2013 - 2014 Calapooia Basin RBA Snorkel Survey Brief

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Calapooia Watershed Council

Introduction

A large wood placement project was implemented in Brush Cr and its 2 major contributing tributaries (WF Brush and Childers Cr) in September of 2013. A total of 342 logs were placed by excavator in approximately 5.7 stream miles. Just prior to this wood placement, a comprehensive pre project snorkel inventory was conducted in the Brush Cr sub basin to describe the distribution and abundance of salmonids so that a baseline could be established for future project effectiveness monitoring. To begin post project monitoring of this significant restoration action, a replicate snorkel survey was conducted 1 year later in the Brush Cr subbasin. This comparison was designed to quantify any potential changes in the abundance and distribution of salmonids associated with the increase in the abundance of full spanning wood. Due to fiscal constraints, a portion of the Brush Cr mainstem was dropped in the post project inventory (2.4 miles). The section dropped was in the mainstem of Brush Cr below any of the structure sites installed in 2013. The excluded reach extended from the confluence of the WF Brush Cr to the upstream edge of the power line crossing on the Melcher property.

This review also includes the results of the 2014 pre project RBA snorkel inventory of a select reach of Courtney Cr, a tributary of the mainstem Calapooia. The selected reach was identified as a potential target for restoration and a pre project baseline of salmonid distribution and abundance was the primary objective of the inventory effort. The beginning and end points of the target reach have been identified in attachment 1 of this document.

Results

Table 1 presents the relative abundance of each salmonid species and age class observed in the targeted stream reaches. The table also includes inter annual comparisons of abundance for Brush Cr, WF Brush Cr and Childers Cr. The estimates of abundance are based on an expansion of the 20% sample of pool habitats only (riffles / rapids / glides not sampled) and therefore are not meant to represent a population estimate for any of the salmonid species.

Table 1

Stream	**0+**	% of total	**Sthd**	% of total	**Cutthroat**	% of total
*Brush 2013 Pre	260	47%	5	50%	250	49%
*Brush 2014 Post	215	54%	**0**		215	44%
WF Brush 2013 Pre	0	0	0		30	6%
WF Brush 2014 Post	**0**	**0**	**0**		**75**	**15%**
Childers 2013 Pre	290	53%	5	50%	230	45%
Childers 2014 Post	180	46%	0		**195**	**40%**
Courtney Pre	**27**		**0**		**600**	
Courtney Trib B Pre	10		0		150	

*Brush Cr surveys normalized to represent similar survey lengths

Table 1 also contains the results of the pre project inventory in Courtney Cr and its primary headwater tributary (Trib B).

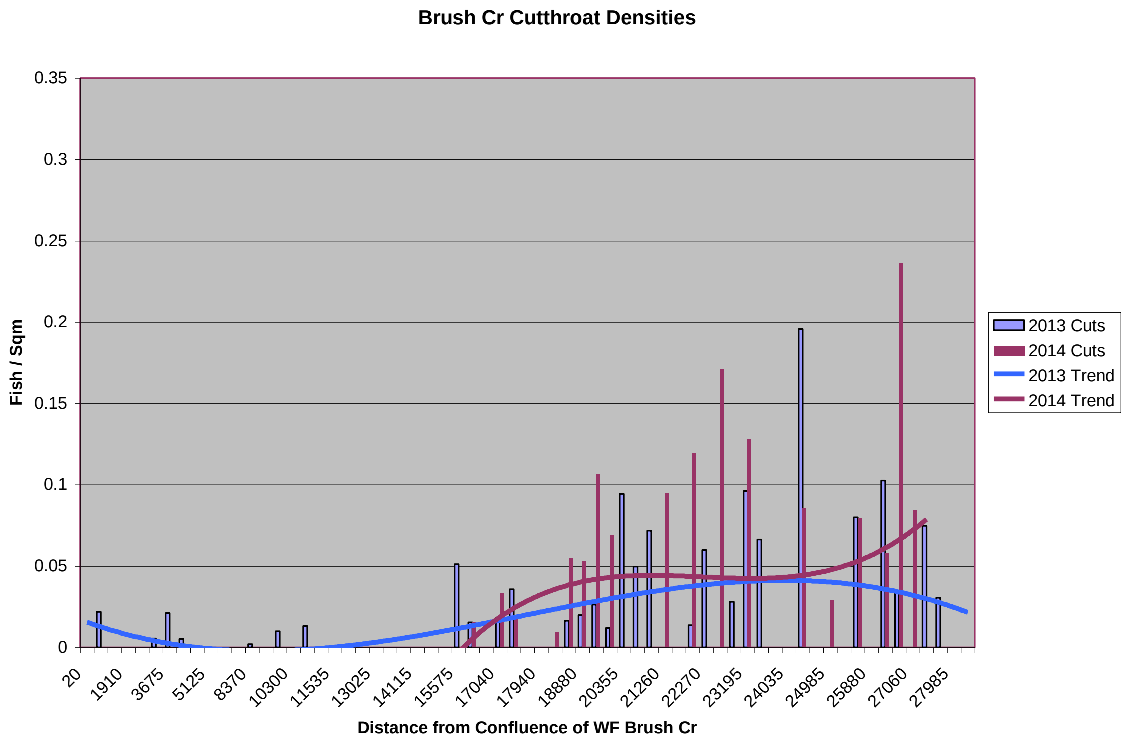
Brush Cr

A significant observation from the 2 year inventory in the Brush Cr subbasin is the current lack of steelhead utilizing the system for spawning and rearing. No steelhead parr were observed in 2014 and only 2 were observed in 2013 (expanded to 10 from the 20% sub sample). This suggests that for both the 2011 and 2012 brood years, there were no adult steelhead that spawned anywhere in the Brush Cr subbasin. The observations of steelhead parr in 2013 were likely upstream migrants from the mainstem Calapooia (a common strategy for summer survival in temperature limited tributaries of the Willamette).

Cutthroat abundance in the Brush Cr subbasin would be classified as low with average reach densities in both sampled years ranging between 0.02 and 0.04 fish / Sqm of pool surface area (the highest average density, 0.04 fish /sqm, was observed in Childers Cr in the post project year). The basin wide abundance of cutthroat between years only varied 5% with a basin total of 510 in 2013 and 485 in 2014. This is well within the range of the variability associated with the snorkel methodology and suggests no measurable change in abundance between the pre and post project inventory.

An interesting observation between the pre and post project year was that the pool occupancy rates remained the same (occupancy = % of pools containing at least 1 older age class cutthroat) in mainstem Brush before and after the project (49% to 50%) but the occupancy rate increased in both Childers Cr (33% to 43%) and WF Brush Cr (26% to 48%) post project. This suggests that although the absolute abundance of Cutthroat has yet to exhibit a significant increase, the distribution of cutthroat has been altered by restoration to favor the higher gradient tributary habitats. It follows that the meta population of 1+ and older age class cutthroat encompasses the entire Brush Cr subbasin and that population structure should be viewed on the larger spatial scale. In this example, it is possible that 1+ and older cutthroat that may have historically occupied lower Brush Cr summer habitats are currently being retained in headwater tributaries at a higher rate as a result of the increase in complexity and roughness associated with wood placement.

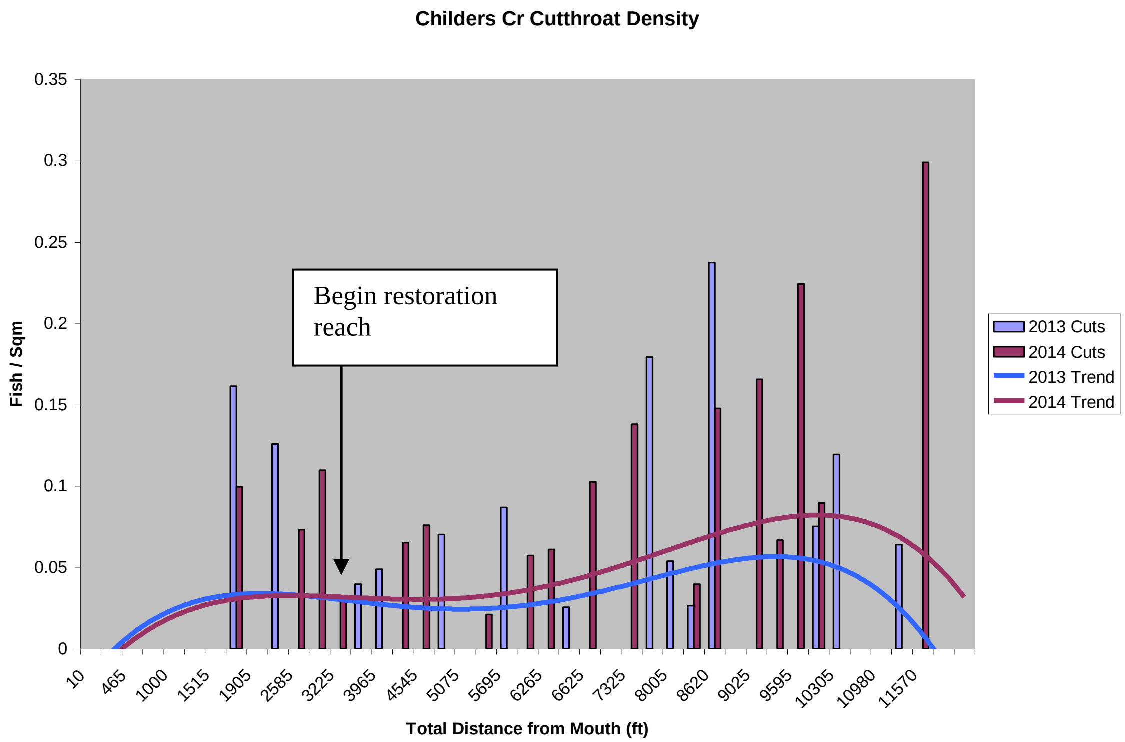
Figure 1



Childers Cr

Figure 2 below exhibits the comparative distribution of cutthroat between pre and post project years. Both years indicate the presence of an upstream temperature dependant migration from the mainstem of Brush Cr. There is also an observed increase in occupancy and abundance in the highest reaches of the inventory on BLM ownership that is likely a response to the increase in roughness and wood complexity associated with restoration actions.

Figure 2



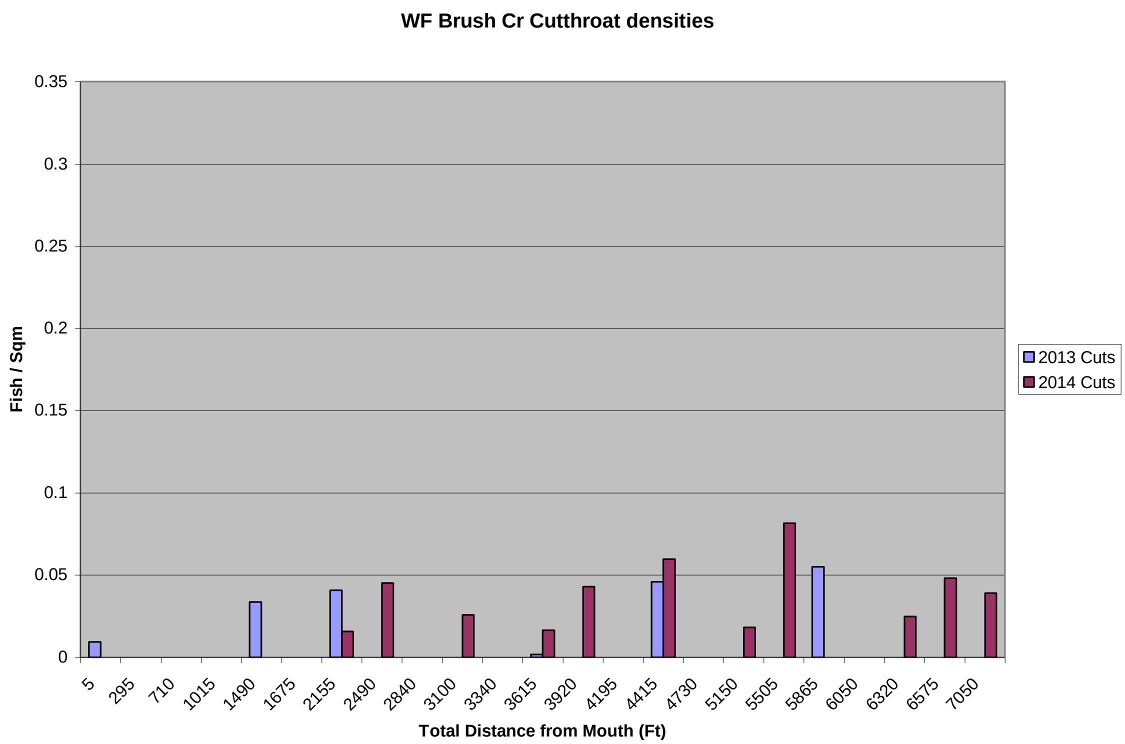
Restoration actions in Childers Cr did not begin until approximately RM 0.6. The trend lines in Figure 2 reflect the interannual changes in average pool density which is heavily influenced by occupancy rates. There is a minor improvement in average pool density between years that is related to more pools being occupied in 2014 (60 %) than in 2013 (33%). This is a trend that suggests the increase in habitat complexity associated with wood placement has improved habitat utilization on the reach scale. It is also interesting that the observed improvements occur in the restored segment of Childers and not the unrestored segment (figure 2).

The absolute number of 1+ and older age cutthroat in Childers Cr declined by 15% between the pre and post project years. This decline could be the result of many sources of variation (changes in aquatic temperature profiles that influence the recruitment of fluvial cutthroat from the mainstem Calapooia, variation in interannual spawning success, etc). It is premature to judge the efficacy of the LWD placement project as it relates to impacts associated with cutthroat abundance. This level of post project evaluation should occur at the 5 year interval as structures mature and develop the characteristics that they were designed to deliver (spawning gravel aggradation, channel braiding, impoundment and deep pool scour). At the 5 year interval, nearly a full cutthroat life cycle has been played out with improvements in survival accumulating for each subsequent year class.

WF Brush Cr

The WF of Brush Cr exhibited a completely different response than observed in Childers Cr. Comparisons between the 2 sampled years exhibit a 150% increase in the abundance of cutthroat (table 1), an increase in pool occupancy rates (26% to 48%) and a doubling in the average pool density (0.01 to 0.02 fish / sqm). Although the distribution pattern of cutthroat observed in figure 3 does not suggest the presence of a temperature dependant migration of cutthroat into WF Brush from the mainstem of Brush Cr, there is a quantifiable increase observed when comparing the pre and post project abundance of cutthroat trout. Temperatures recorded in both WF Brush and Brush Cr were identical (15 deg C) at the time of the survey on August 25, 2014.

Figure 3



Most striking in WF Brush Cr was the complete absence of the 0+ age class of cutthroat in both sampled years which suggests that spawning success remains very low. The observed increase in cutthroat abundance in WF Brush Cr may be the result of multiple factors related to restoration actions (large woody debris placements) and to a change in water management as a result of land owner participation (dam board removal). It is important to note that the primary agricultural landowner on lower WF Brush Cr while partnering to conduct instream restoration, simultaneously altered the timing of dam board installation and removal on 2 formerly impassable irrigation dams within the restored reach. The agreement reached with the CWC was that dam boards would be completely removed from both of the irrigation dams between December 1 and July 1 each year to facilitate open access for spawning migrations of fluvial and anadromous salmonids from the mainstem of Brush Cr or the Calapooia mainstem. Based on cutthroat migration studies done in other Willamette basin tributaries (Beaver Cr, Marys River, Thompson Dam, VanDewetering), fluvial cutthroat spawning migrations can extend between December and June. While it may not be imperative to provide access for the entire fluvial migration window to sustain viability, broad temporal variation maximizes genetic diversity, increasing resilience.

<u>Courtney Cr</u>

A pre-project RBA inventory was conducted on Courtney Cr and its primary unnamed headwater tributary (Trib B) between August 29 and Sept 3, 2014. This inventory was conducted to inform the development and design of an instream restoration project that would potentially span up to 5 river miles including 0.2 miles of Trib B. The timing of the inventory was scheduled to coincide with peak summer temperature profiles to assist in our understanding of how stream temperatures and flow currently limit the abundance of functional summer rearing habitat in the mainstem of Courtney Cr.
It is important to recognize that the start point of the inventory was high in the basin and the result of a preliminary scoping exercise conducted by the CWC to identify the portion of the Courtney Cr subbasin that may retain some level of natural function capable of supporting salmonids (the top aquatic predator utilized as the primary indicator species of system function). The survey began at a bridge crossing on Courtney Cr at road mile 1.0 on Courtney Cr Drive. This point was approximately 17 river miles from the confluence of Courtney Cr with the mainstem Calapooia. This lineal distance includes the streams traverse across almost exclusively low gradient farm land and at least 7.7 miles of Walton and Shedd sloughs. Some of the implications of this lower stream morphology and land use are reviewed in the discussion section.

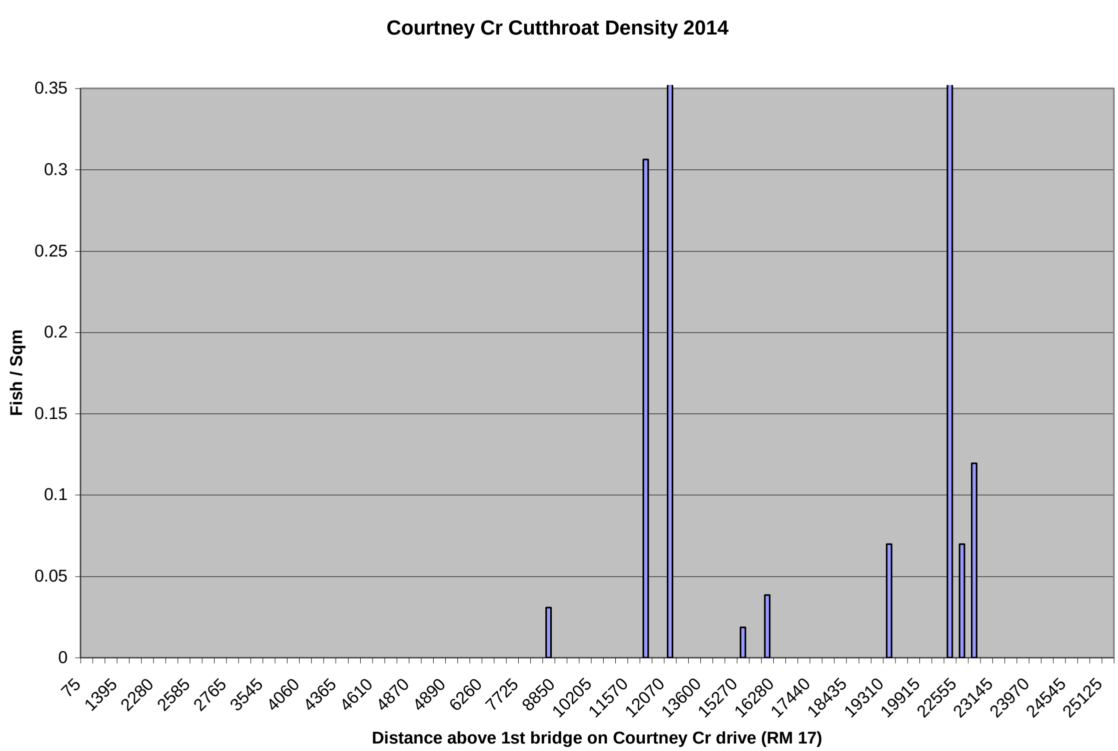
<u>Results</u>

The first 0.9 miles of the inventoried stream segment (which begins at RM 17) encountered only isolated pool habitats with no contiguous surface flow. Some of the isolated pools were as far as 1,000 ft apart separated by only dry stream bed. Figure 4 describes the stark absence of any salmonids in this portion of Courtney Cr. In addition, there were no cutthroat observed for 1.7 miles even though pools became linked 0.9 miles above the start point. Many dead and dying fish of all species (cutthroat, lamprey, red side shiner) were observed in this first 1.7 miles of the inventory. Essentially these habitats were experiencing high mortalities as summer flows subsided, water temperatures soared and DO levels decreased. When the linkage to headwater refugia are terminated, mortalities are significant and non discriminate. Temperatures in this first 1.7 miles were highly variable between 16 and 21 deg C. The variation was associated with the variable pool depths in each of the isolated pools. Deeper pools were accessing a higher percentage of the available hyporheic linkage.

Cutthroat started to be present 1.7 miles above the start point at a point where surface flows relinked isolated pool habitats. At mile 2.2 above the survey start point a cold ground water seep joined a 5 ft deep pool that provided thermal refuge for upstream migrants seeking thermal refuge from warm and nearly isolated habitats downstream. There were a total of 64 cutthroat observed in this pool (92% were 2+ and older adults). 420 feet above this pool was a smaller pool with 28 cutthroat (100% 2+ and older adults). Many of these older age class cutthroat were in the 16 inch range suggesting the presence of a fluvial life history strategy in the subbasin. This suggests that even fluvial cutthroat in the system are being forced out of the lower basin toward headwater thermal refugia during low summer flows suggesting the absence of lower basin thermal refugia (viable ground water seeps from the loss of wetland storage) or the existence of an upper threshold in some water quality parameter being reached in the lower Courtney Cr system. The abnormally high density of older age class cutthroat is a clear indication of a temperature dependant upstream migration from the lower mainstem to thermal refugia in the headwaters. This conclusion is corroborated by the presence of equally high densities of cutthroat below an 8 inch perched culvert at 3.8 miles above the start point (figure 4).

The last observation of significance was the absence of cutthroat in the last ½ mile of the surveyed mainstem. This is an usual pattern of distribution with cutthroat densities usually increasing in headwater reaches as water quality parameters improve (Temperature, DO, etc). The presence of a dense overstory of stream adjacent blackberry has created a condition that deprives the aquatic corridor from solar influence which terminates the potential for primary productivity. In addition, substrates in the reach were clay dominated and providing limited opportunity for algal development or macro invertebrate colonization.

Figure 4



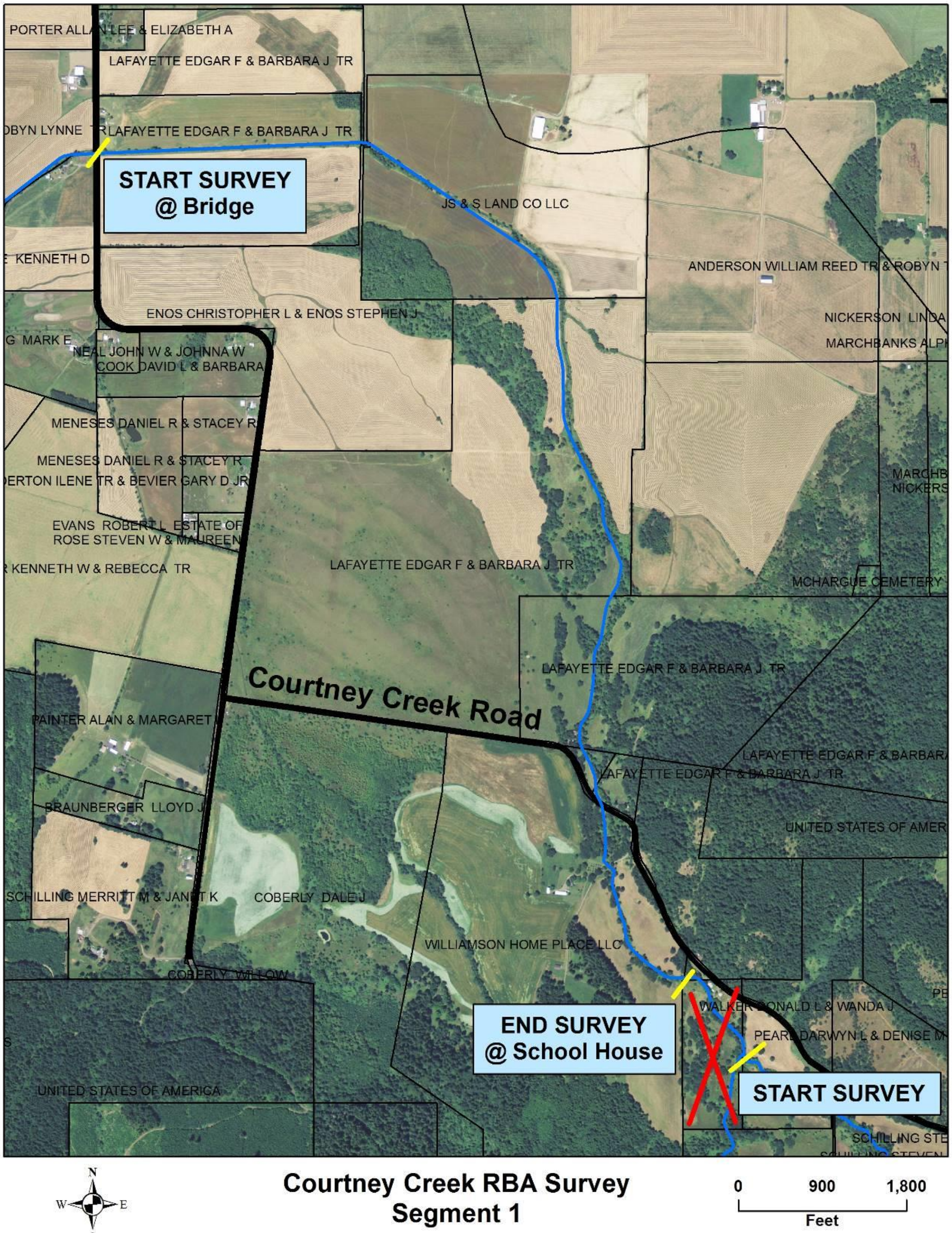
Discussion

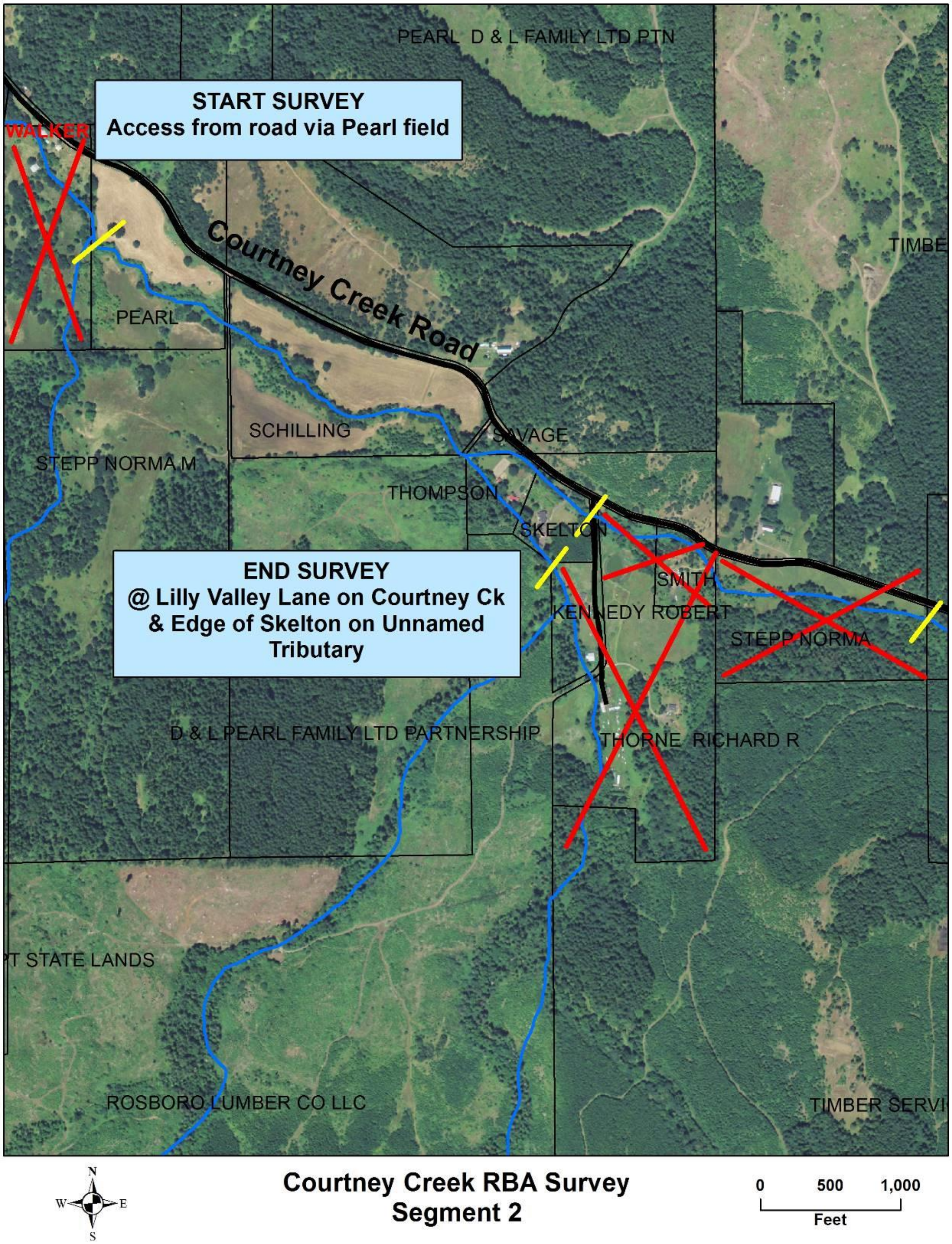
There are basin scale issues that likely influence the observed results that are important to identify. If we assume that Courtney Cr continues to display multiple cutthroat life history strategies (resident and fluvial) then some consideration needs to be given to the concept of seasonal habitat linkage. To review, the fluvial life history dictates that cutthroat (variable age classes) drop out of higher gradient headwater reaches to rear in lower basin stream segments that offer a greater potential for rapid growth (access to a larger and more diverse food base and the opportunity to optimize temperature profiles). These outmigrants must return as adults to headwater reaches for spawning and incubation because of the underlying gradient of the lower reaches that is incapable of sorting viable spawning gravels. This upstream migration requires the basic necessity of contiguous flows that exhibit adequate water quantity and quality for completing the migration between habitats. So very little is known about the timing, range and duration of this fluvial life history that it is impossible for us at this juncture with our limited knowledge base to develop a relationship between the current levels of observed dysfunction and the environmental conditions that create them or exacerbate them. However, it is safe to say that there are multiple issues at play that when combined create catastrophic conditions for the fluvial life history and the linkages between the lower and upper basin that are necessary to maintain viability.

As landowners and organizations move together corporately to restore system function, it is important to have some of these issues at least identified as potential vectors of the observed dysfunction. A short list would include water quantity, water quality and access for unimpeded summer and winter migration. The water quantity issues involve the loss of wetland habitats necessary for seasonal and groundwater storage and excessive agricultural and domestic irrigation during pinch period low summer flows. It is clear from the late August inventory that massive mortalities in the standing crop of cutthroat (both fluvial and resident) are occurring in Courtney Cr associated with some combination of these two issues that is resulting in a completely dry channel that terminates access to critical thermal refuge in the headwaters.

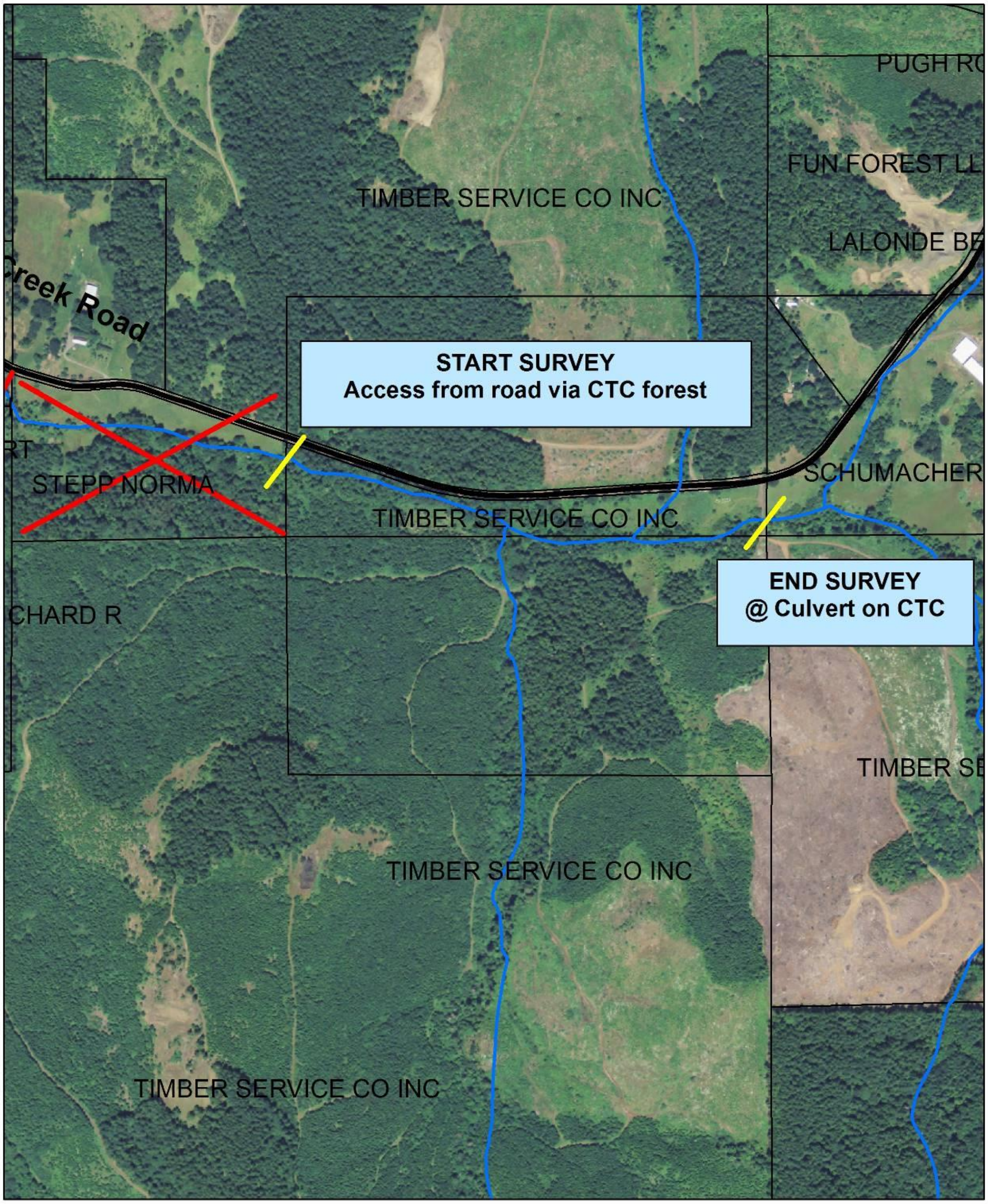
One of the significant observations from the inventory was the differential pool temperatures observed within the isolated pools of the lower 1.7 miles of Courtney above the start point. Deeper pools were accessing a higher percentage of the hyporheic flow sequestered in the accumulated gravel lens providing at least temporary thermal refugia. For this stream segment, log structures should be designed to scour into the existing bedload for the provision of deeper and higher quality thermal refugia. Additional aggradation within this stream segment from the application of full spanning structures would likely exacerbate the current problem. Isolated pools would be less abundant and dry out quicker. Concentrating some effort in the reach upstream of the identified dry channel for the development of off channel wetland restoration to recharge ground water sources would be a high priority restoration objective. In addition, the development of alternate irrigation solutions or the retirement of water rights through the purchase of conservation easements would also be a high priority restoration objective above the observed dry channel reach.

Attachment 1





Courtney Creek RBA Survey
Segment 2



Courtney Creek RBA Survey
Segment 3

0 500 1,000
Feet