# A PRELIMINARY EXAMINATION OF THE EFFECTS OF FERAL PIGS ON WATER QUALITY AND SOIL LOSS WITHIN A HAWAIIAN WATERSHED

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# Problems & Speculations

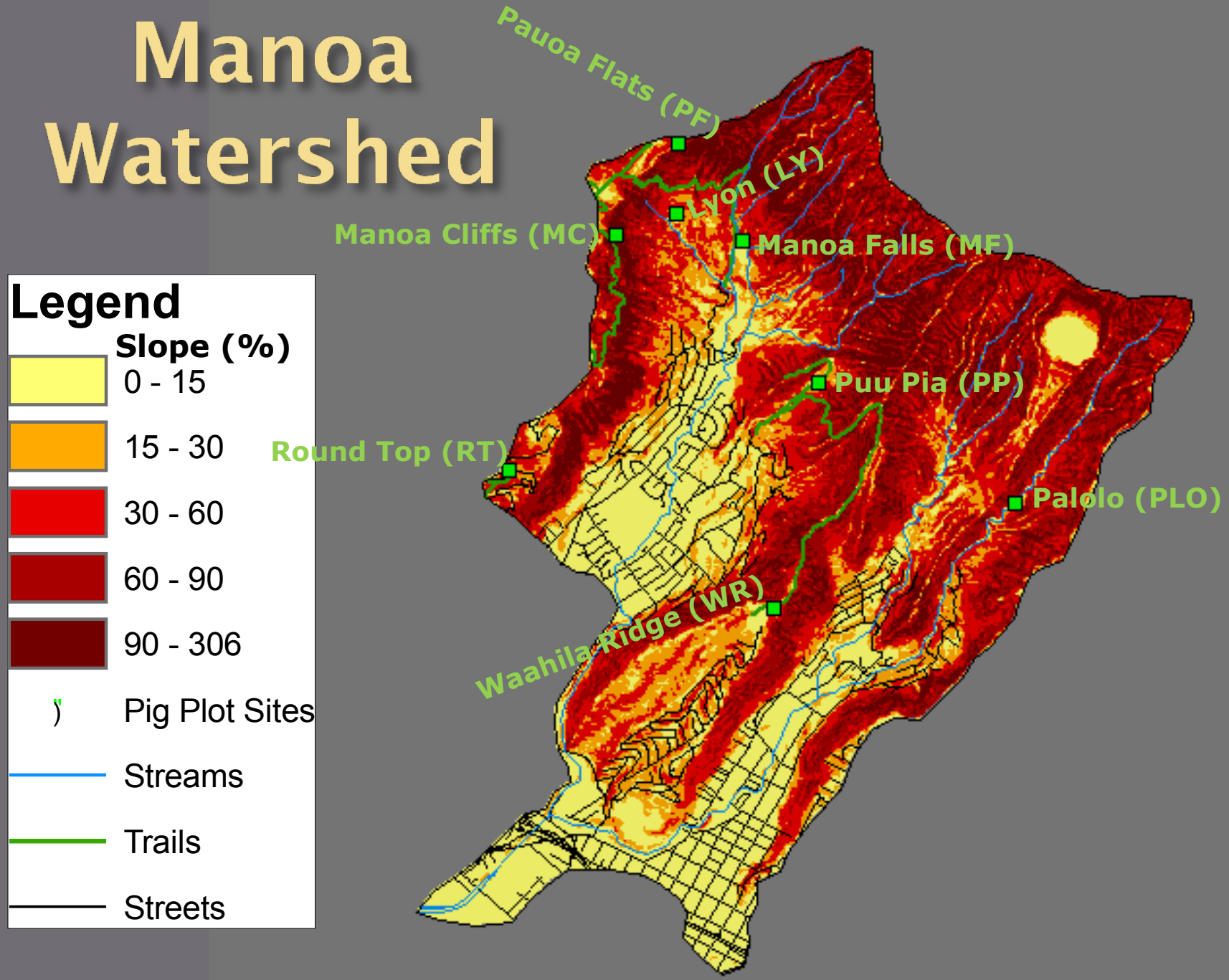
- Spread disease (Freed et al 2005, USGS 2006)
- Destroy/consume native vegetation (Drake 2001, Sweetapple 2004); Spread invasive plants (Stone et al. 1992)
- Reduce soil cover (Mitchell 1997)
- Increase soil loss and runoff
- Sedimentation into streams, estuaries, and coral reefs
- Intensify flooding?

**A hapuu knocked over and consumed by feral pigs**

# Objectives

- How much runoff is generated in the forested areas of Mānoa watershed ?
- How do characteristics (slope, soil type, ground cover, canopy cover, and feral pig disturbance) influence runoff and soil loss within Mānoa watershed?
- What is the water quality of runoff from these higher forested reaches?  Are there differences between runoff amount and sediment loads in the plots where feral pig activity is excluded and those that are unrestricted?

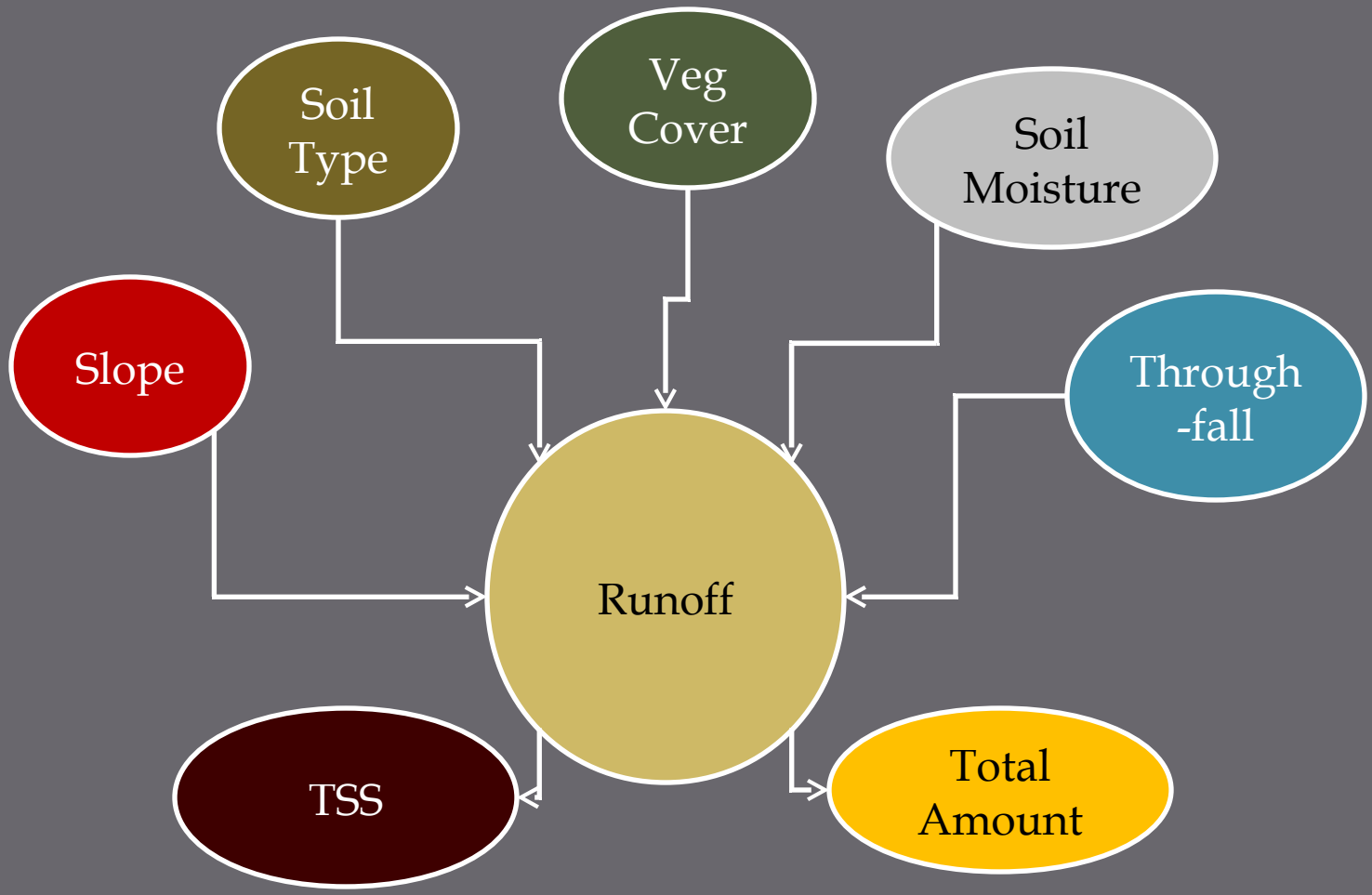
# Manoa Watershed



# Site Layout

# Runoff collection

**How do these interact to influence runoff?**




**What is the content and amount of runoff?**

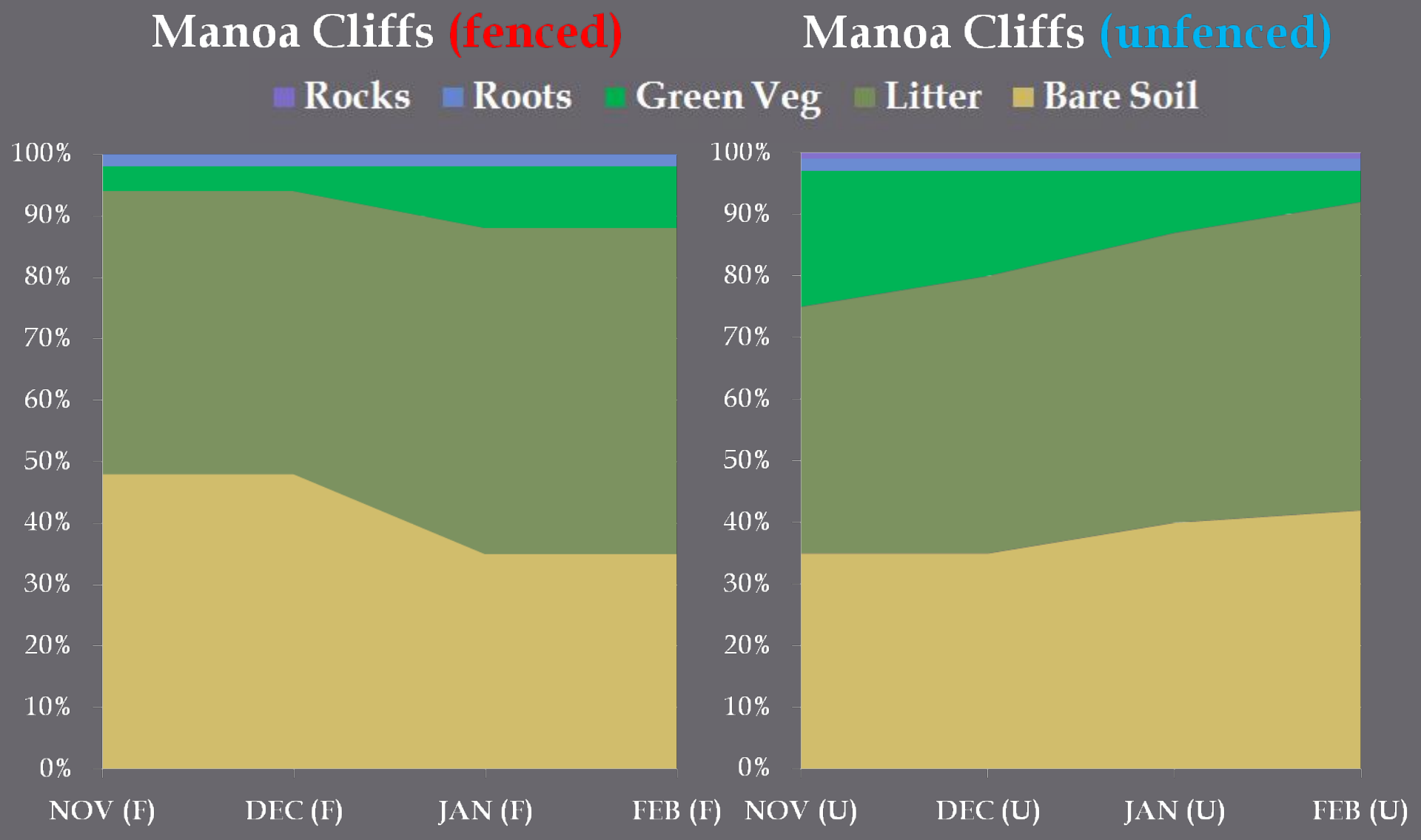
# Data Collection – Runoff

- **Antecedent conditions**
  - Soil Series
  - Slope readings (clinometer)
  - Soil water content
  - Vegetation monitoring
- **After rain event**
  - Throughfall gauge
  - Runoff collection
    - Total volume
    - TSS

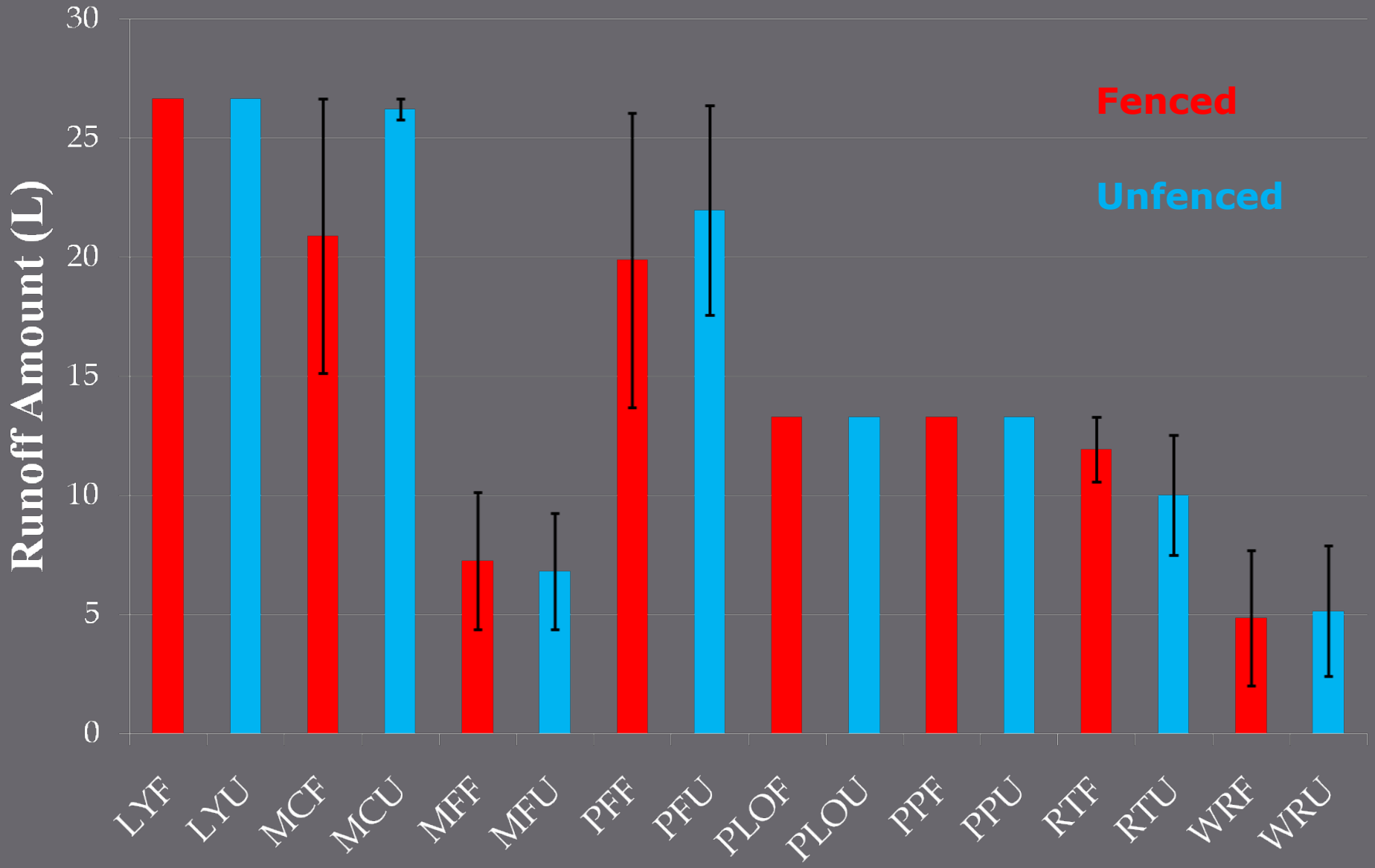
# Data Analyses

- One-way ANOVA
  - Fenced vs. Unfenced
  - Among Sites
  - Post-hoc comparison of means w/ LSD test
- Correlation/Multiple Regression Analysis
  - Spearman (non-linear)

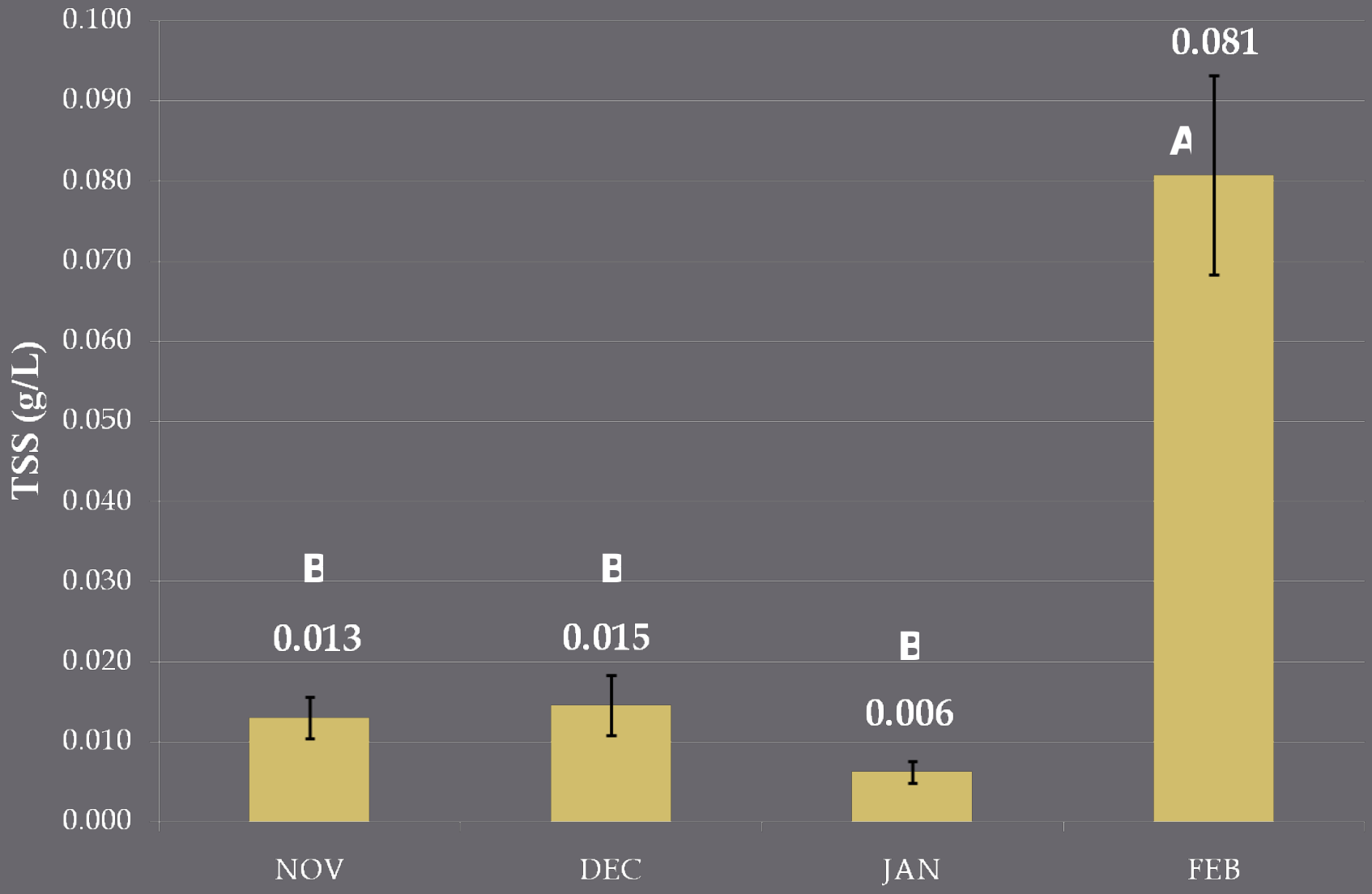
# Vegetation Monitoring



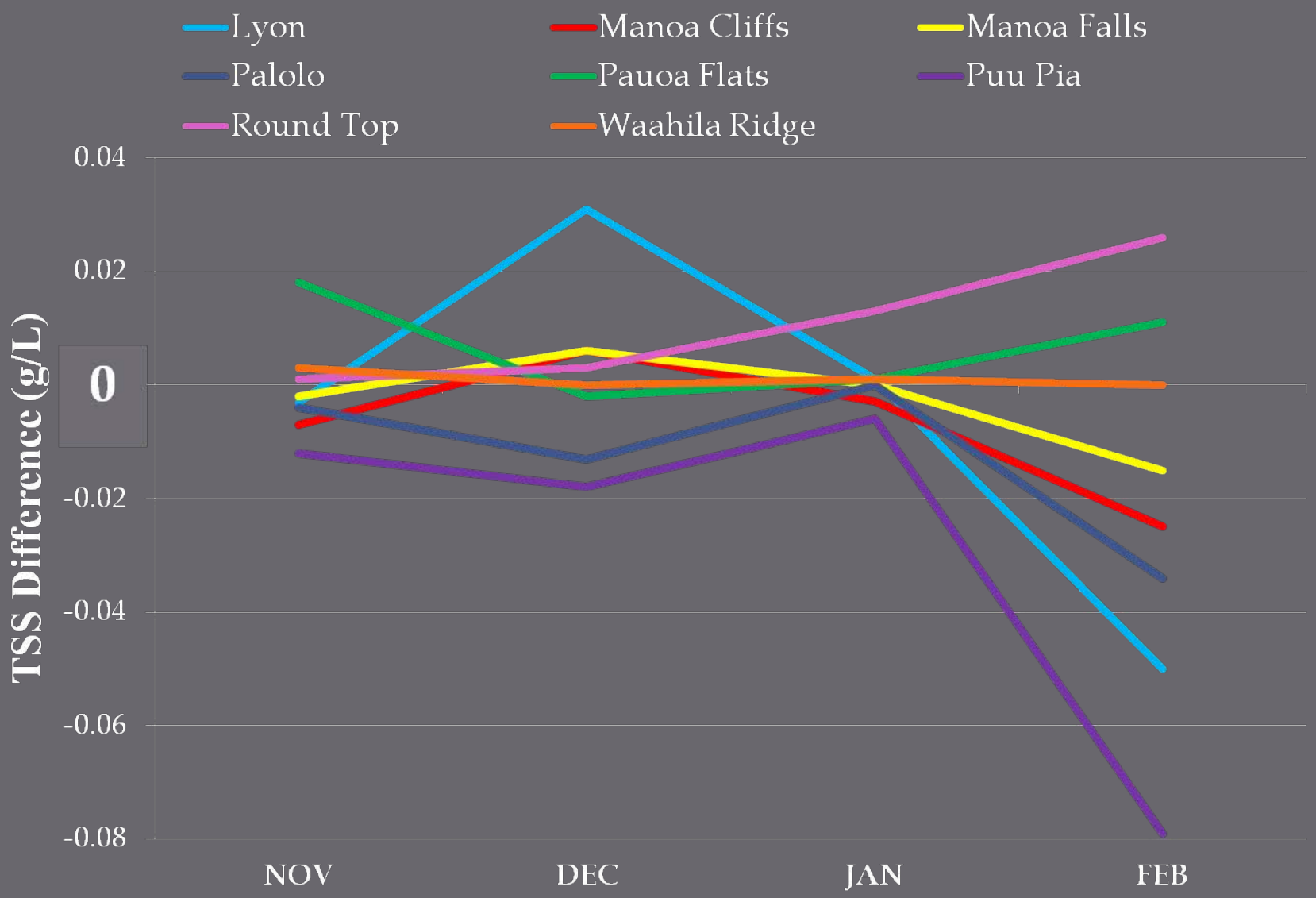
# Avg. Runoff Amount



# Avg TSS in Runoff by Month



# Runoff Results (TSS)



# Correlations with Runoff

| | RO Amt | TSS | TDS | Thrufall | Slope | SMoist | Canopy Cov | Mid Cov | Bare Cov |
|---|---|---|---|---|---|---|---|---|---|
| RO Amt | | 0.66 | -0.55 | 0.64 | NS | 0.76 | NS | NS | NS |
| TSS | | | NS | NS | NS | 0.70 | 0.72 | NS | 0.50 |
| TDS | | | | NS | NS | -0.61 | NS | NS | NS |
| Thru-fall | | | | | NS | 0.61 | NS | NS | NS |
| Slope | | | | | | NS | NS | NS | NS |
| SMoist | | | | | | | 0.61 | NS | NS |
| Canopy Cov | | | | | | | | NS | NS |
| Mid Cov | | | | | | | | | NS |
| Bare Cov | | | | | | | | | |

TSS = -0.03 + 0.10(SoilMoisture) + 0.03(BareSoilCover)

# Conclusions

- Heterogeneity between sites and over time
- Changes in vegetation cover over time
- Large amounts of runoff produced
- TSS trend over time
- Soil water content – highly correlated

# Management Implications

- Identification of areas in the watershed most susceptible to runoff and soil loss
- Provide baseline data that can be used for CBA
- Additional research needed

# Acknowledgments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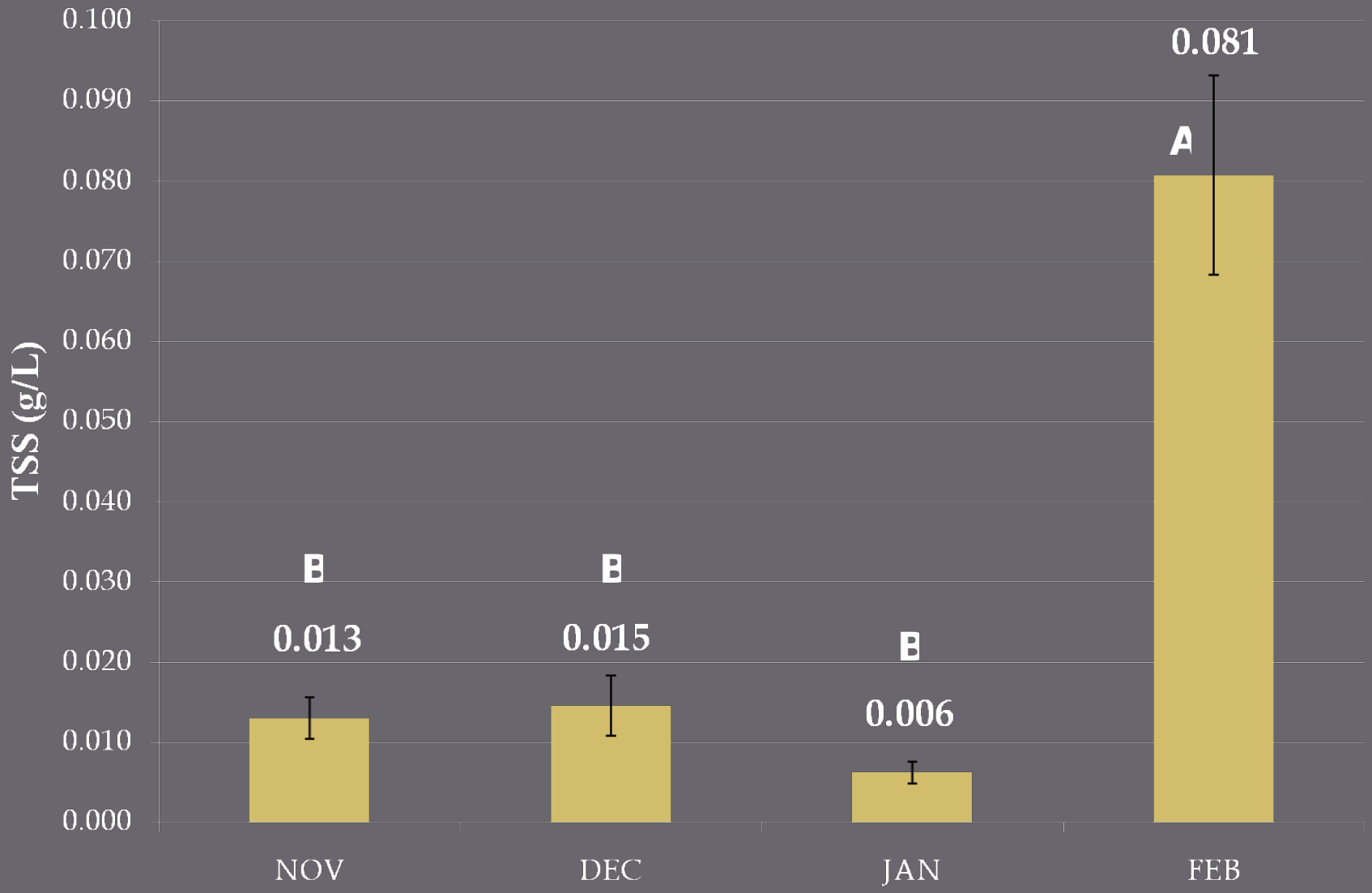
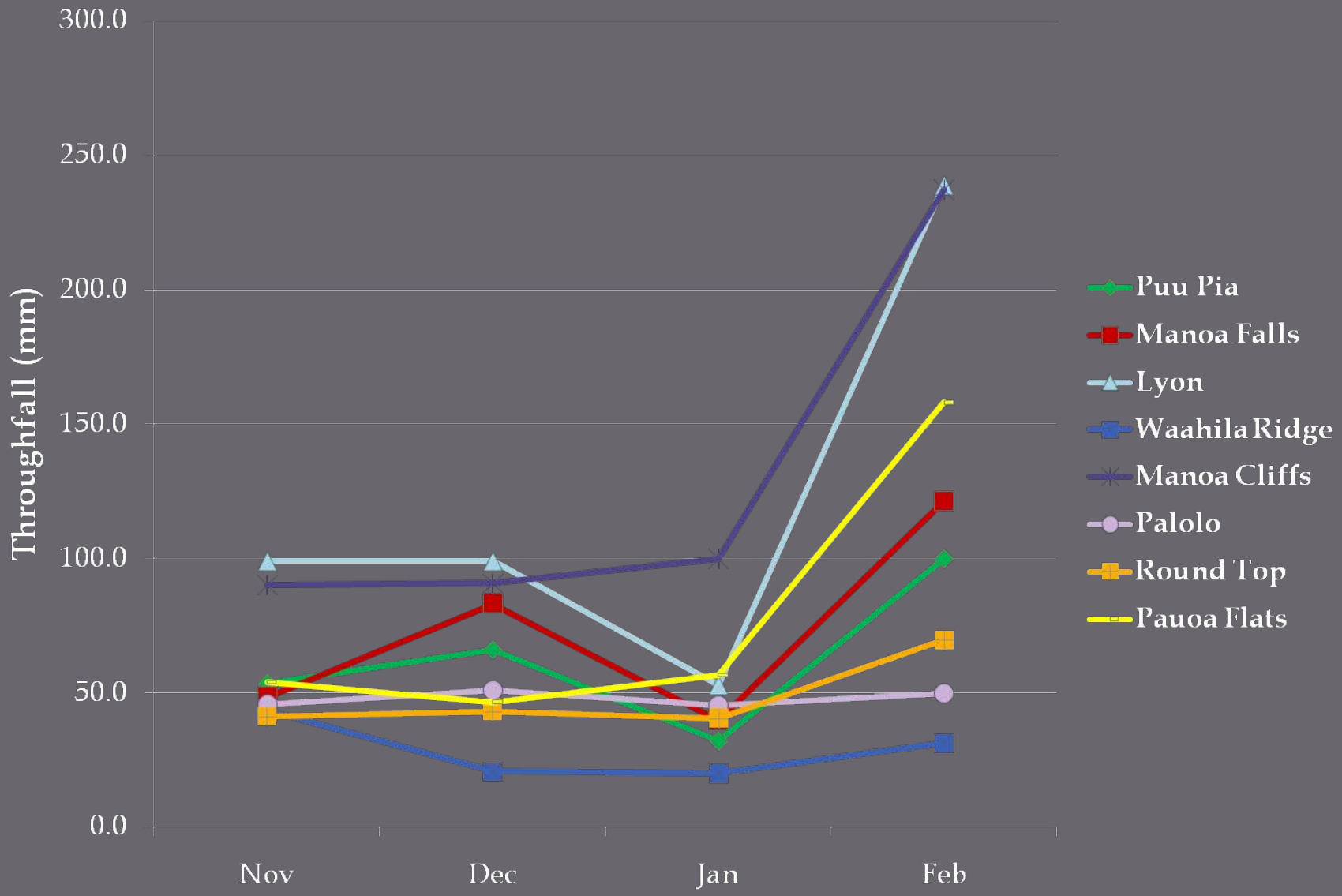
MAHALO
Questions?

# Avg TSS in Runoff by Month



# Throughfall - Results



# Hypotheses

- Runoff and erosion in forested areas of the Mānoa watershed will be correlated with throughfall and slope.
- Forested areas open to pig activity will produce more runoff and erosion than areas in which pig activity has been excluded.
- Areas open to pig activity will negatively affect water quality through increased sediment transport and nutrient input.

# Outline

- Introduction
- Objectives
- Materials and Methods
- Results
- Conclusions
- Questions

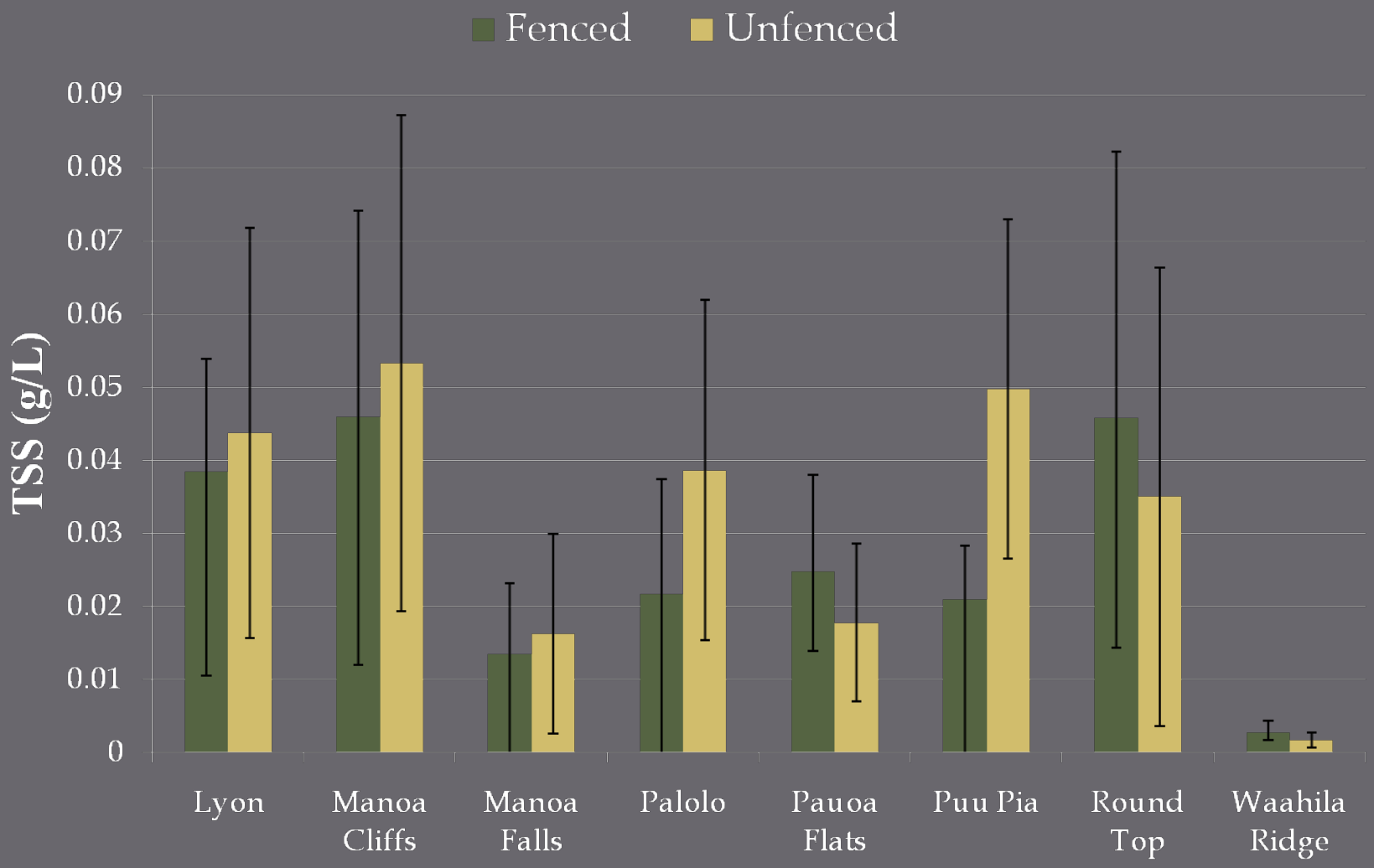
# Conclusions – Hypotheses

- Hypothesis 1 – Correlation between throughfall amount and slope
- Hypothesis 2 – More runoff and erosion in unfenced areas
- Hypothesis 3 – Reduced water quality content in runoff from unfenced plots

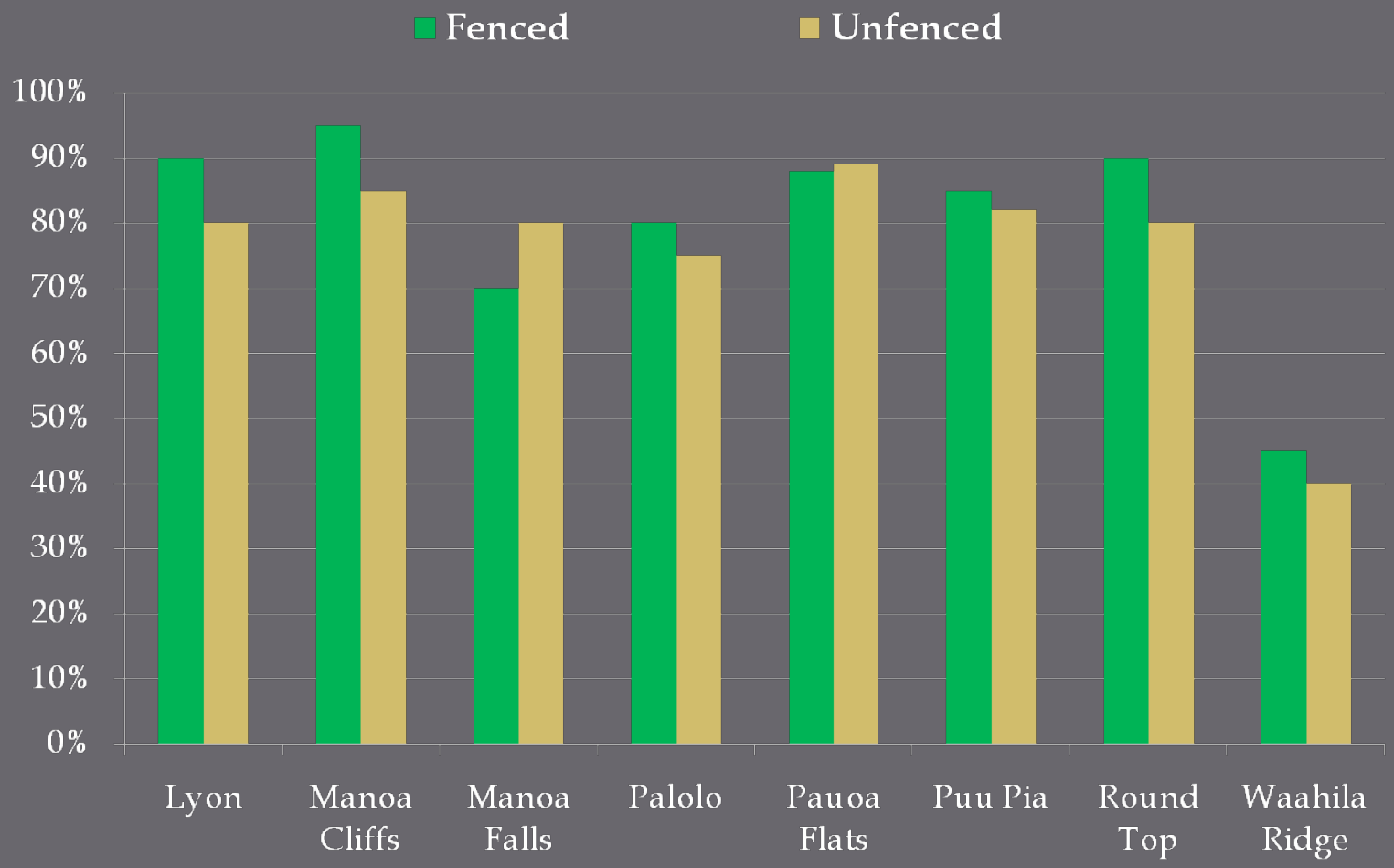
# Runoff Collection

- Activated prior to target week
- Collected after target rainfall (then deactivated)
- Collect only portion of total runoff after thoroughly mixed

# Runoff Results (TSS)



# Vegetation Monitoring Canopy Cover

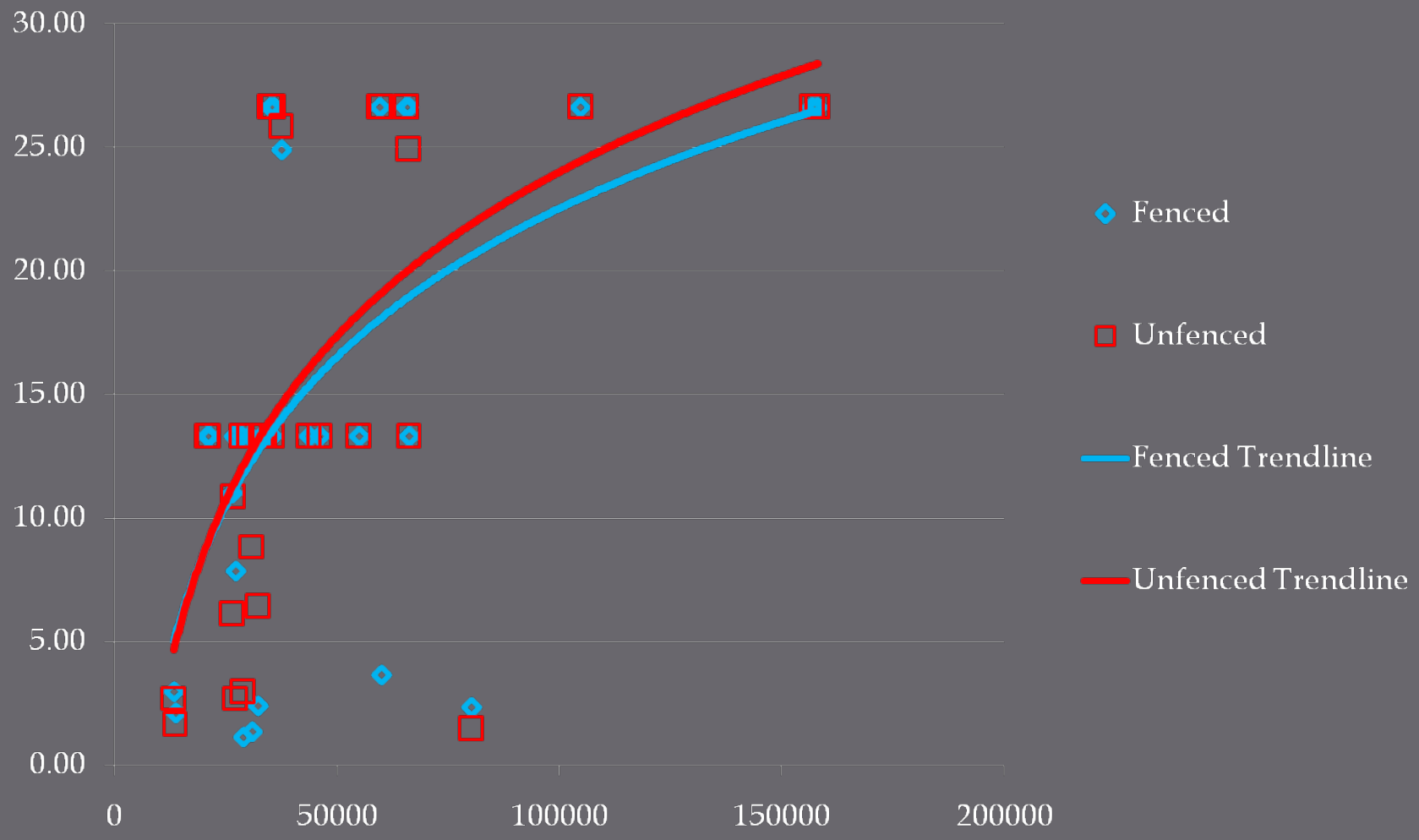



***Canopy cover remained the same for all 4 months

# Vegetation Monitoring Mid-canopy Cover


***Mid-canopy cover remained the same for all 4 months

# Runoff Results (Amount)



# Slope and Background Data

| Site | Elevation | Slope (handheld clinometer) | Soil Series |
|---|---|---|---|
| Lyon | 215m | 15-16% | Lolekaa Silty Clay |
| Manoa Cliffs | 450m | 8% | Rough Mountainous |
| Manoa Falls | 171m | 16-18% | Lolekaa Silty Clay |
| Palolo | 225m | 25-27% | Rough Mountainous |
| Pauoa Flats | 538m | 6% | Rough Mountainous |
| Puu Pia | 209m | 26% | Lolekaa Silty Clay |
| Round Top | 340m | 25-26% | Tantalus Silt Loam |
| Waahila Ridge | 340m | 14% | Manana Silty Clay |

# Site Layout