3.15 Naramata Creek

Naramata Creek flows from the east side of the Okanagan Basin into Okanagan Lake 11 km north of Penticton, B.C. The Naramata Creek watershed is approximately 41.8 km^2 (Associated 2016) and the stream length is 13 km (Lukey & Louie 2015). The creek drains a gently sloping plateau and then enters a steep canyon section before flowing over two terraces with orchards and residences in the town of Naramata near Okanagan Lake (Associated 2017). A summary of creek characteristics is found in Table 3-45 and additional stream-specific data is provided in Appendix B15.

Naramata Creek is known to currently support populations of Kokanee (spawning) and Rainbow (Associated 2016). There is a fish passage barrier located 3.4 km from the mouth. Kokanee spawning conditions have been impacted by water storage and effluent discharges into the creek (Pearson 1977), and fish habitat in general has been degraded by past channel straightening and dredging activities (Wightman & Taylor 1978) in the lower reaches as recently as 1990. The original streambed was much narrower with greater habitat complexity and more pools (Shepherd & Ptolemy 1999). A number of habitat improvements were completed in the creek since 1995 by the local community, including efforts to build Kokanee spawning beds and restoration of riparian areas along the creek.

At present, there are 13 points of diversion within the watershed (Associated 2019); however, the actual volume extracted is unknown. Naramata Creek was used as the community water supply as early as 1905 (Summit 1995) by the Regional District of Okanagan Similkameen (RDOS). The stream is currently fully recorded except during freshet (FLNRORD 2016).

Though there are no developed storage reservoirs in the watershed, a series of ditches store diverted water. Streamflows in Naramata Creek are augmented by the highline diversion, a wooden flume system that diverts water from Chute and Robinson creeks into Naramata Creek to support irrigation and water supply for Naramata. Three storage reservoirs exist within the Chute and Robinson Creek watersheds. Though some of the water is used by licensees, streamflows have historically been augmented during the summer and fall period (Matthews 2002). In 2007, the RDOS switched their water supply to Okanagan Lake and abandoned their use of Naramata Creek. However, the highline diversion is still operational between July and October (Lejbak pers. comm. 2019) and FLNRORD is currently evaluating whether continued operation would be worthwhile to maintain the Kokanee stock (White pers. comm. 2019 as natural flows are considered insufficient to maintain the population (Matthews 2002). Historical information indicates that insufficient flow has always been a limiting factor to fish production in Naramata Creek (Matthews 2002), and fish kills have been reported during periods of reduced flow augmentation (Shepherd & Ptolemy 1999). Naramata Creek is ‘flow sensitive’ in the summer and winter as low flows are below 20% LTMAD and reach as low as 5% LTMAD (Table 3-46). Water losses and gains across the alluvial fan near the mouth are unknown.

Naturalized, residual and maximum licensed flow estimates were provided by Associated (2019) with an estimated data quality rating of C for naturalized flows (data error between 25% and 50%) and D for residual flows (data error greater than 50%). Estimated maximum licensed flows indicate that the creek would be dry from mid-June to mid-September if licensed withdrawal and storage volumes were maximized.

Table 3-45: Naramata Creek description

Drainage Area	41.8 km^2
Median Elevation	1330 m
WSC station	No active or historic WSC stations
LTMAD	0.157 m^3/s (Associated 2019)
Fish species expected	Rainbow, Kokanee (ESSA & Solander 2009)
Land use	Forestry in upper watershed, agriculture and urban development in lower watershed (Associated 2016)

The approach for recommending Okanagan Tennant EFNs for Naramata Creek differed from other creeks due to the history of flow augmentation from the highline diversion. Local fish populations have adapted to the augmented flows and thus, residual flows were used as the upper bound of the Okanagan Tennant EFN instead of naturalized flows. No WUW data was collected in Naramata Creek. Fish periodicity and flow standards described in Table 2-2 to Table 2-6 were used. Weekly Okanagan Tennant EFNs were set to the lower of the residual flow or flow standard. During the summer and fall low flow period, recommended EFNs are equal to the weekly median residual flows to maintain current levels of Rainbow parr rearing and Kokanee spawning habitat capacity, and recommended overwintering EFNs are 50% of spawning flows to protect incubating eggs. A summary of EFNs for Naramata Creek is provided in Table 3-47 including the median EFN and the range of weekly EFNs, with weekly details in Figure 3-32, Figure 3-33 and Appendix B15, and flow sensitivities in Table 3-46. Further information on EFN setting in Naramata Creek is provided at the end of this section.

Table 3-46: Flow sensitivities in Naramata Creek based on naturalized flows

Species & life stage	1-in-2 yr 30-day summer low flow		1-in-2 yr 30-day winter low flow	
	Flow (m^3/s)	% LTMAD	Flow (m^3/s)	% LTMAD
Rainbow rearing	0.012	7%		
Insect production				
Kokanee spawning				
Rainbow overwintering			0.009	5%
Kokanee egg incubation				

Source: Associated (2019)

Table 3-47: EFN summary table for Naramata Creek based on residual flows

Species & life stage	Time period	Okanagan Tennant Recommended EFN				Critical flow	
		Median (m^3/s)	% LTMAD	Min (m^3/s)	Max (m^3/s)	Flow (m^3/s)	% LTMAD
Rainbow rearing & insect production [a]	April 1 – Oct 31	0.090	52%	0.055	0.139	0.009	5%
Rainbow spawning	May 20 – Jul 10	0.492	285%	0.150	0.830	0.086	50%
Kokanee spawning	Sep 17 – Oct 10	0.056	32%	0.029	0.059	0.017	10%
Rainbow overwintering	Nov 1 – Mar 31	0.028	16%	0.028	0.028	0.009	5%

a while EFNs apply to the entire period, median values are presented for the summer low flow period from Jul 15-Sept 30.

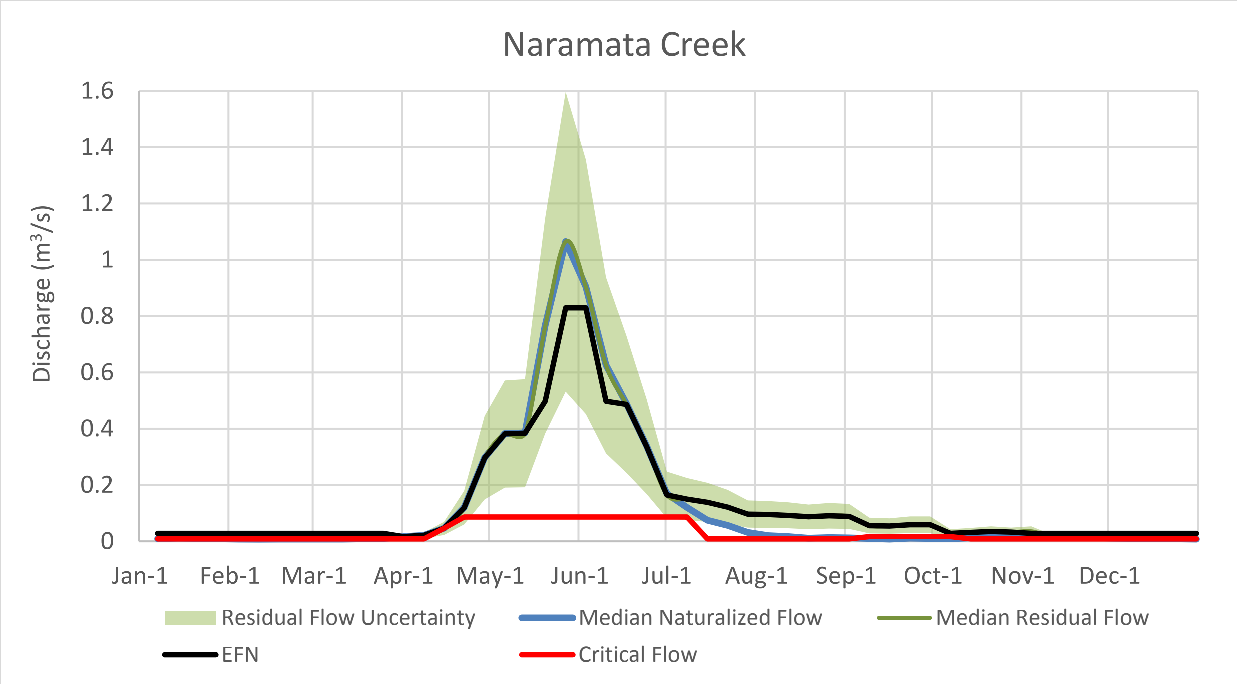

Figure 3-32: Weekly EFNs, critical flow and streamflows in Naramata Creek

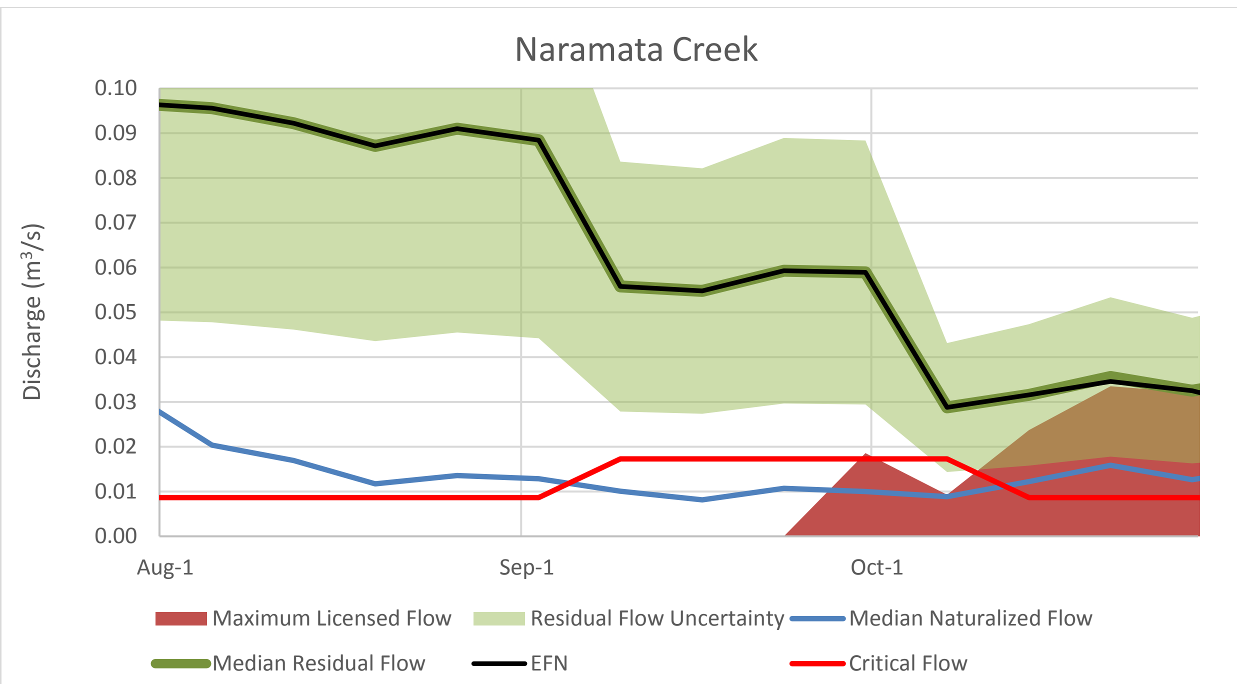

Figure 3-33: Weekly EFNs, critical flow and streamflows during the summer and fall period in Naramata Creek

<u>Rainbow parr rearing</u>

The median recommended Okanagan Tennant EFN for Rainbow rearing is 0.090 m^3/s (57% LTMAD) (Table 3-47) which is equal to the estimated median residual flows during the mid-July to late September period. No recorded hydrometric data is available for comparison. Estimated naturalized weekly flows during the mid-July to late September period are well below the recommended EFN, indicating that continued flow supplementation is required to sustain current levels of parr rearing in the creek and to achieve the EFN (Figure 3-33). No WUW data was collected but past channel widening for flood control likely necessitates the comparatively high EFN. The recommended critical flow for Rainbow rearing is 0.009 m^3/s (5% LTMAD) based on the LTMAD criterion (Table 2-7).

Judging from WUW curves for Rainbow parr rearing in other creeks of similar size (e.g., McDougall Creek), it is likely that Rainbow parr WUW increases rapidly between the naturalized flow estimates (approximately 0.015 m^3/s during the summer low flow period) and our recommended EFN. Given the absence of actual habitat data underlying this EFN, it is recommended to confirm habitat conditions under late summer residual flows (up to approximately 0.1 m^3/s) to refine EFN recommendations and evaluate the potential for continued flow supplementation. The habitat assessments should be coupled with flow monitoring.

Previous EFN recommendations have ranged from a low of 0.085 m^3/s (visual observations from Wightman & Taylor 1978) to 0.255-0.55 m^3/s (ESSA & Solander 2009), the former being almost equivalent to our EFN and the latter being unachievable even with flow augmentation.

Rainbow spawning

The recommended Okanagan Tennant EFN for Rainbow spawning is 0.492 m^3/s (314% LTMAD, Table 3-47). Estimated naturalized and residual flows are greater than the EFN from late-May to late June (Figure 3-32). A previous EFN recommendation by ESSA & Solander (2009) was approximately 0.6 m^3/s. The recommended critical flow for Rainbow spawning is 0.086 m^3/s (50% LTMAD) based on the LTMAD criterion (Table 2-7).

Kokanee spawning

The current level of Kokanee production from Naramata Creek is maintained through flow augmentation from the highline diversion (Matthews 2002). It is likely that Kokanee production under naturalized flows would be severely diminished, as indicated by a fish kill in 1993 that resulted from the temporary interruption of the highline diversion inflows during the Kokanee spawning period (Inkster 1993). EFNs for Kokanee spawning were set to estimated residual flows for the spawning period as stocks have adapted to the augmented flow regime (Associated 2019). The median of the recommended weekly EFNs is 0.056 m^3/s (36% LTMAD, Table 3-47). However, historical EFN recommendations for Kokanee spawning based on visual inspection of the creek were greater at 0.085 m^3/s (Wightman & Taylor 1978) and 0.23 m^3/s, as well as 0.11 m^3/s over the winter for incubation (Shepherd & Ptolemy 1999). Estimated residual flows are much lower and it is unknown whether EFNs could be achieved through management of storage in the Robinson and Chute Creek watersheds. Estimated residual flows prior to the Kokanee spawning period are much greater than those during the Kokanee spawning period (Figure 3-33). If possible, it is recommended to reduce releases during mid-summer to increase supplementation during the Kokanee spawning period. Field investigations of Kokanee spawning habitat conditions under a range of expected flows, coupled with flow monitoring, should be completed to refine EFN recommendations and evaluate the potential for continued flow supplementation. The recommended critical flow for Kokanee spawning is 0.017 m^3/s (10% LTMAD) based on the LTMAD criterion (Table 2-7).

Overwinter incubation flows are recommended at 50% of the Kokanee spawning flows (0.028 m^3/s, 18% LTMAD) but cannot be augmented by the highline diversion as it does not operate in the winter. Estimated naturalized flows in the winter range from 0.008-0.016 m^3/s, which is well below the recommended EFN. Since there was no winter flow augmentation in the past it is expected that maintaining the current residual flow regime will maintain current production levels of Kokanee.