Coyote Gulch Erosion Assessment Using WEPP
September 2014

Cover Photo: Coyote Gulch watershed in Google earth with WEPP Flowpath overlay

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**INTRODUCTION**

The lower canyon tributaries on the Clearwater River near Lewiston, Idaho (figure 1) have recently been analyzed for conservation efforts to improve water quality and salmon steelhead production. Part of these analyses include sediment yield from each watershed that contributes to the geographic region.

Erosion is analyzed within the watersheds for comparative purposes between subcatchments, soil types, and land uses in each watershed by using the Water Erosion Prediction Project (WEPP). WEPP is a watershed model originally intended for use on field-size areas and conservation treatment units and is applicable to concentrated flow and cropland ephemeral gullies in range and forest land applications (Ascough et al, 1997). Most of the drainages located within the watersheds in the lower canyon tributaries on the Clearwater River contain concentrated flow and cropland ephemeral gullies which applicable for use with the WEPP model and will be effective to determine erosion for comparative purposes.

However, the lower canyon tributaries watersheds may include watersheds that are larger than suggested WEPP applicable watershed sizes and may have head cut erosion, sloughing of gully sidewalls, seepage effects, perennial stream channels, and partial area hydrology or baseflow which may make them less applicable to WEPP use (Ascough et al, 1997). Therefore, further analysis of stream conditions and HEC models may be necessary if accurate and detailed sediment production is needed for design models beyond basic comparisons (Ascough et al, 1997).

Coyote Gulch watershed is located within the lower canyon tributaries geographic area (Figure 1) and is analyzed within this report to be compiled with data collected from other lower canyon tributaries watersheds.

![Figure 1. Lower canyon tributaries geographic area.](image-url)
METHODS

SITE DESCRIPTION
The erosion inventory using WEPP for Coyote Gulch watershed is located in central Idaho slightly east of the intersection of Highway 9 and Highway 12 east of Lewiston. The watershed is approximately 1,890 acres and is used predominately for cultivated crops and grassland; however, there is also some evergreen forest within the watershed. At least half of the watershed is comprised of Lickskillet-Alpowa-Rock outcrop complex on high slopes with Pathouse Athena complex on lower slopes. Refer to the Lower Canyon Tributary Atlas for more information on watershed described within this report (Rasmussen, et al. 2014). Data from this report are to be used in the Lower Canyon Tributaries Inventory and Assessment Report.

DATA COLLECTION
Data were collected for this project from the Online version on WEPP watershed (WEPP Watershed, Online GIS Interface). Directions for the use of the website can be found in instructions provided on the website (Frankenburger, 2013). Due to the small size of the watershed, one watershed delineation was necessary to complete the WEPP model run. The critical catchment size was designated as 4 ha (10 acres) and the minimum source channel length was designated as 60 m (197 ft.). The outlet of the watershed was chosen at -116.838714˚:46.446516˚. Appendix A lists the information of the saved project to upload on to the WEPP Database.

The WEPP model was run for a 2 year watershed and flowpath simulation with climate adjustments using PRISM data from Cligen 5.3 using the closest climate station to the watershed. Land cover and soils were processed by individual grid cells with a soil loss tolerance of 5. It was assumed that there were no impoundments within the watershed as none were added. Data were then compiled and summed across watersheds. Any results that included channel erosion returned by WEPP were not used as currently channel beds are assumed to be sand, therefore, the channel erosion returns large unrealistic values of erosion, therefore, only flowpath and hillslope erosion are reported (Elliott 2014).

RESULTS
Overall, 1,890 acres were analyzed by WEPP online which make up 100% of the watershed. It is estimated that approximately 2% of the precipitation within the watershed becomes runoff (watershed discharge) (table 1). The most erosion within the watershed occurred on lands with cultivated crops which yielded 99% of the erosion in the watershed with very little sediment delivered from grasslands and forest which produced 1% of erosion within the watershed (table 2). Approximately 28% of erosion occurred on the Lickskillet-Alpowa-rock outcrop complex on high slopes and 36% of erosion occurred on Palouse-Athena complex soils on with 2-20% slopes. (table 3). The majority of the runoff and erosion occurred in the headwaters on the outside edge of the watershed (figure 2 and figure 4). However, only 6 subwatersheds within the entire watershed of 114 subwatersheds experienced erosion greater than 1 tons/acre-year (figure 2). The majority of the flowpath erosion also appeared to occur primarily in the headwaters along the drainages (figure 3). Similarly to sediment production, the majority of the runoff was produced within the headwaters of Coyote Gulch watershed (figure 4).

Table 1. Overall watershed results.

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watershed area analyzed (acres)</td>
<td>1890</td>
</tr>
<tr>
<td>Watershed discharge volume (acre-ft/year)</td>
<td>772 (3,121,145 ft/year)</td>
</tr>
<tr>
<td>Precipitation volume (acre-ft/year)</td>
<td>3,211 (139,871,066)</td>
</tr>
<tr>
<td>Total precip (in/year)</td>
<td>24.5</td>
</tr>
</tbody>
</table>
Table 2. Hillslope sediment and runoff yields by dominant land cover types in subcatchment.

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Runoff Volume ft(^3)/year</th>
<th>Runoff Volume ft(^3)/day</th>
<th>Sediment Yield tons/year</th>
<th>Sediment Yield tons/acre-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivated Crops</td>
<td>380,720</td>
<td>1,043</td>
<td>170</td>
<td>15</td>
</tr>
<tr>
<td>Developed, Open Space</td>
<td>1,211</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Grasslands/Herbaceous</td>
<td>389,235</td>
<td>1,066</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Shrub/Scrub</td>
<td>173,674</td>
<td>476</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Evergreen Forest</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td>944,840</td>
<td>2,589</td>
<td>172</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 3. Hillslope sediment yield by dominant soil types in subcatchment.

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Runoff Volume ft(^3)/year</th>
<th>Runoff Volume ft(^3)/day</th>
<th>Sediment Yield tons/year</th>
<th>Sediment Yield tons/acre-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oliphant silt loam, 8 to 20 percent slopes</td>
<td>28,291</td>
<td>78</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Almota-Linville complex, 30 to 50 percent slopes</td>
<td>88,273</td>
<td>242</td>
<td>0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Alpowa-Lickskillet complex, 35 to 50 percent slopes</td>
<td>54,049</td>
<td>148</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Lickskillet-Alpowa-Rock outcrop complex, 50 to 75 percent slopes</td>
<td>264,404</td>
<td>724</td>
<td>70.0</td>
<td>7.3</td>
</tr>
<tr>
<td>Calouse-Almota complex, 2 to 15 percent slopes</td>
<td>51,665</td>
<td>142</td>
<td>5.6</td>
<td>0.5</td>
</tr>
<tr>
<td>Palouse-Athena complex, 8 to 20 percent slopes</td>
<td>103,041</td>
<td>282</td>
<td>65.7</td>
<td>4.2</td>
</tr>
<tr>
<td>Palouse-Athena complex, 2 to 8 percent slopes</td>
<td>246,200</td>
<td>675</td>
<td>29.0</td>
<td>2.6</td>
</tr>
<tr>
<td>Chard silt loam, 10 to 25 percent slopes</td>
<td>1,624</td>
<td>4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Linville-Kettenbach association, 45 to 75 percent slopes</td>
<td>107,293</td>
<td>294</td>
<td>1.7</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td>944,840</td>
<td>2,589</td>
<td>172</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 4. Flowpath sediment yields.

<table>
<thead>
<tr>
<th>Runoff Volume ft(^3)/year</th>
<th>Runoff Volume ft(^3)/day</th>
<th>Sediment Yield tons/year</th>
<th>Sediment Yield tons/acre-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>770,855</td>
<td>2,112</td>
<td>258</td>
<td>16</td>
</tr>
</tbody>
</table>
Figure 2. Total hillslope sediment yields by subcatchment.
Figure 3. Total flow path erosion over the watershed.
Figure 4. Total hillslope runoff yields by subcatchment.
DISCUSSION
It was found that most sediment washed from the headwaters of the watershed although most runoff was produced in the upper reaches of the watershed. The values of sediment that are represented do not take road erosion, irrigation, incised channel erosion, impoundments within channels or baseflow. Therefore, to obtain more sediment data, it may be necessary to run disturbed WEPP, HEC, or rerun the WEPP models after entering data regarding irrigation, impoundments, or disturbances that are not represented by National Land Cover Datasets. In order to run these tests, further data must be collected in the field to be used as parameters within these models. WEPP allowed the analysis of approximate erosion within the watershed with topographic, soil, land use, and hydrologic analysis without costly data collection. The erosion which was approximated showed areas that were used for cultivated crop plots within the headwaters of the watershed may benefit most from erosion control as these would produce most hillslope and flowpath sediment based on the WEPP parameters of the Coyote Gulch watershed.

CONCLUSION
More models may be necessary to completely understand the far reaching impacts of erosion within the Coyote Gulch watershed and in incised areas of the stream. However, a basic WEPP model describes erosion occurring most in cultivated areas in the headwaters of Coyote Gulch canyon.
REFERENCES
Elliott, William, interview by Sierra Larson. Civil Engineering Scientist at Rocky Mountain Research Station, Moscow, ID (June 17, 2014).
APPENDICES

APPENDIX A: SAVED PROJECT INFORMATION TO LOAD INTO WEPP
Numbers next to the text signify a drainage that can be delineated in NSREL WEPP Online. Copy text from CSA through Date for each watershed. Every bold number on the left indicates a new watershed.

CSA:4.000000
MSCL:60.000000
EXTENT:-116.927635,46.41753,-116.773483,46.50007
ZOOM:9.000000
OUTLET:-116.838714:46.446516
YEARS:2
STATE:id
STATION:MOSCOW U OF I
DESCRIPTION: