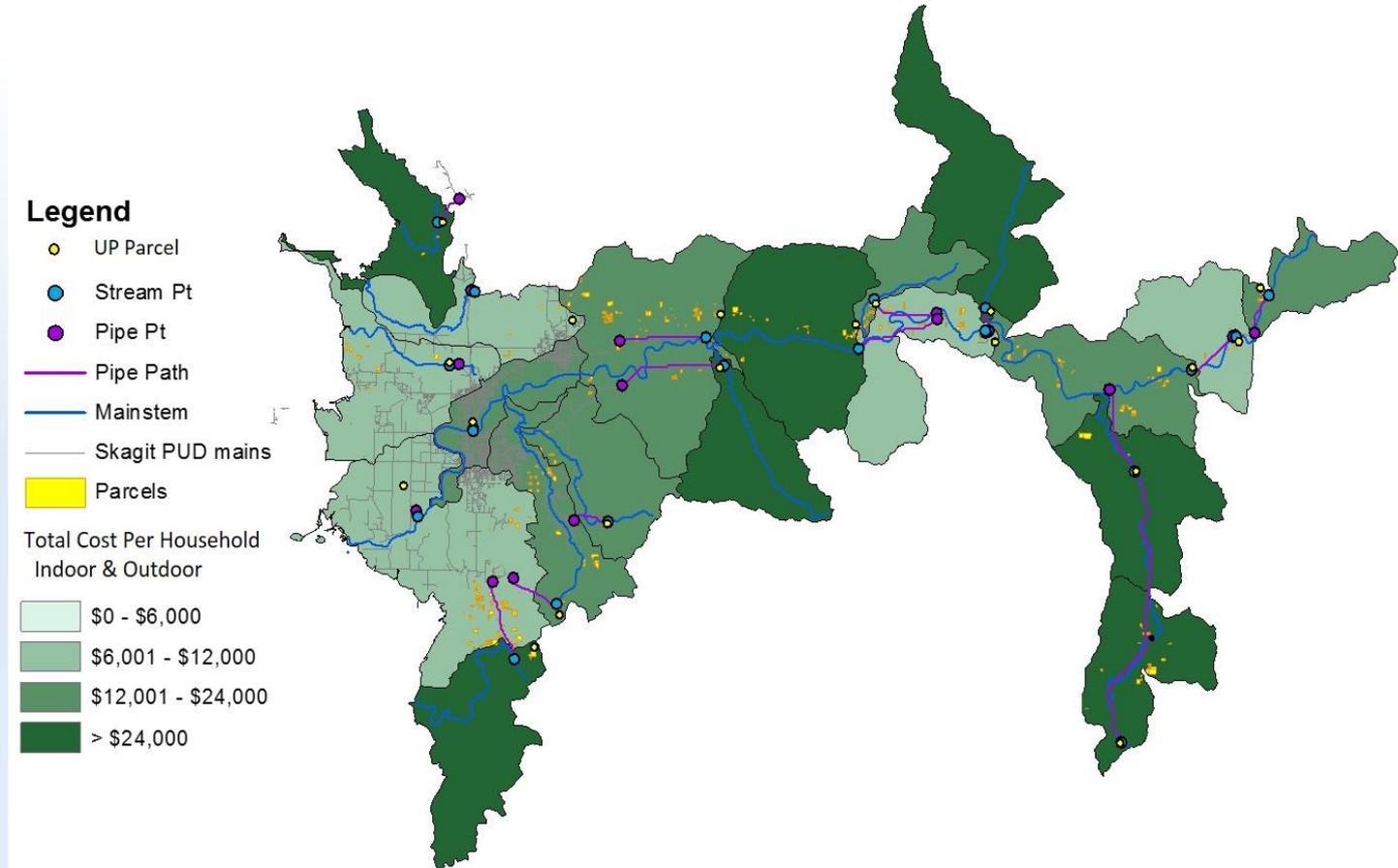
-  UP Parcel
-  Stream Pt
-  Pipe Pt
-  Pipe Path
-  Mainstem
-  Skagit PUD mains
-  Parcels

Total Cost Per Household Indoor Only

-  \$0 - \$6,000
-  \$6,001 - \$12,000
-  \$12,001 - \$24,000
-  > \$24,000



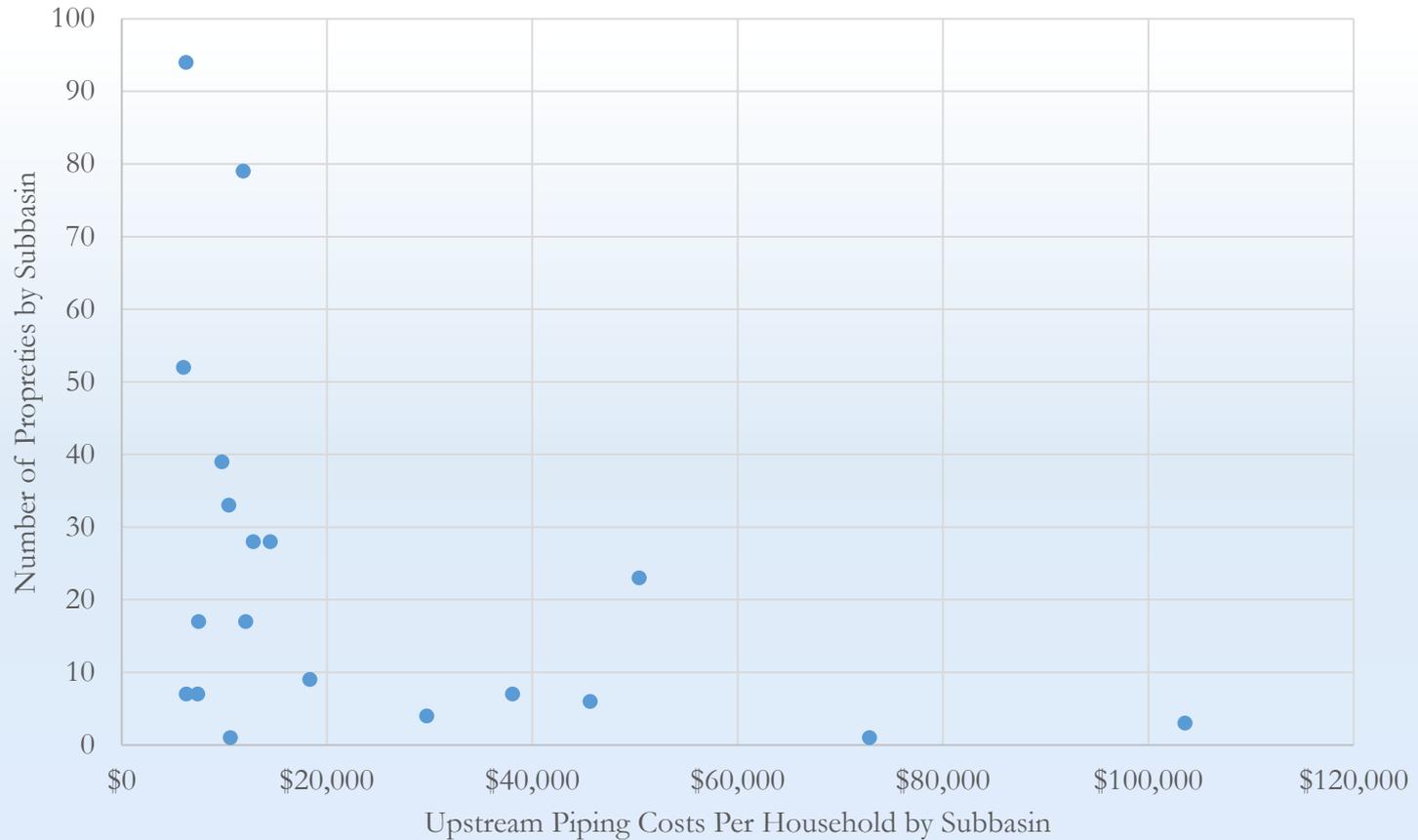
Results: Most Upstream Augmentation Point – Indoor+Outdoor Use



All Results

Flow_ID	HUC_Mainstem	HUC-12 Basin	Number of Propertie:	Total Cost Per Household					
				Lower Bound		High Elevation		Upstream	
				Indoor Only	Indoor/Outdoor	Indoor Only	Indoor/Outdoor	Indoor Only	Indoor/Outdoor
0	171100020204	Lower Samish River	7	\$ 5,895	\$ 8,238	\$ 7,400	\$ 9,744	\$ 7,400	\$ 9,743
2	171100020301	Oyster Creek-Frontal Samish Bay	4	\$ 17,562	\$ 19,917	\$ 29,695	\$ 32,043	\$ 29,694	\$ 32,036
3	171100020302	Joe Leary Slough-Frontal Padilla Bay	17	\$ 5,895	\$ 8,238	\$ 8,793	\$ 14,034	\$ 7,475	\$ 11,399
5	171100050905	Copper Creek-Skagit River	9	\$ 6,207	\$ 8,550	\$ 18,311	\$ 20,656	\$ 18,311	\$ 20,654
6	171100051007	Lake Shannon-Baker River	1	\$ 34,908	\$ 37,251	\$ 72,839	\$ 75,182	\$ 72,840	\$ 75,186
7	171100051101	Rocky Creek-Skagit River	7	\$ 6,273	\$ 8,616	\$ 7,748	\$ 10,091	\$ 6,274	\$ 8,617
8	171100051104	Aldon Creek-Skagit River	39	\$ 5,963	\$ 8,374	\$ 9,353	\$ 15,155	\$ 9,746	\$ 15,943
9	171100060404	Prairie Creek-Sauk River	23	\$ 30,750	\$ 57,958	\$ 50,442	\$ 97,359	\$ 50,401	\$ 97,250
10	171100060405	Sauk River	6	\$ 8,957	\$ 11,300	\$ 20,183	\$ 22,526	\$ 45,630	\$ 47,973
11	171100070103	Grandy Creek	28	\$ 10,107	\$ 16,713	\$ 12,944	\$ 22,349	\$ 12,815	\$ 22,079
12	171100070104	Mill Creek-Skagit River	52	\$ 5,969	\$ 8,461	\$ 6,026	\$ 8,633	\$ 6,001	\$ 8,559
13	171100070105	Loretta Creek-Skagit River	28	\$ 14,462	\$ 25,373	\$ 17,730	\$ 31,910	\$ 14,447	\$ 25,349
14	171100070106	Day Creek	3	\$ 90,283	\$ 92,626	\$ 103,558	\$ 105,901	\$ 103,569	\$ 105,954
15	171100070107	Hansen Creek	79	\$ 5,895	\$ 8,238	\$ 11,709	\$ 16,959	\$ 11,832	\$ 17,143
16	171100070201	East Fork Nookachamps Creek	17	\$ 5,895	\$ 8,238	\$ 7,211	\$ 10,870	\$ 12,063	\$ 20,575
17	171100070202	Nookachamps Creek	33	\$ 5,895	\$ 8,238	\$ 6,009	\$ 8,466	\$ 10,416	\$ 17,308
18	171100070203	Skagit River	1	\$ 5,895	\$ 8,238	\$ 10,582	\$ 12,925	\$ 10,582	\$ 12,926
19	171100070204	Skagit Delta-Frontal Skagit Bay	94	\$ 5,941	\$ 8,306	\$ 6,741	\$ 9,507	\$ 6,255	\$ 8,778
21	171100080304	Stillaguamish River-Frontal Port Susan	7	\$ 30,848	\$ 33,201	\$ 38,409	\$ 40,767	\$ 38,050	\$ 40,392

Relationship between the number of properties and piping mitigation costs by subbasin.



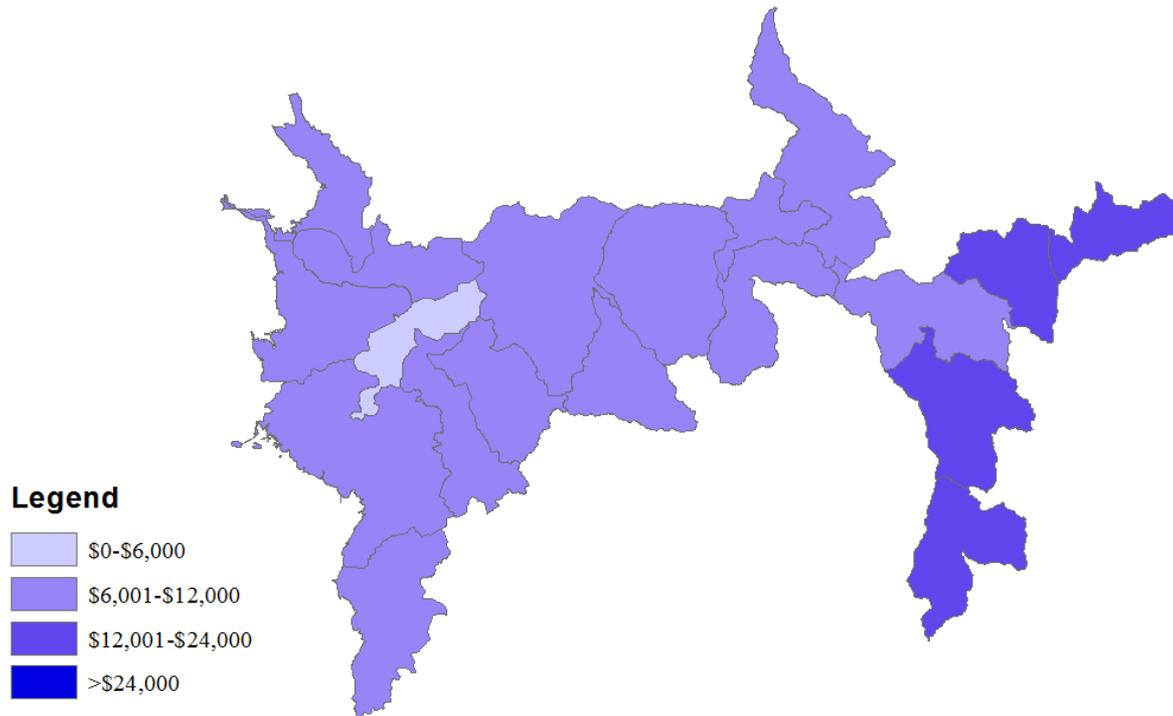
Flow Mitigation: Trucking

- Commercial Truck Rate Approach
 - Jessup called and interviewed about 10 different potential operators in the area.
 - Rates were comparable at between \$115 and \$120 per hour.
 - 4,000 gallon water truck.
 - Calculation: quoted rate times complete travel time from Mt. Vernon + ½ hour of loading and unloading time.

Flow Mitigation: Trucking

- Similar to piping, there are many potential locations within a subbasin to deliver water to for flow mitigation.
- We used the locations of the properties to develop upper and lower cost estimates.
- Steps:
 - Calculate cost to truck water to every property in a subbasin.
 - Middle cost estimate: Average of all the properties in the subbasin.
 - Low and high cost estimates use the properties with the lowest and highest delivery cost estimates.
 - Thus, assumed that cost of delivery to properties in this way is a good approximation to delivering to a single point in the subbasin.

Total cost per household in present value terms for trucking for mitigation assuming a 50 year time horizon, highest estimate per subbasin, and 15 gallons per day (mitigation).



Trucking for flow mitigation results

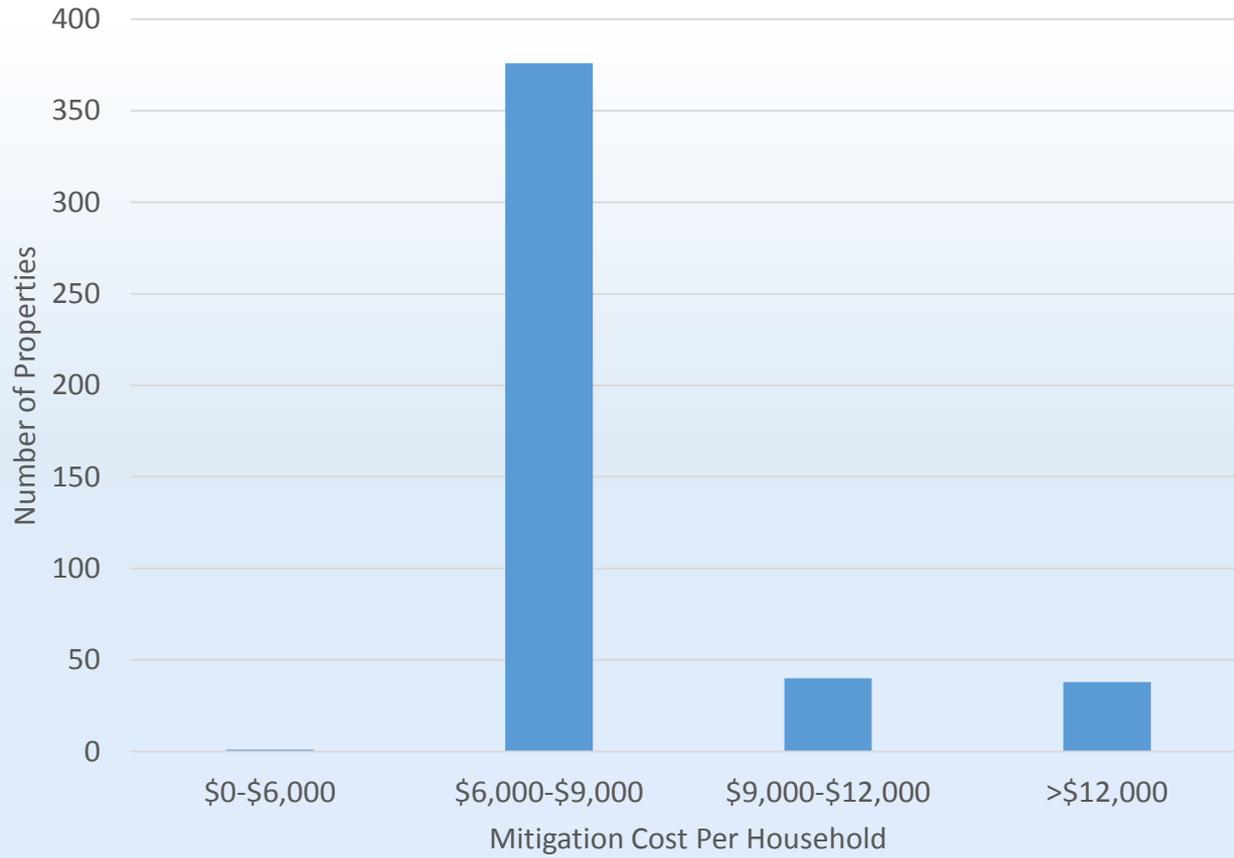
HUC 12 Name	50 Year Present Value			
	Commercial		Truck Operating	
	High	Medium	High	Medium
Lower Samish River	6,704	5,871	3,434	2,635
Oyster Creek-Frontal Samish Bay	7,257	6,910	4,705	4,058
Joe Leary Slough-Frontal Padilla Bay	6,316	5,809	3,187	2,717
Copper Creek-Skagit River	12,326	12,092	13,761	13,456
Lake Shannon-Baker River	9,633	9,633	8,927	8,927
Rocky Creek-Skagit River	13,102	12,370	13,349	12,933
Aldon Creek-Skagit River	11,679	10,567	12,044	10,659
Prairie Creek-Sauk River	15,149	13,777	14,819	13,560
Sauk River	12,408	11,685	12,161	11,783
Grandy Creek	8,774	8,359	7,351	7,122
Mill Creek-Skagit River	11,773	9,637	9,268	7,719
Loretta Creek-Skagit River	8,574	7,964	7,010	6,146
Day Creek	8,245	8,213	4,446	4,422
Hansen Creek	8,268	6,680	5,234	3,872
East Fork Nookachamps Creek	6,269	5,603	2,964	2,249
Nookachamps Creek	6,457	5,203	3,364	1,946
Skagit River	4,316	4,316	847	847
Skagit Delta-Frontal Skagit Bay	6,410	5,707	3,811	2,426
Stillaguamish River-Frontal Port Susan	6,622	6,595	3,387	3,369

Flow Mitigation: Winter flow capture

- Considered the option of doing a general “search” for potential flow capture locations.
- Decided that this would not be informative as willing landowners is the limiting factor.
- A more detailed site-specific study is always necessary, but our focus was on reviewing cost estimates per volume of water stored.
- Estimate \$8,848 per household.

Non-Mitigation Options

- Trucking potable water
 - All of the analysis and cost estimates used for the trucking mitigation water scenario are applicable.
 - DOH monitoring and compliance is an additional cost.
- Rainwater collection
 - Cost estimates are provided by previous reports by Ecology.
 - No new modeling of cost estimates done.
 - At \$25,000 per house this option is higher than alternatives considered.



Summary of results comparing trucking and piping for flow augmentation using upper cost estimates for each.

HUC Number	Basin Name	# of Properties	Piping	Trucking	Lower Cost Choice
171100020204	Lower Samish River	7	\$7,400	\$6,704	\$6,704
171100020301	Oyster Creek-Frontal Samish Bay	4	\$29,694	\$7,257	\$7,257
171100020302	Joe Leary Slough-Frontal Padilla Bay	17	\$7,475	\$6,316	\$6,316
171100050905	Copper Creek-Skagit River	9	\$18,311	\$12,326	\$12,326
171100051007	Lake Shannon-Baker River	1	\$72,840	\$9,633	\$9,633
171100051101	Rocky Creek-Skagit River	7	\$6,274	\$13,102	\$6,274
171100051104	Aldon Creek-Skagit River	39	\$9,746	\$11,679	\$9,746
171100060404	Prairie Creek-Sauk River	23	\$50,401	\$15,149	\$15,149
171100060405	Sauk River	6	\$45,630	\$12,408	\$12,408
171100070103	Grandy Creek	28	\$12,815	\$8,774	\$8,774
171100070104	Mill Creek-Skagit River	52	\$6,001	\$11,773	\$6,001
171100070105	Loretta Creek-Skagit River	28	\$14,447	\$8,574	\$8,574
171100070106	Day Creek	3	\$103,569	\$8,245	\$8,245
171100070107	Hansen Creek	79	\$11,832	\$8,268	\$8,268
171100070201	East Fork Nookachamps Creek	17	\$12,063	\$6,269	\$6,269
171100070202	Nookachamps Creek	33	\$10,416	\$6,457	\$6,457
171100070203	Skagit River	1	\$10,582	\$4,316	\$4,316
171100070204	Skagit Delta-Frontal Skagit Bay	94	\$6,255	\$6,410	\$6,255
171100080304	Stillaguamish River-Frontal Port Susan	7	\$38,050	\$6,622	\$6,622
Totals	Properties	455			
	Piping Cheaper	192			
	Trucking Cheaper	263			

Additional things to consider

Effect of Future Development on Cost Estimates

- Trucking is the cheaper option for more properties right now.
- However, mitigating additional properties beyond the 455 included as the core of this study will make piping increasingly competitive relative to trucking.

Truck Now/Pipe Later

- The investments made at the augmentation point are essentially the same for trucking and piping.
- Given the effect of future development, is it worth considering a scenario where trucking gets going now and then piping is pursued some years down the line?

Outdoor Use

- The results focused more on the indoor use only options because they are lower in cost than indoor+outdoor.
- Similar to future development, including outdoor use makes piping more competitive relative to trucking.
- Also, on a cost per unit of water for piping, including outdoor use significantly lowers the cost.