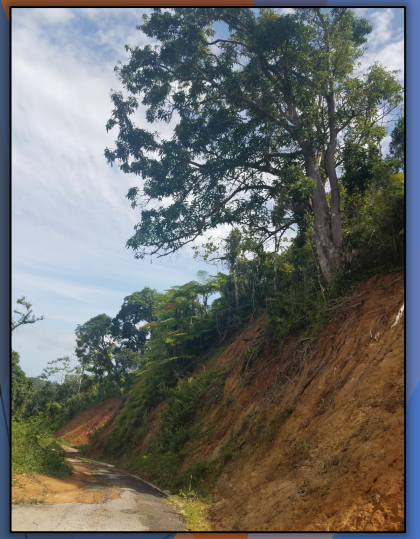
Analysis of Landslide Impact to Transportation Infrastructure and River Morphology – Río Grande de Añasco Watershed



Enhancing the Resiliency of Critical Infrastructure in Island Communities: An Integrated Approach
Sponsored by the National Science Foundation CRISP Program
October 24, 2019
City College of New York

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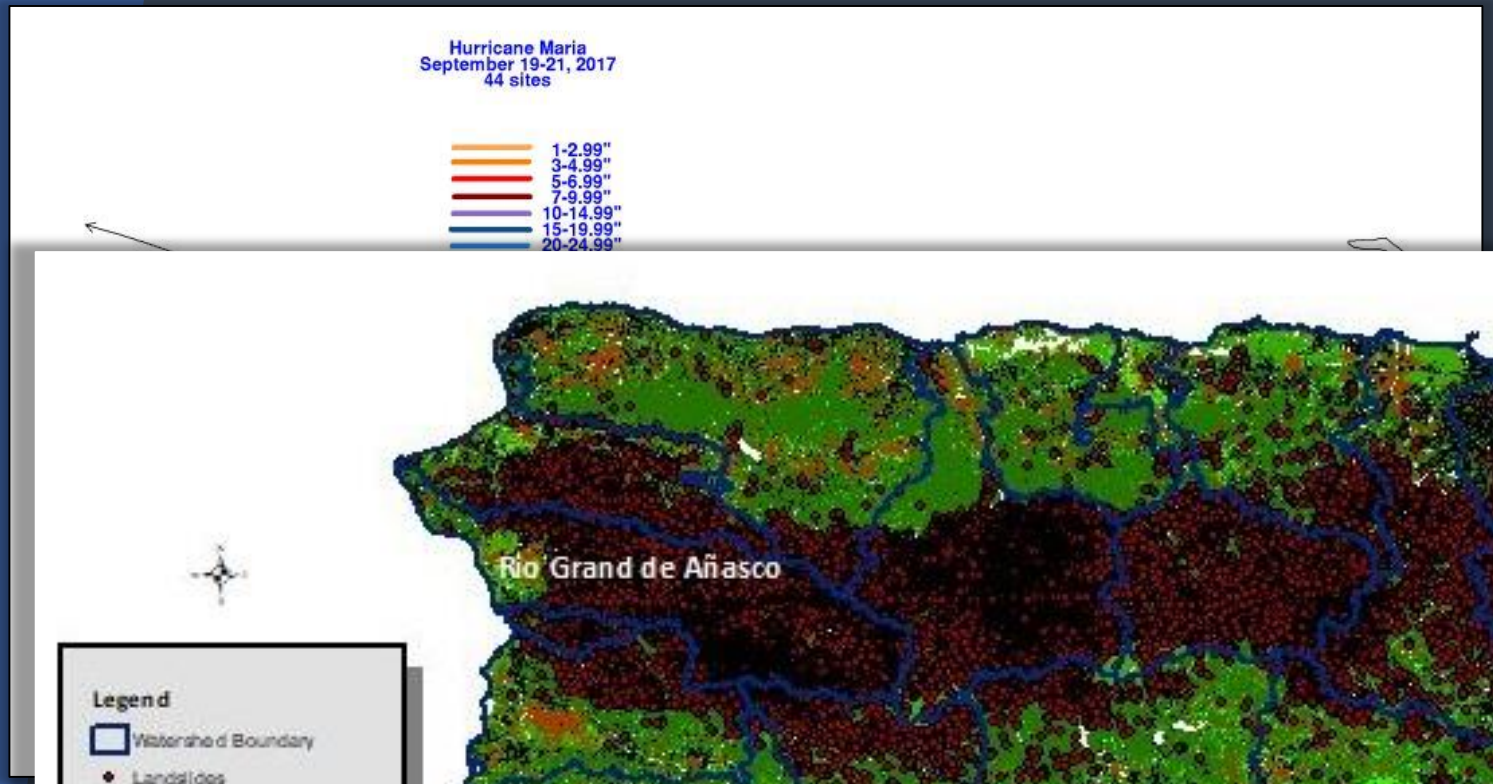
NSF CRISP ERIC Project
PhD Student, Colorado State University, Dept. of Geosciences

Presentation Overview

- Landslide Impact – Río Grande de Añasco Watershed
  - Landslide Density Distribution
  - Evaluating for Soil Type – Clay
  - Evaluating for Proximity to Streams and Roads
- Integration
  - NSF CRISP Project Working Groups
  - Socio-Ecological Assessment (PhD Research, Colorado State University)
  - Inter-agency Watershed Management – Puerto Rico



>70,000 island-wide
Bessette-Kirton et al 2019


N
35 m
N
100 m
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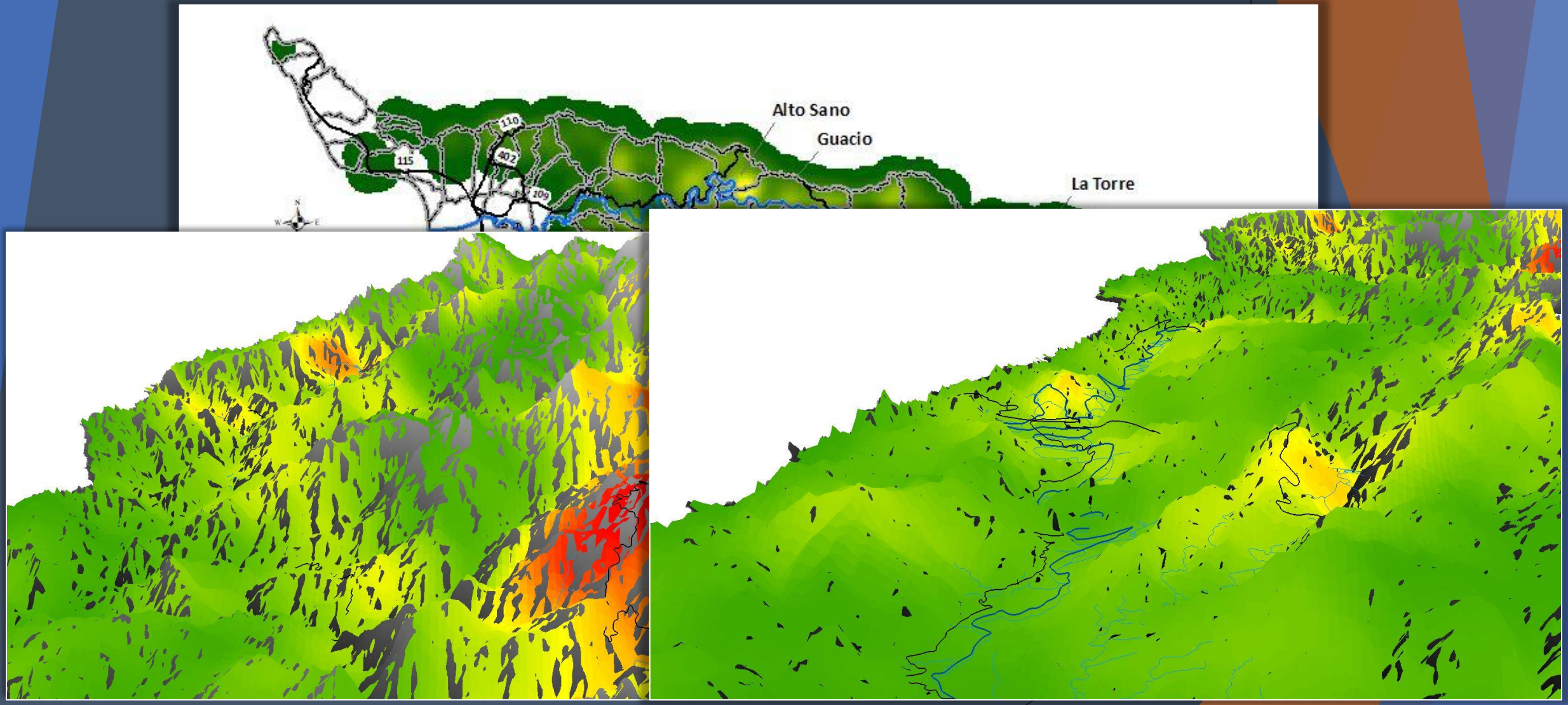
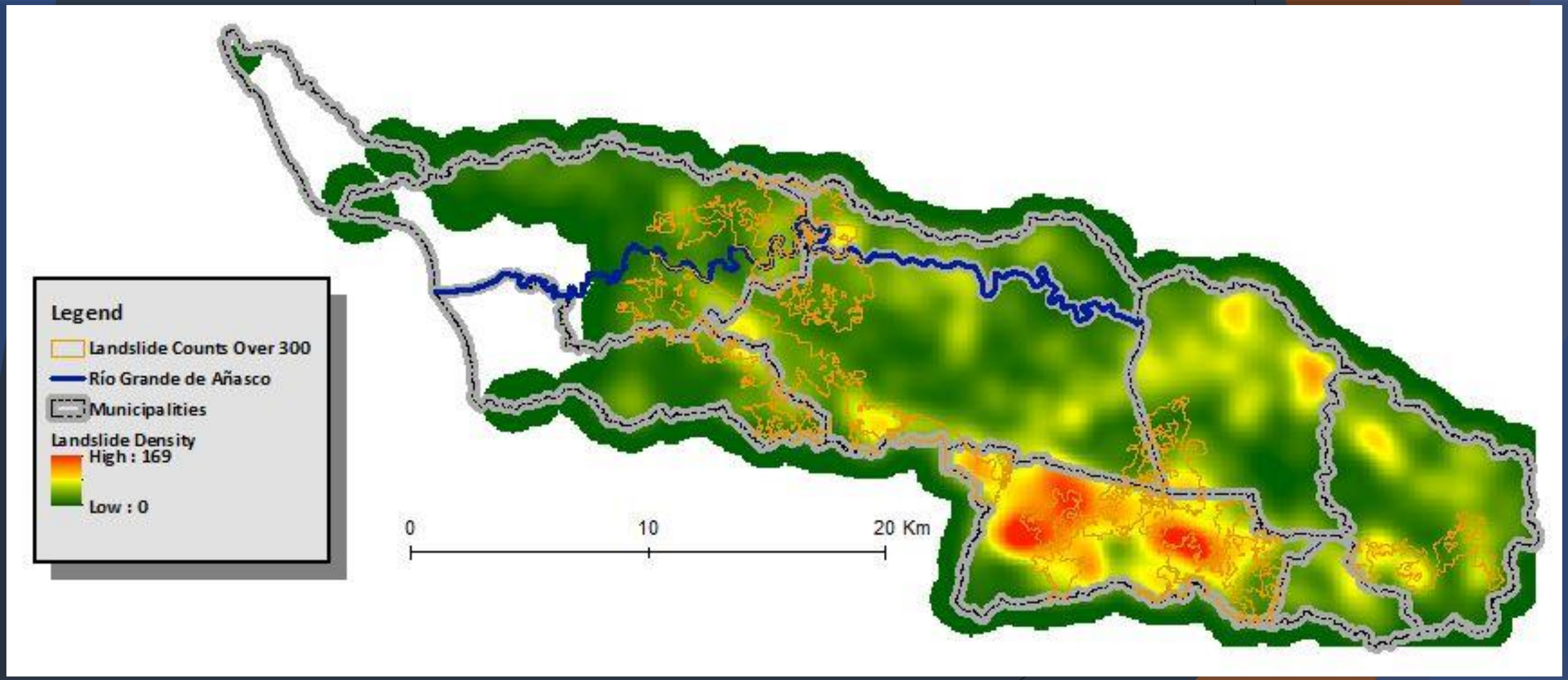
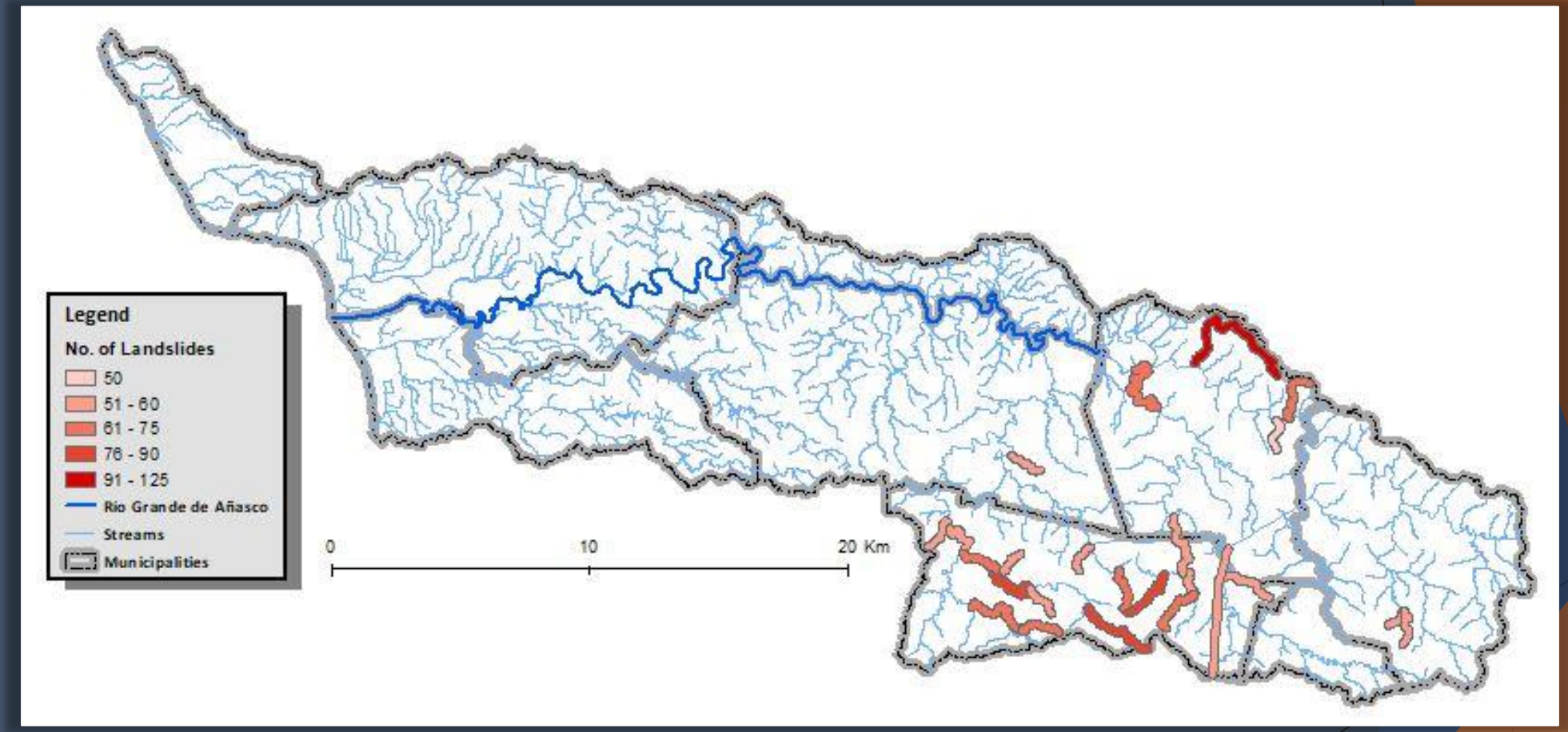
Landslide Density Distribution



Evaluating for Soil Type - Clay



Evaluating for Impact/Interaction Streams & Roads



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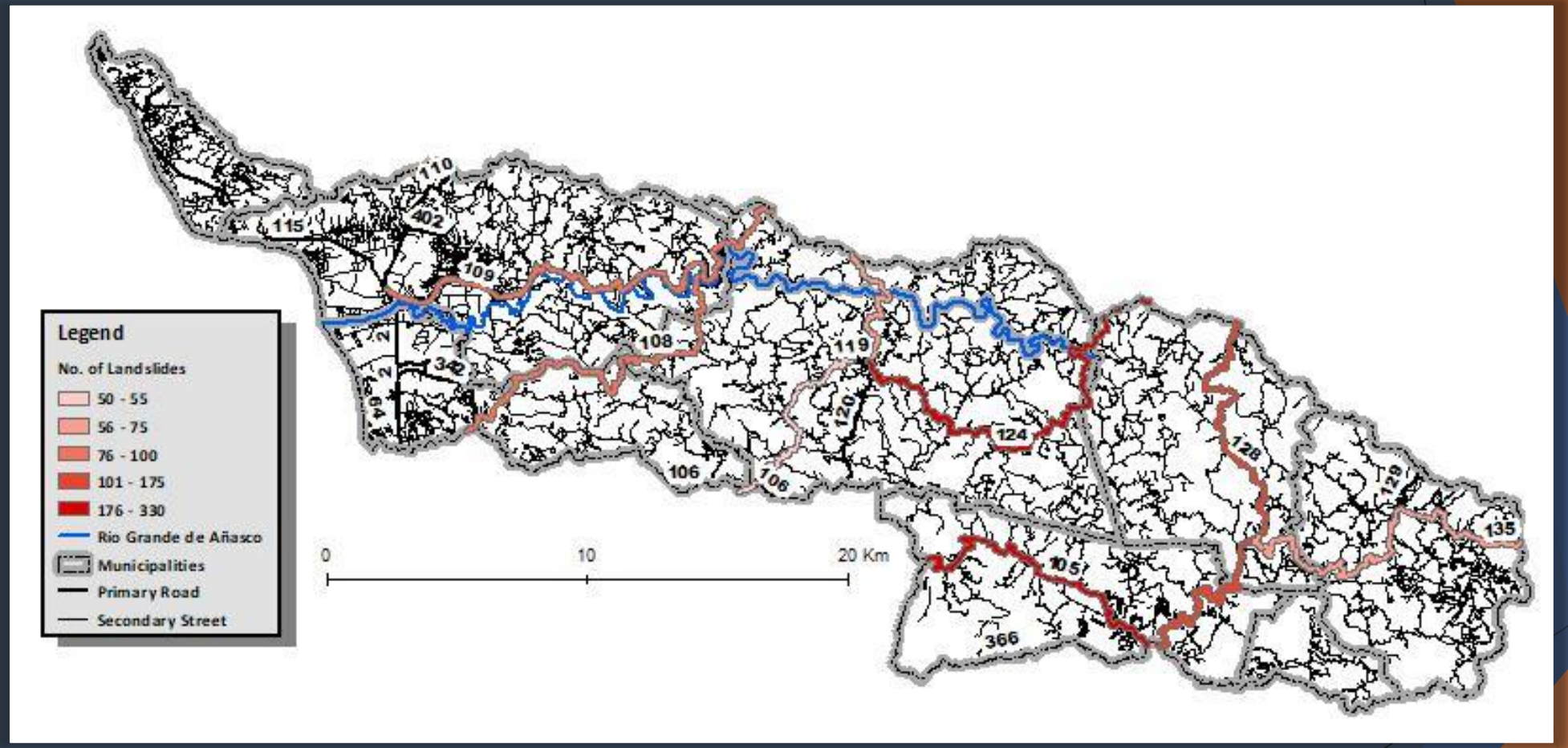

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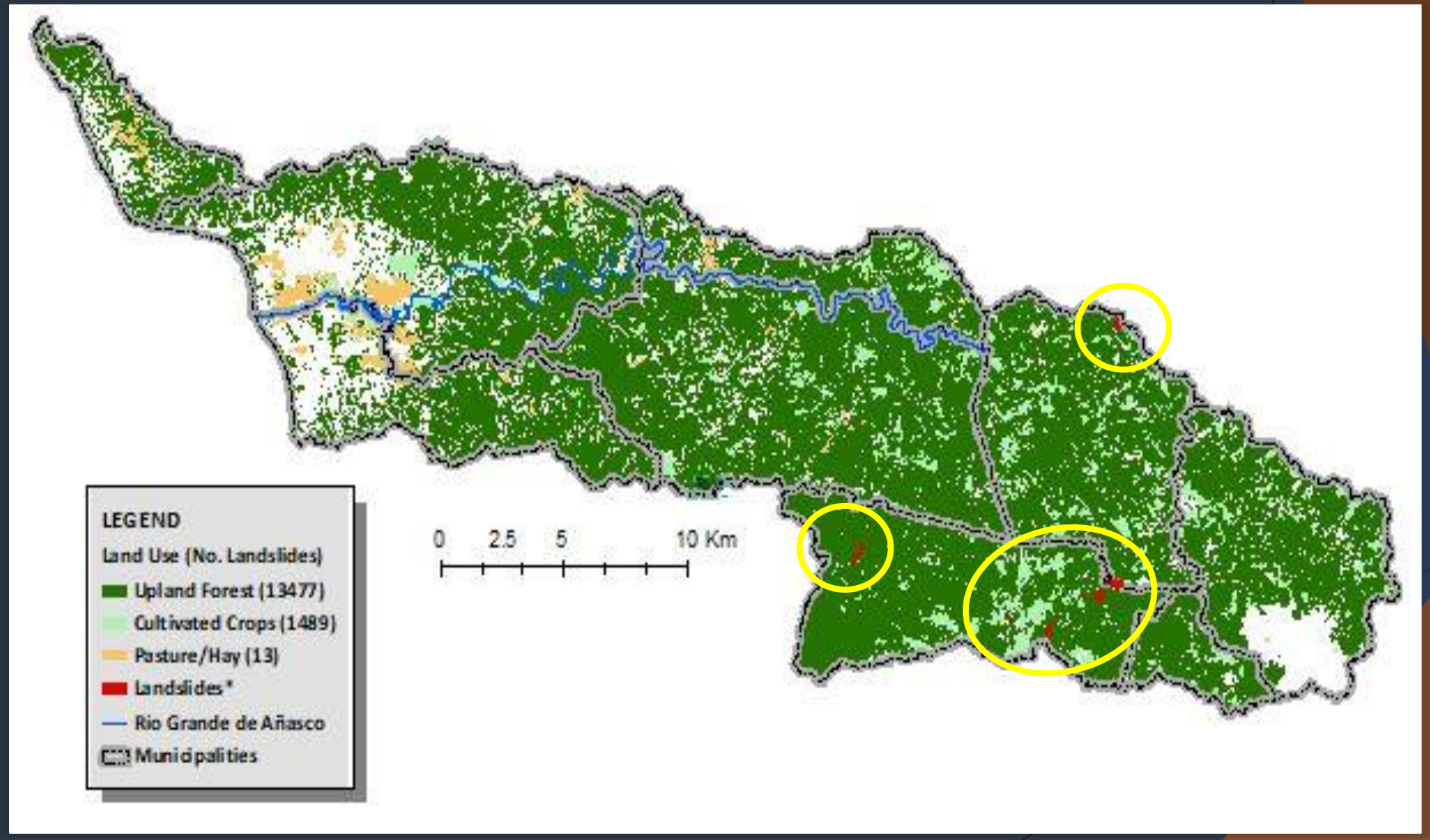
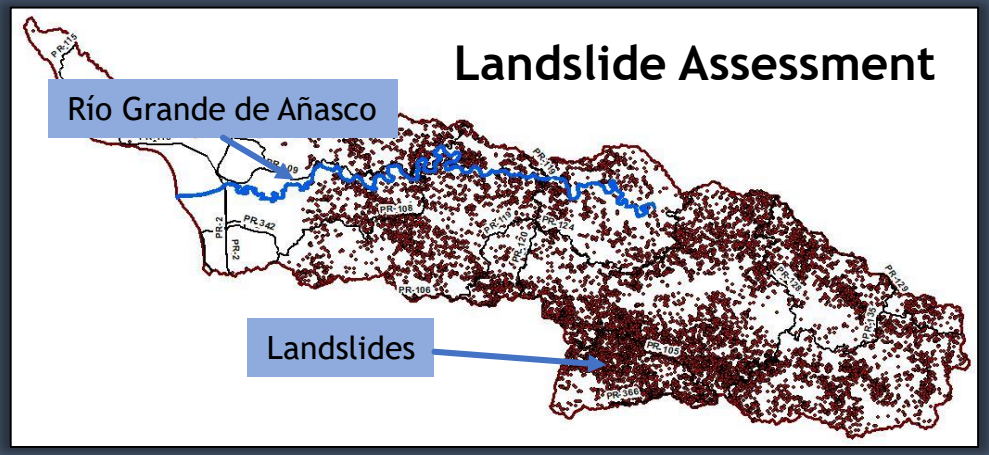
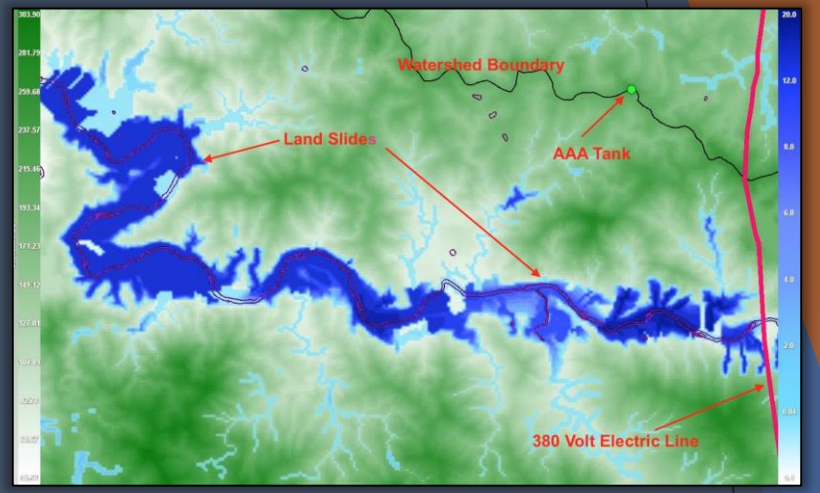


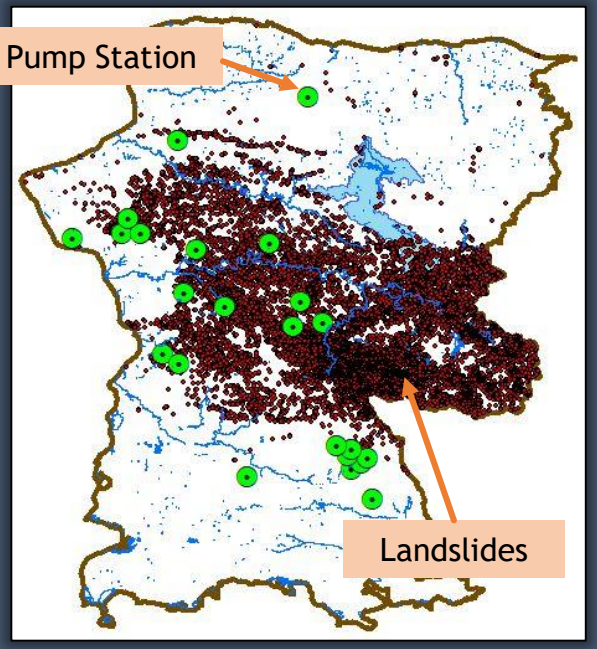
INTEGRATION – NSF CRISP Geophysical Working Groups

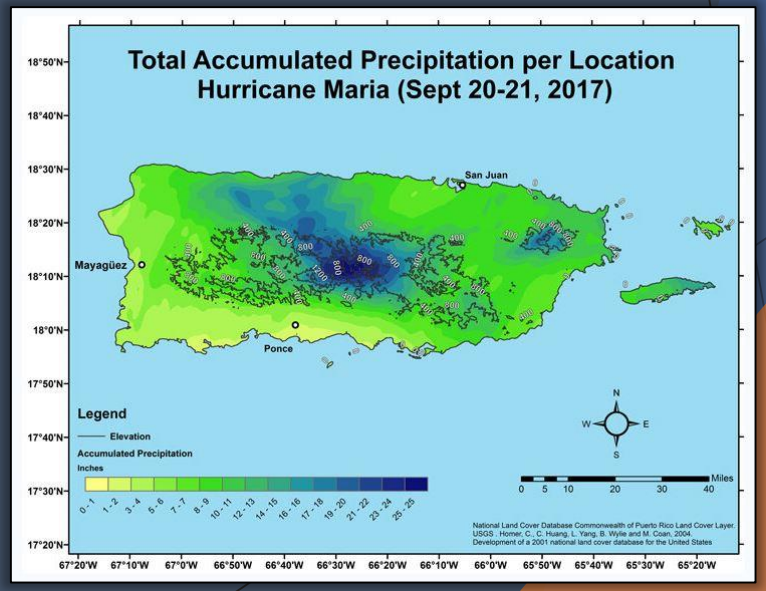




Vflo FLOOD MODELING landslide distribution/ geomorphic change/ key flood zones

WATER DISTRIBUTION MODELING Impact to water distribution networks/ AAA Pump Stations/ Reservoirs





GEOPHYSICAL CLIMATE MODELING Evaluating WRF model precipitation results/ soil moisture/ land use/cover

Socio-Ecological Assessment

- What can be managed?
  - LAND USE – Agriculture - Water Resources
    - Land use debates: agriculture vs conservation or forests (Gould et al. 2017)
    - Impact to and from management of waterways
- Measuring Impact on Socio - Ecosystem Resilience
  - Ecological Analysis
    - Assessment of ecosystem response on landslides
  - Social System Risk Perception Analysis
    - Incorporation of local ecological knowledge
    - Spatial distribution of risk and perspective on risk from erosion/deposition/sedimentation

(Gould et al. 2017)

Assessment of Ecosystem Response
Disturbed Vs. Undisturbed
Abiotic/Biotic

Analysis Framework

Integrative, Collaborative Watershed Management of Socio-Ecological Systems

Community Outreach/Education & Training/Knowledge Capture/Consideration of BOTH Science and Socio-cultural Values

PHASE I
Review/Define Objectives with Stakeholders

PHASE IIa
Preliminary Landslide Assessment

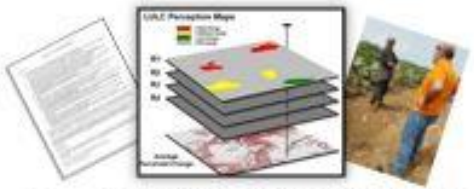
PHASE IIb
Field Components:
Ecological Assessment
Social Risk Assessment

PHASE III
Community Level Analysis & Suggestions for Mgmt

ECOLOGICAL ASSESSMENT

- Plot Level Statistical Analysis
- Physical Assessment of Abiotic and Biotic Characteristics
- Mapping of proximity to roads/stream channels

+



- Farm/Community Level Assessment
- Survey Tools: Focus Groups, Interviews
- Participatory GIS and Sketch Mapping = Avg Risk Perception Map/Mapped Impact of Flooding/Erosion/Deposition
- Searchable Relational Database

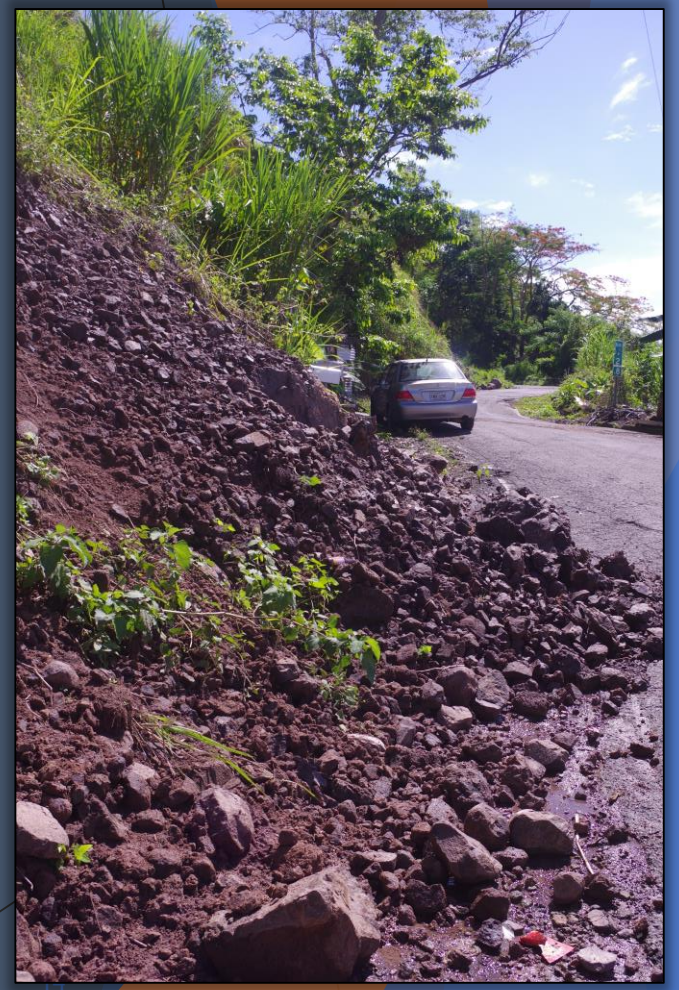
SOCIAL ASSESSMENT

=

- Integration with Vflo Flood Model/Geophysical Models
- Inclusion of local knowledge and spatial distribution of risk perception in management approaches
- Mapped comparisons of socio-ecological response at multiple spatial scales

INTEGRATION - Inter-agency Watershed Management

- Continued integration with NRCS and UPRM/Slides-PR efforts to evaluate and quantify landslides and sediment production.
- Contribution to development of watershed scale inventory and hazard mitigation plan (FEMA CPCB – Community Planning and Capacity Building).



THANK YOU!

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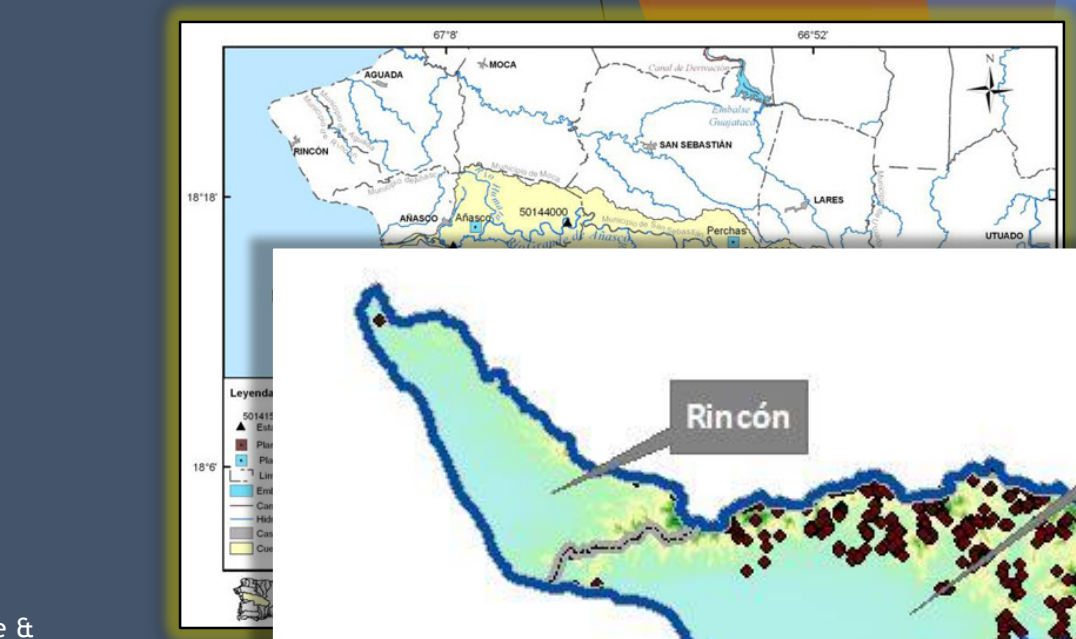
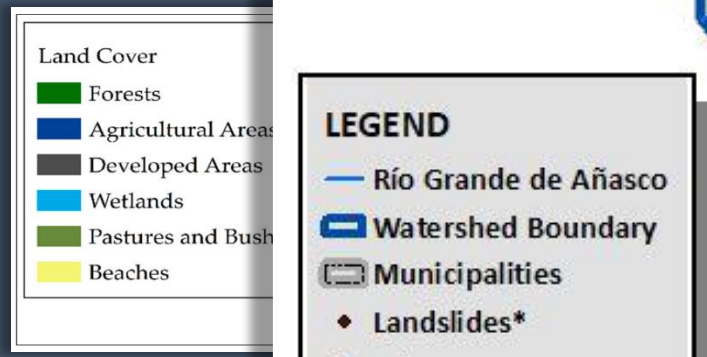
Study Site: Rio Grande de Añasco Watershed

- 275 sq mi, draining ~50,000 ha
  - Rain-fed mountain highlands and coastal lowlands
- Climate: Wet summers (April to November), dry winters
- Ranked #5 impaired watersheds (USDA NRCS)
- Primary land use: Agriculture and Forests (Duque & Melesse, 2016)
- Problems with erosion, sedimentation; Intensification of agricultural production
- ~80% of agricultural production lost in 2017 following Hurricane Irma and Maria





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