

Rapid Assessment of Ecosystem Condition: Tools and Applications for Restoring Sierra Nevada Meadows

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Purpose and Need

- Meadow Ecosystem Services:**
 - Grazing forage
 - Wildlife habitat
 - Groundwater storage/ Augmented baseflows
 - Water quality improvement
 - Flood attenuation
 - Carbon sequestration
 - Recreation
- Meadow Restoration Need:**
 - Limited resource: Comprise only 10% of Sierras
 - Degraded system: Estimated 40-60%

Objectives

- Identify and Delineate:**
 - Where:** Identify meadow locations
 - How Much:** Delineate meadow boundaries
 - Groundtruth desktop delineations
 - Identify delineation discrepancies
- Develop a Meadow Assessment Protocol**
 - Rapid
 - Cost-effective
 - Identifies restoration candidates
 - Technically accessible
- Develop Prioritization Methods**

Case Study Site: Yuba Watershed

- Targeted Meadow**
 - > 20 acres
 - > 5,000 ft msl
- Field Delineation**
 - 26 meadows
 - GPS groundtruthed

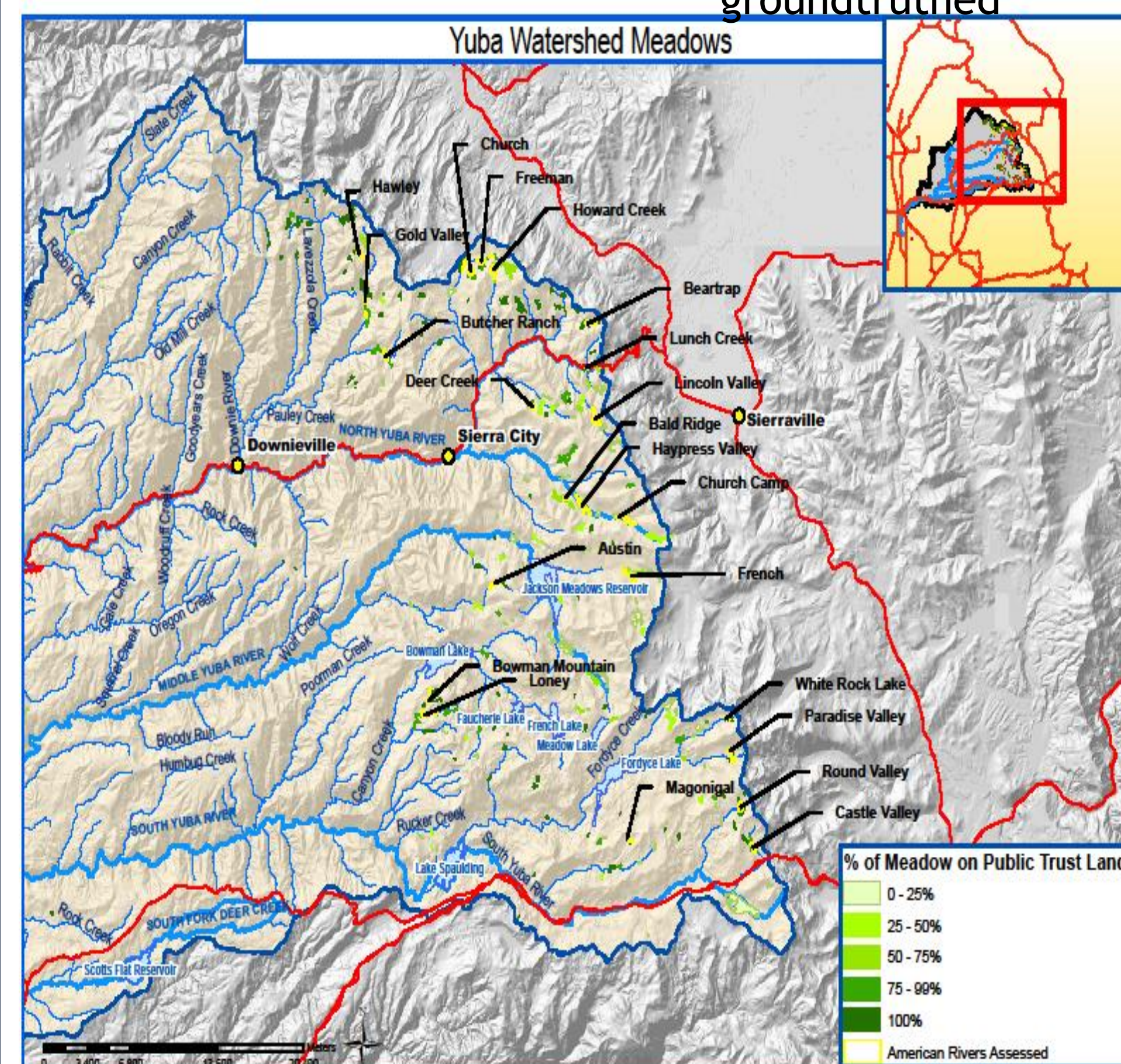


Figure 1: Yuba watershed meadows by area on public trust land

Meadow Identification

- California Department of Fish and Game (CDFG) delineation.
 - Desktop delineation based on:
 - Landsat imagery
 - Topographic and vegetative attributes

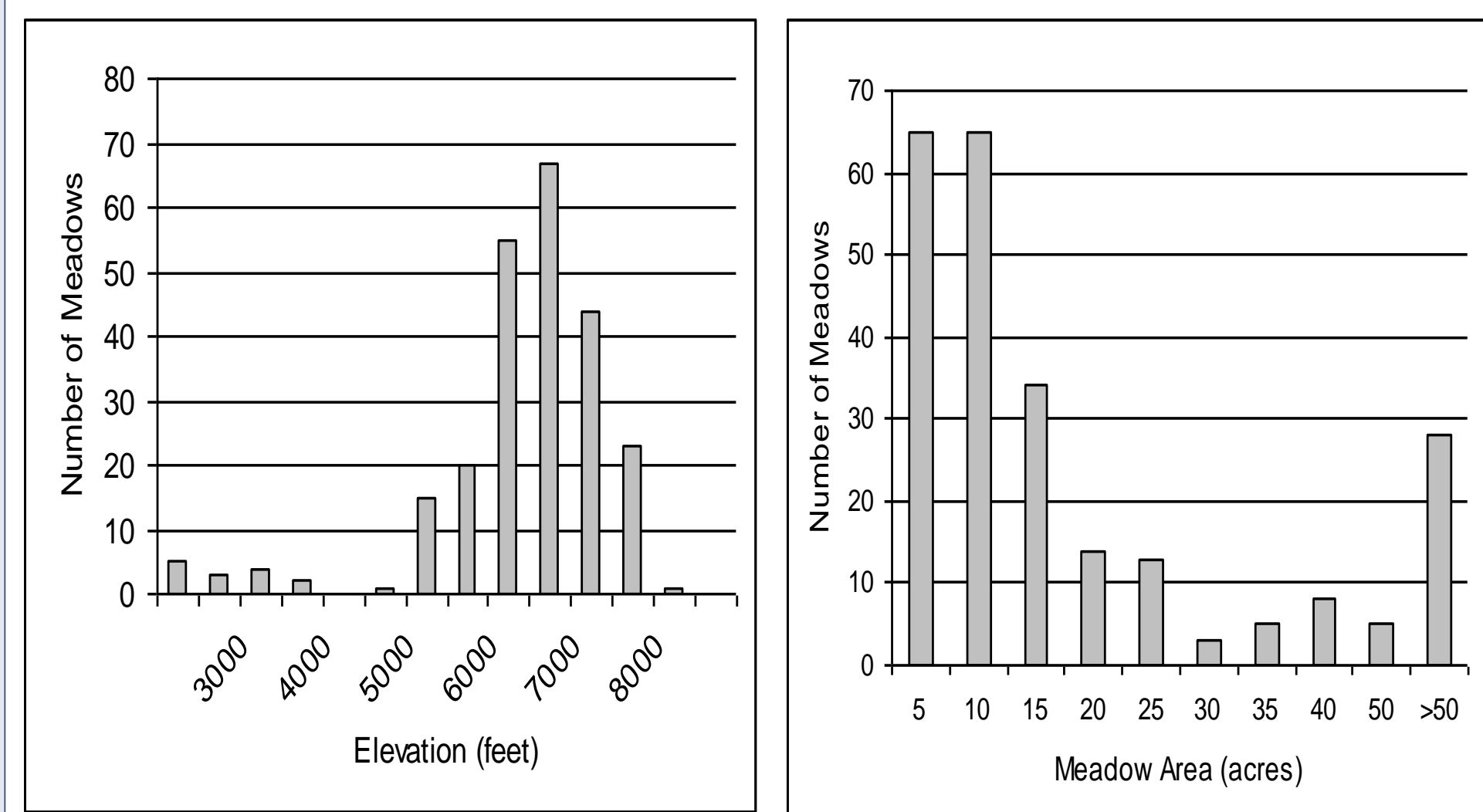


Figure 2: CDFG-delineated meadows of the Yuba watershed distributed by elevation (a) and area (b)

Meadow Delineation Results

- Meadow Size Discrepancy:**
 - Actual size is 52% ± 8% (95% CI) of the CDFG-delineated areas
 - The total groundtruthed area of all meadows was 51% of the total CDFG-delineated meadow acreage
- Causes for Delineation Differentiation:**
 - Inclusion of sloped areas (> 6% grade)
 - Inclusion of alder and willow thickets and thin riparian stringers

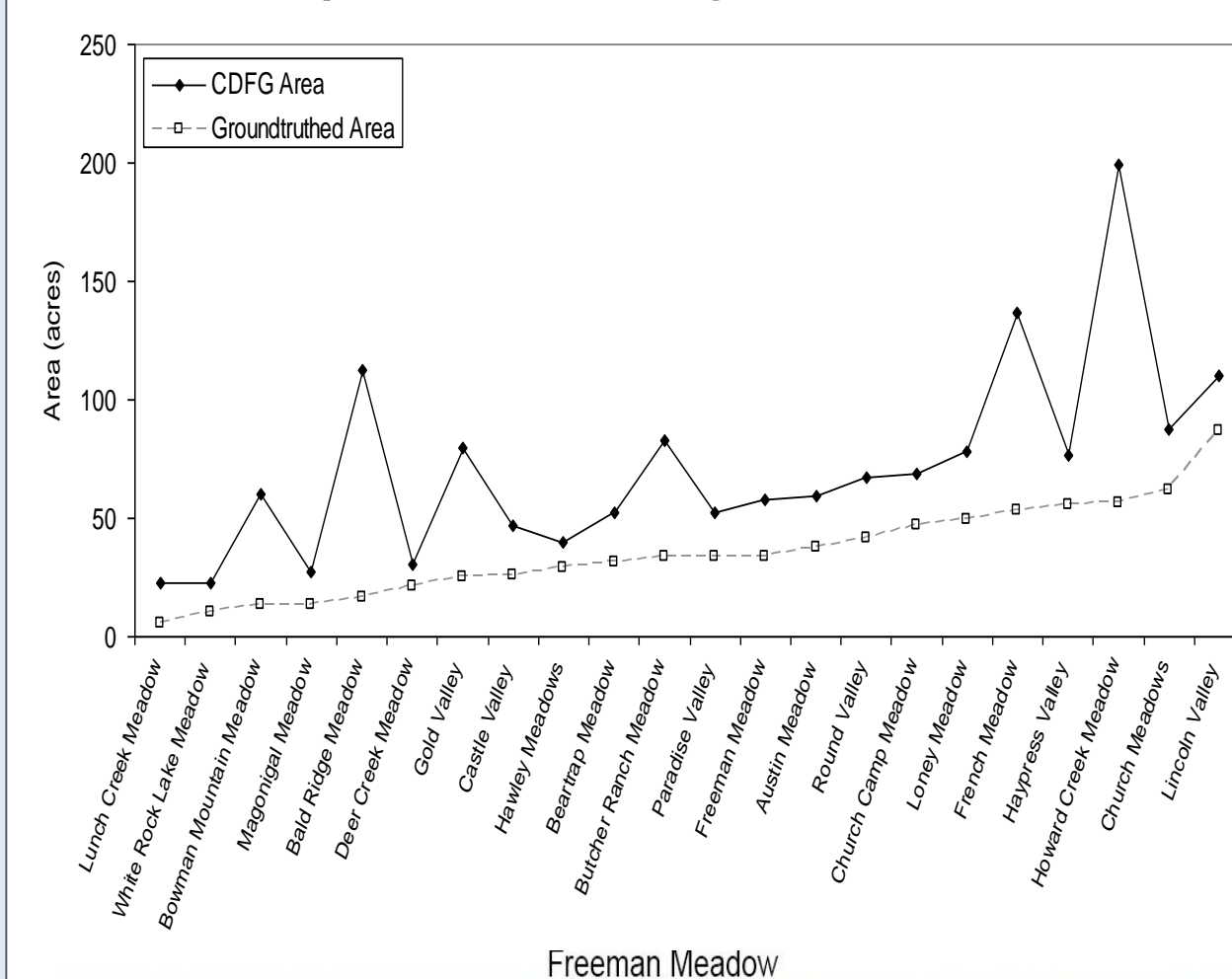


Figure 3: CDFG-delineated and corresponding groundtruthed areas for each meadow surveyed in the Yuba watershed

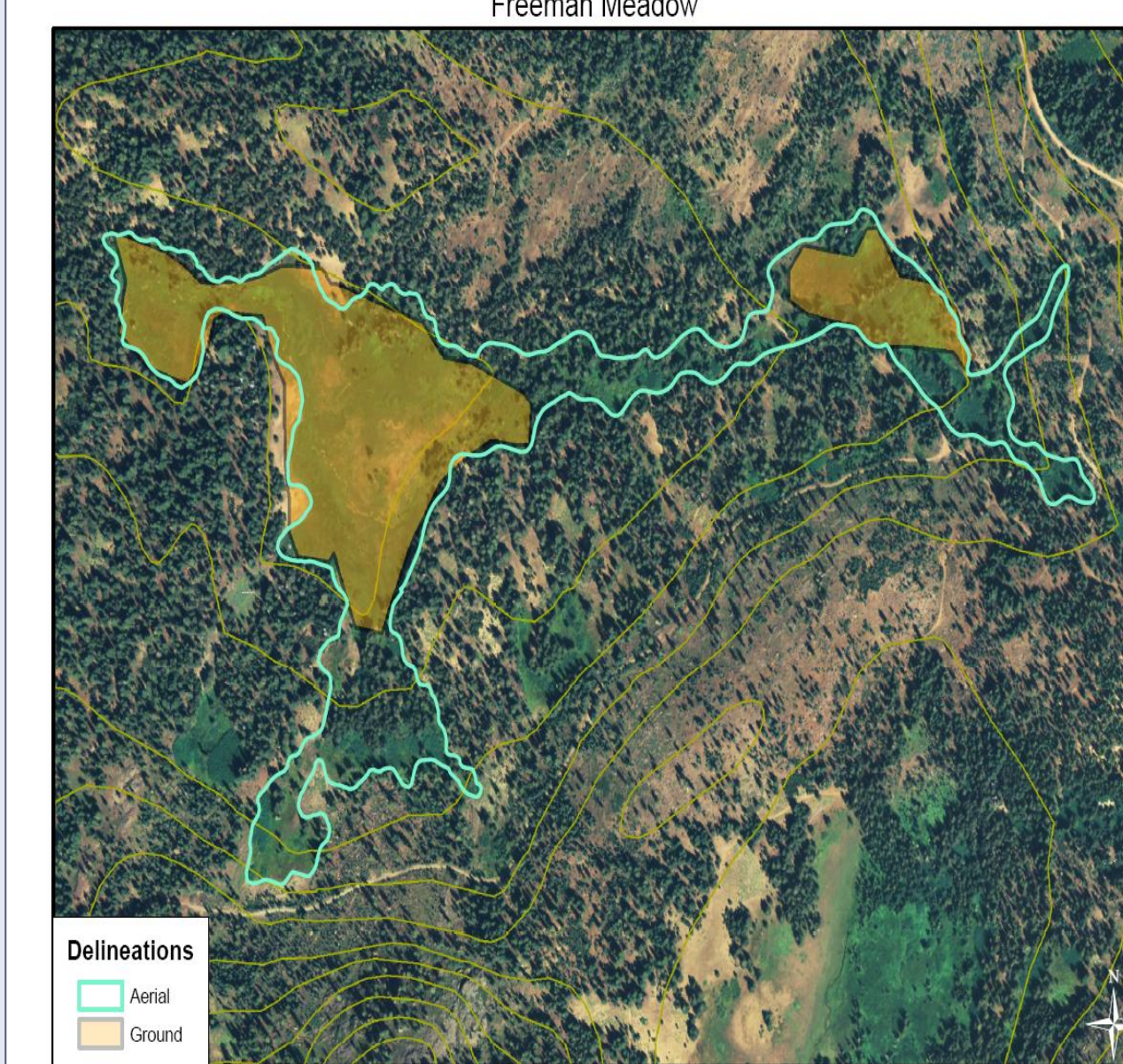


Figure 4: Freeman Meadow in the Yuba watershed is an example of the discrepancy between CDFG aerial delineation (58 acres) and groundtruthed meadow boundary delineation (34 acres)

Scorecard Development

- Adapted from habitat condition indices:
 - EPA Physical Habitat Assessment: Barbour et al., 1999
 - Rapid Habitat Assessment (RHA): Purdy & Moyle 2008
- Focused on key aspects of meadow function primarily based on:
 - Depth of channel incision/floodplain access
 - Bank stability
 - Dominance of plant functional groups
 - Percent bare ground
 - Conifer or sagebrush encroachment

Preliminary Results: Yuba Watershed Meadow Health

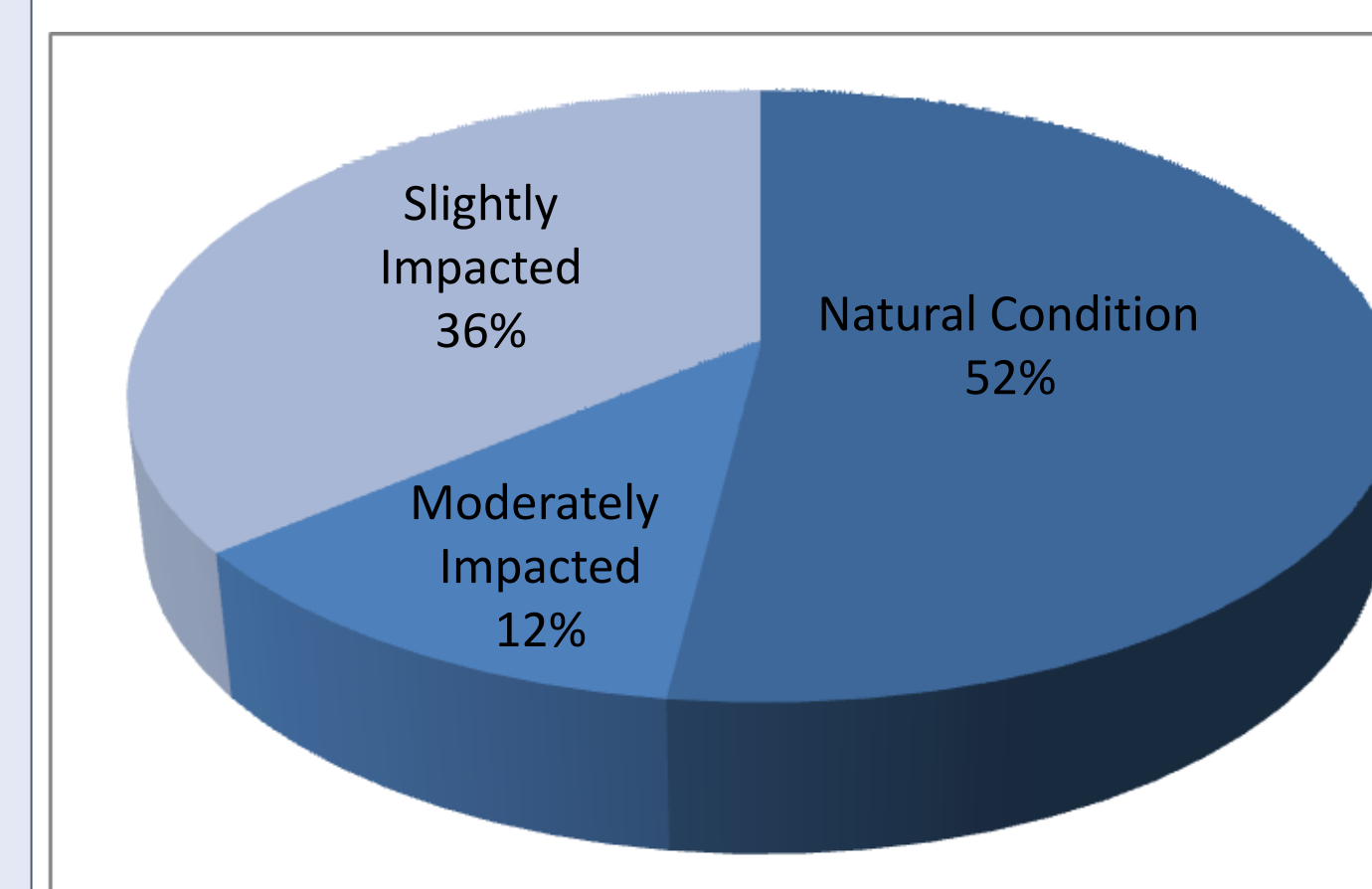


Figure 5: Distribution of Condition Scores for all 26 meadows assessed. No meadows visited were heavily impacted.

Meadow Assessment Prioritization In-depth Analysis Selection

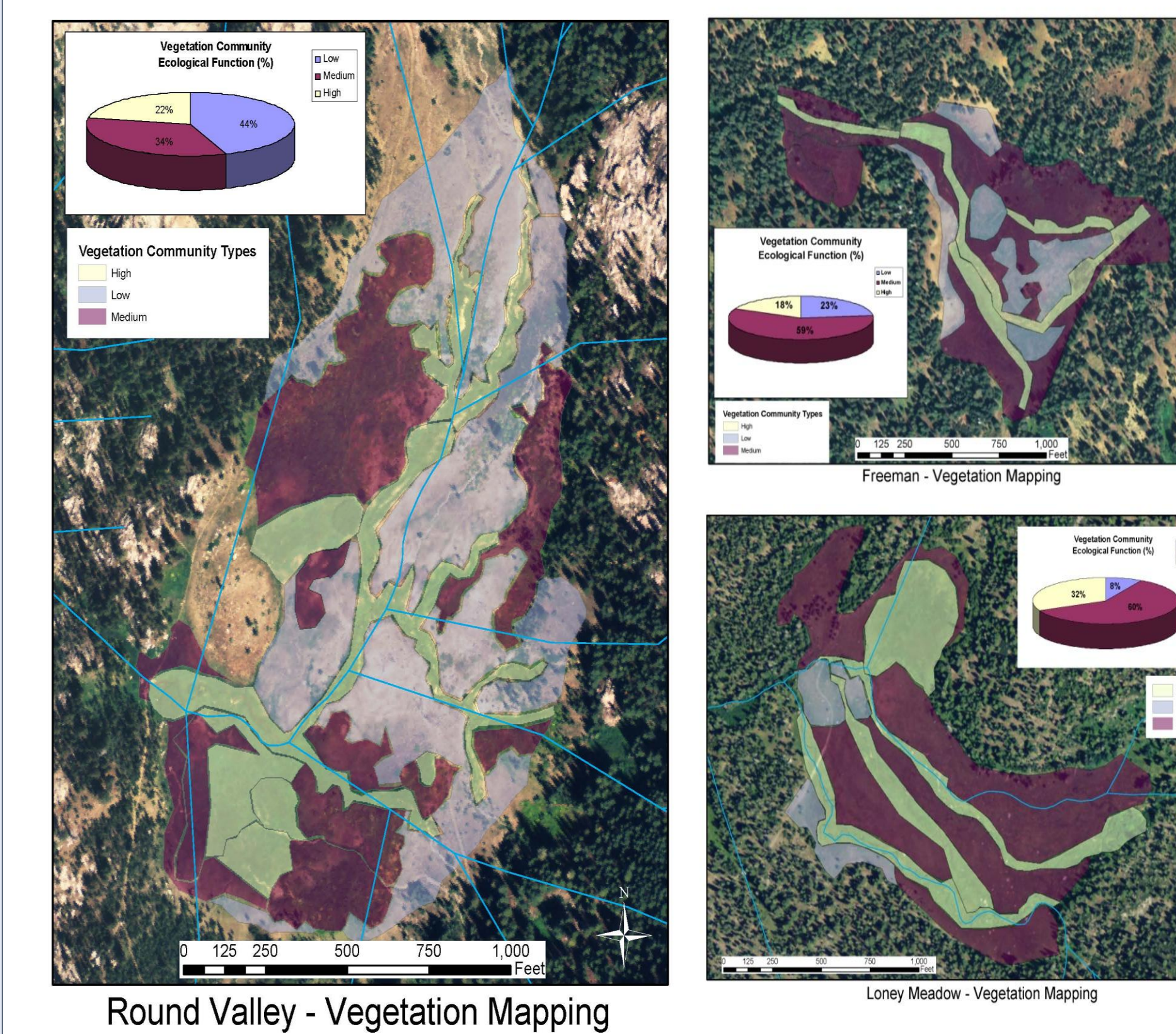
- In-depth Analysis Selection Process**
 - Lowest Meadow Scorecard Condition: 10 lowest scoring meadows
 - Secondary Matrix incorporating:
 - Ownership
 - Accessibility
 - Size
 - Restoration funding potential

| Meadow Name | Condition Rank | Ownership | Accessibility | Size | Future Funding | Observational Data |
|---------------------------|----------------|----------------|---------------|--------|----------------|--|
| French Meadow | 2 | Mostly Private | medium | large | No | Only ~ 1/3 of the meadow is on public land |
| Magopongal Meadow South | 3 | Public | medium | small | No | High cost to restoration benefit ratio; small and complex system |
| Howley Meadow | 4 | Public | difficult | small | Yes | |
| Castle Valley | 6 | Public | Easy | medium | No | See explanation, below. |
| Howard Creek Meadow Lower | 7 | Private | medium | large | No | Mostly Private |
| Lincoln Valley | 8 | Private | easy | large | No | Mostly Private |
| Deer Creek Trib Meadow | 10 | Public | medium | small | No | Small size potential for water storage is low |

Table 1: Decision matrix for the seven meadows not chosen for in-depth analysis.

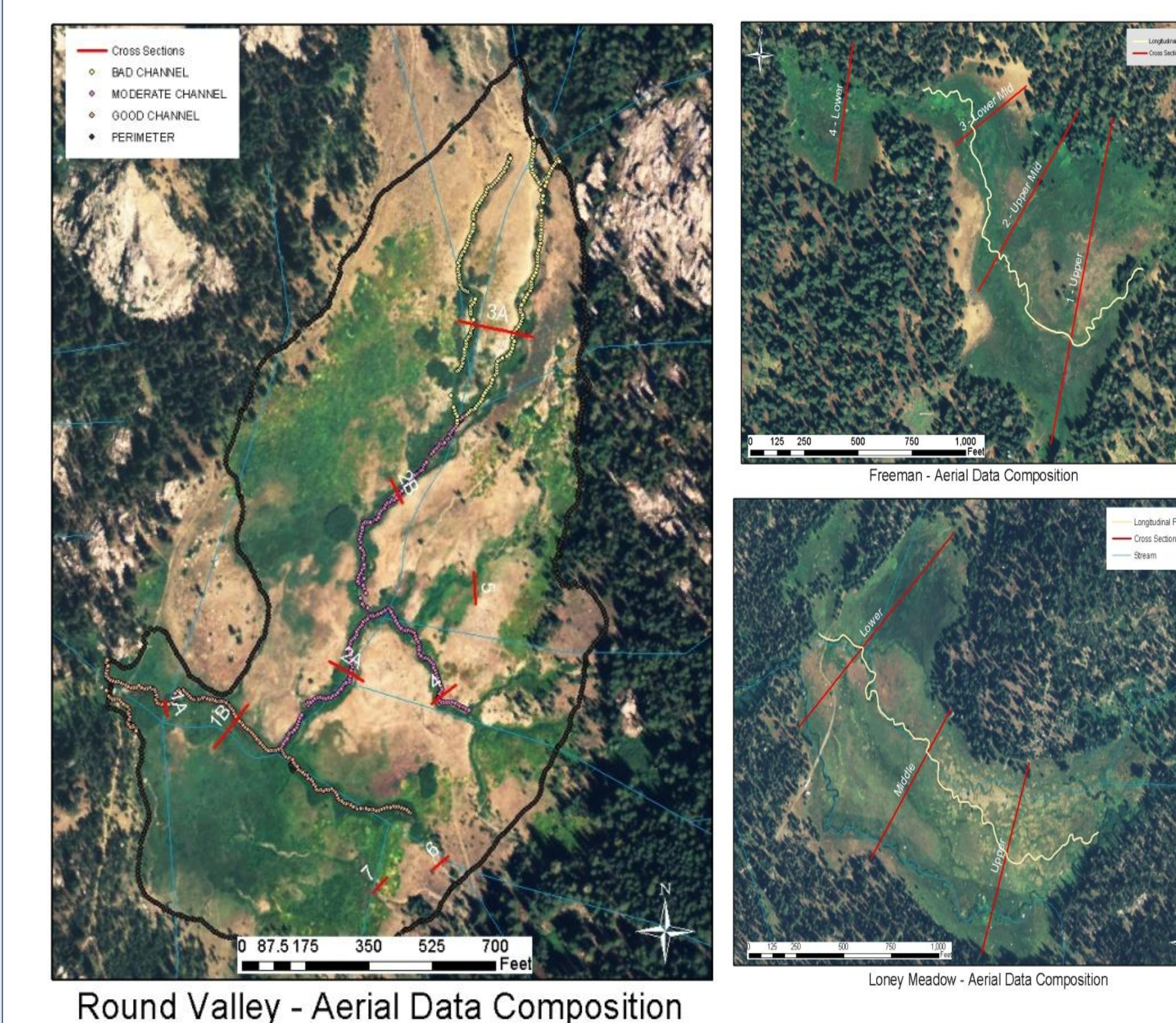
In-depth Analysis Results: Vegetation

- Vegetation ecological function groups based on:
 - Rooting habit: rhizomatous, cespitose
 - Wetland rating: Obligate (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), and upland (UPL)
 - Root depth (for graminoid species)
 - Life history (annual or perennial)
 - Life form (grass, grasslike, forb, woody)
 - Plant height
 - N-fixing capability



| | % area with High Ecological Function Meadow vegetation | % Medium Function | % Low Function |
|------------------|--|-------------------|----------------|
| Freeman Meadow | 18 | 59 | 23 |
| Loney Meadow | 32 | 60 | 8 |
| Round Valley Mdw | 22 | 34 | 44 |

In-depth Analysis Results: Channel Condition



| | Freeman | Loney | Round |
|---------------------|---------|-------|-------|
| Slope (%) | 0.8 | 0.94 | 2.2 |
| Sinuosity | 1.7 | 1.3 | 1.16 |
| Stream Length (ft.) | 2097 | 2283 | 2440 |

Conclusions

- Meadow size is currently overestimated, thus an improved desktop delineation methodology is needed and groundtruthing
- Stepwise approach to more detailed meadow assessment protocols proved time and cost efficient
- Future Effort:
 - Quantifying restoration benefits
 - Forage quality
 - Flood attenuation
 - Instream flows: summer base flows
 - Terrestrial and aquatic habitat
 - Public meadow restoration database

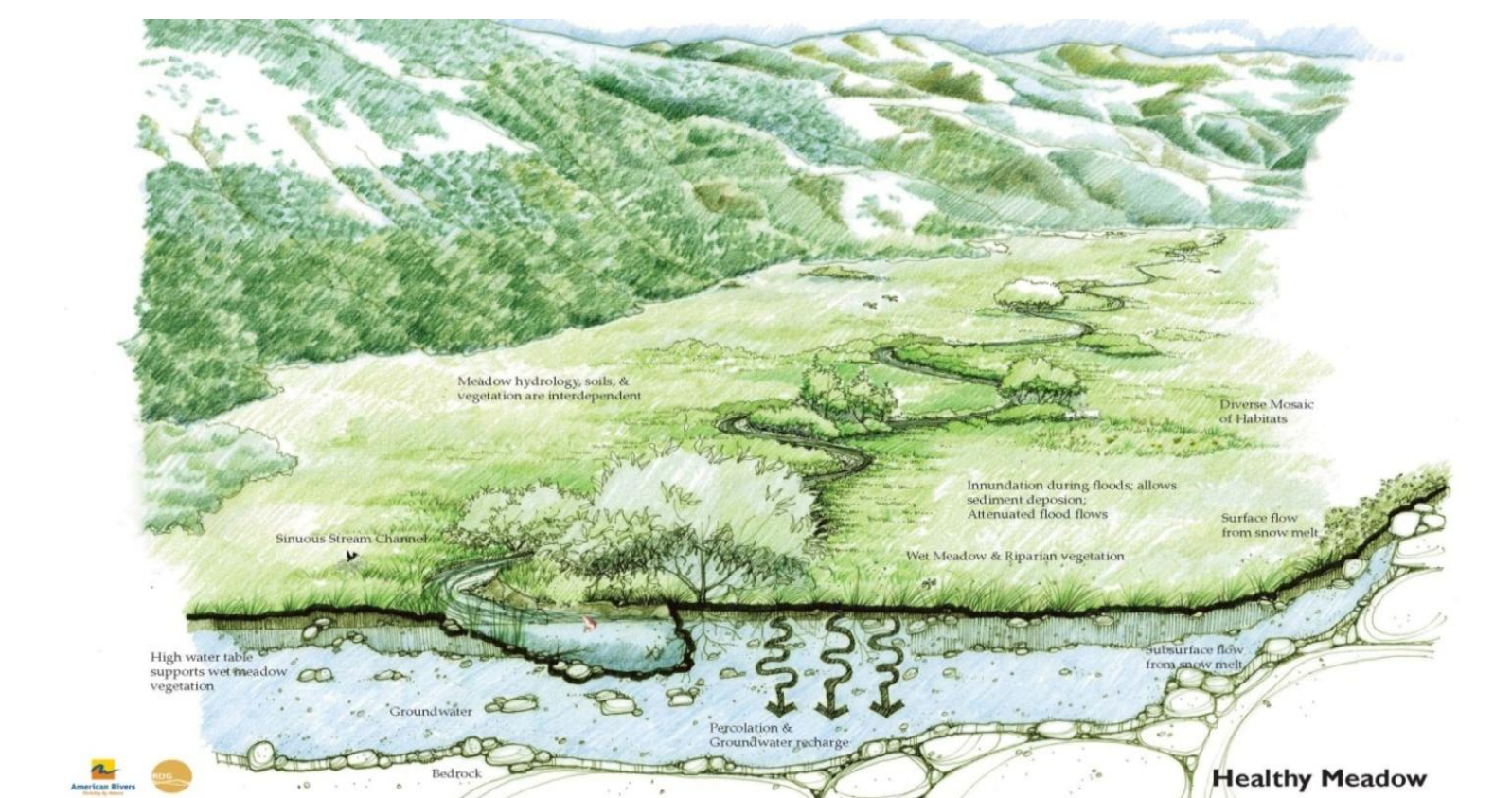


Figure 6: Ecological functions that restored healthy meadows can provide

References

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