

**Oregon Department of Agriculture  
2008 Landscape Monitoring of the  
Coos & Coquille, Upper and North Fork John Day, Mid-Coast,  
Mid-Deschutes, North Coast, and Yamhill Basins  
First Replication of 2003 Monitoring**

## **Introduction**

This report presents the results of the Oregon Department of Agriculture's (ODA) riparian condition monitoring of six basins in the state. The objective of this project was to provide visual data for establishing trends in riparian landscape condition. This project is a continuation of our previously developed methods for landscape condition monitoring as discussed in other ODA reports. This report discusses the first replication of landscape condition monitoring, as the basins photographed in 2008 were previously photographed in 2003.

Use of remotely-sensed imagery allows us to assess the condition of large areas without requiring as much labor as with a ground-based effort. In addition, using GIS-compatible imagery allows for direct comparison of the same locations to identify long-term trends.

This report documents our findings and conclusions from the monitoring project. Information on the methods applied can be reviewed in the ODA documents "Riparian Condition Monitoring of the Clackamas, Hood River, Lower Deschutes, Lower Willamette, Molalla/Pudding, and Wallowa Basins" dated February 2005 and "Assessment and Monitoring of Riparian Conditions Using Remote Sensing and GIS Applications" dated April 2005.

Aerial photographs were taken in late May through early June 2008. Ground truthing was done in late May and early June 2008.

## **Interpretation and Analysis**

As mentioned above, 2008 was the first year where we re-photographed basins that had previously been monitored. This enables us to track changes in landscape cover over time. The 2008 aerial photographs were compared to the 2003 photographs by overlaying the cover codes from 2003 onto the 2008 images. This was possible because orthorectification of the imagery typically had an error of less than 15 feet. Some imagery was found to have areas with larger orthorectification errors, and these are noted in the discussions of the individual streams later in this document.

Cover codes for each band were reported on tables for each riparian band (e.g. 30-foot left, 30-foot right, etc.) and expressed both as a quantity and as a percentage of the total for each band. The cumulative percentage of cover type was then calculated, and the change in cumulative percent from 2003 to 2008 was calculated by subtraction. This was a way for us to see reach-wide changes in land cover. In addition, riparian index scores were generated by changing the

cover codes into numeric values. This method makes it easier to spot gross changes in landscape cover from one round of monitoring to another.

Streams with significant changes in their riparian index scores (i.e. a change in one or more) were assessed closely to try to identify the reasons for the change, besides just looking at the change in cumulative percent land cover type. Most of the streams monitored did not have significant changes in their riparian index scores.

The air photos were evaluated by assigning a code to each dot within the six bands along the stream. The codes were added to an attribute table attached to each photo, and later written to an Excel spreadsheet associated with each stream mosaic. Codes applied to the dots consisted of:

- T: Tree
- S: Shrub/brush
- G: Grass
- B: Bare
- W: Water
- I: Infrastructure
- U: Unknown

The modifier A was added to the end of each code when the dot fell within an area of agricultural activity (e.g. GA for grass in a pasture, SA for a blueberry field). Though the photos examined covered agricultural land, this modifier was needed to distinguish between areas where currently active agricultural activities were evident, versus areas where no active agricultural management was apparent.

Category T consists of all vegetation with a distinct canopy or branching structure. Category S is used for clumped or bunch-like vegetation that has indistinct canopies. Category G is used for all green-colored vegetation that has a carpet-like appearance. Bare ground was indicated by non-green patches that were at least 30% white, gray, or brown and did not contain infrastructure. Water was indicated by dark blue or black colors that were not the result of shade, and are in a location where water would be (i.e. not on top of a tree). Roads and infrastructure were indicated by visual recognition. Specific types of infrastructure include, but are not limited to the following:

- Roads, buildings, corrals, bridges, utilities, tanks, vehicles, irrigation conveyances, waste storage, equipment, quarries, improved surfaces, cemeteries, and park structures.

The riparian index scores are intended to be a numeric system to track changes in landscape cover; they do not always demonstrate which sites are “better” than others. Ideally, the riparian index scores will be compared to a measure of site capability to compare what could be growing at a site with what was observed growing. Because of this, there is a potential to have riparian index scores higher than they should be, especially in cases where juniper trees have encroached on a stream, or when people plant non-native trees.

For some streams, we did not photograph the entire reach in 2008 that was covered in 2003. This was done intentionally for two reasons. First of all, 2003 was the first year of landscape monitoring, and we found that, among other things:

- 1) Not all the area originally photographed could be considered in agricultural use, despite having been described as agricultural land in the GIS database we originally used to pick appropriate stream reaches for monitoring, and;
- 2) Very long (e.g. greater than about five mile) reaches of stream did not necessarily show much variation in land use, at least in the coastal basins.

As expected, not covering the entire reach in 2008 did affect the riparian index scores and landscape cover percentages for some of the streams. These affects are noted in the discussion of the individual streams. There was also a difference in image processing between 2003 and 2008. In 2003, our air photo supplier (then known as Embedded Systems Research (ESR), now known as Eagle Digital Images (Eagle)), used an overlay, or mosaic method to produce a single digital file of a stream reach. However, this sometimes led to very large files with many images overlaid, and this sometimes caused problems with viewing the photos within our GIS system. In 2004, Eagle began edge-matching photographs together to create a single file covering an entire reach, thus solving the problem of file size and occasional distortion of the image. This change also may have led to changes in how we interpreted some landscape cover.

Tables of the cover categories for each stream are included in this document following discussion of basin-specific conditions. These tables show the percentage of each category for each band as a cumulative percent. Tables showing the difference in cumulative percent cover between 2003 and 2008 are also included in the basin-specific discussions, along with the different riparian index scores. There is also a discussion of streams monitored in 2008 that were not monitored in 2003.

### **Coos & Coquille Basin**

Five streams in this basin were monitored in 2003. Four of these – Bear Creek, Catching Creek, Palouse Creek, and Twomile Creek – were also monitored in 2008. The South Fork Coquille River was photographed both years, but the air photos from 2003 were not analyzed because the file size was too large for our GIS system to process smoothly. In 2003, we also monitored Middle Creek, but results of the image analysis showed that very little of this stream could be considered agricultural land, so it was not monitored in 2008.

All four of the streams in this basin had significant changes in their riparian index scores from 2003 to 2008. Bear and Catching creeks had increased scores, while Palouse and Twomile creeks had decreases in their scores.

<b>Riparian Index Score</b>		
	<b>2003</b>	<b>2008</b>
<b>Bear Creek</b>	33.49	36.72
<b>Catching Creek</b>	36.25	41.1
<b>Palouse Creek</b>	46.12	43.13
<b>Twomile Creek</b>	46.34	44.5

Visual assessment of the 2003 and 2008 Bear Creek air photos showed that many areas had noticeably denser vegetation within 90 feet of the stream bank. Some areas that were cultivated to the edge of the channel in 2003 (about 1,500 feet of channel) showed established riparian buffers in 2008. Other areas observed appeared to have improved pasture conditions.

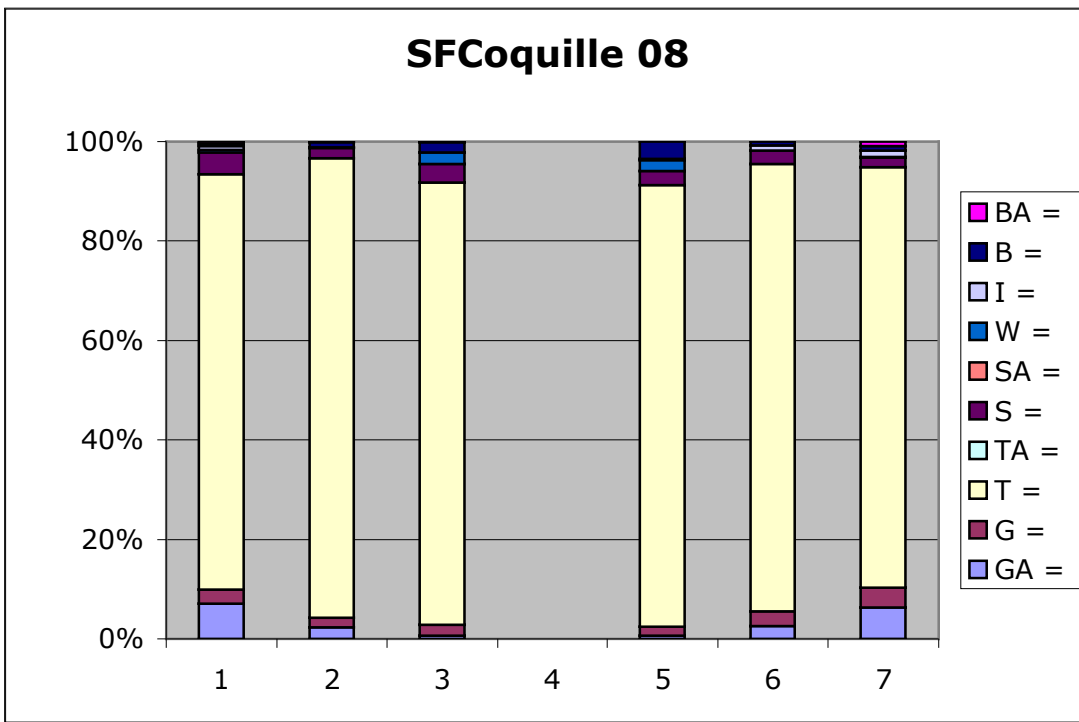
Improved pasture conditions were also visible along Catching Creek. This stream had a noticeable increase in tree density where the cumulative percent increase was about 63% (averaging 10% per band). Some areas within 90 feet of the streambank were also flooded in 2003 and not in 2008, resulting in more visible riparian vegetation.

Palouse and Twomile creeks had reduced riparian index scores for very different reasons. Palouse Creek had been dredged shortly before the 2003 air photos were taken, and the dredge spoils were left alongside the stream, effectively producing a levy. According to Department of State Lands staff, the dredging was a permitted activity, and the permittee was required to spread out the spoil pile after it dried. However, the 2008 ground truthing found that the spoil pile was still in place. This reduces the ability of the area to produce suitable riparian vegetation. Twomile Creek actually had an area of about 1,800 feet of disturbed ground along one bank of the stream in 2003 that subsequently was found well vegetated in 2008 (resulting in a 23% cumulative reduction in bare ground), however, the overall riparian index score decreased because tree density decreased by about 29% (cumulatively). Part of this was because the upper 100 feet of stream was not photographed in 2008.

The 2008 South Fork Coquille monitoring site had a riparian index score of 66.3. All bands of riparian landscape cover were dominated by trees, with percentages ranging from 83 to 92. Bare agriculture cover was 1% or less in each band. A graph and table of the landscape cover for this stream is shown below.

PERCENTAGES

GA =	7.10	2.33	0.58	0.67	2.54	6.30
G =	2.73	1.98	2.19	1.79	3.00	4.01
T =	83.17	92.21	88.58	88.17	89.73	84.19
TA =	0.00	0.00	0.00	0.00	0.00	0.00
S =	4.34	2.09	3.69	2.79	2.76	1.93
SA =	0.00	0.00	0.00	0.00	0.00	0.11
W =	0.50	0.10	2.30	2.13	0.00	0.00
I =	0.79	0.00	0.00	0.30	1.04	1.24
B =	0.49	1.04	2.08	3.44	0.73	0.93
BA =	0.40	0.10	0.10	0.00	0.00	0.93



On the x-axis of this graph the stream would be located at 4, and the numbers to the right and left of 4 represent the three bands on either side of the stream.

## Upper and North Fork John Day Basin

Five streams were monitored in this basin in 2003 and 2008. In 2003, we relied on digital aerial photographs contracted by the U.S. Bureau of Land Management. These did not have as good a resolution as the ones obtained by ESR/Eagle, but they were available at no cost to us. Using these images in 2003 enabled us to cover more basins in the first year of this project.

All five of the streams monitored showed significant differences in riparian index scores from 2003 to 2008. Fox and Long Creek's scores increased, but the scores for Camas, Rock, and Strawberry Creek decreased. The increase in score for Fox Creek was due to an increase in shrub and tree growth. This may have resulted from wetter conditions after 2003, because the other streams monitored in this basin all showed indications of increased flow. The increase in Long Creek's score was due to increased grass cover, also due to wetter conditions. AGRIMET weather station data for 2003-2008 showed six inches of precipitation more than the period 1998-2003.

On Camas Creek, there was a loss of tree cover due to channel migration. A cumulative 52% loss of trees occurred because the channel widened in many places, and because the 2008 photo extended farther east than the 2003 photo. The same thing occurred at Strawberry Creek, where many dead trees were visible in the 2008 photograph, and some sections of the active stream channel had widened by 100%. In addition, some of the channel meanders had been abandoned, and other sections of the stream were anastomosing (creating more than one active channel). The reduction in Rock Creek's score was due to orthorectification errors on the BLM's 2003 photographs. These did not 'line-up' well with our 2008 photos, so the same locations within the stream reach were not being monitored.

<b>Riparian Index Scores</b>		
<b>John Day</b>	<b>2003</b>	<b>2008</b>
<b>Camas Creek</b>	42.95	40.74
<b>Fox Creek</b>	50.11	55.35
<b>Long Creek</b>	31.89	34.81
<b>Rock Creek</b>	54.87	46.99
<b>Strawberry Creek</b>	58.08	52.64

## Mid-Coast Basin

Four streams that were monitored in 2003 were also monitored in 2008 in this basin. Three additional streams were originally monitored in 2003 but were not re-done in 2008 because we determined that we had a large enough sample size of streams in this basin. However, we did add another stream in 2008 – the North Fork Siuslaw – as a replacement for the mainstem Siuslaw done in 2003. This change was made because we decided the North Fork Siuslaw was more representative of agricultural use than the mainstem.

Of the four streams monitored both in 2003 and 2008, two had no significant change in their riparian index scores, while the other two had a significant decrease.

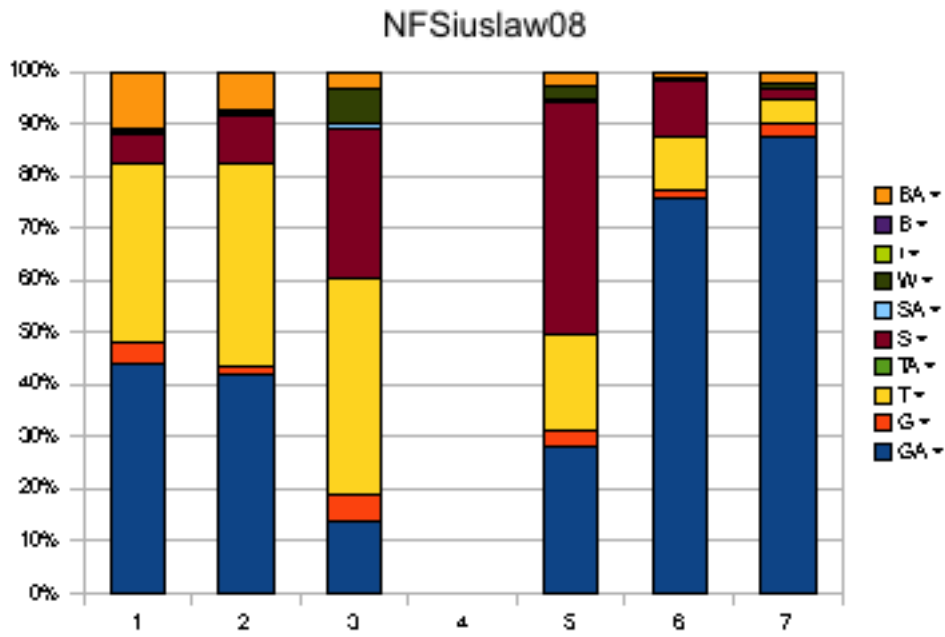
<b>Mid-Coast Basin</b>		
	<b>2003</b>	<b>2008</b>
<b>Bummer Creek</b>	54.69	54.25
<b>Deadwood Creek</b>	62.64	58.75
<b>Elk Creek</b>	65.43	61.5
<b>Indian Creek</b>	62.95	62.17

However, after extensive review of the air photos, both 2003 and 2008 versions, it appears that the differences in riparian scores for Deadwood and Elk Creek were due to interpretation errors in 2003. As mentioned previously, 2003 was the first year of this project, and ODA staff were not yet proficient in identifying all landscape features. Also at that time, three staff members were doing interpretations independently. Testing of observer agreement on one stream in 2003 showed that the three staff agreed on interpretations 80% of the time. Examination of the landscape cover data from 2003 to 2008 suggests that all streams had a reduction in tree cover, but detailed examination of the photos side-by-side does not bear this out. It appears instead that many shadowed areas were interpreted as being tree cover in 2003, when the 2008 photos had better lighting conditions showing the presence of other landscape features. Overall, there did not appear to be an appreciable change in landscape cover from 2003 to 2008.

The North Fork Siuslaw had the lowest riparian index score of all the streams monitored in 2008 of 43.01. This is mostly due to the low percentage of trees on the right bank where no more than 16% of any band were trees. Bare agricultural cover ranged from 1 to 9.6%.

PERCENTAGES

GA =	38.58	35.89	12.23	24.85	62.88	76.9
G =	3.4	1.53	4.28	3.03	1.23	2.13
T =	30.25	33.13	36.39	16.36	8.59	3.95
TA =	0	0	0	0	0	0
S =	4.94	8.28	24.77	39.39	8.9	2.13
SA =	0.62	0.31	1.22	0.61	0	0
W =	0	0.31	5.5	2.12	0	0.61
I =	0	0	0	0	0	0
B =	0.31	0	0.31	0	0.31	0.3
BA =	9.57	6.44	2.75	2.42	1.23	1.82



## Mid-Deschutes Basin

Six streams were monitored in this basin that were also monitored in 2003. Two had significant changes in riparian index scores. As with the John Day Basin, conditions appeared to be wetter in 2008 compared to 2003. This was especially evident in the photos of Amity, Indian, and Willow creeks.

<b>Mid-Deschutes</b>		
	<b>2003</b>	<b>2008</b>
<b>Amity Creek</b>	35.69	37.26
<b>Antelope Crk.</b>	29.38	29.86
<b>Indian Creek</b>	42.26	39.5
<b>Pony Creek</b>	35.12	35.72
<b>Trout Creek</b>	35.19	35.38
<b>Willow Creek</b>	37.41	37.35

Amity Creek showed evidence of lateral channel migration between 2003 and 2008. In some areas, the channel was measured as having moved 15 feet; one meander showed 75 feet of displacement. A delta bar at the mouth of the stream was measured as being 12 feet longer than in 2003, and some other lateral bars in the stream had also increased in size. This indicates a large amount of sediment transport in the stream. Amity also had an increase in shrub and tree growth, and a decrease in bare land and bare/agricultural land. These factors – high sediment loads, reduced bare ground, and increased vegetation – may indicate past erosion problems that are now healing. The high sediment loads may be the result of material eroded years ago working through the stream channel.

Antelope Creek landscape cover consists of 84% grass and grass/agriculture. This number declined slightly from 2003, but not enough to significantly change its riparian index score.

Even though Indian Creek had a lowered riparian score in 2008 compared to 2003, this appeared to be due to re-classification of grass to grass/agriculture. The 2008 photos showed a larger area being grazed, possibly because of wetter conditions.

Both Trout and Pony Creeks had very little change in landscape cover and no significant change in their riparian index scores. Willow Creek also had no significant change in its score, though the landscape cover data showed a large loss of trees. This appeared to be the result of flooding or some other natural disturbance, because one large grove of trees was observed in the 2008 photos to be dead, standing snags and fallen logs. These trees appeared intact in the 2003 photos.

The riparian score didn't change appreciatively because of a decrease in bare/agricultural cover, and increases in grass/agriculture and shrub cover.

### **North Coast Basin**

Five streams were monitored in this basin that were originally monitored in 2003. Of these, only the Kilchis River showed a significant difference in riparian score.

	<b>North Coast</b>	
	<b>2003</b>	<b>2008</b>
<b>Miami River</b>	49.37	49.53
<b>Lewis &amp; Clark</b>	52.88	52.97
<b>Kilchis River</b>	54.62	52.33
<b>Nehalem R.</b>	54.52	54.06
<b>NF Nehalem</b>	48.48	47.87

This difference was most likely due to the 2008 photos covering less of the stream than in 2003. The change in landscape cover showed an increase in grass/agriculture and a loss of bare/agriculture and trees.

A few of the other streams had significant changes in land cover types. The North Fork Nehalem had a cumulative 21% increase in grass plus grass/agriculture, a 45% decrease in trees, and a 21% increase in shrubs. The Miami had a cumulative 34% reduction in infrastructure, due to the removal of some dirt roads.

## Yamhill Basin

Six streams were monitored in this basin in 2003 and 2008. The riparian index scores for these streams were very consistent from 2003 to 2008.

Yamhill Basin		
	2003	2008
Berry Creek	46.18	46.12
Dupee Creek	53.81	52.02
Millican Creek	65.5	64.71
Panther Creek	54.64	54.51
Springbrook Creek	61.78	59.01
Turner Creek	63.3	63.28

Springbrook Creek had the largest change in riparian index score and this was probably because of urban development encroaching on the stream corridor. Urban development led to a loss of tree cover and an increase in grass cover. The other streams did not have significant changes in land cover elements.

## Discussion and Conclusion

Overall, this project showed that riparian landscape cover trends could be monitored using the methods described in this report. Though some problems with image replication were encountered, many of these problems should be rectified by the improved air photo processing methods developed by the contractor after 2003. In some of the photos discussed above, weather patterns affected the landscape cover. Though this should have been obvious, we didn't expect to see this much difference in landscape cover due to weather conditions. This could be an important factor in other basins where large flow events and/or flooding were visible in the photos.

Validation of this methodology comes from having most stream reaches with about the same landscape cover in 2003 and 2008. This is especially evident in the Yamhill Basin. The riparian index scores for those streams were relatively high in 2003, so we didn't expect to see much change. Only Springbrook Creek, where conversion of farmland to suburbs had occurred, showed a significant change.

A site capability analysis project is planned for summer of 2010 of the Middle Deschutes Basin. This will be a pilot scale project to assess the types and amount of riparian vegetation that the stream reaches are capable of producing. After this project is completed, the site capability will be compared to the landscape cover identified in the 2008 air photos. This should enable us to calculate the 'expected' riparian index score for comparison to the measured score.