Four Beetles Project

Mendocino National Forest

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Introduction:

The project I worked on with Forest Service is the Four Beetles located in the Mendocino Forest. The Four Beetles Project is being proposed as a management response to forest health decline, in compliance with Section 8204 of the Agriculture Act of 2014 (also referred to as the 2014 Farm Bill). The forested area within the Upper Grindstone Creek Watershed and Log Spring Creek-Thomes Creek Watershed have been the two watersheds on the forest most impacted with tree mortality from insect and disease, (2015, Trip Report), and mortality is spreading. Although insect and disease outbreaks provide some benefits to ecosystems (such as snag and downed wood creation), when the outbreaks become too intense ecosystems may be slow to recover and heavy fuel loads will result from fallen snags.

The purpose of this proposed project is to improve forest health and resiliency by reducing competition for resources (water, sunlight, nutrients) between trees located within both watersheds. There is a need to close the gap between the existing and desired conditions while protecting resources within the proposed project area. Also to increase forest stands resilience and resistance to further large-scale disturbances such as insect and disease outbreaks and wildfire throughout Four Beetles project area.

Structure:

In my internship, I was introduced to the Four Beetles project in archeology and hydrology. In the archeology project, we surveyed the Four Beetles for historical artifacts to confirm and update the datum that is already on file. According to the National Historic Preservation Act, all historical sites must be preserved from any new developments. Within the Four Beetles project there are many historical locations that must be resurveyed by archeologists to update the data and keep the sites preserved. Artifacts in the Mendocino National Forest are defined as materials that are at least fifty years old. Examples of some the sites observed were obsidian and chert flakes, projectile points. Another illustration observed is house pits and glades. For a location to be considered a site, there must be a minimum of ten flakes of the same kind in the same spot, projectile point, or any artifact that will prove fifty or more years of age.

Sites can be established anywhere but are separated into two different categories; primary and secondary sites. A set of attributes that make a site primary are glades that have a slope of less than thirty percent, have access to water, and good look out points are sites that are potential of being a historical site. Attributes that make a site secondary are slopes higher than 30 percent and locations that are not to stable. These locations are considered secondary because the probability of Indians living there is unlikely and artifacts could have been moved by water, windstorm, or mud/rock slides. When a site is found, archeologists flag, conduct intensive survey and record a boundary line using Trimble GPS unit. Once the archeologists have surveyed the sites, the botanist, hydrologist, geologist, wildlife and fish biologist will begin working in the Four Beetles project to help improve the forest health. While working with the hydrologist, a peak flow analysis was conducted on perennial, intermittent and ephemeral streams.

Part of the project is to evaluate the watershed's level of cumulative disturbance to help depict the cumulative watershed effects (CWE) for that watershed. To quantify and provide context for the level of disturbance in a watershed, the Equivalent Roaded Acre (ERA) analysis framework is an approved method in the Pacific Southwest Region. Using a modified Phankuch Channel Stability Rating (see image below for Phankuch form), the upper, lower and bottom banks were evaluated in a scale, which determine the type of stream by utilizing the Rosgen Stream Classification System. The information gathered from the stream surveys help determine the effects of that watershed and with that support the ERA analysis.

SCI Ver. 6 Form 10: Modified Pfankuch Channel Stability Rating Four Beetles Project

GPS Zone:____ Upper Reach: e________ n________

Accuracy: ±____ Lower Reach: e________ n________

Watershed:________ Width/Depth Ratio:________

Stream Type:________ Reach:________ Date:________ Observers:________ Comments:________ Fish: ☐

KEY	CATEGORY	EXCELLENT (Description)	Rating	GOOD (Description)	Rating	FAIR (Description)	Rating	POOR (Description)	Rating
1	Landform Slope	Bank slope gradient < 30%	2	Bank slope gradient 30% - 40%	4	Bank slope gradient 40% - 60%	6	Bank slope gradient 60% +	8
2	Mass Wasting	No evidence of past or future mass wasting	3	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent/large sediment yearlong OR imminent danger of same.	12
3	Debris Jam Potential	Essentially absent from immediate channel area	3	Present, but mostly small twigs and limbs.	4	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
4	Vegetative Bank Protection	90% + plant density. Vigor and variety suggest a deep, dense, soil binding, root mass.	3	70-90% density. Fewer plant specimens or lower vigor suggests a less dense or deep root mass.	6	50-70% density. Lower vigor & still fewer species form a somewhat shallow & discontinuous root mass.	9	< 50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	12
5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio < 7.	1	Adequate. Overbank flows rare. W/D ratio 8 to 15.	2	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3	Inadequate. Overbank flows common. W/D ratio > 25.	4
6	Bank Rock Content	65% with large, angular boulders 12"+ numerous.	2	40 to 65%, mostly small boulders to cobbles 6-12".	4	20 to 40%, with most in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes, 1-3" or less.	8
7	Obstructions Flow Deflectors Sediment Traps	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools & riffles stable.	2	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	4	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting & filling of pools.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migrations occurring.	8
8	Cutting	Little or none evident. Infrequent raw banks less than 6" high generally.	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	8	Significant. Cuts 12"-24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
9	Deposition	Little or no enlargement of channel or point bar	4	Some new increase in bar formation, mostly from coarse gravels	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposits of predominantly fine particles. Accelerated bar development.	16
10	Rock Angularity	Sharp edges and corners, plane surfaces roughened.	1	Rounded corners and edges, surfaces smooth and flat.	2	Corners & edges well rounded in two dimensions.	3	Well rounded in all dimensions, surfaces smooth.	4
11	Brightness	Surface dull, darkened, or stained. Gen. not "bright".	1	Mostly dull, but may have up to 35% bright surfaces.	2	Mixture, 50-50% dull and bright, ±or- 15% i.e., 35-65%.	3	Predominantly bright, 65%+ exposed or scoured surfaces.	4
12	Consolidation (Particle Packing)	Assorted sizes tightly packed and / or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
13	Bottom Size Distribution & % Stable Materials	No change in sizes evident. Stable materials 80-100%.	4	Slight shift in either direction. Stable materials 50-80%.	8	Moderate change in sizes, stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
	% Substrate Composition:	Bedrock =	Boulders (> 10") =	Large Cobble (5" – 10") =	Small Cobble (2" – 5") =	Gravel (0.1" – 2") =		Sand < 0.1" =	Silt =
14	Scouring & Depositing	Less than 5% of the bottom affected by scouring & deposition	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
15	Clinging Aquatic Vegetation (Algae)	Abundant. Growth largely moss like, dark green, perennial. In swift water too.	1	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters.	2	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	3	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4

<38 Excellent 39-76 Good 77-114 Fair >114 Poor EXCELLENT TOTAL ☐ GOOD TOTAL ☐ FAIR TOTAL ☐ POOR TOTAL ☐

Rosgen Score Modifier:

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
Good (stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
Fair (Mod. Unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
Good (stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
Fair (Mod. Unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Pfankuch Total =

Rosgen Stream Type =

Modified Channel Stability Rating =

In order to get an accurate Phankuch rating when surveying the upper bank, we had to keep in mind landform, mass wasting, debris jam potential and vegetative bank protection. The landform was examined by measuring the gradient of the bank slope using a clinometer. Mass wasting is described the extent of existing or potential detachment of large pieces of ground and their movement into waterways below. When examining mass movement in banks, we had to keep note of slumping or sliding, which produces large amounts of soil to rivers and causes constrictions such as an increase flow velocity and sedimentation. Debris jam potential was observed by tree trunks, limbs, twigs, and leaves that are deposited into the river banks and form the source of the bulk of the obstructions, flow deflectors and sediment traps rated for the lower banks which increases obstacles to the unremitting direction and force of flow. Vegetation bank protection helps prevent mass wasting. Trees and scrub use their roots to hold soil in place, and the stems help reduce the velocity of flood flows by taking so of the energy out of the water.

In the lower banks, we had to look out for channel capacity, bank rock content, sediment traps, cutting and deposition. Channel capacity is described as low width to depth ratios, which indicate a deep channel and an increase in flow where high ratios indicate a wide and shallow channel whose lower banks generally overflow. When the capacity of the channel is exceeded, deposits of sediment are found on the lower banks and organic debris may be trapped in bank vegetation. Bank rock content is the composition of bank material indicating the capacity of the bank to resist erosion by flow. Since vegetation is generally lacking from the lower banks, the volume, size and shape of the rock component primarily determine the resistance of bank flow. Sediment traps are objects like large rocks, embedded logs and bridge pylons that will change the direction and sometimes the velocity of the flow. This may but not always cause problems where the flow is deflected against unstable banks and bottom materials. Firmly embedded obstructions such as logs or large boulders can provide long-term cover for fish. Cutting is the erosion of banks by flow that produce near vertical walls with overhanging sods of roots that eventually topple in the water. Deposition is the appearance of sand and gravel bars where they did not previously exist. This can be a sign of upstream erosion, or can be caused in the cut banks.

Finally, when surveying the bottom bank of a stream, we had to record rock angularity, brightness, particle consolidation, bottom size distribution, scouring and clinging aquatic vegetation (algae and moss). The streams rock angularity is the angular fragments of rock. Angular rocks are more resistant to tumbling then rounded rocks, which pack poorly, and depending on the size, are easily moved downstream. The algae built up or dullness on the rock evaluates the brightness of a rock. Stones that are in motion do not gather moss or algae, rather become refined by recurrent tumbling. Another way to determine a rock's brightness is by striking two rocks together and observing the brightness of the inner fragments in comparison to the surface. Particle packing is determined by the overlapping of rock. Packing makes the bed resistant to movement by flow forces and is not easily moved. Scouring is the amount of rock affected by algae or brightness gone dull in the stream. Another part of the survey is to observe the amount of aquatic vegetation that a stream acquires. Since aquatic vegetation is easily washed because the lack of roots, distribution and abundance of vegetation in the river will influence light conditions, nutrient levels, and time elapsed since proceeding flood events. As we survey a stream, an ocular bottom size distribution was generated by a visual "pebble count", and was utilized to determine streambed stability. This visual pebble count is the percent estimate of how much bedrock, boulder >10", large cobble 5" to 10", small cobble 2" to 5", gravel 0.1" to 2", sand <0.1" and silt was observed within a 100 foot length.

When the Pfhankuch Channel Stability survey is completed, the pebble count is utilized to determine the Rosgen Stream Type and a Phankuch stream stability rating. The Rosgen and Phankuch assessments then can be rated as good, fair or poor. The data gathered from the stream is utilized for the Equivalent Roaded Acre Analysis and it is used to determine the Threshold of Concern (TOC) at a small watershed scale, some 200 to 1,000 acres in size. In the *Equivalent Roaded Acre Analysis Process*, John Kelley District Hydrologist states, "TOC is based on the amount of disturbance (ERAs) within a watershed, below which limited impacts on stream stability or condition would be expected to occur due to stream peak flows and from large storm events. If cumulative impacts related to overall disturbance levels." Kelley indicated that the TOC coefficient for the watershed is assigned based on the stream's stability rating; the more stable the stream is, the greater the TOC coefficient. Utilizing the Stream Stability / TOC Coefficient Crosswalk Table, shown below in Figure 2, the hydrologist can generate a possible TOC coefficient from the stream's Pfankuch rating. If a stream has not been surveyed, the hydrologist is required to use the lowest coefficient for a given watershed in the ERA analysis.

Stream Stability / TOC Coefficient Crosswalk Mendocino National Forest		
Pfankuch Stability Rating	**Descriptor**	**TOC Coefficient**
0-13	High Excellent	0.16
14-26	Med Excellent	0.15
27-39	Low Excellent	0.14
40-52	High Good	0.14
53-65	Med Good	0.13
66-78	Low Good	0.12
79-91	High Fair	0.12
92-104	Med Fair	0.11
105-117	Low Fair	0.10
118-130	High Poor	0.10
131-148	Med Poor	0.09
149-156	Low Poor	0.08

The data gathered from the streams is used to determine bank and road erosion.

Conclusion:

This internship experience has helped me further develop professional skills, and problem solving skills. As I come closer to the end of my educational goal, this experience will become useful as a Civil Engineer. After getting a feel of the Forest Service, I am confident on pursuing a career within the USDA as a Civil Engineer.

References:

Fair, Curtis. Personal Interview. District Archeologist. U.S. Department of Agriculture Forest Service. Mendocino, California. Region 5. June 2016

Kelley, John. Personal Interview. District Hydrologist. U.S. Department of Agriculture Forest Service. Mendocino, California. Region 5. June 2016

Pfankuch, D.J. 1975. *Stream reach inventory and channel stability evaluation.* U.S Department of Agriculture Forest Service. Region 1. Missoula, Montana

Vandame, Mike 2009. *Equivalent Roaded Acre Analysis Process.* U.S. Department of Agriculture Forest Service. Region 5. Mendocino, California