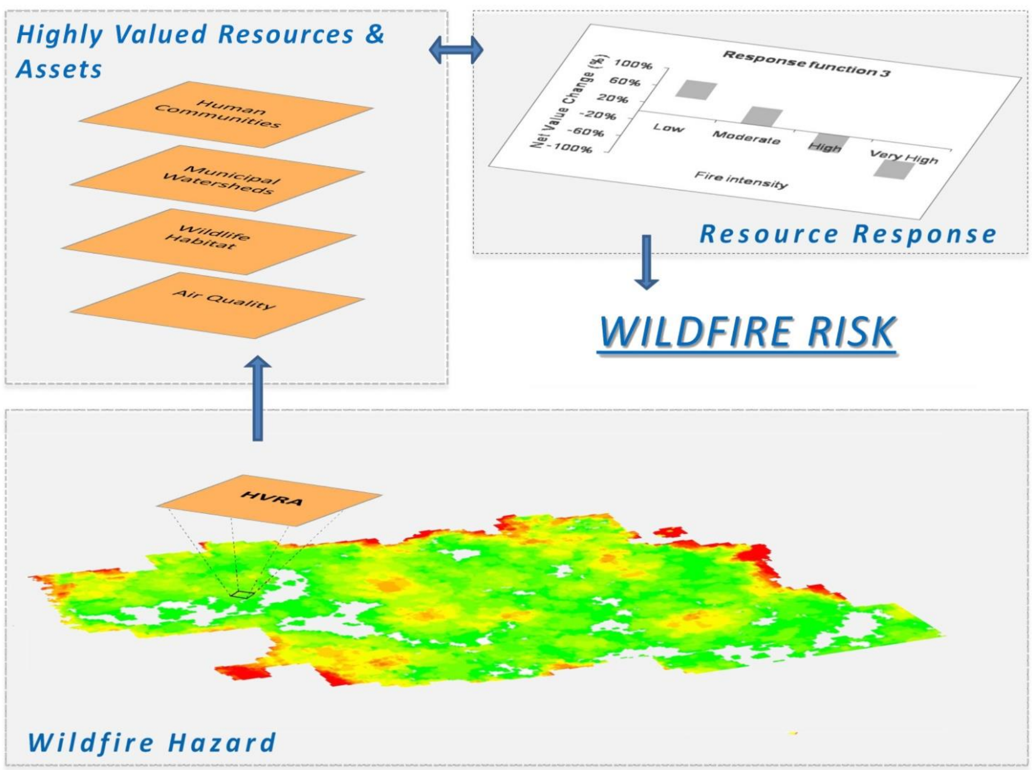
Upper Monument Creek Wildfire Risk Assessment

I. Risk Assessment Framework

The framework used is scalable from national to project level scale and is based on processes developed by the Science Team for the National Cohesive Strategy.

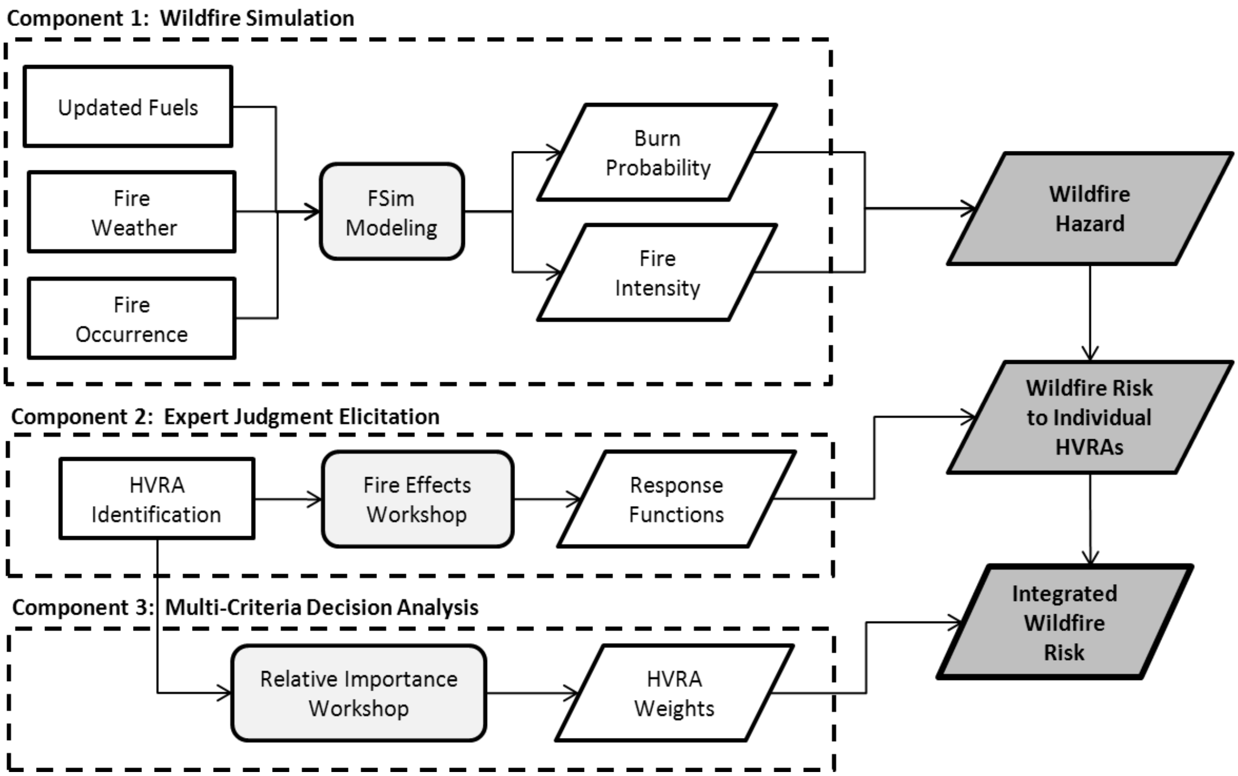
Three main pieces of information were utilized to generate wildfire risk outputs: maps of burn probability and fire intensity generated from wildfire simulations (wildfire hazard), spatially identified highly valued resources and assets (HVRAs), and response functions that describe the effects of fire to each HVRA. Figure 1 illustrates the conceptual approach to assessing wildfire risk in a spatially explicit, quantitative framework. Pairing maps of wildfire hazard with HVRA maps provides important information regarding where on the landscape HVRAs are likely to interact with fire, and with what fire intensity (also known as exposure analysis). Defining responses functions further helps to characterize the impacts to various HVRAs from this interaction with fire.

Figure 3: Illustration of spatial, quantitative approach to assessing wildfire risk utilized



The primary components of the analysis process used to estimate wildfire risk are shown in Figure 2.

Figure 2: Flowchart for integrated wildfire risk assessment process, with three primary analytical components identified



Component 1, wildfire simulation was form the Large Fire Simulator (FSIM) analysis prepared specifically for the Pike and San Isabel National Forests and Comanche and Cimarron National Grasslands wildfire Risk Assessment conducted in August 2012.

Two workshops to address **Component 2** were held in May and June 2013. At the first workshop the HVRAs relevant to the UMC were identified. The HVRA's developed from analysis area consistent spatial data used for the UMC Wildfire Risk Assessment are shown in Table 1.

Table 1: Highly Valued Resources and Assets used in Rocky Mountain Region Wildfire Risk Assessment

HVRA	Sub-HVRA
WUI (Wildland Urban Interface)	low population density (< 28)
	moderate population density (28 - 250)
	high population density (250+ / sq mi)
Water Supply (Drinking Water Importance)	Low Importance to surface drinking water
	Moderate Importance to surface drinking water

HVRA	Sub-HVRA
	High importance to surface drinking water
Infra-structure	Transmission Lines
	Communication Facilities
	Recreation Residences / FS Administrative sites/Experimental Forest Facilities
	FS Recreation Infra-Structure (campgrounds, trailheads, etc.)
	Water Infrastructure (water treatment etc)
	Water Associated Electrical Transmission
	Water Associated Communication Facilities
Habitat (TES and Candidate Species)	Preble's meadow jumping mouse
	Mexican spotted owl foraging
	Mexican spotted owl nesting
Wildlife Habitat	Big Game Winter Range (Elk and Deer)
	Bighorn Sheep Lambing
Vegetation Composition (BPS and S-Class)	Dry-Mesic Mixed Conifer UMC
	Gambel Oak-Mixed Montane Shrubland UMC
	Lodgepole Pine Forest UMC
	Mesic Mixed Conifer UMC
	Montane Riparian Systems
	Montane-Subalpine Grassland UMC
	Pinyon-Juniper Woodland UMC
	Ponderosa Pine/Douglas-Fir Woodland UMC
CNHP Sensitive Plants	Porter's Feathergrass
	Strap Style Gayfeather
	Mountain willow/Blue-joint reedgrass

At the second workshop expert judgment from resource specialists and fire behavior specialists engaged in the Upper Monument Creek Collaborative was elicited regarding how identified HVRAs may be affected by fire.

The response function framework used requires definition of quantitative fire-HVRA relationships as a function of fire intensity, measured with flame lengths. HVRA response is related to fire intensity because it integrates two important fire characteristics – fuel consumption and spread rate. This approach quantifies net value change (NVC) to a given HVRA as the percentage change in the initial resource value resulting from a fire at a given intensity. That is, response functions address relative rather than absolute change in resource or asset value, and represent both beneficial and adverse effects to the HVRA. Longer-term dynamics of post-fire regrowth, succession, or future disturbance, were not modeled as the focus was on identifying the HVRAs short- to mid-term fire effects.

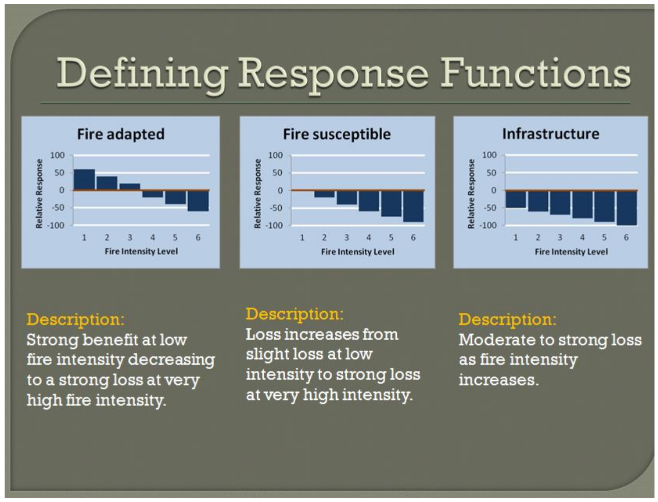
In addition to potential fire behavior, two additional variables Erosion Risk and Succession Classes (S-Classes) were utilized in the development of the response functions (Table 2).

Table 2: Variables used to developed Response Functions in Rocky Mountain Region Wildfire Risk Assessment

HVRA	Sub-HVRA	Variable 1	Variable 2	Variable 3
WUI	Low, Moderate and High Density			Flame Length
Watersheds	Moderate and High Importance	Erosion Risk		Flame Length
Infrastructure	Multiple Items			Flame Length
Habitat (TES)	Mexican Spotted Owl and Preble's Meadow Jumping Mouse			Flame Length
Wildlife Habitat	Big Game Winter Range and Big horn Sheep Lambing			Flame Length
Vegetation Composition	Multiple Sub-Layers for Biophysical Settings (BPS) occurring in the analysis Area		Succession (S) Classes	Flame Length
CNHP Sensitive Plants	Multiple Species			Flame Length

Examples of three stylized response function are shown in Figure 5.

Figure 5: Stylized Response Functions



The Response Functions (RF) developed for the analysis are shown in Table 3.

Table 3: Response Functions utilized in UMC Wildfire Risk Assessment

HVRA	Sub-HVRA	Variable 1	Variable 2	Variable 3					
		Erosion Class	S-Class	Flame Length Category (ft)					
				0–2	2–4	4–6	6 – 8	8–12	12+
WUI	low population density (< 28)			0	-10	-50	-75	-100	-100
	moderate population density (28 - 250)			0	-10	-50	-75	-100	-100
	high population density (250+ / sq mi)			0	-10	-50	-75	-100	-100
Water Supply	Low Importance to surface drinking water	none - low		0	-10	-20	-30	-40	-50
		mod		-5	-15	-30	-50	-100	-100
		high		-10	-25	-50	-75	-100	-100
	Moderate Importance to surface drinking water	none - low		0	-10	-20	-30	-40	-50
		mod		-5	-15	-30	-50	-100	-100
		high		-10	-25	-50	-75	-100	-100
	High importance to surface drinking water	none - low		0	-10	-20	-30	-40	-50
		mod		-5	-15	-30	-50	-100	-100

		high		-10	-25	-50	-75	-100	-100
Infra-structure	Transmission Lines			0	0	0	-30	-40	-50
	Communication Facilities			0	0	0	-30	-40	-50
	Recreation Residences / FS Administrative sites/Experimental Forest Facilities			-10	-20	-40	-80	-100	-100
	FS Recreation Infra-Structure (campgrounds, trailheads, etc.)			0	-10	-10	-20	-50	-70
	Water Infrastructure (water treatment etc)			-10	-20	-30	-50	-60	-75
	Water Associated Electrical Transmission			-20	-40	-60	-80	-100	-100
	Water Associated Communication Facilities			-20	-40	-60	-80	-100	-100
Habitat (TES and Candidate Species)	Preble's meadow jumping mouse			10	20	-20	-60	-100	-100
	Mexican spotted owl foraging			25	10	-25	-75	-100	-100
	Mexican spotted owl nesting			0	-25	-50	-90	-100	-100
Wildlife Habitat	Big Game Winter Range (Elk and Deer)			100	100	25	-25	-50	-75
	Bighorn Sheep Lambing			0	10	50	75	100	100
Vegetation Compostion (BPS and S-Class)	Dry-Mesic Mixed Conifer UMC		A	20	10	0	-20	-60	-100
			B	20	35	50	0	-25	-40
			C	100	100	50	10	-50	-75
			D	100	100	75	10	-50	-75
			E	100	100	50	50	-100	-100
	Gambel Oak-Mixed Montane Shrubland UMC		A	50	0	-40	-100	-100	-100
			B	50	-20	-50	-100	-100	-100
			C	20	-20	-50	-100	-100	-100
	Lodgepole Pine Forest UMC		A	0	0	0	0	0	0
			B	0	-25	-100	-100	-100	-100
			C	-50	-75	-100	-100	-100	-100
			D	0	-25	-100	-100	-100	-100
			E	0	-25	-100	-100	-100	-100
	Mesic Mixed Conifer UMC		A	10	10	-50	-75	-100	-100
			B	10	10	-50	-75	-100	-100
			C	100	100	0	-25	-75	-90
			D	100	100	50	0	-50	-75
			E	20	20	-10	-50	-100	-100

	Montane Riparian Systems		A	10	10	0	-50	-75	-100
			B	20	10	0	-25	-50	-100
			C	20	10	0	-100	-100	-100
			N	0	0	0	0	0	0
	Montane-Subalpine Grassland UMC		A	100	100	100	100	100	100
			B	100	100	100	100	100	100
			U	100	100	100	100	100	100
	Pinyon-Juniper Woodland UMC		A	0	-25	-50	-75	-100	-100
			C	50	0	-50	-75	-100	-100
			D	50	0	-50	-75	-100	-100
	Ponderosa Pine/Douglas-Fir Woodland UMC		A	20	10	0	-20	-60	-100
			B	20	35	50	0	-10	-20
			C	100	100	50	0	-25	-50
			D	100	100	75	0	-25	-50
			E	100	100	50	50	-100	-100
CNHP Sensitive Plants	Porter's Feathergrass			-100	-100	-100	-100	-100	-100
	Strap Style Gayfeather			-100	-100	-100	-100	-100	-100
	Mountain willow/Blue-joint reedgrass			-100	-100	-100	-100	-100	-100

Members of the UMC Collaborative established the relative importance across HVRAs in a second workshop that addressed **Component 3** (workshop 3). The purpose of this workshop was to establish quantitative weights that differentiate the relative importance of HVRAs. The weights are used for calculation and visualization of weighted risk scores that summarize risks across all HVRAs. The overall approach is based on leadership input, group consensus, and iterative refinement of relative importance scores. The specific approach used is a well-established multi-criteria decision analysis technique known as the Simple Multi-Attribute Rating Technique, or SMART. Weights were assigned according to a 4-step process (below), which first proceeds across HVRA categories, and then hierarchically across sub-HVRAs within an HVRA category.

1. Rank HVRAs (or sub-HVRAs) according to importance to Forest
2. Provide qualitative justification for rankings, and their relation to existing guidance/doctrine/policy (e.g., Forest Management Plans; USDA Strategic Plan)
3. Assign top-ranked HVRA (sub-HVRA) a score of 100; assign all other HVRAs (sub-HVRAs) relative importance scores on scale of 0-100. Relative importance scores were also converted into percentages of overall importance across HVRAs and across sub-HVRAs within a given HVRA category.
4. Review, critique, and refine scores (iterative for both HVRAs and sub-HVRAs)

The relative importance values established and the resulting weights are displayed in Figures 6, 7 and 8 and Table 4.

Figure 6: HVRA Relative Importance

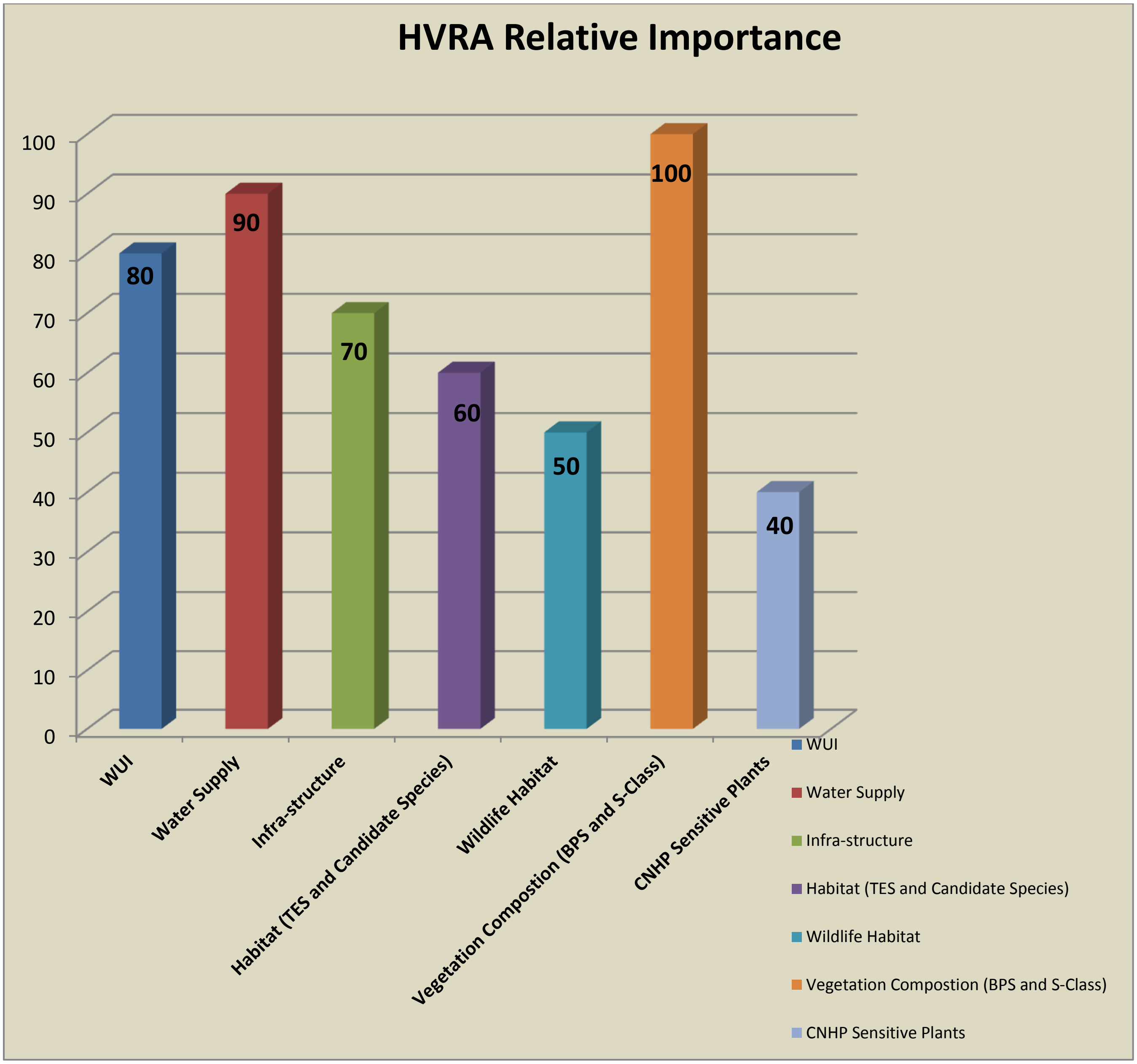


Figure 7: Share of Relative Importance across HVRAs

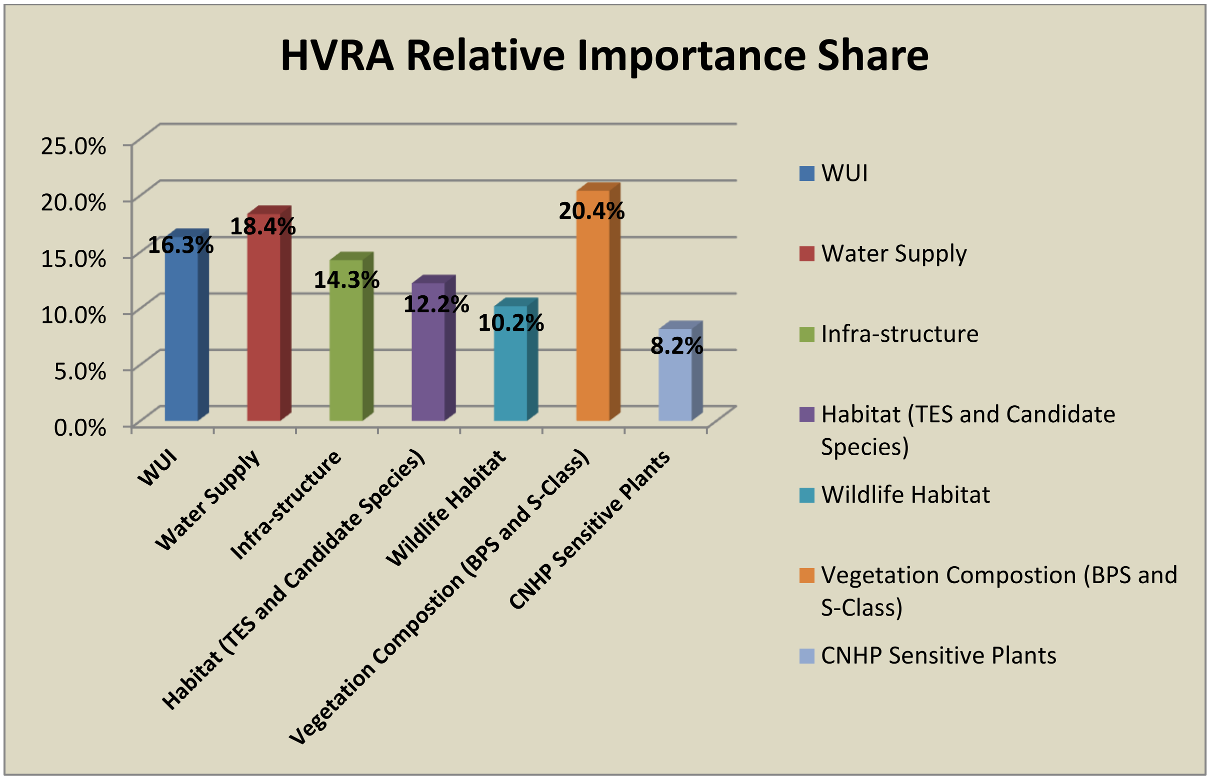


Figure 8: Share of Relative Importance across HVRAs

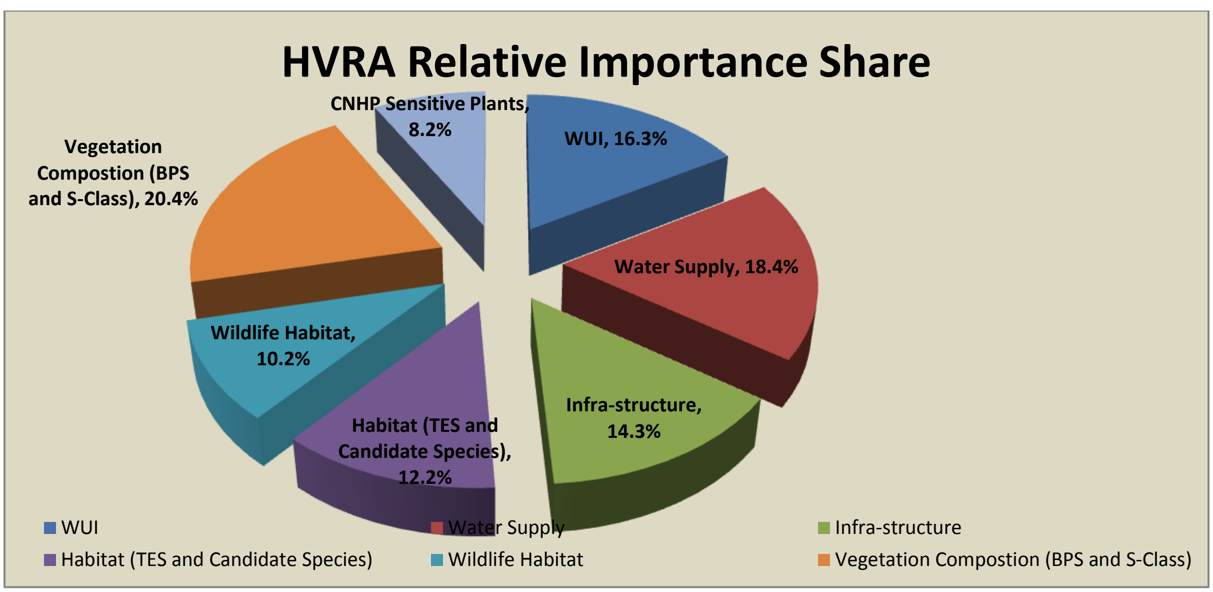


Figure 8: Share of Relative Importance across sub-HVRAs

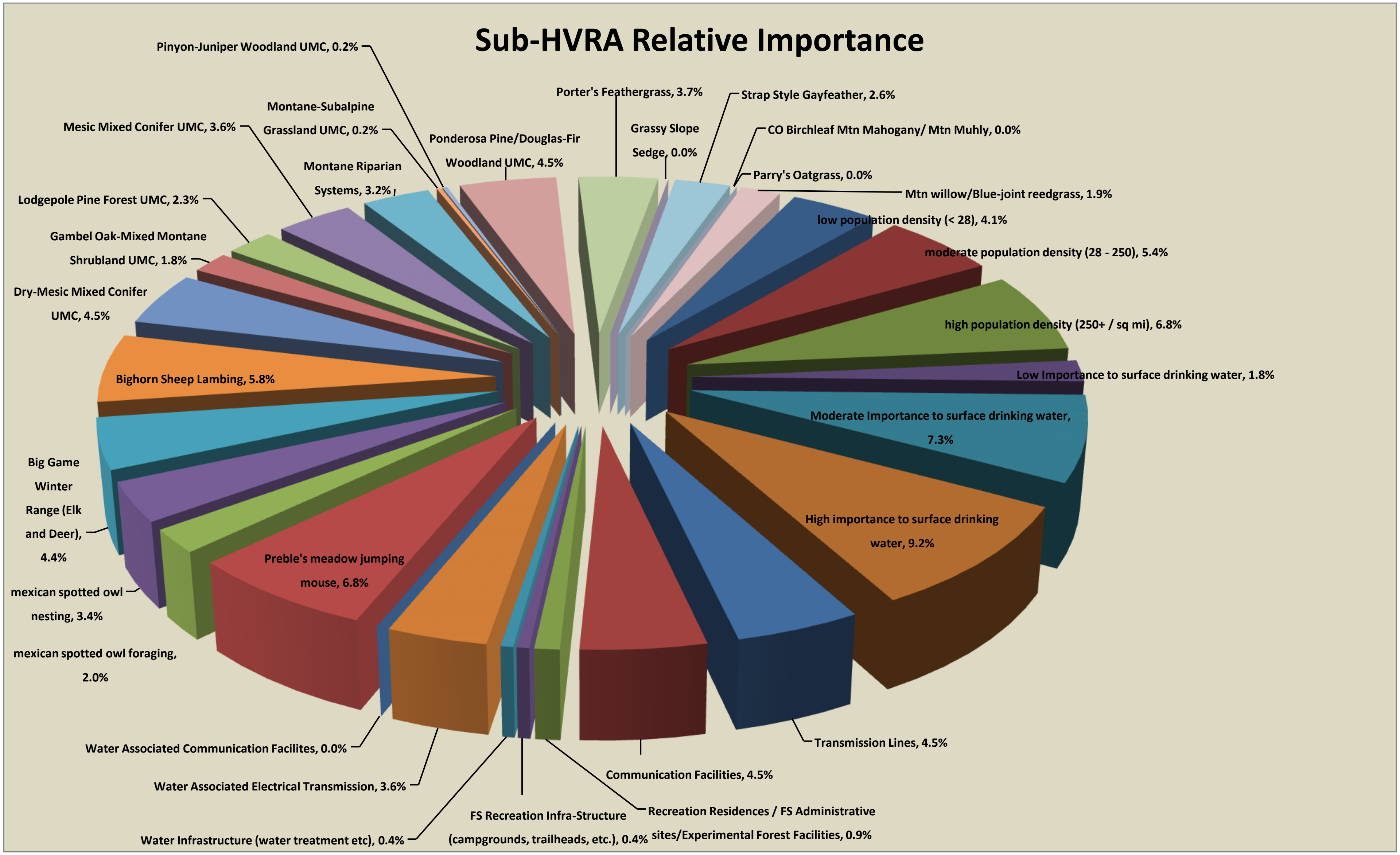


Table 4: Relative Importance Scores and Weights across HVRAs utilized in Upper Monument Creek Wildfire Risk Assessment

HVRA	HVRA Relative Importance	HVRA Relative Importance Share	Sub-HVRA	Sub HVRA Relative Importance	Sub HVRA Relative Importance Share	Overall RI Share
WUI	80	16.3%	low population density (< 28)	60	25.0%	4.1%
			moderate population density (28 - 250)	80	33.3%	5.4%
			high population density (250+ / sq mi)	100	41.7%	6.8%
Water Supply	90	18.4%	Low Importance to surface drinking water	20	10.0%	1.8%
			Moderate Importance to surface drinking water	80	40.0%	7.3%
			High importance to surface drinking water	100	50.0%	9.2%
Infra-structure	70	14.3%	Transmission Lines	100	31.3%	4.5%
			Communication Facilities	100	31.3%	4.5%
			Recreation Residences / FS Administrative sites/Experimental Forest Facilities	20	6.3%	0.9%
			FS Recreation Infra-Structure (campgrounds, trailheads, etc.)	10	3.1%	0.4%
			Water Infrastructure (water treatment etc)	10	3.1%	0.4%
			Water Associated Electrical Transmission	80	25.0%	3.6%
			Water Associated Communication Facilities	0	0.0%	0.0%
Habitat (TES and Candidate Species)	60	12.2%	Preble's meadow jumping mouse	100	55.6%	6.8%
			Mexican spotted owl foraging	30	16.7%	2.0%
			Mexican spotted owl nesting	50	27.8%	3.4%
Wildlife Habitat	50	10.2%	Big Game Winter Range (Elk and Deer)	75	42.9%	4.4%

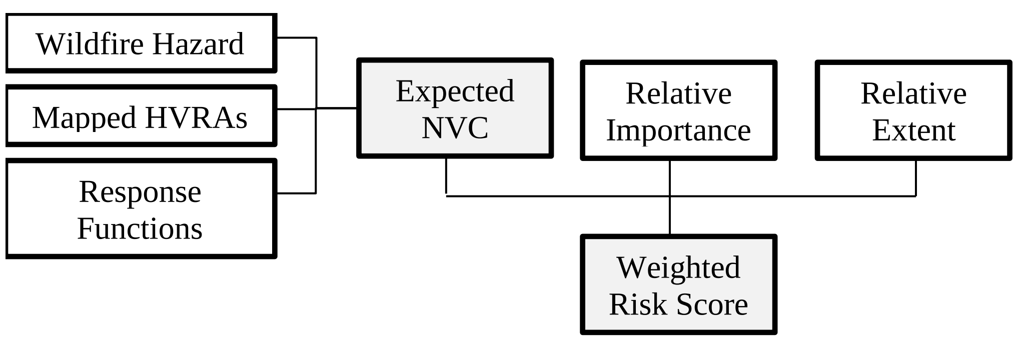
			Bighorn Sheep Lambing	100	57.1%	5.8%
Vegetation Composition (BPS and S-Class)	**100**	**20.4%**	Dry-Mesic Mixed Conifer UMC	100	22.2%	4.5%
			Gambel Oak-Mixed Montane Shrubland UMC	40	8.9%	1.8%
			Lodgepole Pine Forest UMC	50	11.1%	2.3%
			Mesic Mixed Conifer UMC	80	17.8%	3.6%
			Montane Riparian Systems	70	15.6%	3.2%
			Montane-Subalpine Grassland UMC	5	1.1%	0.2%
			Pinyon-Juniper Woodland UMC	5	1.1%	0.2%
			Ponderosa Pine/Douglas-Fir Woodland UMC	100	22.2%	4.5%

CNHP Sensitive Plants	**40**	**8.2%**	Porter's Feathergrass	100	45.5%	3.7%
			Strap Style Gayfeather	70	31.8%	2.6%
			Mtn willow/Blue-joint reedgrass	50	22.7%	1.9%

Relative importance scores are allocated to HVRAs on a per pixel basis. Thus, for HVRAs with a very broad extent, the relative importance per individual pixel might be very low. However for more rare HVRAs the relative importance per pixel might be very high

The three components when combined (Figure 10) provide a weighted Forest Wildfire Risk score that were used as one component to inform the WFHF allocation Process. Wildfire Risk equals the summation over fire intensity and HVRA of the probability of a burn of a given fire intensity × the associated change in value to the NHVRA at that flame length.

Figure 10: Key Components of the Forest Wildfire Risk Score



The results of the Wildfire Risk assessment are shown in Figures 11 -20. It is important to recognize that the graphs are not displaying the amounts of the HVRA on an individual watershed but the sum of the probability of a burn of a given fire intensity × the associated change in value to the NHVRA at that flame length for every pixel in the UMC analysis across all HVRAs on that pixel.

The data was summarized at the HUC 12 level (6[th] order watershed) and in a variety of combinations of HVRA's to inform the UMC Collaborative of how each of the HVRAs contribute to wildfire risk within the UMC analysis area. The attached series of maps display the various aspects of wildfire risk in the UMC planning Area spatially.

Figure 11: Expected loss Total Wildfire Risk - all HVRAs

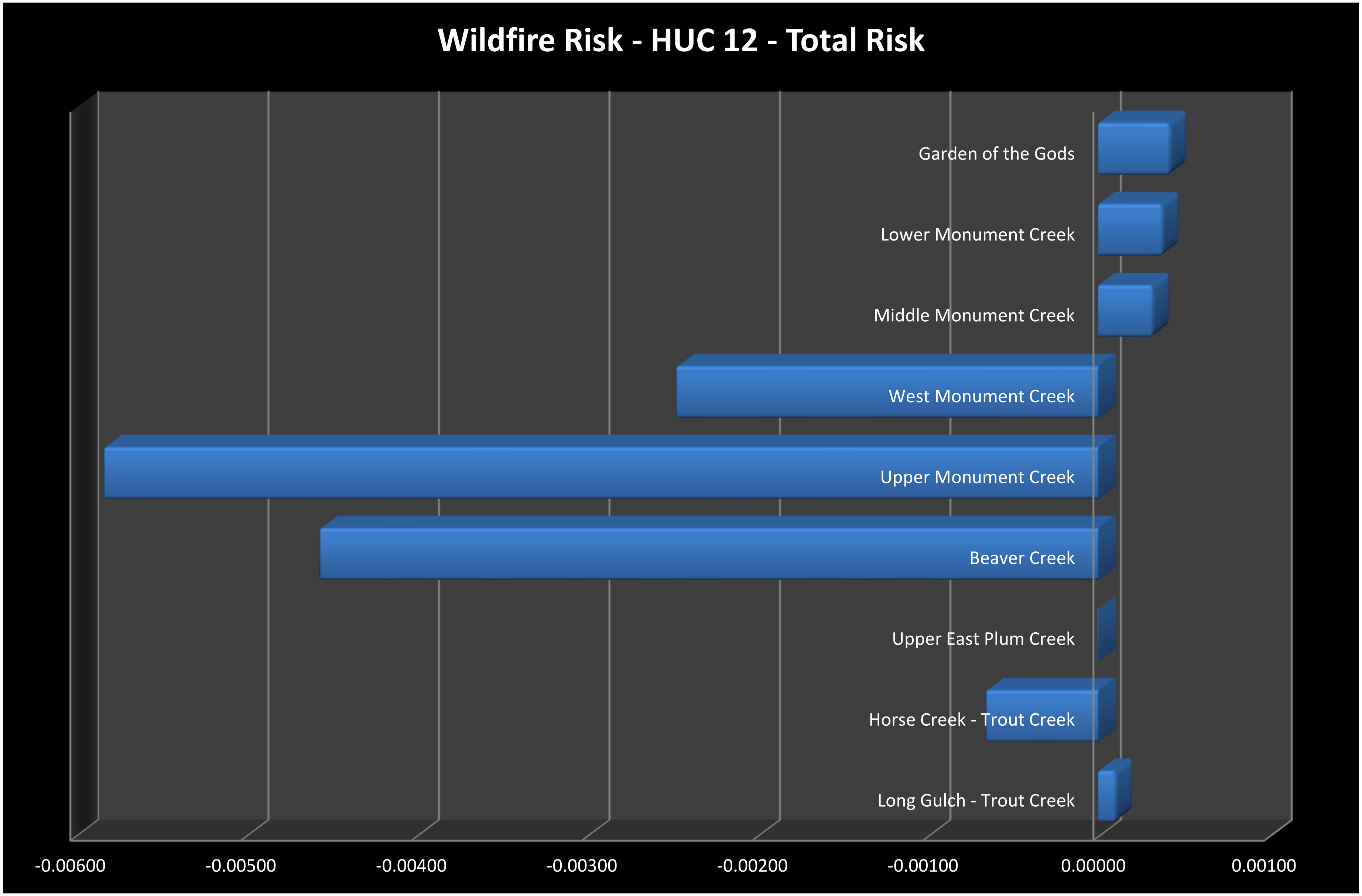


Figure 12: Expected loss (Wildfire Risk) across all HVRAs

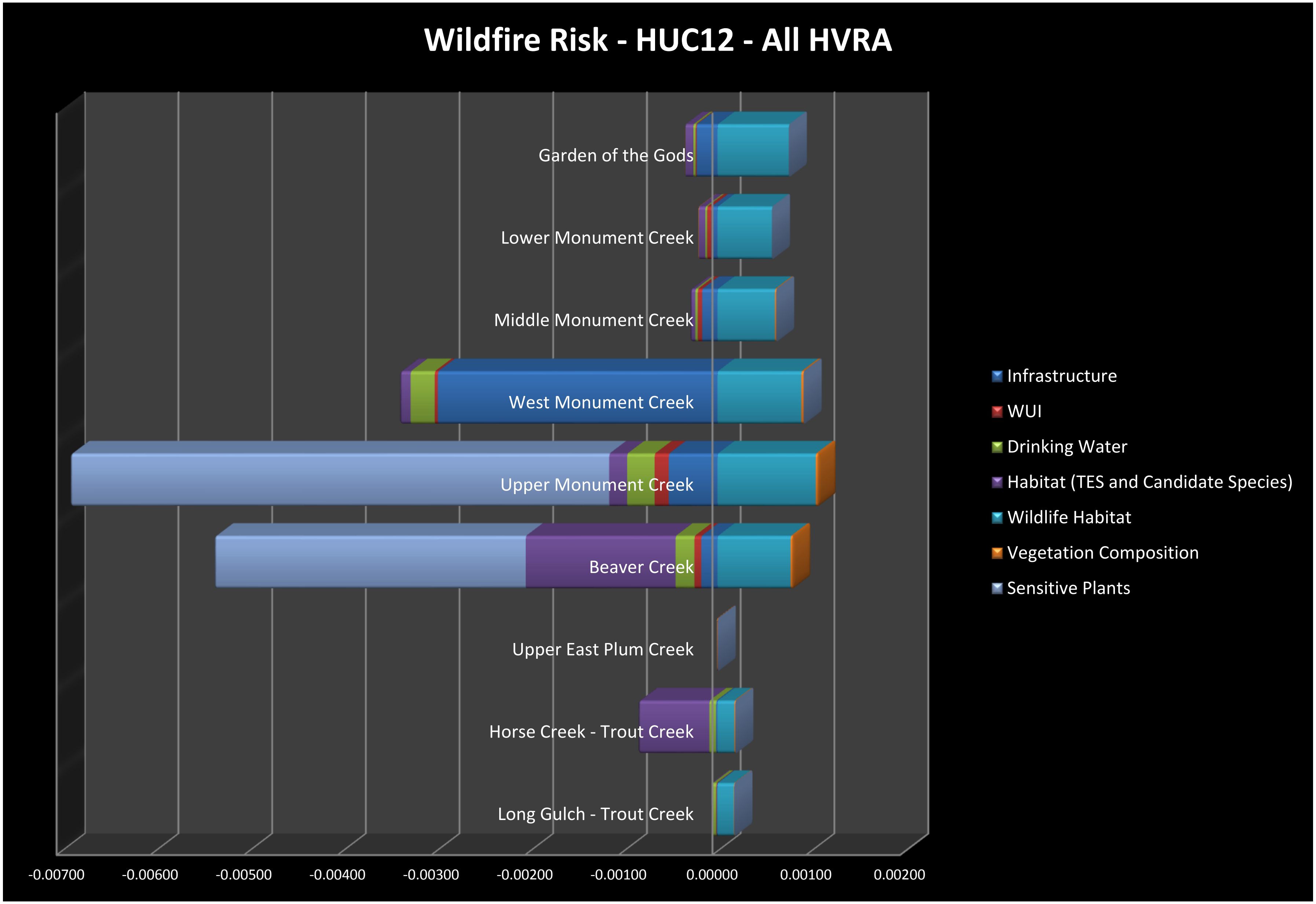


Figure 13: Expected loss (Wildfire Risk) – Infrastructure WUI and Drink Water HVRAs

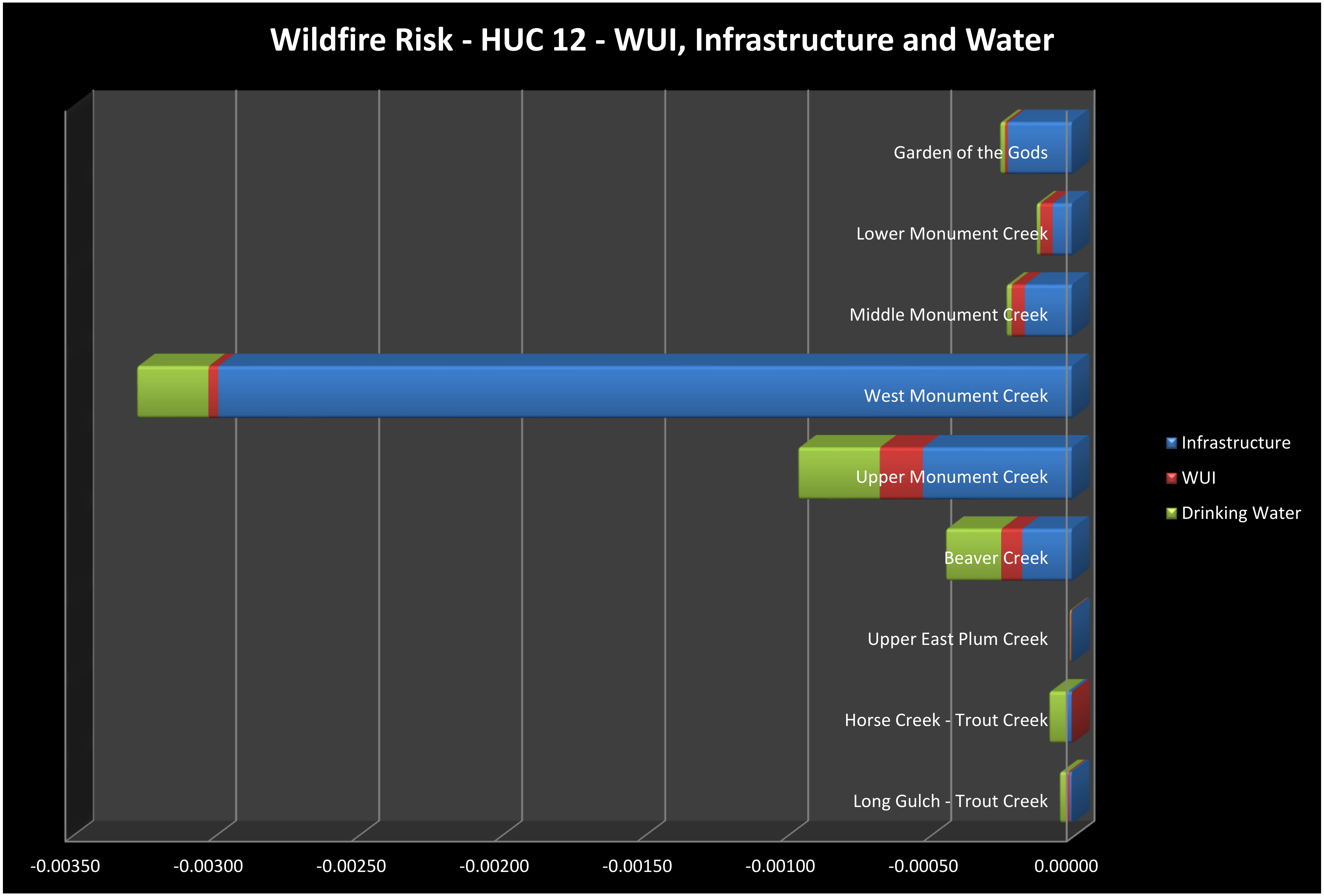


Figure 14: Expected loss (Wildfire Risk) – Infrastructure HVRA

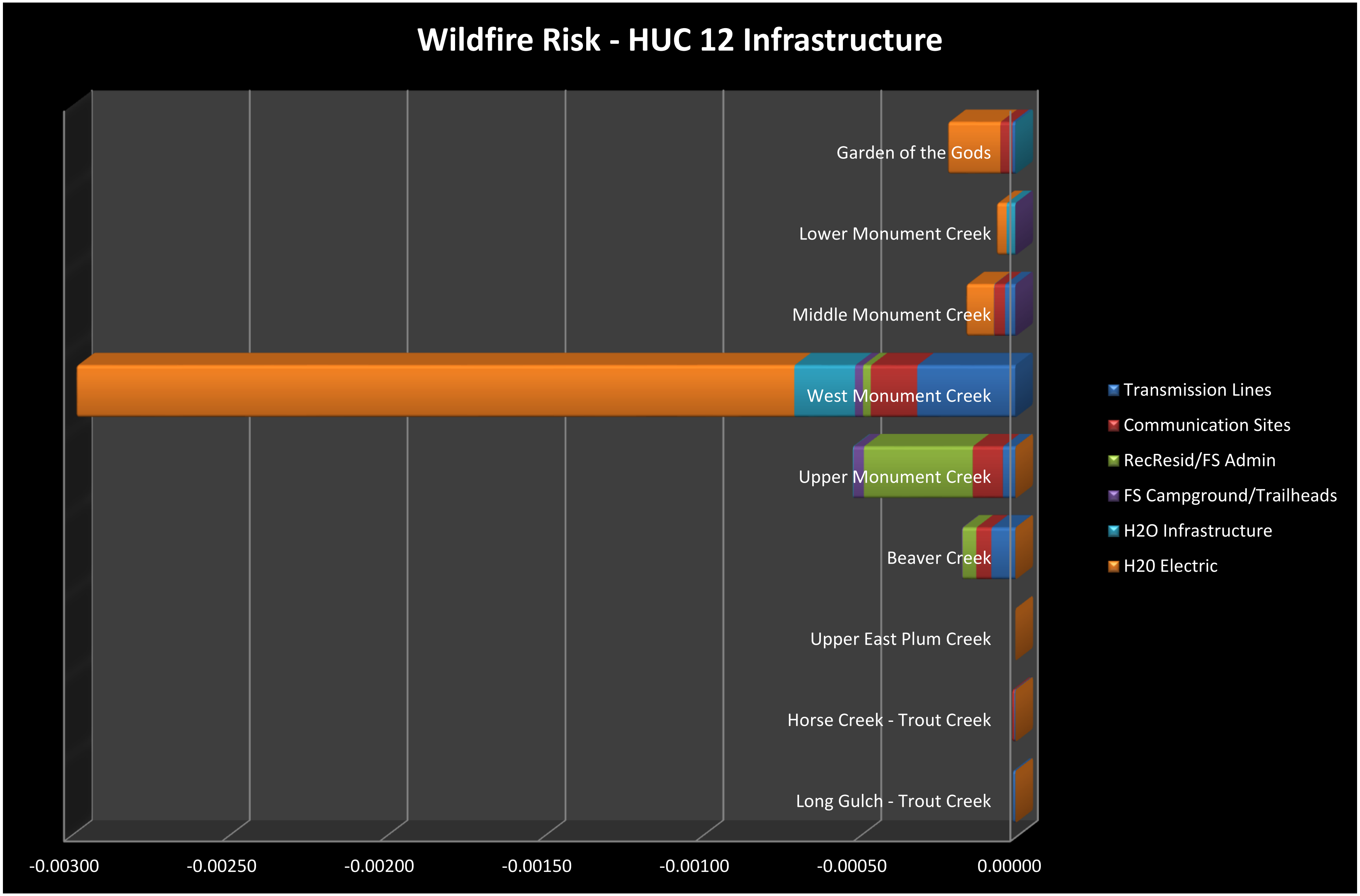


Figure 15: Expected loss (Wildfire Risk) – WUI HVRA

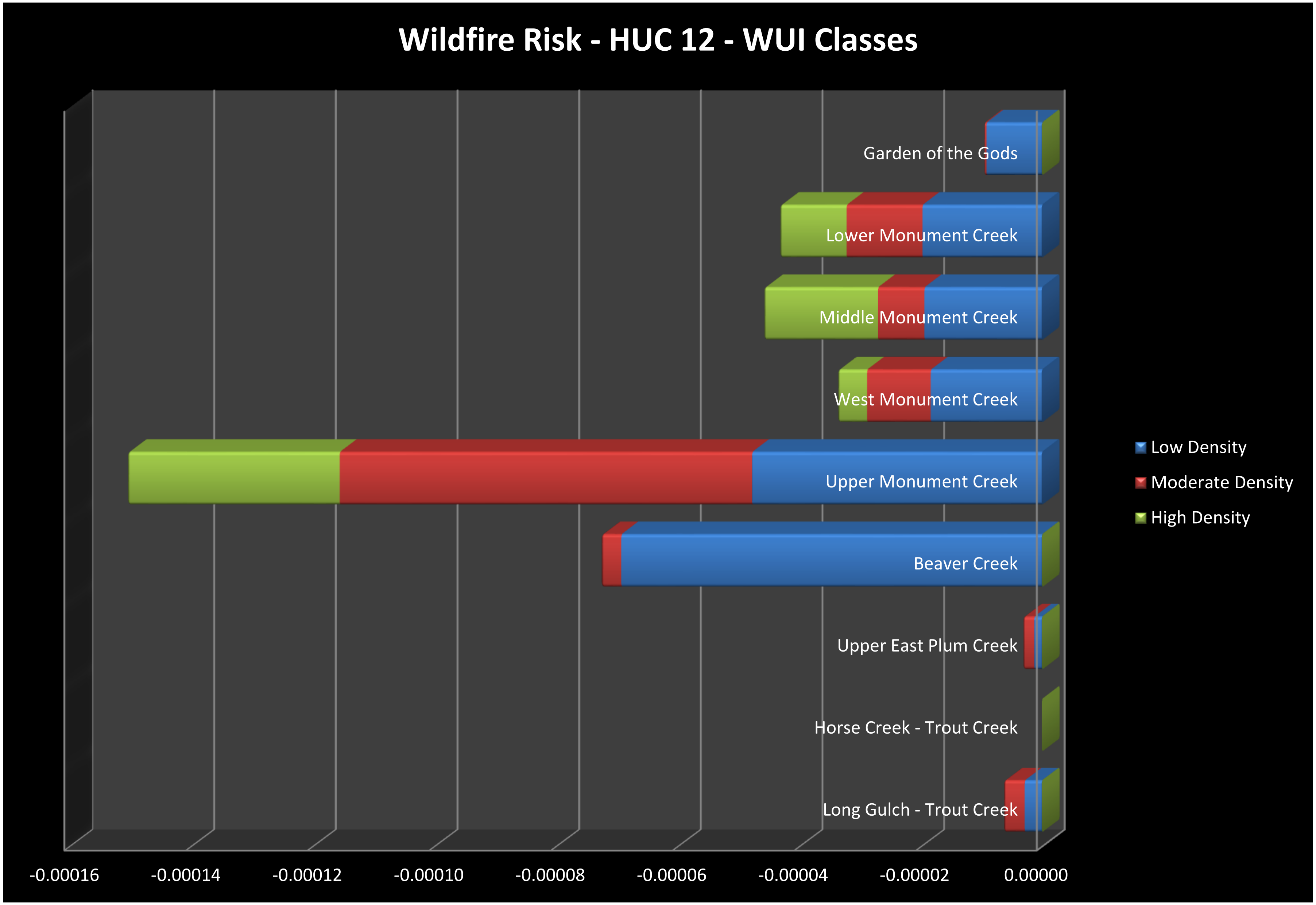


Figure 16: Expected loss (Wildfire Risk) – Drinking Water Importance HVRA by Erosion Class

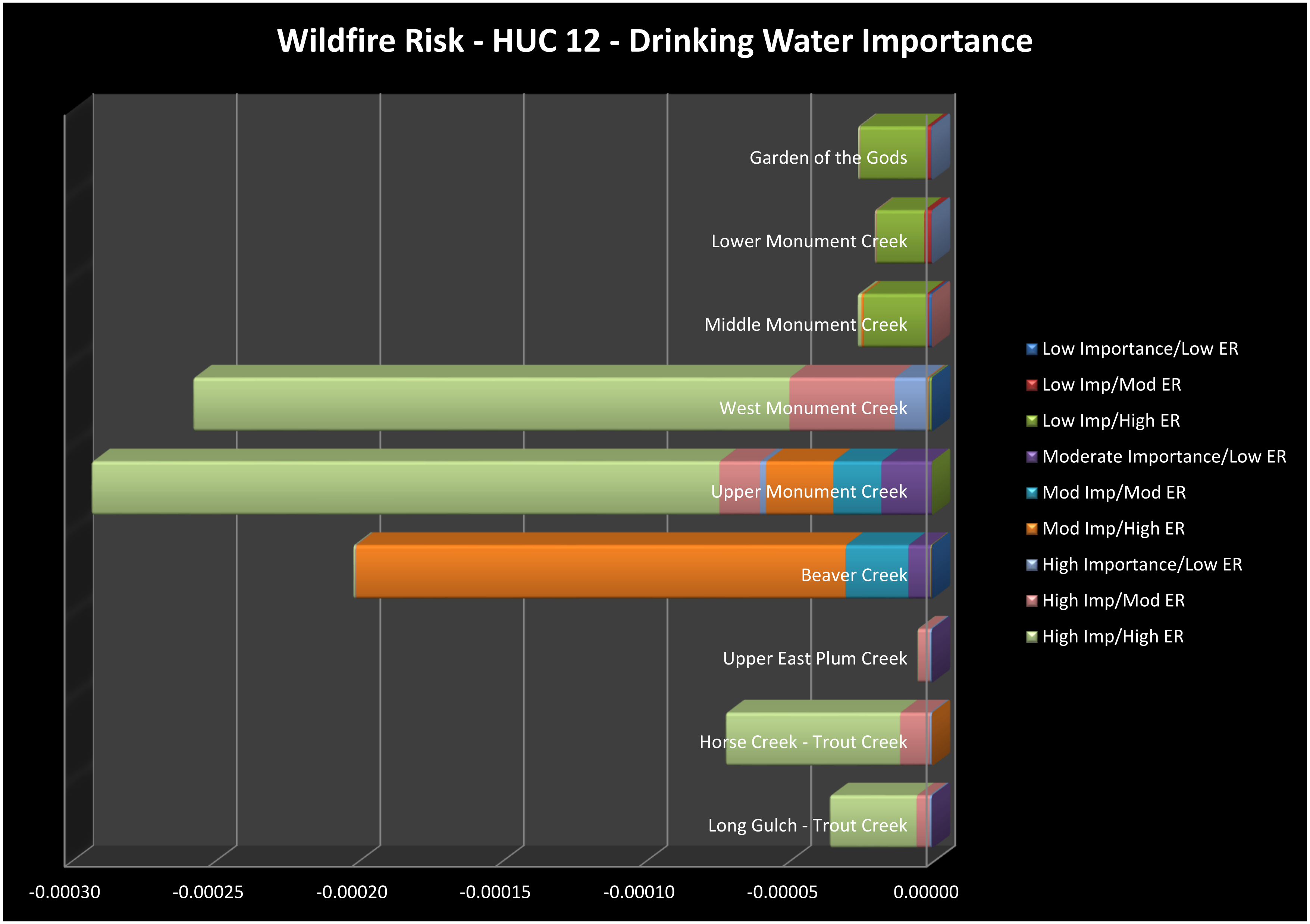


Figure 17: Expected loss (Wildfire Risk) – Wildlife Habitat, Vegetation Composition, TES Habitat and Sensitive Plants HVRAs

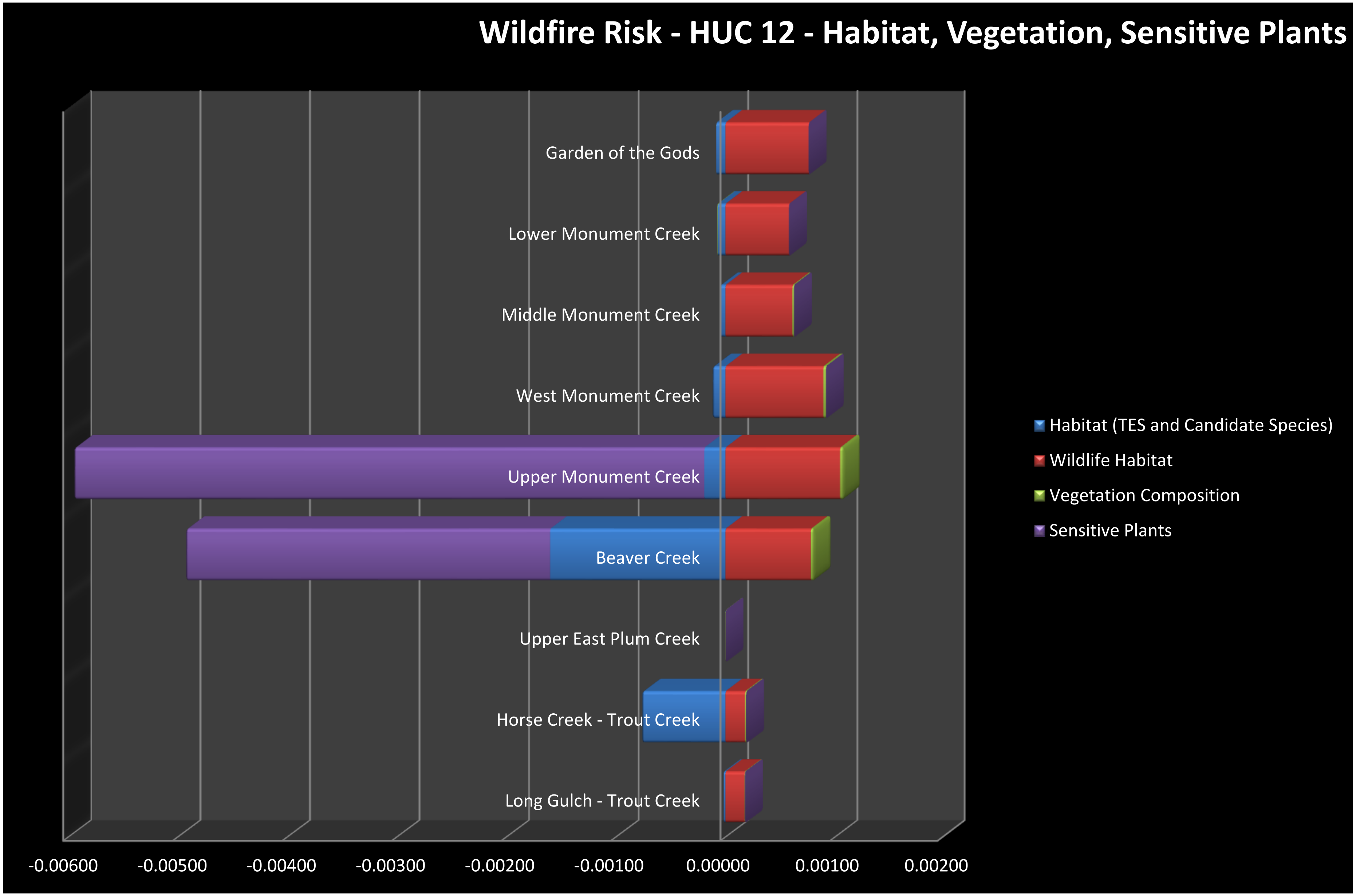


Figure 18: Expected loss (Wildfire Risk) –TES Habitat HVRA

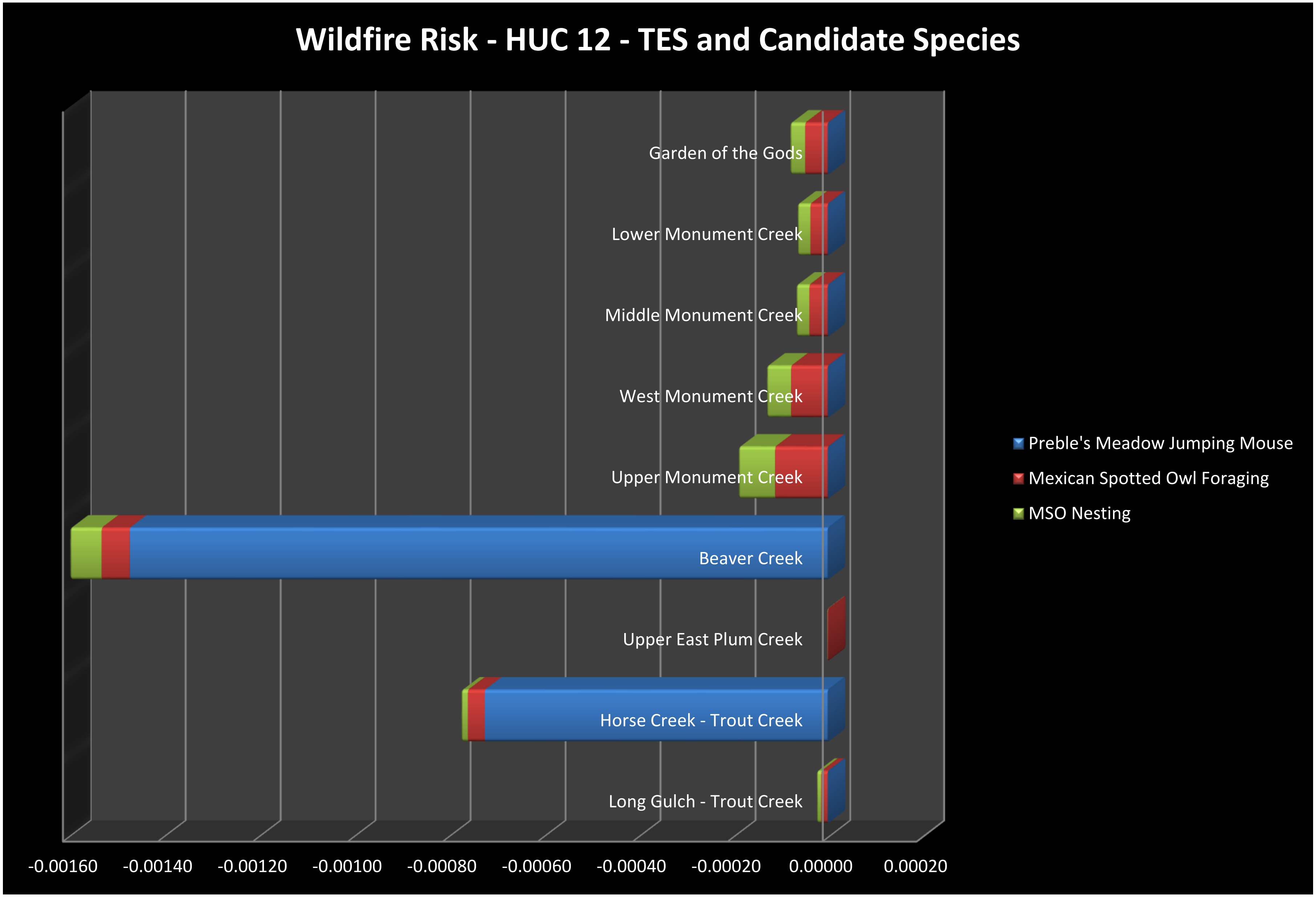


Figure 19: Expected loss (Wildfire Risk) – Wildlife Habitat HVRA

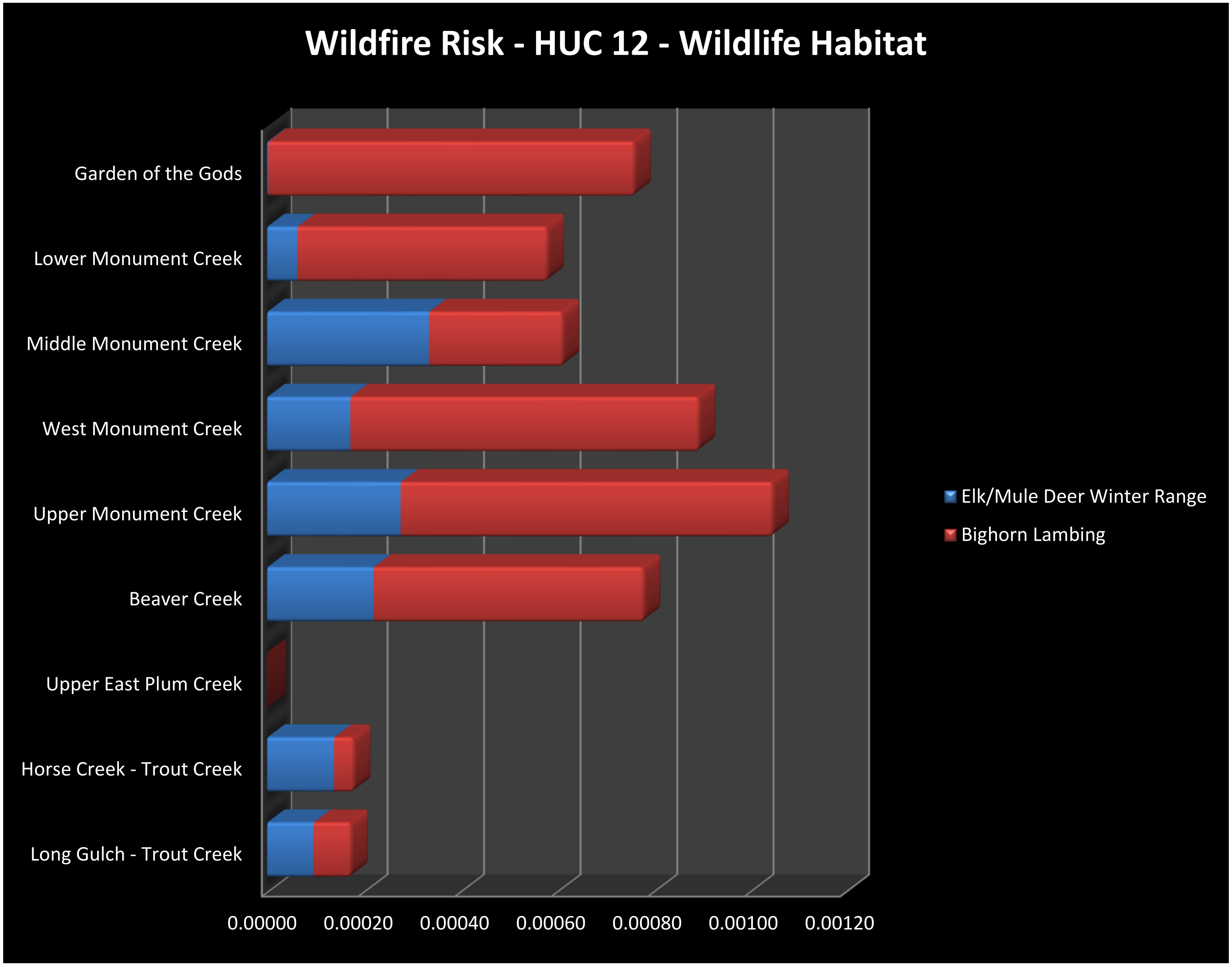


Figure 20: Expected loss (Wildfire Risk) – Vegetation Composition HVRA

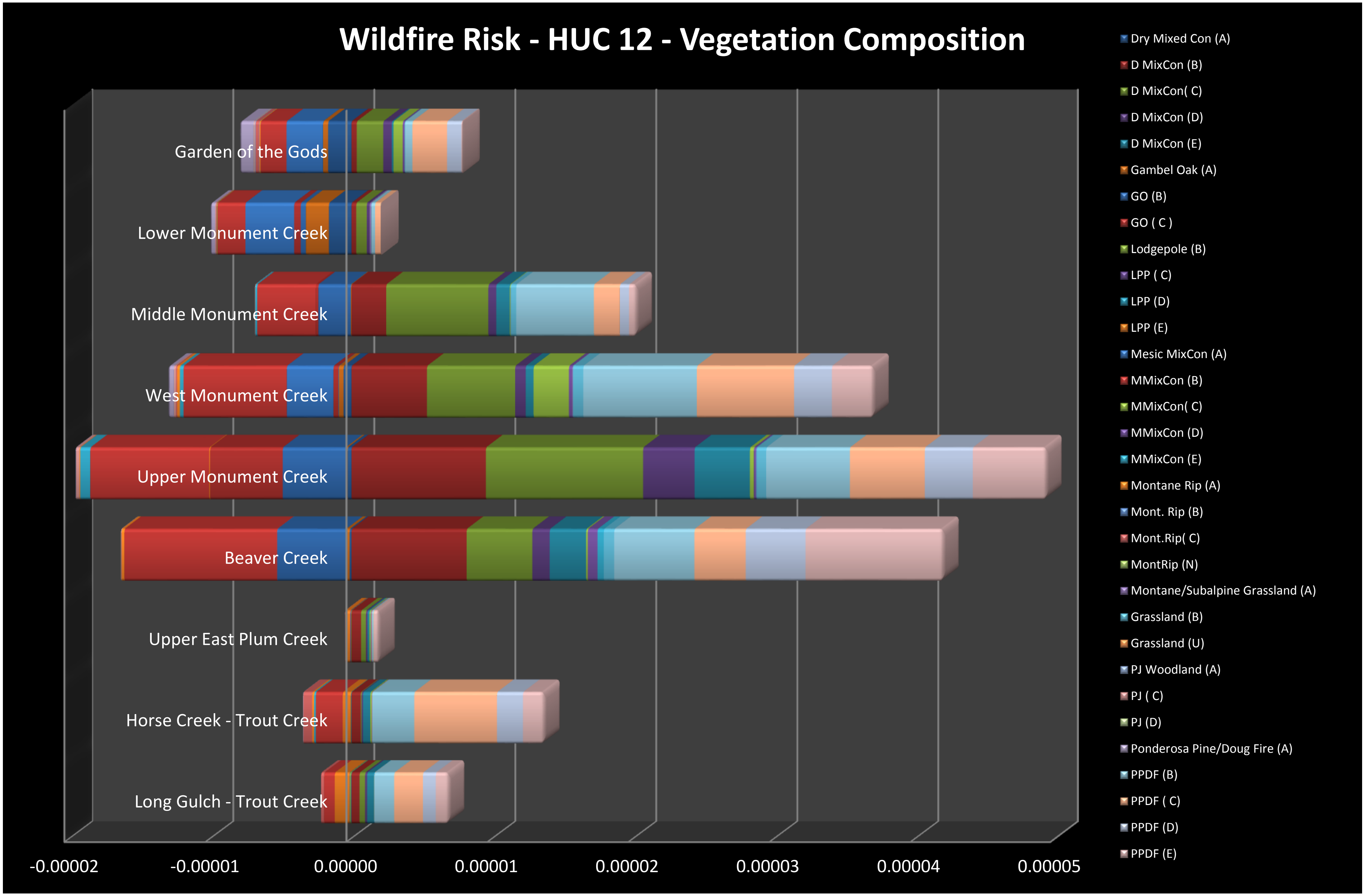


Figure 20: Expected loss (Wildfire Risk) – TES Habitat HVRA