# TECHNICAL MEMORANDUM

September 13, 2014

To: Crystal River Ranch Executive Board

From : Lawrence Dominguez, Owner, Sr. Aquatic Ecologist

RE: Vane Monitoring Reference Point and Top of Undisturbed Left and Right Bank Survey, Crystal River Ranch Reach White River, Pierce County, WA

## Summary

This memo documents the second and third part of a three part baseline assessment project that includes 1) shoreline condition assessment and long-term monitoring recommendations, 2) installation of shoreline erosion markers in vane areas to monitor long –term trends in vane-associated erosion, and 3) cross section survey/shoreline demarcation along the White River's Crystal River Ranch (CRR) reach. The main objectives were to geo-reference a baseline bank shoreline location related to standing trees and metal vane stakes for long-term erosion monitoring. On November 1 - 2, 2013 67 trees were tagged as erosion reference markers at the 14 vane sites, one partial channel cross section was surveyed, and field reconnaissance was conducted to determine cross section placement. The location of the undisturbed left bank was marked with GPS.

On April 6, 2014, the location of the undisturbed left bank was marked with GPS. Two cross sections widths were measured but the team determined that an effort to capture shoreline geo-referencing would be the best long-term investment for baseline conditions. Channel cross-sections, for the scope and intent of the project, would not provide extensive points of bank location and the river's high bedload movement would likely yield high year-to-year variation with limited interpretation about how the limited number of cross sections relate to the more important issue of lateral bank erosion. The combination of the GPS surveyed left and right undisturbed top of banks will allow extraction of any number of channel widths estimated from future desktop analyses.

## Sites

The 14 vane sites are located on the western bank of the White River along 0.65 miles of Crystal River Ranch shoreline commons property. Vane 1 is in the northern, downstream end of the project and Vanes 13 and 14 are grouped at the southern upstream end.

Figure 1 shows the general location of vanes.


Figure 1 General locations of vanes 1 -14 on White River's western shoreline. River flow is right to left.

## Method

Based on previous recommendations, a basic, repeatable, and defensible marker placement procedure was used to establish the location of the shoreline edge in relation to 14 vanes on CRR community property. For each location, a standard procedure was used to establish and mark locations of trees that will serve as long term markers for determining the relative location of the top of undisturbed bank. The following are terms used for the marker placement:

**Azimuth**: Magnetic azimuths based on magnetic north ranging from 0° to 360° (Figure 2). All marker locations are referenced from vane heel stakes.

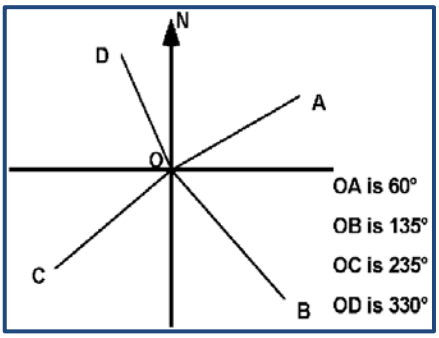


Figure 2 Graphic showing azimuth reading system to locate markers from vane heel stakes.

**Undisturbed bank** – the extent to which the top of the bank has no sign of erosion and maintains horizontal condition (no slumping). There could be some undercut area. In such a case, the extent of undisturbed bank is where the top of bank is horizontal or where the undercut slope is projected to meet the top of bank, whichever projects further towards the steam.

**Vane heel and toe stakes**: Post construction metal stakes which mark buried vane endpoints. The toe stake is closest to the stream and the heel stake is inland.

1) Monitors walked the shoreline area identifying vigorous and undamaged trees that had a high likelihood of standing long-term other than loss due to bank erosion. Other selection factors for trees were conifer, unobstructed line-of-sight from vane-heel stake, distributed throughout segment at varying distances from bank.

2) Sequentially-numbered aluminum tree tags were placed on the trees with aluminum nails that protruded 2-3 inches beyond the outer bark. Tags were placed head-high or above to minimize vandalism and in view from the upland side of the tree.

3) Distance from the vane heel marker was documented with a 300-ft Nylon tape measure or a hand-held laser rangefinder. A florescent 10 in. by 12 in. placard served as a target. In comparing laser rangefinder to tape distances, the rangefinder variance was < 0.3 percent. The rangefinder was determined a reliable device in unobstructed views.

4) Each tree marked was assigned the following metrics: a numbered tag, the distance from the undisturbed bank to the nearest outer bark at breast height, the distance from the vane heel marker to the nearest outer bark at breast height, magnetic azimuth from the vane heel marker.

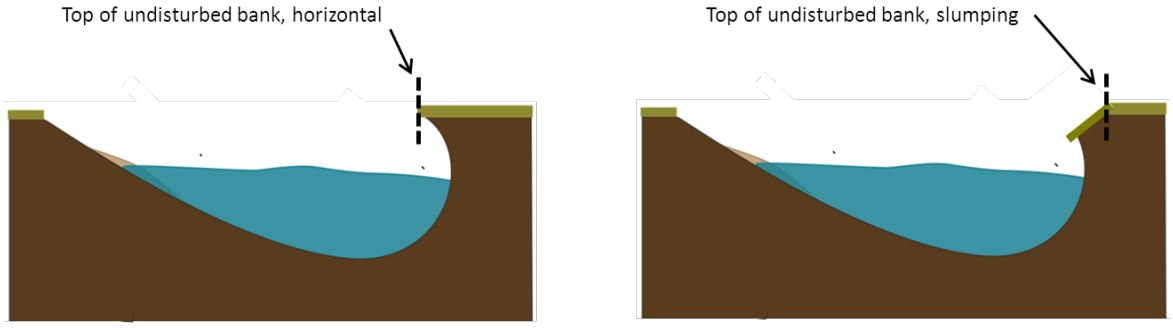


Figure 3 Determining top of undisturbed bank. The left figure indicates the location to measure if the top of bank represents the undisturbed top of bank elevation even if there is some undercut. The right image indictes the undisturbed top of bank location if the top of bank is slumping.

**Results and Discussion**

A total of 57 markers and vane toe stakes were referenced. Marker locational data are included as an attachment. The summary of markers is as follows:

| Vane no. | Markers used | Distance between toe and heel stakes (ft.) | Azimuth from heel to toe stake (degrees) |
|---|---|---|---|
| 1 | 401, 402, 404, 405, 407, 408 | Not available | Not available |
| 2 | 409, 410, 411, 412, 413, 414, 415, 416 | Not available | Not available |
| 3 | 417, 418, 419, 420 | Not available | Not available |
| 4 | 421, 422, 423, 424, 425, 426 | 121.8 | 320 |
| 5 | 427, 428, 429, 430 | Not available | Not available |
| 6 | 431, 432, 433 | 75 | |
| 7 | 434, 435, 436 | 73.5 | 105 |
| 8 | 437, 438, 439, 440 | 61.8 | 98 |
| 9 | 441, 442, 443 | 75 | 95 |
| 10 | 444, 445, 446 | 73.4 | 80 |
| 11 | 447, 448 | 129 | 86 |
| 12 | 449, 450, 451 | 73.5 | 107 |
| 13 | 452, 453, 454, 455, | 56.4 | 117 |
| 14 | 454, 456, 457, 458 | 90.2 | 131 |

Universal Trans Mercatur (UTM) units using North Latitude and Longitude Zone 10 were recorded along the total top of undisturbed bank. The readings were recorded with sub-3 meter accuracy using a Garmin GPX 60CSx. The segment created by a multi-point coverage represents the top of undisturbed bank, essentially a shoreline delineation at the top of bank. See the attached map. The shoreline map was created in lieu of some cross sections because in the long term it is most concerning for landowners on both sides of the river to observe changes in channel margin locations than in variation in in-channel bathymetry/topography. Indeed the elevation changes in the substrate give an indication where deposition and scour is occurring, but

useful channel cross-sections called for in modeling or more complex risk analysis would entail a more extensive cross-section surveys beyond the scope of this project.

**Materials Provided**

This final project summary provides:

- Establish measurement grid and record data for each vane site including marker trees with metal tags. Vane toe and heel geo-referenced.
- Identified and mapped top of left and right bank in lieu of collecting 3 or more channel cross sections across the White River.
- Appendix C, page 27, of the previously submitted Crystal River Ranch Baseline Assessment Nov 2012 contains an outline of a complete report.
- Shoreline Map with raw data file
- Reference markers to top of bank measurement geo-referenced with GPS coordinates

**Summary of vane markers**

All azimuths and distances taken from vane heel unless noted. Aluminum markers placed on trees between 4 and 6' height.

| Vane | Tree/mark | Description | Distance to Undisturbed Top of bank (ft) | Distance from Vane heel (ft) | azimuth from heel peg (degrees) |
|---|---|---|---|---|---|
| 1 | 401 | fir | 7 | 131 | 239 |
| 1 | 402 | | | 139 | 236 |
| | 404 | cottonwood | 13 | 192 | 248 |
| 1 | 405 | lg central tree | | 52.8 | |
| 1 | 407 | small bench | 3.0 | 93 | 199 |
| 1 | 408 | snag | 0 | 151.5 | |
| 2 | 409 | | 3.5 | 93.9 | 195 |
| 2 | 410 | | 11.5 | 80.5 | 203 |
| 2 | 411 | | 4 | 82.5 | 217 |
| 2 | 412 | | 19.5 | 63.3 | 224 |
| 2 | 413 | | 3 | 83.8 | 243 |
| 2 | 414 | | 50.5 | 97.5 | 293 |
| 2 | 415 | | 6 | 132.0 | 275 |
| 2 | 416 | | 11 | 52.5 | 283 |
| 2 | toe peg | | 2.0 | | |
| 3 | 417 | | 5 | 75 | 243 |
| 3 | 418 | | 7.85 | 93 | 252 |
| 3 | 419 | | 5 | 105 | 256 |
| 3 | 420 | | 5.75 | 138 | 265 |
| 3 | toe peg | | 1.5 | | |
| 4 | 421 | ctnwd | 27.3 | 64.6 | 335 |
| 4 | 422 | ctnwd | 7.6 | 74.1 | 346 |
| 4 | 423 | ctnwd | 6.5 | 59.7 | 5 |
| 4 | 424 | fir | 27 | 45.5 | 70 |
| 4 | 425 | ctnwd | 4.5 | 59.8 | 47 |
| 4 | 426 | fir | 8 | 23.4 (distance from toe) | 320 |
| 4 | toe peg | | 7.5 | 121.8 | |
| 5 | 427 | | 7.5 | 73.5 | 77 |
| 5 | 428 | | 10.5 | 69 | 112 |
| 5 | 429 | | 18 | 69 | 121 |
| 5 | 430 | | 8.1 | 98.9 | 131 |
| 5 | toe peg | | 7.0 | | |
| 6 | 431 | | 3.75 | 60 | 65 |
| 6 | 432 | | 8.45 | 60 | 81 |
| 6 | 433 | | 13.4 | 100.5 | 122 |
| 6 | toe peg | | 6 | 75 | 102 |
| 7 | 434 | | 30.0 | 23.4 | 28 |

| | | | | | |
|---|---|---|---|---|---|
| 7 | 435 | gray pvc stake by new, small tree | 9.8 | 42 | 83 |
| 7 | 436 | Nahume property, fir at fenceline | 27 | 69 | 131 |
| 7 | toe peg | | 0 | 73.5 | 105 |
| 8 | 437 | | 6.5 | 55.5 | 75 |
| 8 | 438 | | 13.2 | 49.5 | 75 |
| 8 | 439 | | 40.5 | 42 | 126 |
| 8 | 440 | | 6.75 | 78 | 106 |
| 8 | toe peg | | | 61.8 | 98 |
| 9 | 441 | | 2 | 76.5 | 87 |
| 9 | 442 | | 5 | 87 | 101 |
| 9 | 443 | | 54 | 43.5 | 126 |
| 9 | toe peg | | 10.45 | 75 | 95 |
| 10 | 444 | | 20.25 | 29.7 | 31 |
| 10 | 445 | | 2 | 73.5 | 74 |
| 10 | 446 | | 3.5 | 58.5 | 101 |
| 10 | toe peg | | 8 | 73.4 | 80 |
| 11 | 447 | alder | 6.5 | 108 | 76 |
| 11 | 448 | | 14.65 | 141 | 91 |
| 11 | toe peg | | 12 | 129 | 86 |
| 12 | 449 | | 4.5 | 51 | 28 |
| 12 | 450 | | 4.3 | 57 | 82 |
| 12 | 451 | | 14 | 77.5 | 107 |
| 12 | toe peg | | 0 | 73.5 | 107 |
| 13 | 452 | alder | 36 | 43.5 | 0 |
| 13 | 453 | alder | 4.4 | 36 | 64 |
| 13 | 454 | common to vane 14 | 0 | 70.5 | 117 |
| 13 | 455 | | 37.8 | 30.2 | 150 |
| 13 | toe peg | | 5.55 | 56.4 | 117 |
| 14 | 454 | common to vane 13 | 0 | 50.8 | 25 |
| 14 | 456 | | 0 | 94.5 | 125 |
| 14 | 457 | | 8.15 | 85.5 | 140 |
| 14 | 458 | | 26.5 | 67.5 | 145 |
| 14 | toe peg | | 4 | 90.2 | 131 |


**EcoAssets**
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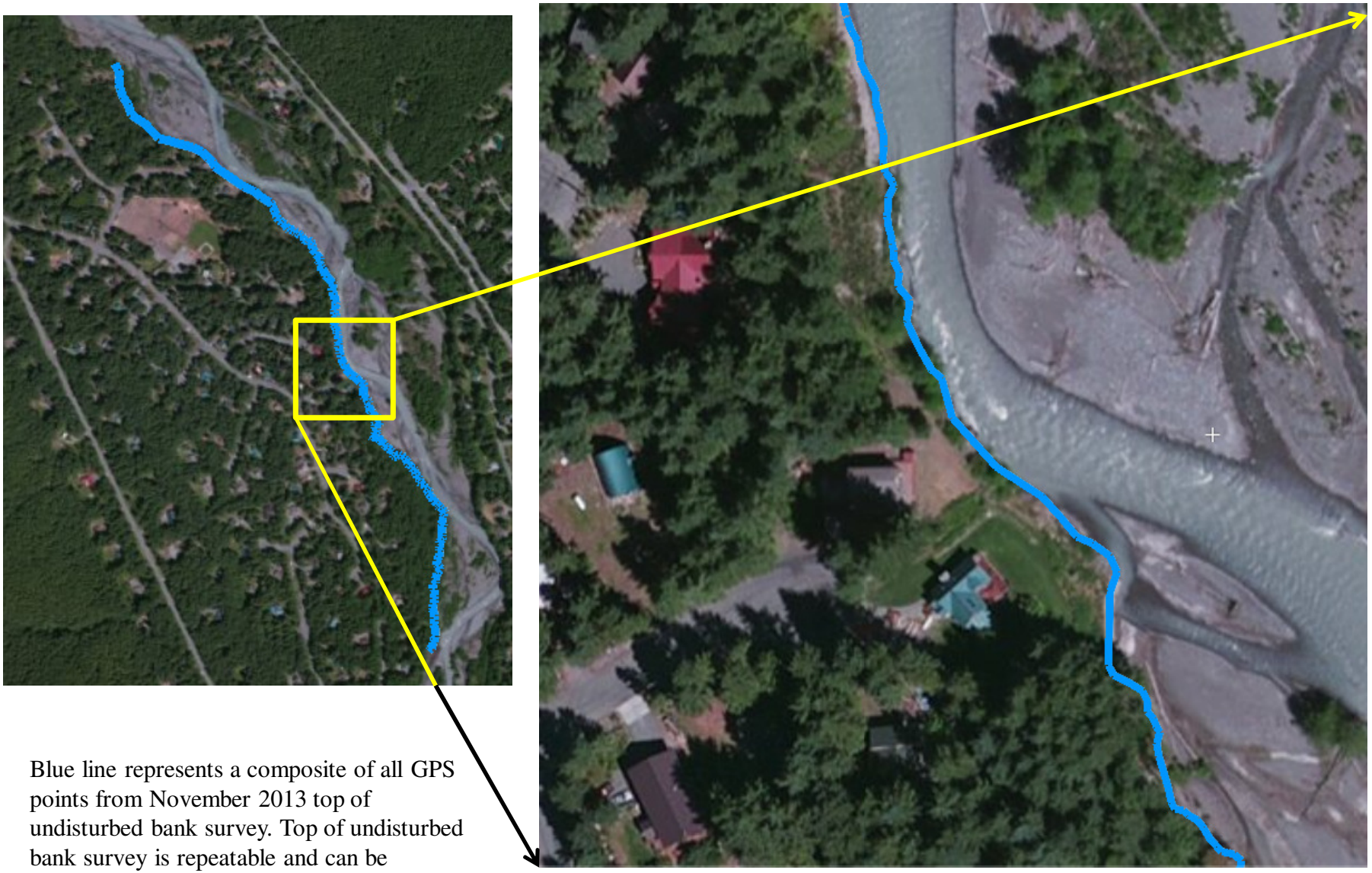
***360.915.4194 Olympia, WA***

**Top of Undisturbed Bank based on Waypoint and Tracks Nov 2013 and Apr 2014**
White River, Pierce Co., WA
*(Locations approximate based on GPS coordinates and remote imagery )*



Blue line represents a composite of all GPS points from November 2013 top of undisturbed bank survey. Top of undisturbed bank survey is repeatable and can be compared over time to estimate the erosion rate.