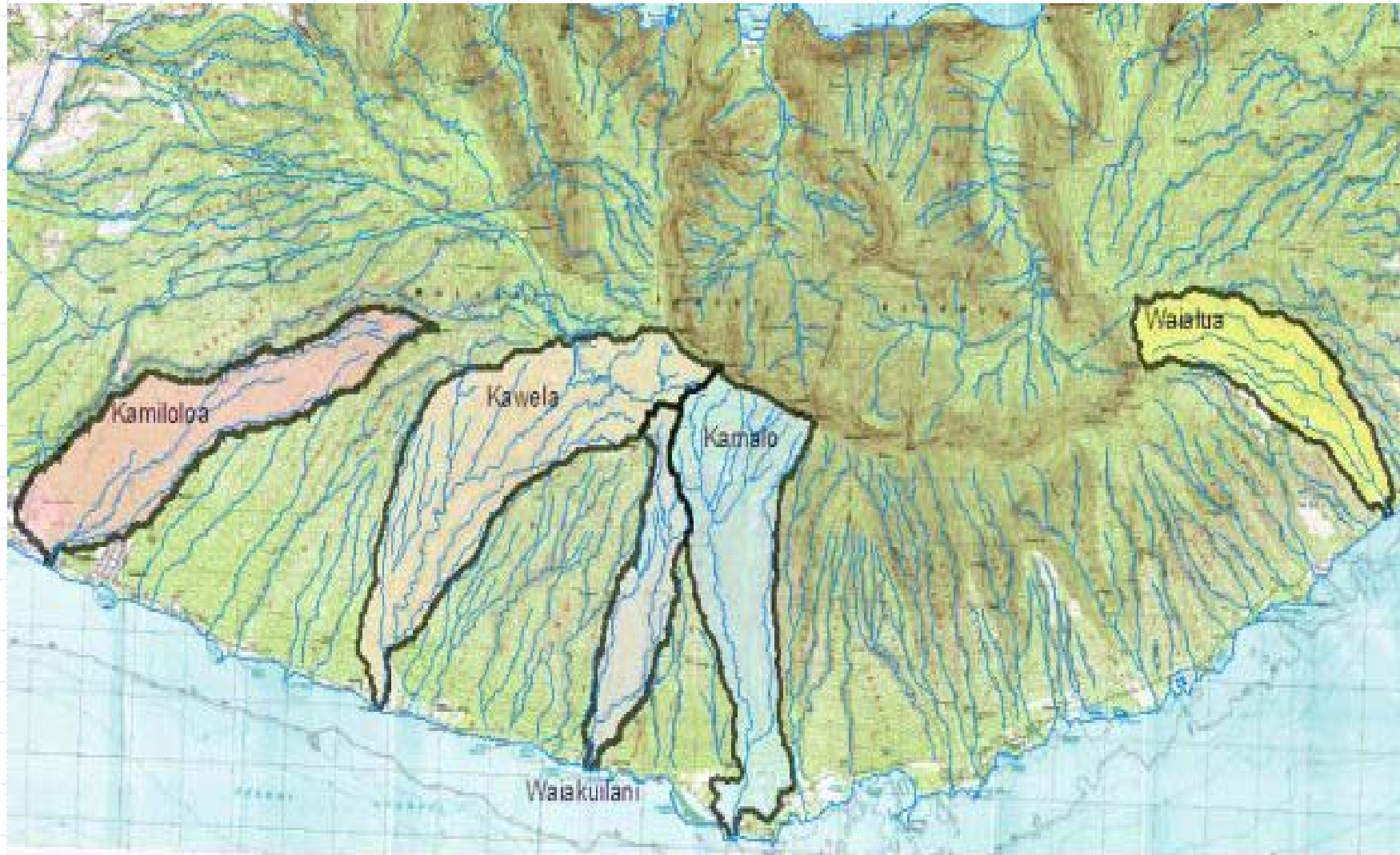


Ahupua'a Planning on Molokai— getting to implementation

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Center for
Watershed
Protection





Molokai Watersheds

Mahola to

- ◆ Molokai-Lanai Soil and Water Conservation District
- ◆ Steering Committee for Hawaii's Local Action Strategy to Address Land-based Threats to Coral Reef
- ◆ Hawaii Clean Water Branch
- ◆ NOAA

Objective of Today's Workshop

- ◆ Learn some new ideas (and refine some old ones)
- ◆ Do some brainstorming on how watershed practices can be implemented in next 2 or 3 years in Molokai
- ◆ Do a first draft of an action strategy

Ahupua'a- from the mountain to the sea





Key Themes

- Why Molokai is Different
- Some Watershed Basics
- Erosion Control Strategies
 - Upland Reforestation
 - Steep Slope Protection
 - Stabilize Channels
 - Sediment Basins
 - Fish Pond Restoration
 - New Construction



Key Themes

- Improving Inspection and Enforcement
- Better Coordination with State and Federal Agencies
- Wetland Protection
- Addressing New Development
- Watershed Education for Molokai
- Improving Molokai Watershed Capacity
- Others?



Guiding watershed philosophy

- Build on the ahupua'a concept
- Restore the forests that sustain groundwater
- Reduce the runoff and sediment loads that flow from streams to the reef
- Respect native Hawaiian traditions
- Develop island solutions and local capacity to implement them
- Protect the watersheds from cumulative impact of any future development

Others?

Why Molokai is Different



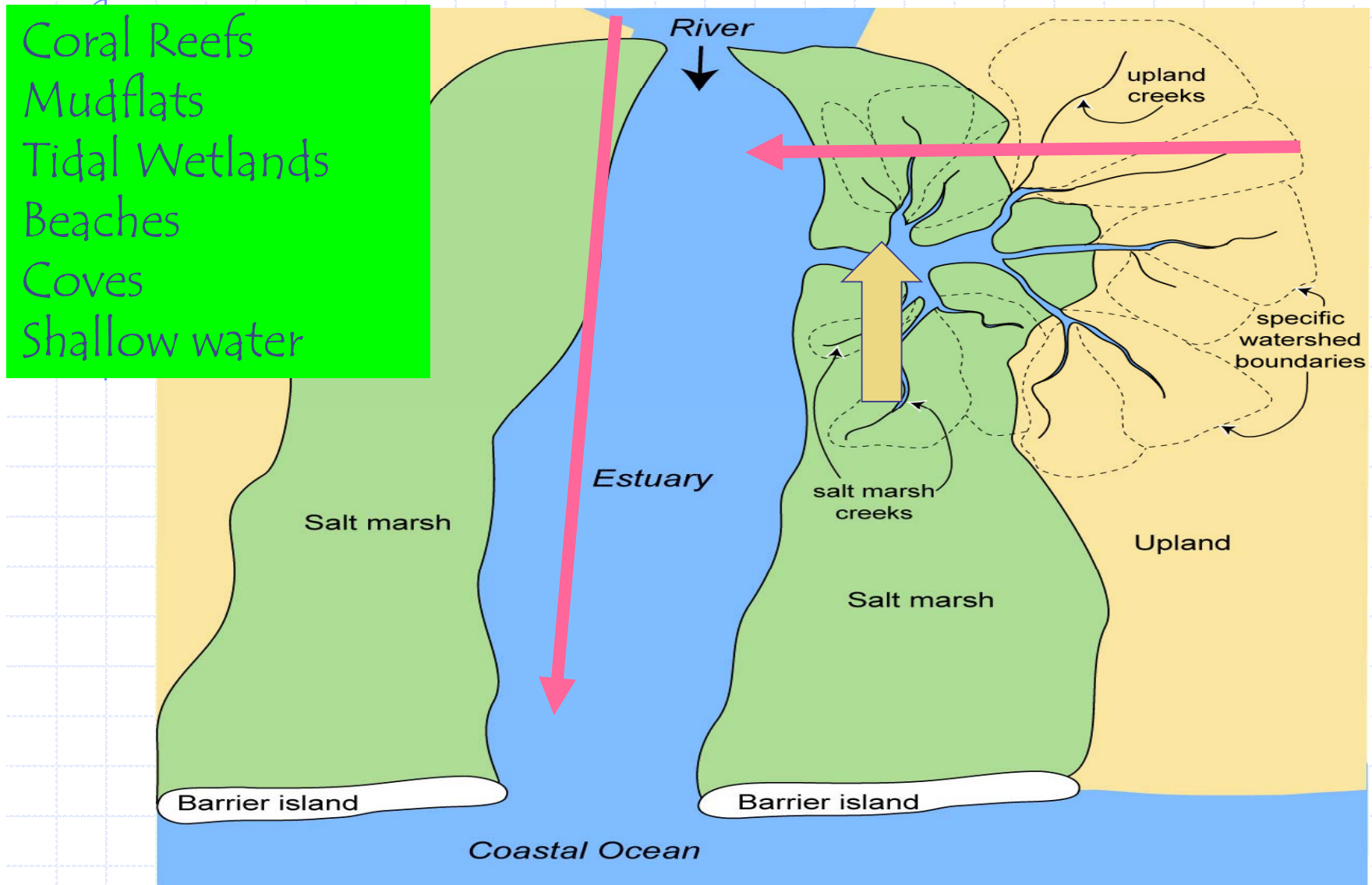
1. Rainfall and ET
2. Sensitive Near-shore Ecosystems
3. Terrain
4. Development Patterns
5. Soils
6. Vegetation
7. Local Expertise and Construction Materials



1. Rainfall and ET

- Highly variable annual rainfall depending on elevation and aspect--10 to 300 inches per year
 - (Mainland 15 to 60 inches)
- Leeward areas have extensive dry seasons
- Evapotranspiration sends 60 to 70 inches back to the sky (mainland 15 to 30)
- Fog as much as 30% of annual rainfall at high elevations

2. Sensitive Near-shore Ecosystems



Impact of Past Land Management on Molokai

- Forest Loss
- Greater Erosion
- Declining Groundwater Recharge
- Loss of Aquatic Diversity in Near-shore Ecosystems



Impacts of Land Development on Island Ecosystems

- Nitrogen
- Sediment Loads
- Bacteria
- Aquatic Diversity in Near-shore Ecosystems



Nitrogen in Island Runoff

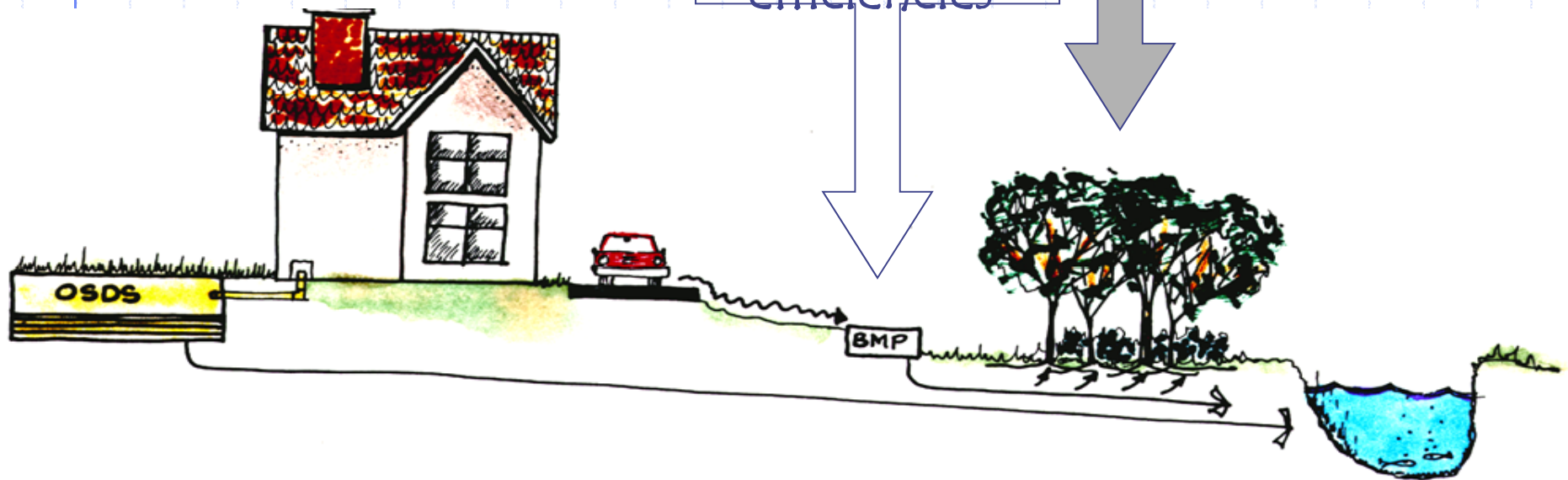
- High Loadings of Nitrogen
 - Stormwater runoff and septic systems
 - Harm to coral reefs, seagrasses
 - Very hard to remove
 - Hi delivery

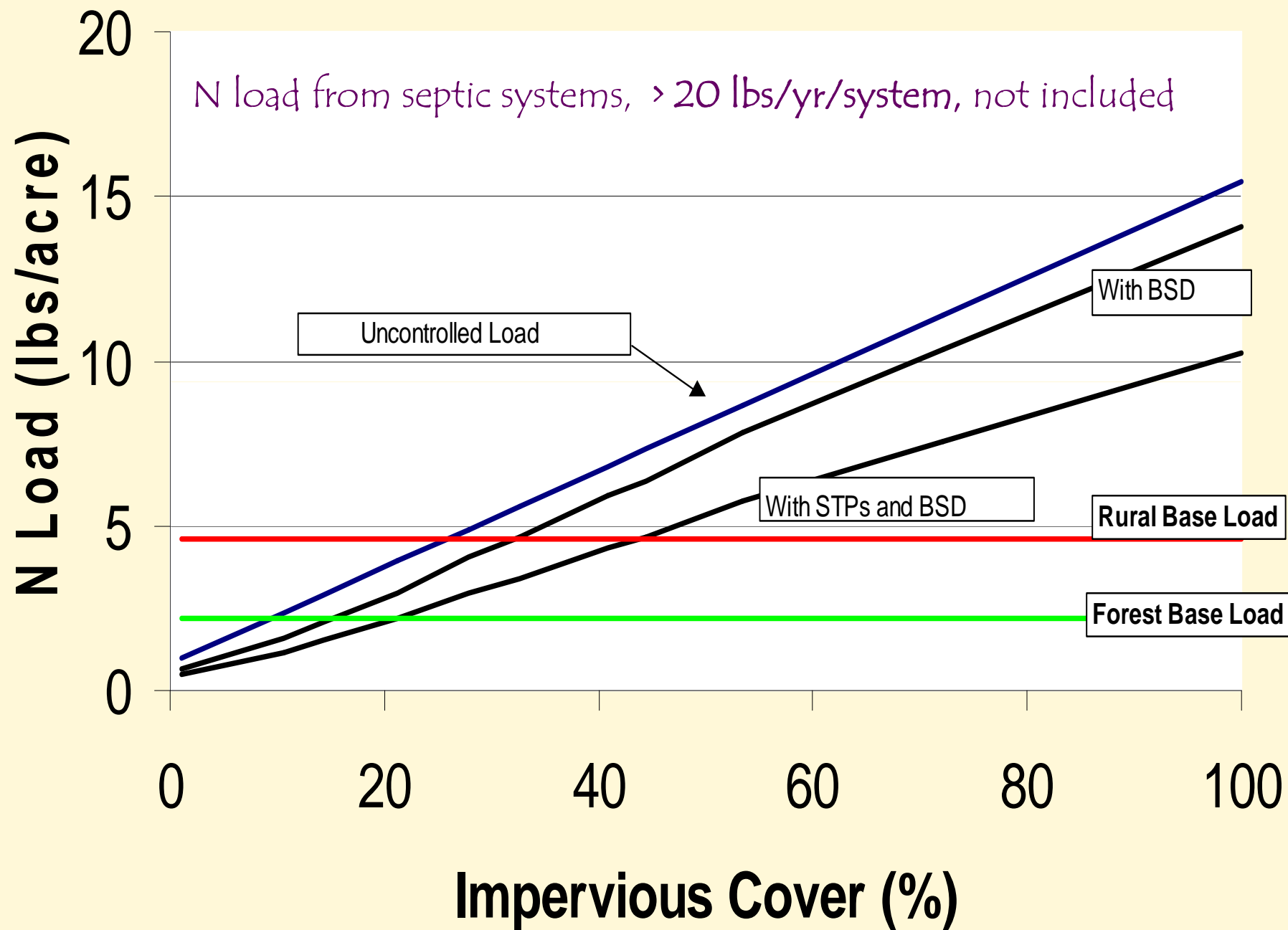


Septics + residential runoff
= high N

Best protection

Small removal
efficiencies

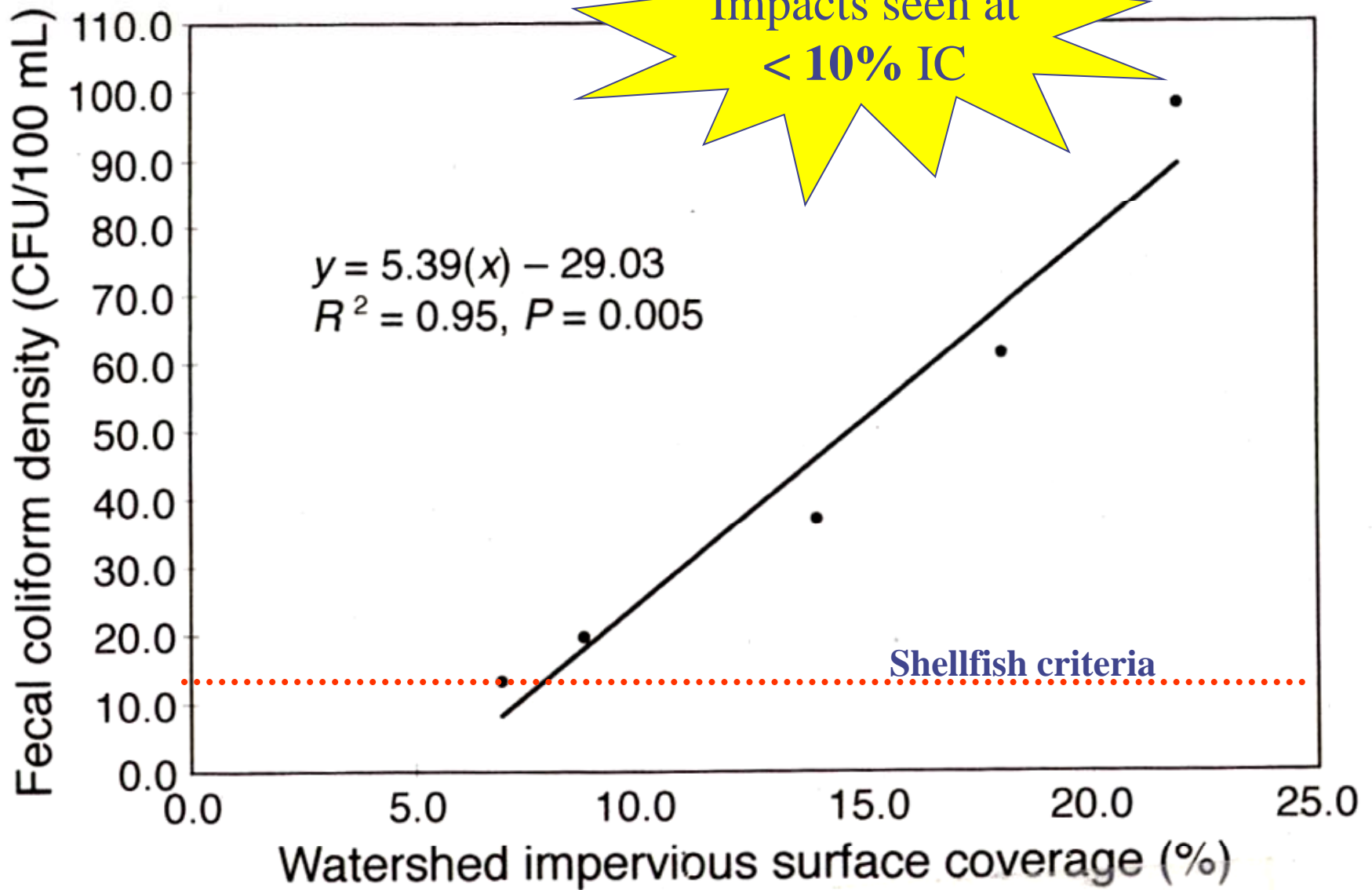






**RIVER WATER
UNSAFE
NO FISHING, SWIMMING
OR OTHER WATER
RELATED ACTIVITIES**
BY ORDER OF THE BOARD OF HEALTH
MONT. CO. COMBINED HEALTH DISTRICT

Urban bacteria levels in runoff can close beaches and shellfish beds



Potential Sources of Coliform Bacteria: A Host of Suspects

- ◇ Straight-pipes
- ◇ Sanitary sewer overflows
- ◇ Illegal sanitary connections to storm drain
- ◇ Illegal sewage disposal/transient dumping
- ◇ Failing septic systems
- ◇ Marinas and campgrounds
- ◇ Dogs and cats
- ◇ Feral animals, birds, cattle, deer,

Challenges in managing bacteria in urban watersheds-

- Swimming, shellfish harvesting and recreational contact limited in many urban watersheds
- Storm water f.coli levels exceed standards by factor of 20 to 50
- Stormwater practices need to reduce bacteria levels by 99% to meet standards



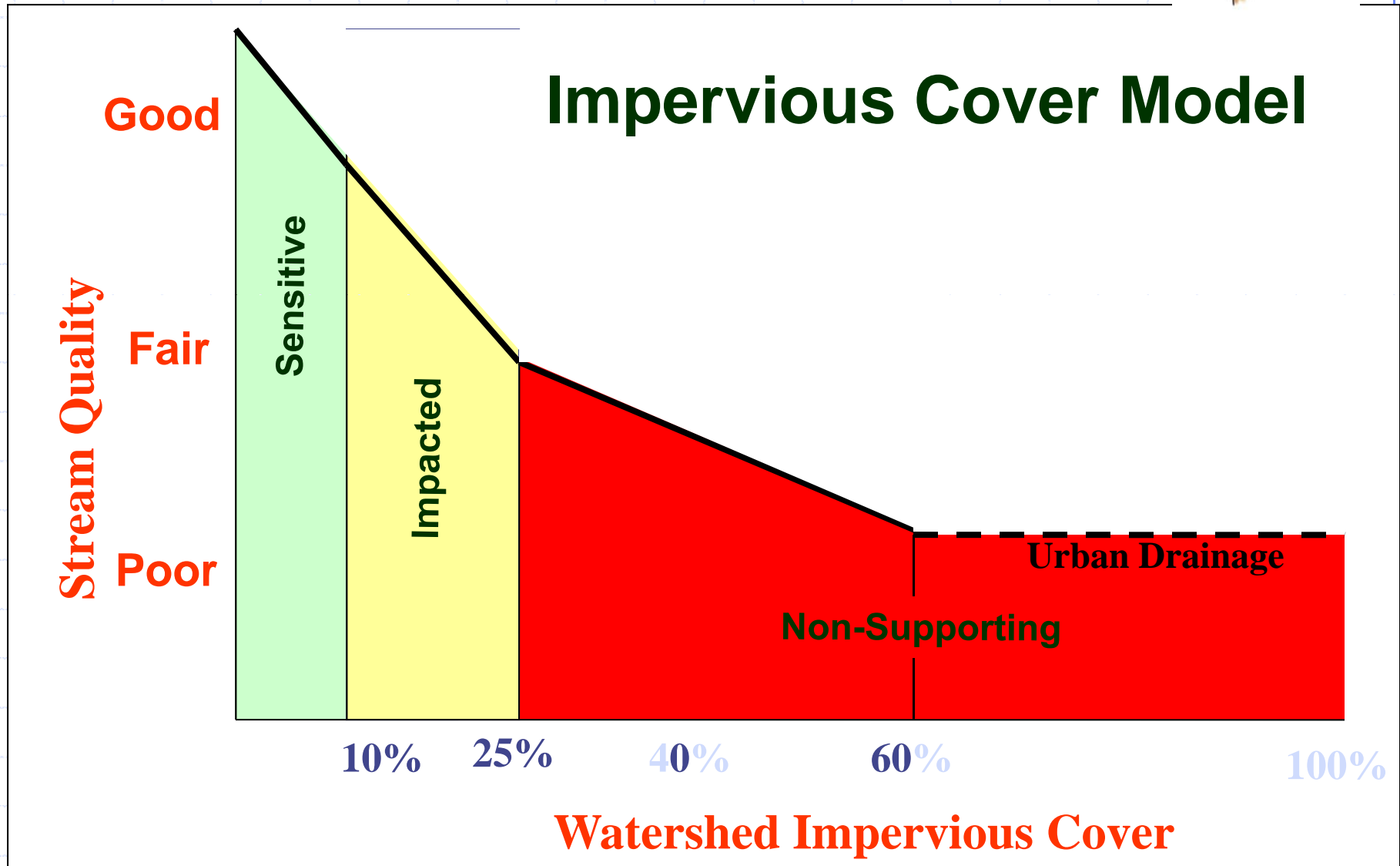


Severe bank erosion and mass wasting in headwaters

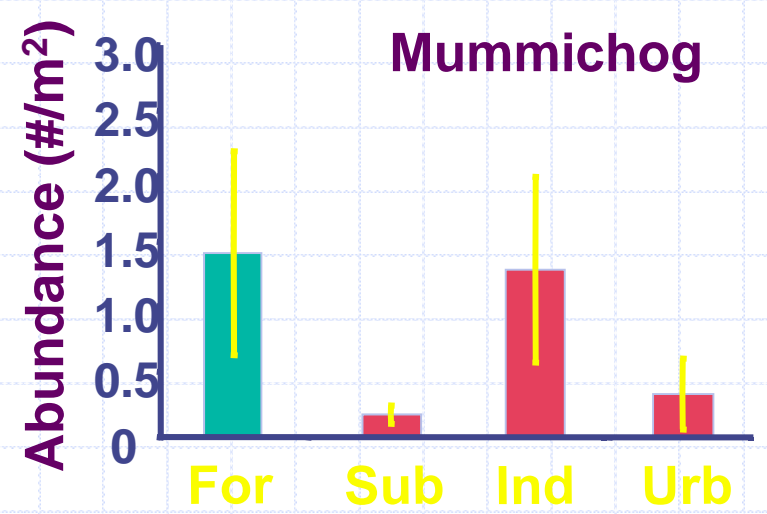
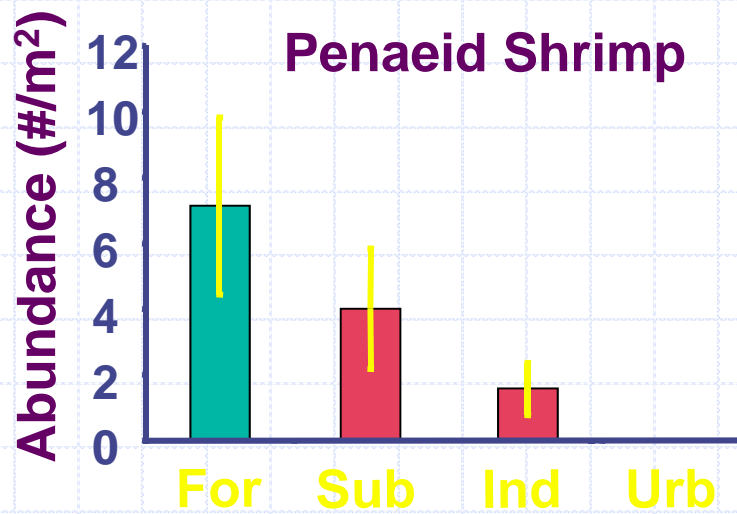
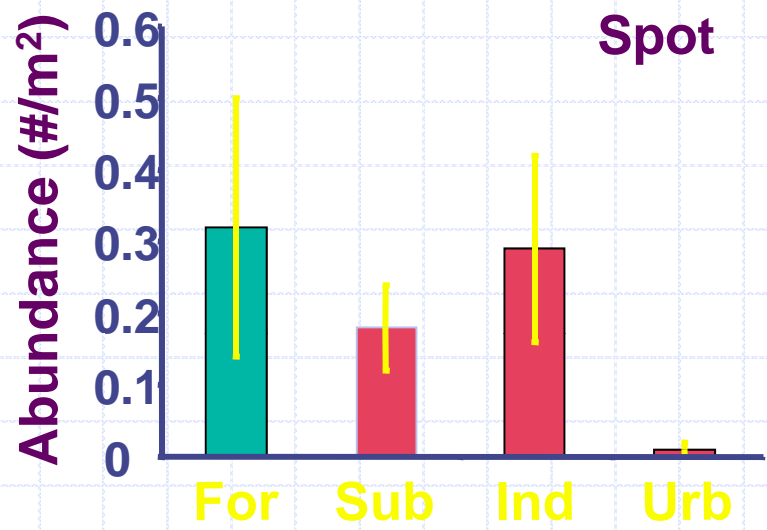
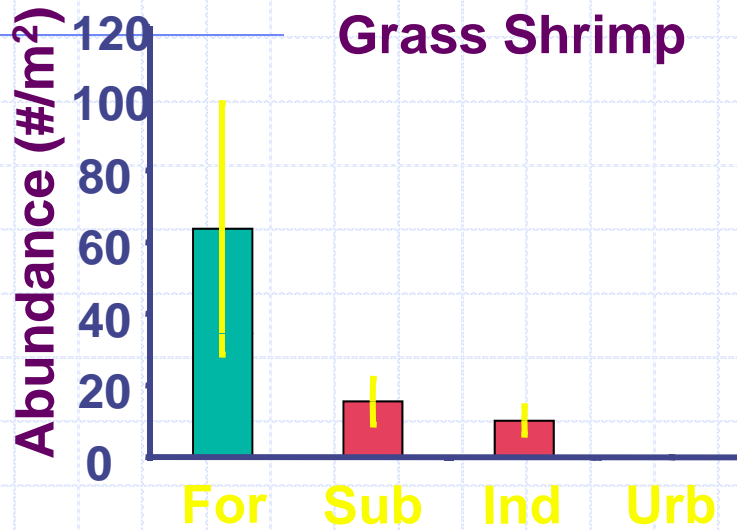


Deposited in sensitive nearshore ecosystems

For Islands: IC and Exposed Soil



Fish and Crustaceans

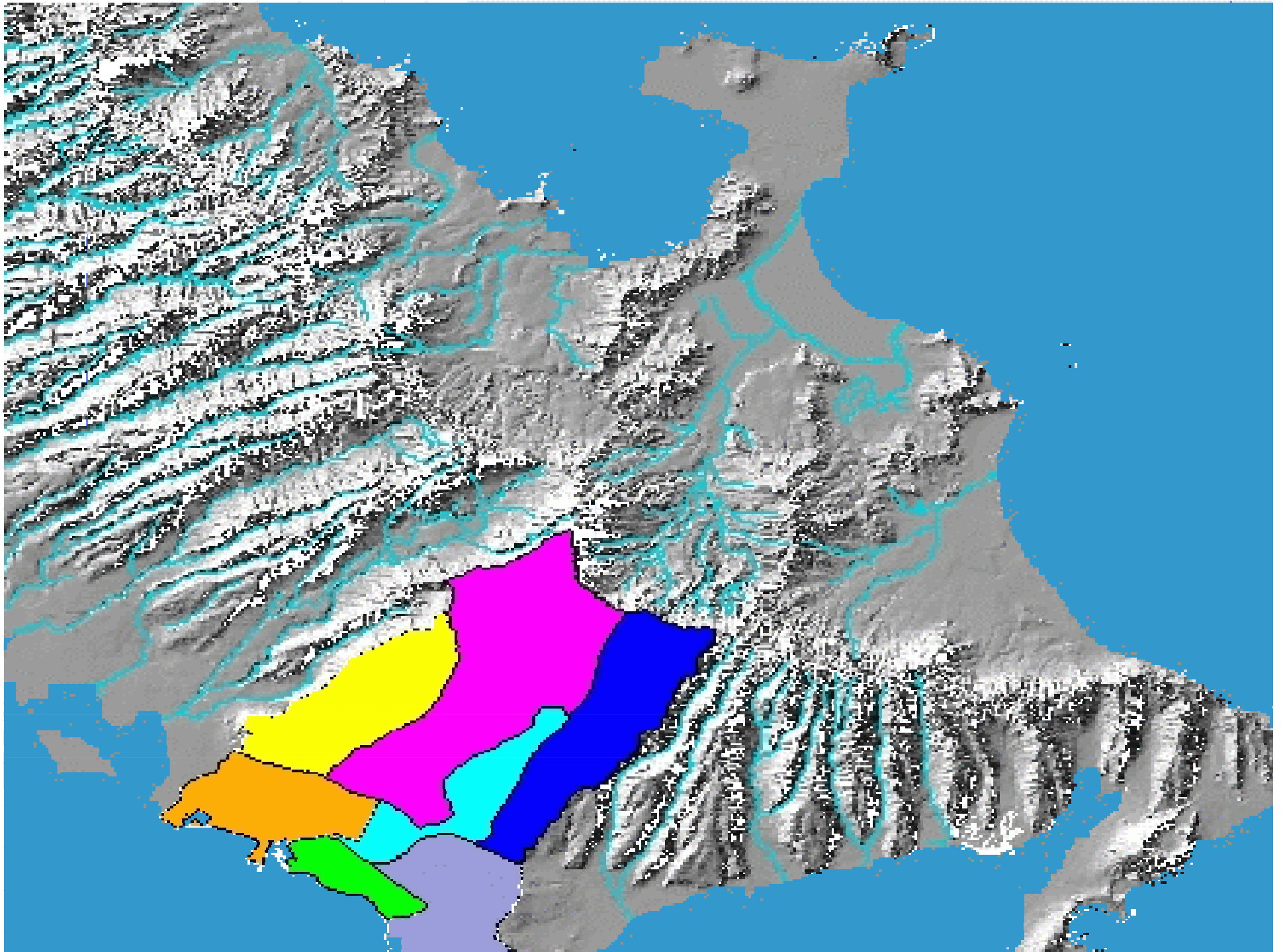


Source: Holland et al, 2001



3. Terrain

- Most islands have
 - areas of steep and flat terrain
 - very small watersheds
 - Very short streams
- Steep terrain is recharge area for aquifers used in flat terrain



Steep Terrain



- Extremely steep slopes
- Hillslope erosion and landslides
- Extensive erosion from road system
- Erodeable but thin soils
- Receive 3 to 10X more rain
- Forest slopes are primary island recharge area
- Small short streams

Flat Terrain Factors



- Low Head
- Ditch drainage (streams are rare)
- Deeper soils
- High water table
- Lot of water to move
- Wetlands present

4. Molokai Development Patterns



- Low Growth Pressure (comp islands)
- Mostly Single Family Homes
- Hi land prices
- Small parcels
- On-site wastewater disposal
- Scarce fresh water
- Homestead Parcels
- Relatively few land owners



Photograph by Clarence Taylor, St. Thomas

VIEW OF CHARLOTTE-AMALIA FROM LUCCHETTI'S HILL, ST. THOMAS

Deboy and Faris, 1918



5. Most Island soils are:

- Thin (a few feet deep)
- Nutrient poor and acidic
- Highly permeable (6 to 20 inch/hr)
- Poor water holding capacity
- Highly erodible
- Vary depending on whether are of volcanic or coral origin

Makes it hard to establish dense vegetative cover after soils are exposed w/o irrigation



6. Vegetation

- Year round growing season
- Invasive species a problem
- Warm season grasses vary widely in their tolerance and nitrogen requirements
- Some site preparation and soil amendments may be needed to get vegetation started
- Grazing pressure from feral animals limits growth
- Traditional HI plants may show promise (coir, taro)



7. Local Expertise

- Many designers and contractors unfamiliar with watershed restoration practices
- Simple construction techniques desirable
- Plan on limited long term maintenance, beyond vegetative management
- Many development regulations administered from another island.



7. Construction Materials

- Many construction materials may not be available or extremely expensive to import (e.g., peat, hardwood mulch, riverstone, geotextiles, etc)
- Other indigenous materials should be promoted (sand, local stone, shredded coconut fiber, native plants)
- Seed and compost sources should be locally derived to prevent introduction of invasive plants



*Did we miss any important
island factors that might
influence watershed practices
in Molokai?*