WRIA 8 10-Year Plan Update Technical Forum Summary

Swedish Cultural Center, 1920 Dexter Ave N., Seattle, WA 98109
Tuesday, November 17, 2015 from 9:00 a.m. to 4:00 p.m.

WRIA 8 Technical Forum overview

On November 17, 2015, the Water Resources Inventory Area (WRIA) 8 Technical Committee hosted a workshop-style Technical Forum assembling fisheries scientists and technical experts across the watershed. Meeting participants heard about the latest research on Chinook salmon recovery challenges and brainstormed priority actions and areas of investigation for consideration in the WRIA 8 10-Year Plan Update.

Note: This summary synthesizes the discussion outcomes of the Technical Forum. The WRIA 8 Technical Committee received additional input submitted by meeting participants via individual comment forms.

Summary Contents

I. Workshop objectives	pg. 2
II. Bottlenecks to recovery – presentation summaries	pg. 2
A. Predation *(Dave Beauchamp, UW/USGS)*	pg. 2
B. Artificial light *(Roger Tabor and Mark Celedonia, USFWS)*	pg. 4
C. Juvenile survival / life history diversity *(Joe Anderson, WDFW)*	pg. 7
III. Summary of group discussions	pg. 9
A. Prioritized limiting factors to Chinook recovery	pg. 9
Matrix of information gaps, approaches, and key questions	pg. 10
B. Institutional needs and management considerations	pg. 12
C. Experts and resources	pg. 12
D. Potential partnerships	pg. 13
IV. Next steps	pg. 13
Appendix A. Meeting participants	pg. 14

I. Workshop objectives

Sarah Brandt (EnviroIssues) opened the Technical Forum by welcoming participants and providing an overview of the workshop objectives, which were to:

- Share information on the state of the science regarding Chinook salmon recovery
- Discuss emerging issues / bottlenecks / biggest threats to recovery in WRIA 8
- Identify (and begin to prioritize) limiting factors and information gaps
- Consider possible approaches to address and fill knowledge gaps that could inform the WRIA 8 10-Year Plan Update

Scott Stolnack (WRIA 8 Technical Committee) provided remarks to further frame the purpose of the Technical Forum. He explained that the WRIA 8 team chose presentations on predation, artificial light, and juvenile survival/life history diversity for the workshop agenda, because these are emerging as potentially important bottlenecks to Chinook recovery in the watershed. He welcomed discussions about all topics, though encouraged participants to focus on those in the purview of freshwater managers. He explained that the outcomes of the day's discussions will help inform the WRIA 8 Technical Committee's forthcoming 10-year Plan Update for the next decade of monitoring and studies in the Lake Washington/Cedar/Sammamish watershed.

II. Bottlenecks to recovery: What are the most pressing limiting factors?

In the morning, participants heard from four presenters about the latest research on potential obstacles to Chinook salmon recovery: predation, artificial light, and juvenile survival. Their presentations highlighted key take-aways and data gaps where additional focus could improve the Chinook recovery strategy and the WRIA 8 10-year Plan update. Key points from each presentation are summarized below.

A. Predation

Dave Beauchamp (UW/USGS) presented about research that he and Casey Clark (UW) have been conducting on juvenile Chinook salmon predation in Lake Washington.

- **Key predator species:** Cutthroat trout and northern pikeminnow are the two most threatening in-water predators of Chinook salmon. With these species, Lake Washington is a predator-rich environment – even more so than Puget Sound for juvenile Chinook. Fish in these populations above 300 mm in length have a higher rate of predation on juvenile salmon. Pikeminnow, as a warm water species, has an increased capacity to feed in higher water temperatures.

- **Emerging in-water predators**: While per capita predation of Chinook by smallmouth bass is still low, the smallmouth bass population appears to be increasing significantly over the past decade. Walleye is less abundant, though the species is a new emerging threat for predation of Chinook.

- **Bioenergetics modeling:** Beauchamp and Clark have been inputting data on size structure, thermal experience, growth, and survival of cutthroat trout and northern pikeminnow into a bioenergetics model. This model allows them to calculate estimated consumption rates, which can be scaled up to population-level predation rates. This helps identify what species or size class of predator impose the most impact on Chinook survival, what environmental factors influence predation, whether or not there are seasonal patterns, etc.

- **Estimated mortality rate:** Using 2005 data, they estimate a 39% mortality rate that year for juvenile Chinook from cutthroat trout. Predation rate from northern pikeminnow is still unknown, though they are more abundant than cutthroat trout.

- **Distribution of predation:** Most Chinook mortality by predation is occurring in the Cedar River and Lake Washington. Predation mortality in the Ship Canal was considered to be quite low in 1999, but this conclusion should be revisited in light of the higher contemporary abundance of smallmouth bass and warmer temperatures during smolt outmigrations over the past 15 years.

- **Reducing predation mortality in Chinook:** To reduce Chinook mortality from predation, potential strategies include:
    - Reducing predator abundance or size structure so there are fewer effective predators.
    - Supporting faster Chinook growth to reduce vulnerability. Data show a strong relationship between weight and survival rate. In Puget Sound, juvenile Chinook that access offshore waters increase their body mass by 2-4 times during the months of June and July; juvenile Chinook in WRIA8 substitute Lake Washington as their early estuarine/marine feeding and growth habitat; it is yet unknown whether there is a parallel period of critical growth for juvenile Chinook in Lake Washington.
    - Reducing the efficacy of predators by limiting their access to prey or their ability to find prey. Since most predators of Chinook feed visually, light and turbidity affect feeding.

- **Effects of artificial light:** Ambient light and glare from urban light pollution is relatively high within Lake Washington and Puget Sound. This light has increased the threat of nocturnal predation by seven-fold in Seattle, and cutthroat trout in Lake Washington feed though the night under current conditions, whereas as recently as 1985, peak predation occurred during dusk and dawn with little to no predation at night. Their predation time has extended from 3 hrs/day to 8-15 hrs/day. Juvenile salmon normally migrate at night at relatively shallow depths of 0-5 m; light at current levels penetrates to ~15 m. In marine waters (e.g. Puget Sound) juvenile salmon of all species initially remain in the upper 15 m of the water column all day and night through at least July. Artificial light penetration remains an important issue during early marine life stages.

- **Restoration concerns for Chinook:** There are several restoration concerns for Chinook in Lake Washington and the Ship Canal, including:
    - Increasing predation threats from artificial light pollution and non-natives such as walleye.
    - Thermal impacts of the Ship Canal becoming a barrier for adult Chinook, and the need for a continuous cold water corridor from the lake thermocline to the locks.
    - Delayed mortality related to the freshwater experience.
    - Growth and thermal experience, and the size of smolts achieved by July.

Q&A on predation and light: Dave Beauchamp fielded the following questions from meeting participants:

- **Is there a desired baseline for ambient light that cities should try to achieve?** There is no single baseline number; optimal conditions vary on a case-by-case basis. We see maximum reaction distances of predators to juvenile salmon at 20 lux, but predators are still effective below 1 Lux. We have measured surface light levels averaging 4 Lux at night on Lake Washington (Mazur and Beauchamp 2006) with reflection off of cloud cover increasing light by a factor of 4x. Shielding lights will reduce impacts, particularly on floating bridges. For navigation lighting on bridges, the external red lights for boat safety are less impactful, as red attenuates more rapidly with depth than other colors.

- **Many cities are moving to cool-blue LED street lights – should they be red instead?** The LED spectrum is actually better, though the blue range within that spectrum has a spike of sensitivity. What's more impactful is that these lights are brighter. It would be beneficial if these LED street lights had fewer lumens.

- **Is planting shoreline trees for shade an effective approach to reducing light pollution?** Shading from trees could be a benefit in some situations, but important predation interactions also occur offshore where direct lighting is less important than the diffuse long-distance skyglow. Additionally, a significant portion of the predation occurs in Winter-Spring, so it would be best to use conifers. Addressing light sources is more important.

- **Could harvest management of predators be used as a strategy for reducing juvenile Chinook mortality?** There is currently not enough angling pressure to limit predator populations, and walleye are not abundant enough to be a targeted fishery. In the long term, it's possible that we will need to institute harvesting of these non-natives at an industrial scale (as has been done at Yellowstone Lake), but that is an action that would need to be agreed upon by WDFW and Muckleshoot tribal co-managers.

- **In this watershed, Lake Washington functions as our estuary. In estimating predation rates, it appears that you would want to compare survival rates of Chinook in our watershed with those that have access to an estuary.** We've been working on that very comparison for four watersheds in Puget Sound. Specifically we are looking for evidence of size-selective mortality and observing that across watersheds, juvenile abundance is very similar until they migrate offshore in June-July, size-selective mortality increases at some point after this, and could be occurring within Puget Sound or in the later life stages in transition or oceanic regions.

B. Artificial light

Roger Tabor (USFWS) and Mark Celedonia (USFWS) both presented their research on the effects of light on Chinook behavior in the watershed.

Artificial light study along shorelines of Lake Washington and Lake Sammamish:

- **Study purpose:** Roger Tabor and Alex Bell conducted studies in 2014-2015 at the south end of Lake Washington and Lake Sammamish to investigate whether fish are attracted to artificial light. Between the months of January and May, juvenile Chinook inhabit nearshore, shallow water (0-1 m deep) along highly developed shorelines where there is considerable nighttime lighting. Despite this, the influence of nighttime artificial lighting on juvenile Chinook is not well known.

- **Study design:** The experiment systematically added three levels of incandescent light (1 – bright light, 50 lux max; 2 – dim light, 5 lux max; and 3 – no light) to nine shoreline sections at one site in each lake. These light trials (lasting 1-2 hours) were conducted in March, April, and May. Fish were collected by beach seine, then counted and measured.

- **Results:** The results of the study suggest that fish are attracted to light, particularly in the month of March (for Lake Washington) and May (for Lake Sammamish-hatchery Chinook) during which approximately 1,600-1,700 subyearling salmonids (Chinook, coho, and sockeye) were captured. Under control conditions (nights when no light added), approximately 100-600 were captured. On nights when lights were used, bright light had a stronger effect than dim light on fish presence at the sampling sites. Conversely, cutthroat trout and yearling coho salmon were more prevalent in control sampling nights or in dim and no light treatments.

- **Limitations:** Roger explained a few limitations of the study:
    - The team couldn't start sampling earlier in the year (January – February) due to permitting delay, though they hypothesize that they would likely have seen an even larger effect during those months.
    - Lake Sammamish had a large woody debris structure at one end of the shoreline site, so the juvenile salmonids (Chinook and coho) were not uniformly distributed along the site.
    - All sampling results may be biased against bright light conditions, as fish are more active under lit conditions and may be better able to avoid the seine.
    - The experiments only lit areas that were less than 0.5 m deep and lit areas in deeper waters may be attractive to larger fish than what was observed.

- **Bird predation:** A great blue heron was observed feeding under bright lights in one experimental trial; this shoreline-oriented predator has been seen feeding in other artificially lit areas and should be considered in discussions of Chinook predation and nighttime artificial lighting.

- **Conclusions:** Nighttime lighting can have a strong effect on fish behavior and may increase juvenile Chinook vulnerability to predation. Subyearling salmonids seemed very attracted to light, and the effect was strongest when fish were smallest in March for all three salmonid species. These trials present preliminary data; additional studies should be done to test other types of light (not just incandescent) and other stages of life history (i.e., effects on fish in January-February).

Artificial light study along SR 520 and Ship Canal:

- **Study overview:** In 2007-2008, Mark Celedonia and Roger Tabor investigated juvenile Chinook behavior at two study sites – one at the west end of the SR 520 Bridge, and one between the I-5 Bridge and University Bridge in the Ship Canal. A fine-scale acoustic tracking system was used to track hatchery Chinook.

- **Site conditions:**
    - **SR 520 Bridge:** At this site, the light sources included sodium-type (orange) street lamps from the bridge deck and an overwater apartment building with exterior lights. Measured light levels in this area were 0.9-8.6 lux, with shadow lines and with ambient light at 0.12-0.14 lux.
    - **I-5 and University Bridges**: Unlike the SR 520 Bridge site, at the I5 bridge there were no bright focal areas of light on the water, but there was a shadow (approx. 0.1 lux in the shadow; 2 lux on the light side); the University Bridge cool-color fluorescent/LED navigation light cast about 2.5 lux onto the water. Sodium lamps on University Bridge support columns cast bright light into the water (up to 226 lux).

- **Results**:
    - **At the 520 Bridge**, the study tracked 78 fish over the course of two years, the distribution of which was presented in heat maps. The heat maps shows that the hatchery fish hot spots correlate to two areas: 1) areas of bright light beneath light sources on the bridge and the apartment; and, 2) shadow lines along the bridge. Fish avoided shaded areas beneath the structures. At this site, attraction to light was stronger in 2008 than 2007; this may be due to warmer conditions in 2007 (leading to advanced smoltification) and/or more turbid conditions in 2007 (leading to potentially less predation risk). The influence of light on fish behavior extended 43 m from the edge of the bridge where light intensity diminished to ambient levels.
    - **At the I-5 and University Bridges**, the study tracked 38 fish over the course of two years. Similar to the observations at the other site, the distribution of these fish showed hot spots at lights and along the shadow lines. They avoided the moderately lit area beneath the University Bridge, indicating that type of light and wavelength spectrum may have an effect on attraction.

- **Implications**: Some areas of potential impacts to Chinook and outstanding questions include:
    - **Shadow lines:** Are fish that stay near the shadow lines using that area as a source of cover from predation, or is predation risk greater?
    - **Potential effects on fish migration:** Light attraction was observed 40 minutes after sunset until 20 minutes before sunrise. Chinook in Lake Washington and the Ship Canal actively migrate during the day. Active migration begins 45 minutes before sunrise and ends about 17 minutes before sunset. This means that the beginning of their daily migration behavior may be delayed by about 25 minutes, however the significance of that delay is unclear.

- **Recommendations**: This is a preliminary study and offered the following areas for further inquiry and management:
    - Investigate implications of light and attraction (increased feeding, shadow lines, predation, migration delay).
    - Investigate ways to further minimize attraction (effects of wavelength spectrum, light duration).
    - Projects near and over the water should incorporate efforts to minimize spill lighting onto water and shadow line effects.

Q&A on artificial light: Roger Tabor and Mark Celedonia fielded the following questions from participants:

- **What effect does moon phase have on artificial light attraction?** If there is an increase in ambient light, the spatial area of attraction to artificial light is reduced, so a full moon would reduce the spatial extent of the light attraction effect. At the south end of Lake Washington, sky glow is higher than the light intensity of a full moon on a clear night.

- **Is the driver of this light attraction a behavioral or feeding mechanism? It would be good to collect data on biomass density to answer this mechanism question.** The attraction is so strong that it’s likely a behavior mechanism, though it could be a combination of both.

- **Is light a benefit in terms of Chinook growth?** Chinook grow fast in Lake Washington, but the relationship of light with that growth is unknown.

- **In the absence of artificial light, Chinook stop migrating at night when it is dark. Why is this?** Tracking studies show that Chinook in Lake Washington are nearshore during the day, then at night they move offshore, probably to feed. In the Ship Canal, however, these trends do not apply. We're not sure why they stop migrating at the end of the day; most species, including Chinook in other systems, migrate at night. One possibility is that the smelt and other prey organisms are reacting to light while predators are focusing on things deeper in the water column.

C. Juvenile survival / life history diversity

Joe Anderson (WDFW) presented about research he and Kelly Kiyohara (WDFW) have conducted on general patterns of Chinook salmon with respect to size and survival rate, and productivity and survival seen instream and in Lake Washington.

- **Calculating abundance with traps:** The team operates three traps of varying designs to capture Chinook fry and parr – one on Bear Creek (operated February through mid-July) and two on the Cedar River (one incline plan trap operated January through early May, and one screw trap operated mid-April through mid-July). All fish are counted and enumerated by species, then a subset are marked for recapture and released further upstream to give an estimate of the efficiency of each trap. From this, an estimate on the species abundance is calculated. The traps will have different efficiency values based on hydrologic flow and season.

- **Measured juvenile Chinook abundance:** On the Cedar River, approximately 1.5 million Chinook were estimated in 2014. This is the highest estimate for juveniles throughout the life of the project (begun in 1999). On Bear Creek, approximately 60,000 Chinook were counted in 2014 (similar to abundance measured in 2009).

- **Migration timing:** On the Cedar River, average peak migration (i.e., when most juveniles are moving downstream) occurred in late February/early March during trap years 2005-2014. On Bear Creek, the average peak migration was observed in late May through early June. For both sites, the exact week of peak migration varies year to year, but there are two pulses of migration, one in February-March and another in May-June.

- **Body size at outmigration:** On both streams, fry (less than 45 mm fork length) were observed February-March and parr (more than 45 mm) were observed beginning in early April. Overall, in most years, more fry were trapped on the Cedar River, while more parr were trapped on Bear Creek.

- **Abundance of two life history strategies:** On the Cedar River, the number of parr hasn't changed over the course of trapping years (1999-2014), but the abundance of fry has increased considerably since 2012; it is a fry-dominated stream. By contrast, Bear Creek is a parr-dominated stream.

- **Limitations on rearing:** One hypothesis for this difference is that there are differing carrying capacities between the two streams. As the number of spawners increases in a stream system, smolt abundance levels out eventually because the river reaches its carrying capacity. This may be the case for parr but not for fry (i.e., there is not much limiting spawning, but there is a limitation for parr rearing).

- **Growth advantages in Lake Washington:** Fry that survive migration to Lake Washington in earlier months experience more rapid growth than the other members of their cohort rearing in the stream; there is a measured growth advantage to being in the lake earlier. However, we are not able to monitor relative survival between the lake and the river.

- **Survival to Ballard Locks:** Between 2010 and 2014, the team used PIT tags to evaluate survival of Chinook to the locks. Thousands pf parr were tagged in late May through early June on the Cedar River, on Bear Creek, and at Issaquah hatchery (2014 only for hatchery). The percent detected at the locks ranged from 2.7%-29.4%. In 2014, when fish were tagged at all three sites, the Issaquah hatchery parr had the lowest percentage detection at the locks. (Results do not correct for route choice.) Overall, larger fish were more likely to survive to the locks and fish tagged in earlier months (i.e., those migrating earlier) were more likely to be detected. Fish arriving at the locks in later months may be less likely to use smolt flumes in search of colder waters, and thus less likely to be detected. Thus, the migration timing result may be influenced by route choice and not necessarily a survival difference.

- **Conclusions**:
    - Observations on these two streams reveal that there are two juvenile migration strategies – fry migrating earlier at a smaller size, and parr that migrate after rearing and growing in the river.
    - Fry are more numerous than parr in Cedar River, while parr are typically more numerous than fry in Bear Creek.
    - Fry exhibit density independent productivity from the river, while parr exhibit density dependent productivity from the river (i.e., there is a carrying capacity for rearing within the river).
    - For PIT tagged parr, detection at the Ballard locks appears linked to larger size at tagging and early migration from river.

- **Implications for recovery:** Data show that restoring juvenile parr rearing habitat on the Cedar River (e.g., through increased floodplain connectivity) should be a focus of restoration; recovery efforts that increase quality and quantity of parr rearing habitat will benefit the Chinook population. Long-term monitoring data will be essential to identify limiting life stages and evaluate success.

Q&A on juvenile survival / life history diversity: Joe Anderson fielded the following questions and comments from participants:

- **The proportion of juveniles using the smolt flumes outfitted with PIT tag detectors at the locks** vs. alternate routes without PIT tag detectors is difficult to pin down. In general, the smolt flumes have a relatively high detection efficiency for the fish that use the flumes, but there are other routes that are not monitored (i.e., through large and small locks). Route choice may change over the season; the smolt flumes draw water from the surface and fish may seek other routes when surface water warms during early summer.

- **The Army Corps is putting PIT tag detectors into one of the large filling culverts this season** to see what they can quantify for that mode of exit.

- **Should we customize recovery strategies to better match differences in life histories?** Any time a system reaches carrying capacity, an increase in habitat supporting that limited stage will benefit the population. Increasing juvenile rearing capacity is worth considering for our system.

- **Have you measured adults coming back up fish ladder at the locks?** No, but the ultimate goal is to have more adults returning to the watershed. This is a good area to investigate.

- **What are the effects of the Landsburg fish passage, and could it have caused the increase fry production in recent years?** The increased fry production observed at the trap from 2012 to present doesn't match up with the timeline of providing fish passage at Landsburg; the observed increase in fry was 4-7 years after the fish passage was installed. Furthermore, increasing adult returns are not confined to the area above Landsburg – the highest number of redds since the 1970s were observed in 2007. The large number of fry observed at the trap 2012 - 2014 might be caused by small, young fry being flushed out with higher flows.

III. Summary of group discussions

After lunch, Sarah Brandt guided participants through a discussion of additional bottlenecks or threats to recovery and questions emerging from the presentations. Participants then broke off into small groups to discuss specific questions on data gaps, resources, recovery options, priority technical activities, etc., and shared their findings with the larger group. Discussion highlights are listed below.

A. Priority limiting factors to Chinook recovery

Forum participants proposed the following priority-level rankings of limiting factors to recovery. See the matrix of information gaps, approaches for addressing those gaps, and key management questions by limiting factor on pp. 10-11.

First-tier priorities

- Ballard Locks and Ship Canal operations – effects on temperature, dissolved oxygen, and concomitant decreased resistance to disease/parasites
- Rearing and refuge – lack of woody debris (especially on the Cedar River) and floodplain connectivity
- Lake survival – especially with the effects of artificial light and predation
- Temperature – especially in the Ship Canal and Sammamish River

Second-tier priorities

- Water quality – stormwater, toxic loading of phthalates and dialysis drugs (though there was some discussion that this could be a first-tier priority, especially in Lake Union)
- Flows – both winter and summer; high flows scour redds and low flows could make Lake Sammamish completely inaccessible to migrating fish
- Invasive aquatic vegetation

Other limiting factors

- Piers and docks
- Genetic introgression or other issues related to hatchery operations

Limiting factors (threats)	Information gaps	Approaches for addressing gaps & threats	Key questions
First-tier priorities			
Ballard Locks & Ship Canal operations	• Data on survival rates to/through locks • The effect of operations on water quality and temperature • The effect of the Landsburg fish passage	• Improve PIT tag detection at the locks to monitor migration of juveniles and adults in and out of WRIA 8	• What actions can the Army Corps take to improve survival in the Ship Canal? • Which is bigger challenge to fish – adult or juvenile passage at the Ballard Locks?
Rearing and refuge	• Status and trends population monitoring in stream, including better tracking of changes in species composition • The effects of woody debris and riparian conifers on juvenile carrying capacity • Are there spawning limitations in tributaries at the north end of Lake Washington?	• Use PIT tags on adults and juveniles • Partner with WDFW on existing status/trends research	• What management actions can we take to support parr in the river? • Should we customize restoration based on different life histories across the watershed? Does early spawning in smaller creeks mean that we should focus recovery efforts in those creeks?
Lake survival & predation	• Status and trends population monitoring in Lake Washington, including better tracking of changes in species composition • Migratory pathways and pinch points in Lake Washington • Distribution of fry in South Lake Washington • Effects of docks and piers on migration and predation, best designs • Relative impacts of harvest and poaching (salmon and predators)	• PIT tagging on adults and juveniles • Acoustic monitoring • Increase overhanging vegetation around shorelines • Partner with WDFW on existing status/trends research	• What management actions can we take to support increasing fry survival in the lake?
Temperature	• Data on Chinook survival rates under different temperature regimes		• How can we address temperature in the Sammamish River?

Limiting factors (threats)	Information gaps	Approaches for addressing gaps & threats	Key questions
Second-tier priorities			
Water quality	• The relative importance of water quality (and stormwater quality specifically) on salmon recovery		• Are current stormwater regulations and treatment standards adequate? • What specific recommendations can the plan put forth to address stormwater?
Flows			• Are there any adaptive management approaches we can look at now based on summer low-flow predictions under climate change scenarios?
Invasive aquatic vegetation	*No specific discussion*		

B. Institutional needs and management considerations
Through the afternoon, participants raised the following needs and management considerations.

Institutional needs

- Funding (How can we ensure monitoring and predation studies are properly funded?)
- Evaluation and monitoring of recovery projects
- Formalized recognition of best available science and the work that underlies planning
- A strategic communications strategy, including the appropriate level of communication to decision-makers
- Targeted topics to build public interest and momentum
- Identification of social barriers (e.g., to reducing light pollution), followed by appropriate education and outreach to address those barriers

Overarching management considerations and questions

- Opportunities for monitoring and research should be targeted where there are potential management actions in mind.
- Can WRIA 8 provide incentives and/or guidance to help jurisdictions in making sound policy decisions?
- How can we make rules that are more effective and that increase compliance and enforcement?
- What does the build-out scenario (under current Urban Growth Area boundaries) of the watershed mean for Chinook recovery? Is there a need to modify zoning or land use regulations?
- What impact does hatchery fish (genetic) introgression have in the basin? How can the hatcheries work together with Chinook recovery?

C. Experts and resources
Throughout the course of the forum, the following technical experts were identified as resources to be consulted during plan updates and in future work.

Expert	Topic	Notes
Dan Schindler	Food webs	Dan's group should be considered for salmon recovery funding
Nick Gayeski	Relative survival of Chinook reared in lake vs. river	Nick's research could inform strategy on where to devote recovery efforts (in the lake vs. river)
King & Snohomish Counties	NPDES studies will have results in 2017	
Army Corps	Locks management	WRIA 8 should continue to develop relationships with Corps technical folks to align research objectives in the locks
Paul DeVries & Kelly Kiyohara	PIT tagging	Army Corps has also conducted PIT tag research in locks filling culverts
Nick Gayeski & Brian Kennedy	Microchemistry and juvenile life history	See above
Roger Peters	Flows and juvenile salmon	See Scott Stolnack for abstract info

D. Potential partnerships

The following entities were identified as potential partners with whom WRIA 8 can look to coordinate research efforts and leverage resources.

- Army Corps – has a matching funds program that could be leveraged
- Experts in non-represented disciplines for new perspectives (e.g., fluid dynamics)
- Formal merging of resources with groups of similar interests (e.g., the Cedar River Watershed Habitat Conservation Plan, the Issaquah hatchery, etc.)
- WDFW and others – for status and trends research
- Universities and community colleges

IV. Next steps

Scott Stolnack closed the forum by providing an overview of the next steps toward recovery planning.

- The WRIA 8 team will release their State of Watershed Report in January.
- On Feb. 4, 2016, the WRIA 8 team will host the Salmon Summit gathering watershed partners across disciplines. Discussions during this event will be informed by the Technical Forum key takeaways.
- The Technical Committee will use the outcomes of this forum to develop:
    - Recommendations for the 10-year Salmon Recovery Plan Update
    - A monitoring and adaptive management plan
- The 10-year Plan Update will be completed by the end of 2016

Scott noted that there is an ongoing opportunity to submit feedback and ideas, and welcomed participants to join the Technical Committee.

Appendix A. Technical Forum participants

Name	Organization
Scott Stolnack	WRIA 8
Jason Wilkinson	WRIA 8
Jason Mulvihill-Kuntz	WRIA 8
Sarah Brandt	EnviroIssues (facilitator)
Lauren Dennis	EnviroIssues (facilitation support)
Aaron Bosworth	WDFW
Bethany Craig	WDFW
Bill Way	The Watershed Company
Brett Gaddis	Snohomish County
Casey Clark	UW
Christa Heller	WDFW
Don Davidson	Long Live the Kings
Daniel Lantz	KC DNRP
Dave Beauchamp	UW/USGS
Eric Warner	Muckleshoot
Jamey Selleck	Natural Resources Consultants
Jeff Burkey	KC DNRP
Jim Bower	KC DNRP
Joe Anderson	WDFW
Josh Kubo	KC DNRP
Kate O'Laughlin	King County
Kelly Kiyohara	WDFW
Kit Paulsen	City of Bellevue
Mark Celedonia	USFWS
Matt Longenbaugh	NMFW
Paul Devries	R2 Resource Consultants, Inc.
Roger Tabor	USFWS
Stacy Vynne	Puget Sound Partnership
Stewart Reinbold	WDFW
Susan O'Neil	Long Live the Kings
Tom Hardy	City of Redmond