

YRAA Hatchery Hydrology --Memorandum

This memo summarizes preliminary findings regarding locating a water supply to support hatchery operations in the Yakutat area. I was contacted by Nate Endicott to review potential hatchery water supplies at two sites. On April 27, 2014 we visited the abandoned cold storage YKI site on the south west end of Monti Bay, and a site at Sawmill Cove. I had previously visited these sites with Johnathan Pavlik on February 8, 2014. Discharges appeared to be considerably greater during the February visit but no discharge measurements were conducted. I was asked to look at these sites to examine their potential to yield water supplies for two different hatchery plans.

Plan 1: Incubation of 10,000,000 chum salmon eggs requiring a continuous flow of 200 gallons/min or 0.45 cubic feet per second (cfs). This plan would be tried as a proof of concept to determine if suitable adult returns would result. If the initial results were favorable then the Yakutat Regional Aquaculture Association would proceed with a larger project.

Plan 2: Incubation of 40,000,000 chum salmon eggs and requiring a continuous flow of 760 gallons/min or 1.7 cfs. This plan represents a proposed full scale hatchery.

YKI Cold Storage Site Evaluation

During the April 27 visit there was a small amount of water exiting the kettle pond immediately above the proposed site. The water rapidly infiltrated into the ground downstream of the pond outlet. We followed the channel down to tide water where it again emerged as surface water immediately upstream of Monti Bay. The amount of water present at the time was not enough to measure with conventional current meters. I would estimate the flow volume at approximately 0.02-0.05 cfs or about 9-20 gpm. The flow at the time of our visit was clearly insufficient to provide water for either hatchery scenario.

Additional computations were developed for this site to determine the potential of utilizing water from a series of kettle ponds upslope of the YKI cold storage site. No bathymetric data exists for these ponds so I proceeded with calculations using assumed average depths. The area of the ponds was calculated using GIS software (figure 1) and a range of potential water volumes for each pond was generated using assumed average depths (table 1). In addition to the pond volume calculations I provided projections as to how long it would take to deplete the storage in the ponds under the two different flow scenarios (table 2). In addition I calculated the annual average rainfall incident on the pond surfaces to provide crude estimates of water availability. The annual average rainfall onto the pond surfaces, assuming it could be fully utilized, would provide approximately 24 days and 93 days of flow at the rates of 760 and 200 gpm, respectively.

These analyses were conducted to determine potential water availability at this site. It had been proposed to me that water exiting the ponds might be supplemented by storage in the ponds should the natural discharge from the ponds periodically fall short. The calculations submitted here suggest this site is not adequate to support even the smaller of the two proposed hatchery scenarios. Although the ponds likely have additional contributing drainage area, and therefore additional rainfall contributions

to discharge, the drainage area would have to be increased by a factor of four to supply an annual average discharge of 200 gallons/min. This includes the assumption that all of the rainfall could be fully utilized for hatchery operations.



Figure 1. Showing the ponds above the proposed YKI cold storage site and their computed areas.

	Area (acres)	Area (ft ²)	Volume (ft ³) @ 5 ft deep	Volume (ft ³) @ 10 ft deep	Volume (ft ³) @ 15 ft deep	Volume (ft ³) @ 20 ft deep
Pond a	3.69	160736	803682	1607364	2571782.4	3214728
Pond b	0.73	31799	158994	317988	476982	635976
Pond c	1.92	83635	418176	836352	1254528	1672704
Total	6.34	276170	1380852	2761704	4303292	5523408

Table 1. Area and volume computations of YKI cold storage site ponds assuming different average depths.

	Pond depth (in feet)			
	5 ft	10ft	15 ft	20 ft
Flow rate	Depletion time (in days)			
760 gallons/min	9	19	29	38
200 gallons/min	36	72	112	143

Table 2. Storage depletion times for the YKI cold storage ponds using assumed depths of 5-20 feet.

Sawmill Cove Site Evaluation

I visited the Sawmill Cove site with Nate Endicott on April 27, 2014. We conducted discharge measurements on a series of distributed springs that appear to emerge at an abrupt break in hill slope just before the springs enter Sawmill Cove. These springs were measured with conventional flow meters, however, the accuracy of the measurements remain poor due to the small size of the springs at the time of measurements. We measured the three larger springs just to the east of the log loading dock. Some of the available spring water was not measured due to the small size and distributed configuration. The unmeasured spring water is a considerable amount when compared to the springs we measured. It may represent 10-20 percent of the available water at this site. However, the distributed configuration made it nearly impossible to measure accurately.

These springs were measured again on May 23, 2014 and again I was unable to measure the same small distributed springs east of the log loading dock. Due to the lack of water measured on the April 27 visit I expanded my measurement to include an additional spring just west of the log loading dock. A summary of discharge measurements is shown in table 3.

Location	Date	
	27-Apr-14	23-May-14
Spring A	Discharge (ft ³ /s) 0.24	Discharge (ft ³ /s) 0.16
Spring B	0.04	0.03
Spring C	0.48	0.54
Spring west	not measured	0.35
Total	0.76	1.08

Table 3. Discharge measurements at Sawmill Cove springs

Ophir Creek Comparisons

Instantaneous discharge measurements on these springs provide limited information without some comparison to typical hydrologic conditions. For instance, spring discharges are likely to be much greater following several weeks of rain in October when the soils have been saturated with consistent rainfall. When a continuous water source is required it is important to know what discharges can be expected during seasonal low flow or drought conditions. In order to add perspective to the two discharge measurements shown in table 3, I constructed flow duration curves from the nearby gaging station on Ophir Creek (figure 2). Flow duration curves use all of the discharge record to show the percentage of time flows of a specific magnitude are equaled or exceeded. Using flow duration curves in combination with discharge measurements on Ophir Creek taken in near the same time as the spring measurements in table 3, one can infer how the spring measurements taken on April 27 and May 23 compare to “normal” hydrologic conditions.

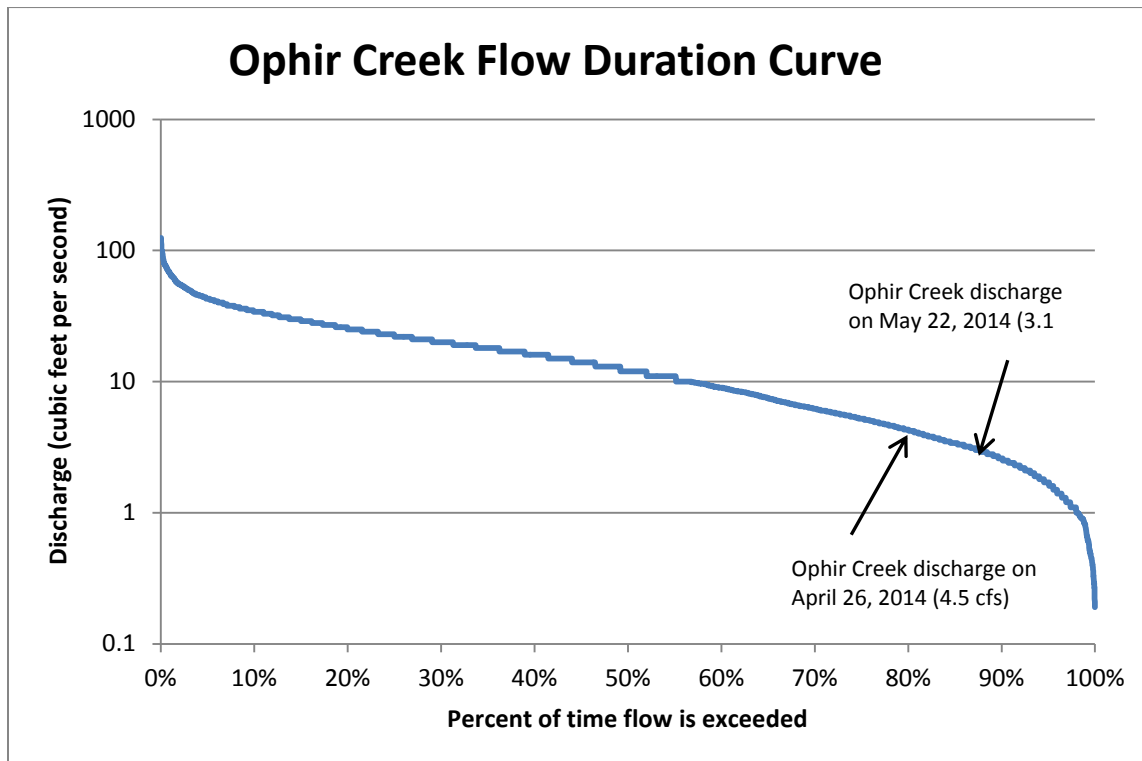


Figure 2. Ophir Creek duration curve and Ophir Creek discharge measurements taken near the same time as the spring measurements at the proposed Sawmill Cove site.

The Ophir Creek gage was in operation since 1991 and represents a relatively long streamflow data set and should provide useful estimates of flow conditions at the Sawmill Cove springs. When the spring measurements taken on April 27, are compared to the Ophir Creek measurement taken on April 26 we see that flows of this magnitude have historically been exceeded about 79 percent of the time. The other 21 percent of the time we can expect spring discharges to be less. When we make a similar

comparison of the spring measurements taken on May 23 with the Ophir Creek measurement of May 22, we see that flows of this magnitude are exceeded on Ophir Creek about 87 percent of the time.

The results of this analysis suggest that spring discharges measured in April and May of 2014 represent low-flow hydrologic conditions but discharges even lower can be expected as often as 2 out of 10 days. It is important to note that the spring flows appeared similar during both the April and May visit when compared to the 45 percent flow reduction in Ophir Creek. This may indicate that Ophir Creek may not generate good hydrographic comparisons. It could alternatively be explained by measurement error or bias as these small streams are difficult to measure accurately with conventional current meters. In either case these flow measurements suggest these springs alone will likely provide insufficient discharge to support the larger hatchery plan, which would require flow of $1.7 \text{ ft}^3/\text{s}$. These springs alone may be sufficient for the small scale scenario requiring $0.45 \text{ ft}^3/\text{s}$, assuming the springs can be effectively utilized.

Sawmill Cove Ponds

The ponds located to the south west of Sawmill Cove (figure 3) are considerably larger than those at the YKI site. If your project was granted access to utilize water within the ponds they could potentially provide an additional water source. I generated tables of storage and depletion rates (tables 4 and 5) using similar methods and assumptions as used to generate tables at the YKI sites.



Figure 3. Location and area of the Sawmill Cove Ponds.

	Area (acres)	Area (ft ²)	Volume (5ft deep)	Volume 10ft deep)	Volume 15 ft deep	Volume 20 ft deep
Pond north	19.21	836788	4183940	8367880	12551820	16735760
Pond south	19.44	846806	4234030	8468060	12702090	16936120
Total	38.65	1683594	8417970	16835940	25253910	33671880

Table 4. Area and volume computations of the Sawmill Cove ponds assuming different average depths.

	Pond depth (in feet)			
	5 ft	10ft	15 ft	20 ft
Flow rate	Depletion time (in days)			
760 gallons/min	58	115	173	231
200 gallons/min	218	437	655	874

Table 5. Storage depletion times for the YKI cold storage ponds using assumed depths of 5-20 feet.

Tables 4 and 5 show the theoretical depletion of pond water for a range of volumes derived from depth assumptions. It is important to note that the depth computations are based on assumptions and these calculations, as with the calculations at the YKI site, were conducted to examine feasibility only. Accurate volume computations can only be achieved through bathymetric (depth) surveys of the ponds. Storage depletion times range from 58-231 days for the 760 gpm flow rate, and from 218-874 days using the 200 gpm flow rate, using the assumed depths of 5 to 20 feet. The annual average rainfall on the ponds, assuming it could be fully utilized, would provide approximately 149 days and 564 days of discharge at the rates of 760 and 200 gpm, respectively.

Discussion

The potential hatchery water sources examined were atypical with respect to other hatchery projects I am familiar with around southeast Alaska. The projects I am familiar with (i.e. DIPAC, Hidden Falls, Neets Bay, Medvejie) typically have water sourced from larger streams with drainage areas exceeding 2-3 square miles. Diverting source water on these larger streams is likely to be a simple project. Determination of adequate water supplies in these types of projects would likely be accomplished either by streamflow gaging if the water supply appears to be marginal as indicated by a small drainage area, or by a drainage area and precipitation extrapolation method. The sites we examined in Yakutat both have small and poorly defined drainage areas. The discharge source at the YKI site emerges from a small

pond and is confined to a single channel but has a surface area of just 1.92 acres. The Sawmill Cove site also has a small poorly defined drainage area as the water source appears to be a series of distributed springs. The number of springs and their small size would make conventional stream gaging difficult and expensive at this site.

The small drainage area and pond volume of the YKI cold storage site suggests that this site would not be feasible for either hatchery plan and I would suggest elimination of this site as an option. The discharges measured at the Sawmill Cove site suggest it may be a viable option for the smaller hatchery option requiring 200 gallons per minute using the spring discharge alone. However, this is based on a limited number of discharge measurements and a hydrologic comparison to Ophir Creek, which may not be valid. Furthermore, this is based on the assumption that flow from these springs can be fully utilized. During the site visits I noticed that most of the surface water emerges very near tide water. If you hope to avoid pumping, you may have a very marginal amount of elevation difference between where the water emerges from the hill slope and tide water, limiting placement of hatchery facilities.

The two discharge measurements of 341 and 328 gallons per minute indicate that the springs at the Sawmill Cove site would likely not be a viable option for an incubation facility requiring flow rates of 760 gallons per minute without periodic supplementation from another source. The ponds located to the south west of Sawmill Cove may have sufficient storage to provide the needed additional water but this is based on a number of assumptions as to the depths of these ponds. I have not conducted a site visit at the ponds and cannot comment on their actual depths. Furthermore, these analyses were conducted to provide crude estimates of potential water supply. I cannot provide useful comments on the feasibility or legality of utilizing water from the ponds or the springs measured at either site.

I am pleased to have had the opportunity to provide these estimates of water availability but would again caution that the information presented here was extrapolated from very little actual flow data. Additional measurements and surveys should be capable of providing improved estimates of water availability. I've attached suggestions of additional work that would aid in refining estimates of water availability should you consider further examination of the Sawmill Cove site or other sites. Should you have any questions or would like to discuss additional investigations, please feel free to contact me.

Sincerely,

Ed Neal

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