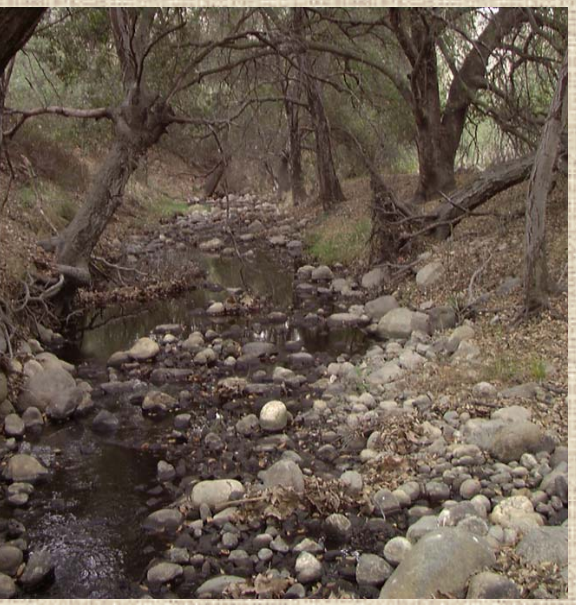
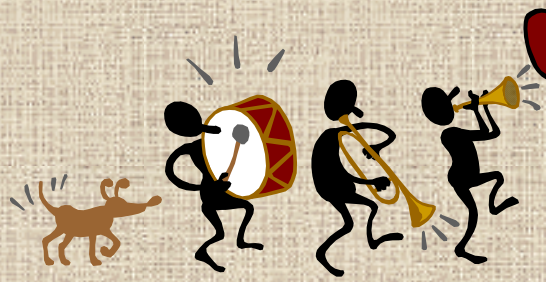
Multi-Scale Assessment of Riparian Ecosystem Integrity (MAREI) Assessment, Alternatives, and Restoration in Southern California Watersheds



Special Area Management Plan

- Objectives
  - "…develop and implement a watershed-wide aquatic resource management plan and implementation program, which will include preservation, enhancement, and restoration of aquatic resources, while allowing reasonable and responsible economic development and activities within the watershed…"
  - Establish general programmatic permits for activities regulated under the 404 Program



Special Area Management Plan

- Requirements (Regulatory Guidance Letter 86-10)
  - Area experiencing rapid development and heavy permitting activity
  - Active involvement of federal, state, and local governmental agencies, non-governmental agencies, and stakeholders
  - Coordination with existing programs in establishing protection and management areas
  - Defined regulatory product (i.e., general permit)

Special Area Management Plan

- Payoffs
  - Regulated public gets an efficient and predictable permit review process
  - Corps gets the capability to look synoptically at Waters of the United States (WoUS) within in a watershed context

SAMP Watershed Locations

Los Angeles

Orange County

San Diego Creek

San Juan/San Mateo

Camp Pendleton

Oceanside

San Jacinto

Hemet

Western Riverside County

Santa Margarita

San Luis Rey

San Diego County

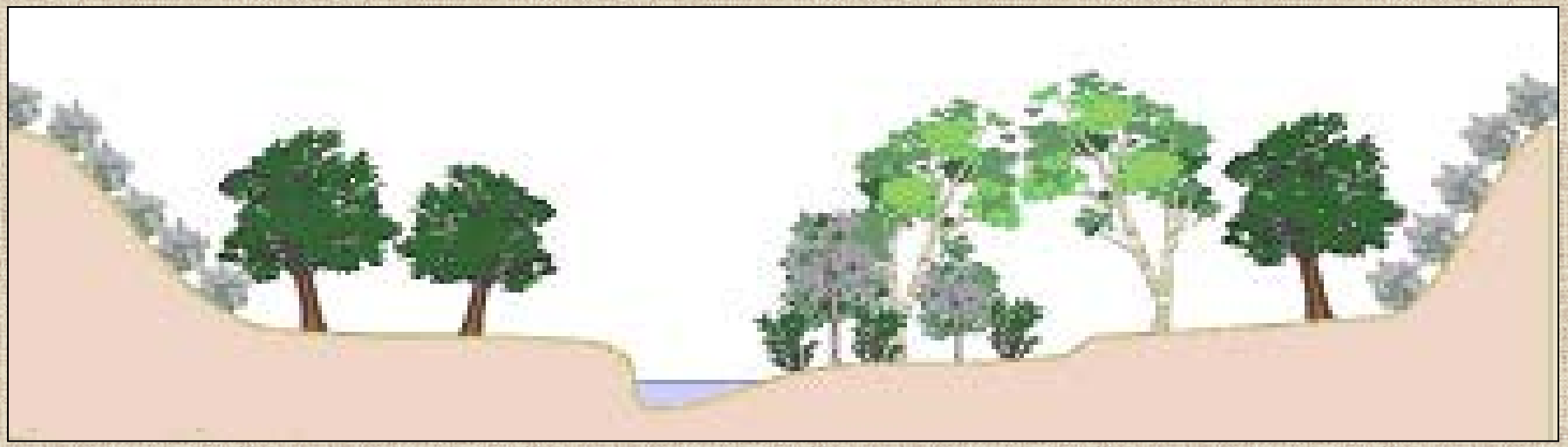
Miramar

San Diego

Otay

Riparian Ecosystems

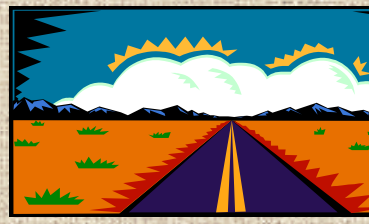
- Areas along ephemeral, intermittent, and perennial streams where surface and/or groundwater interactions result in distinctive geomorphic features and vegetation communities
- Normally includes the bankfull stream channel, active floodplain, and infrequently flooded terraces



- This "functional" definition of riparian ecosystem often encompasses areas that are not regulated WoUS

Riparian Ecosystem Integrity

- Riparian ecosystem integrity is defined in the context of a reference condition prior to cultural alteration
  - High integrity riparian ecosystems exhibit the full range of physical, chemical, and biological attributes and processes that characterized riparian ecosystems in the region, over short and long term cycles, and
  - Support a balanced, diverse, and adaptive biological community that has resulted from evolutionary and biogeographic processes
- The integrity of riparian ecosystems depends on physical, chemical, and biological attributes and processes across multiple spatial scales including the riparian ecosystem proper and its drainage basin



MAREI Approach

- Phase 1: Identify location of riparian ecosystems
- Phase 2: Conduct baseline assessment of hydrologic, water quality, and habitat integrity of riparian ecosystems
- Phase 3: Conduct alternatives analysis
- Phase 4: Develop a watershed restoration plan
- Phase 5: Conduct supplementary studies for indicator revision/verification/calibration

Observation # 1

- As with all attempts to shift paradigms, we are currently caught in a conceptual/semantic vortex
- Don't despair, this is a normal and necessary step albeit painful

Observation #2

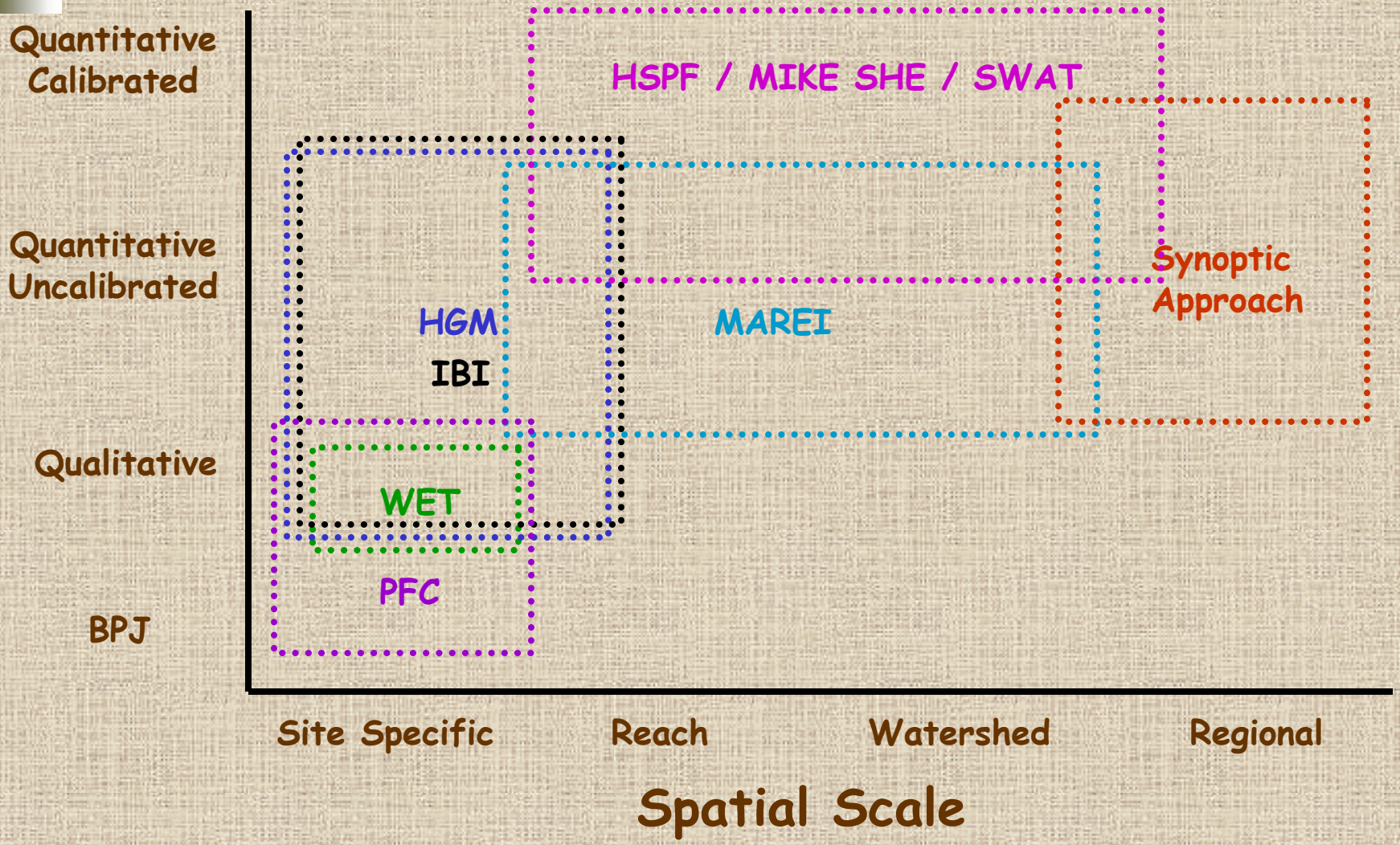
- Five Steps for Guiding Compensatory Mitigation
  - **Landscape Assessment (?)**
  - **Historical Assessment**
  - **Assessment of Remaining Aquatic Resources (Baseline?)**
  - Analysis of Priorities and Restoration Options
  - Determination of Where, When, and How Much

Observation # 2

- The integrity of wetland ecosystems depends on physical, chemical, and biological attributes and processes across multiple spatial scales including the wetland ecosystem proper, adjacent upland areas, and its drainage basin

- There is a difference between assessing the function/condition/integrity of wetlands in a watershed using "site specific" techniques, and assessing function/condition/integrity of wetlands in a watershed using techniques that explicitly consider structural characteristics and processes across multiple spatial scales in the assessment

Classifying Wetland Assessment Techniques



Observation # 2

- Conclusion
  - The steps for guiding compensatory mitigation in watersheds need to provide explicit guidance on how wetlands in a watershed should be assessed (i.e., site specific vs. multiscale)

Observation #3

- Five Steps for Guiding Compensatory Mitigation
  - Landscape Assessment (?)
  - Historical Assessment
  - Assessment of Remaining Aquatic Resources (Baseline?)
  - **Analysis of Priorities and Restoration Options**
  - **Determination of Where, When, and How Much**

Observation # 3

- Scoderi and Shabman (2001)
  - …"recognition of the surrounding watershed condition is essential to selecting a location for a particular wetland restoration or creation site…"
  - However…"regulators and in-lieu-fee administrators we interviewed are suggesting much more. They believe that **compensatory mitigation should be governed by priorities for wetland restoration and protection in individual watersheds** rather than by the current regulatory practice of favoring on-site and in-kind replication of wetlands lost to fill permits."
  - "Some people agree in principle that watershed-oriented compensatory mitigation is environmentally desirable but view it as unworkable until formal watershed plans have been developed for all of the nation's watersheds."

Observation # 3

- Scoderi and Shabman (2001)
  - …"**we do not believe that formal watershed plans are necessary**…"
  - "In the in-lieu-fee programs we studied, the **program administrators and Corps regulatory staff jointly select the types and locations of mitigation actions that serve their understanding of watershed priorities for wetland restoration and protection**. This is a workable and low-cost process for guiding decisions on compensation actions that would best serve watershed priorities in consideration of what was or would be lost by fill permits."

Questions I am Supposed to Answer

- What criteria did you use to analyze priorities and restoration options?
- How were the criteria developed (i.e., what information or data were used)?
- What tools were employed to compare the criteria (i.e., ranking, GIS, other decision support tools)?

Answers to Questions I Heard

- What criteria did you use to analyze priorities and restoration options?
  - Rich Sumner: reference profiles
  - Josh Collins: restoration of habitat (consensus on target quantities)
  - Cara Stallman: consensus (arbitrary?) ranking based on site specific assessment of condition
  - Eric Wold: consensus (arbitrary?) based on site specific assessment of condition

Answers to Questions I Heard

- How were the criteria developed (i.e., what information or data were used)?
  - ?
- What tools were employed to compare the criteria (i.e., ranking, GIS, other decision support tools)?
  - ?

My Answers to Questions

- What criteria did you use to analyze (select?) priorities and restoration options?
  - Biggest Bank for the Buck
  - Restoration in Selected High Integrity Subwatershed(s)
  - Restoration of Target Species Habitat
  - Develop Connections Between Existing Large Riparian or Upland Habitat Patches

My Answers to Questions

- How were the criteria developed (i.e., what information or data were used)?
  - Consultation with the Los Angeles District
- What tools were employed to compare the (results of each?) criteria (i.e., ranking, GIS, other decision support tools)?

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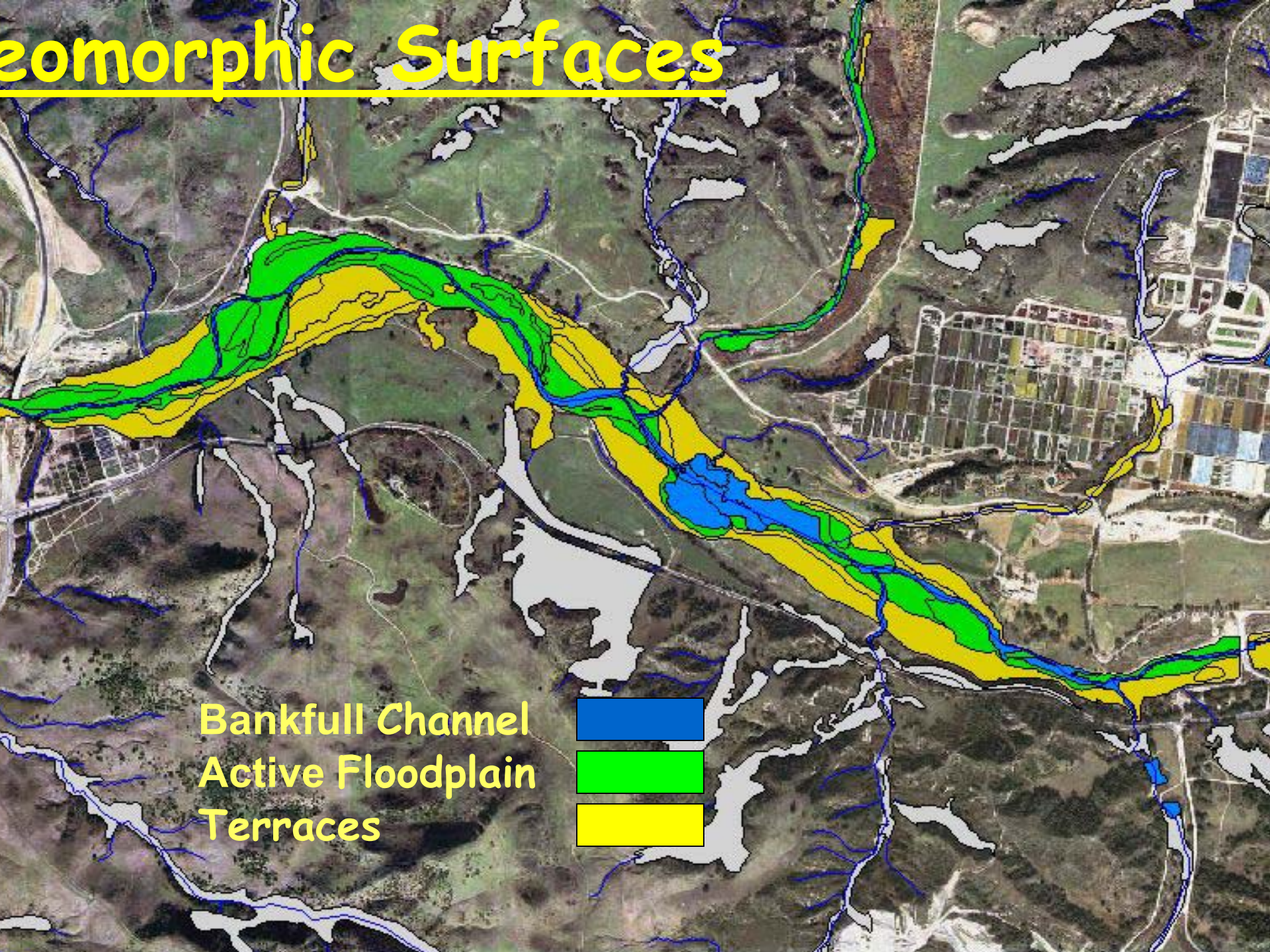
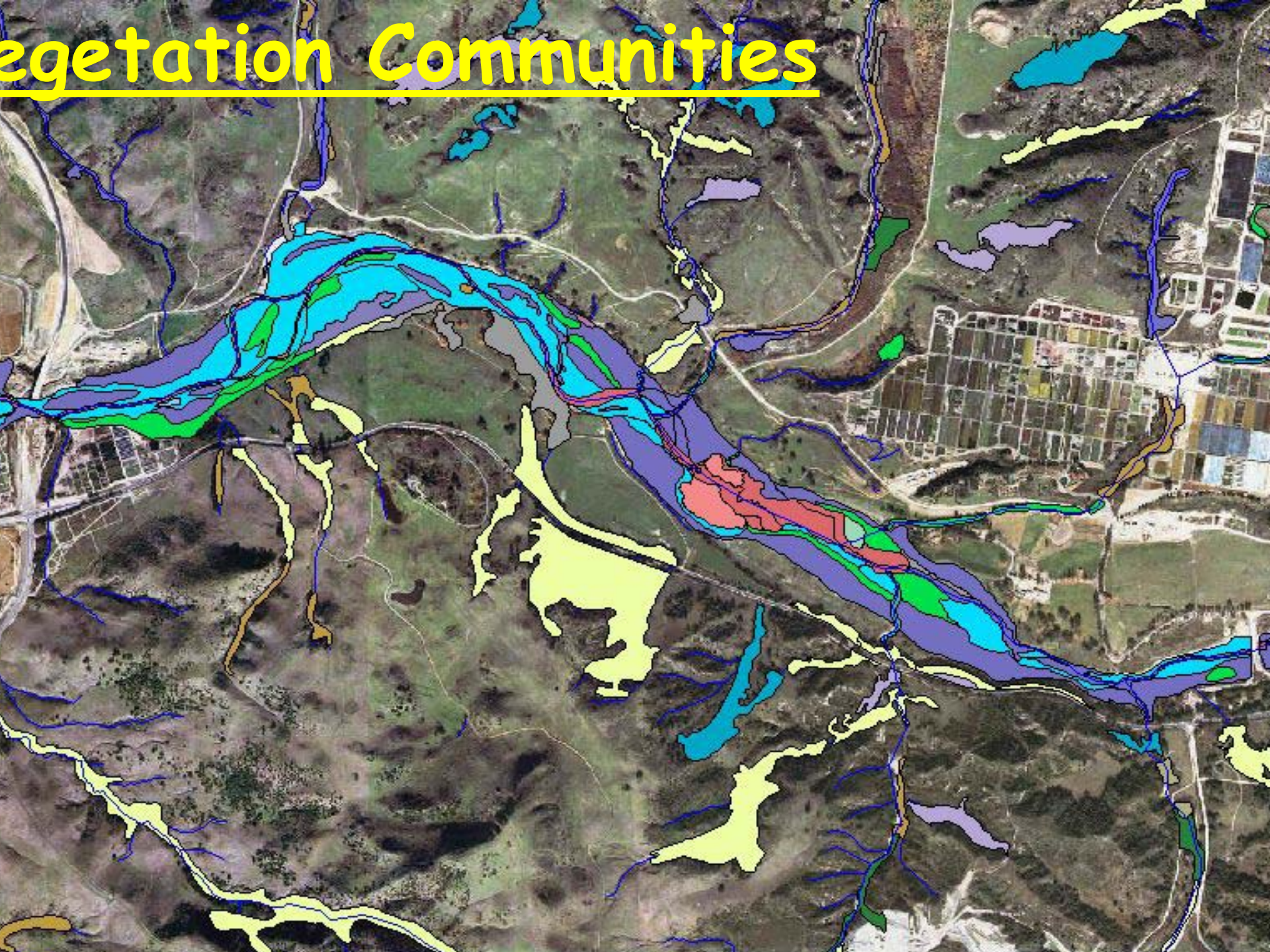
Phase 1: Identification of Riparian Ecosystems

- Planning level delineation of Waters of the United States (WoUS), aquatic resources, and riparian ecosystems (Bob Lichvar – CRREL)
  - Develop GIS coverage for WoUS and riparian ecosystems using aerial photographs and topographic maps
  - Verify with a stratified random array of field samples
  - Assign a "probability" of jurisdictional status to each mapped polygon based on federal and state criteria

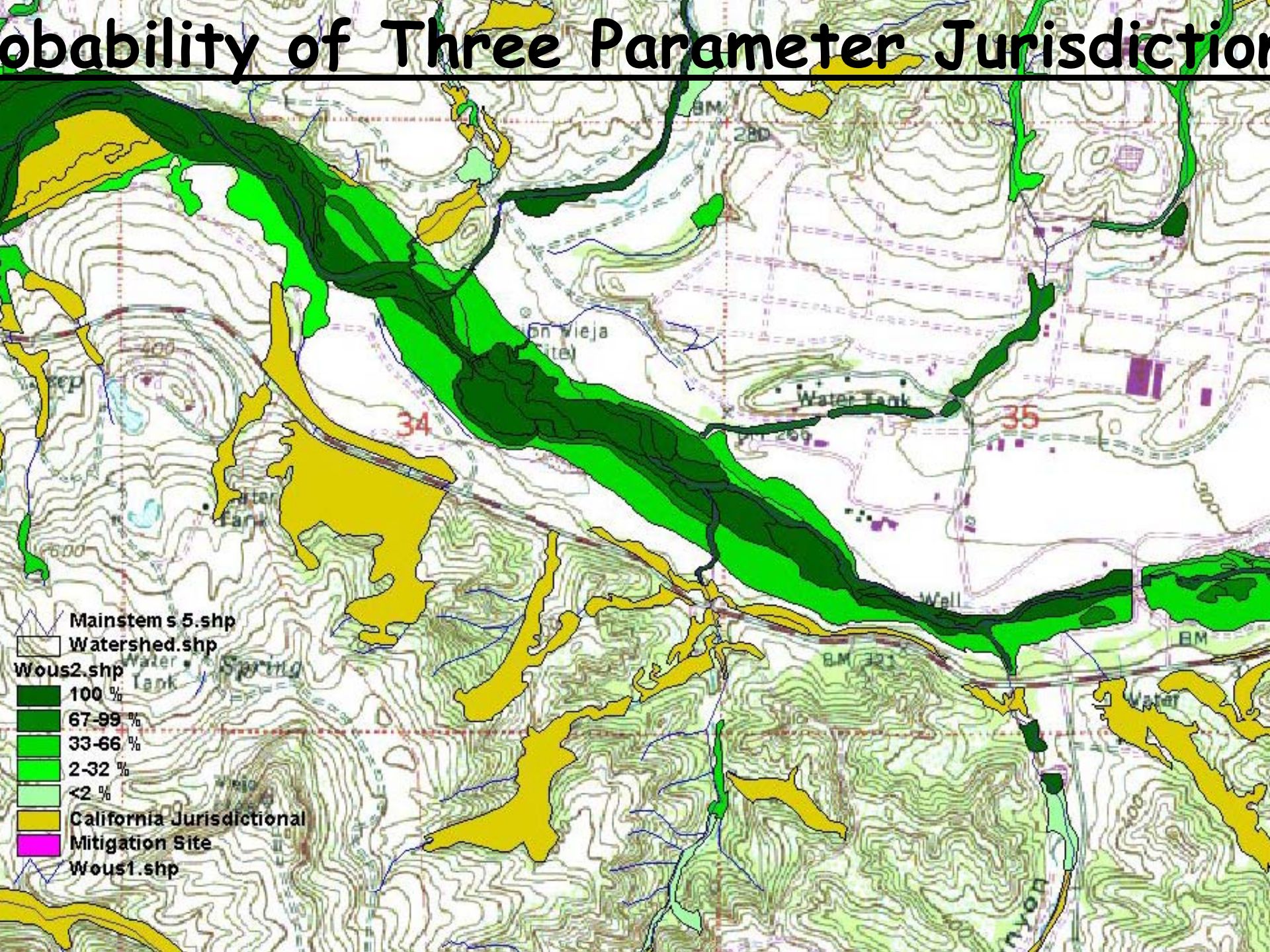
eomorphic Surfaces



egetation Communities



obability of Three Parameter Jurisdiction

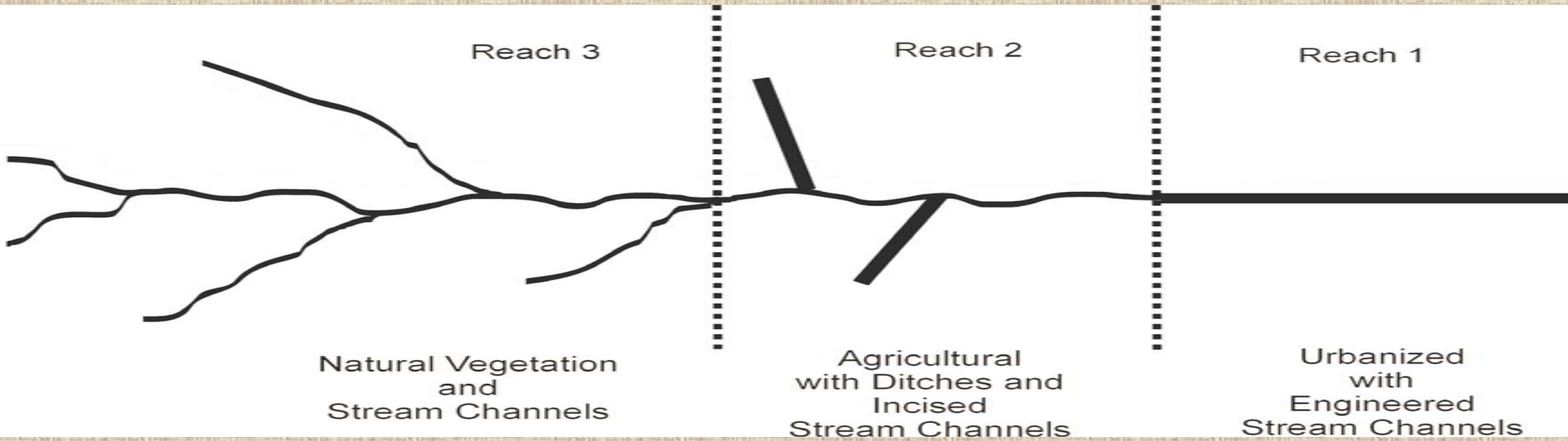


Phase 2: Baseline Assessment

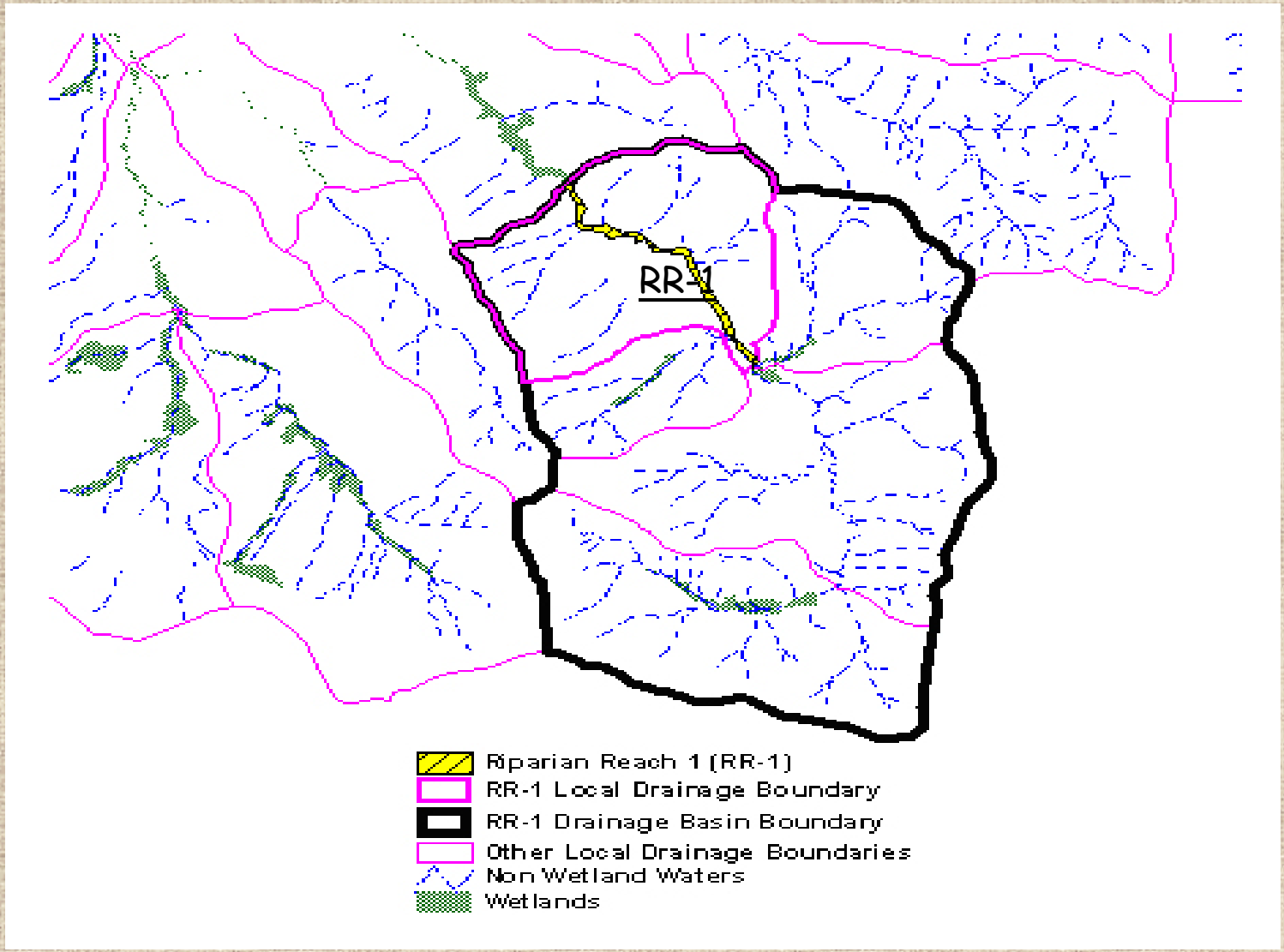
- Define riparian ecosystem assessment units
- Assess hydrologic, water quality, and habitat integrity of the riparian ecosystem units using "indicators" of across multiple spatial scales
- Calculate integrity indices and integrity units for each assessment unit

Riparian Reach Assessment Units

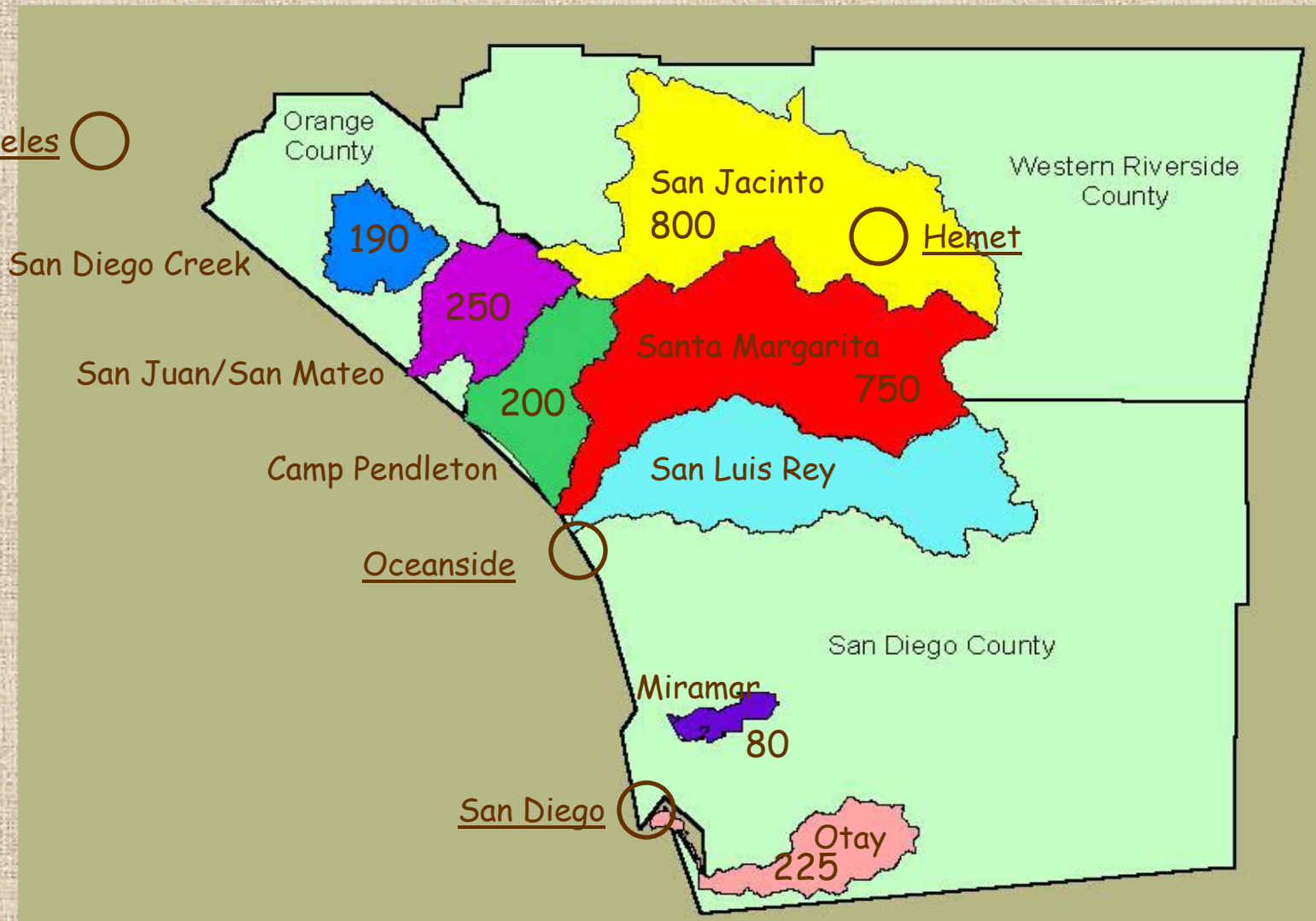
- Riparian reaches are defined as a segment of riparian ecosystem along a mainstem channel that is relatively homogeneous with respect to geology, geomorphology, stream channel geometry, substrate, and hydrologic regim vegetation communities, and cultural alteration
- Riparian reaches are initially identified remotely using aerial photos / topographic maps, and then verified / revised during field data collection



Riparian Reach Assessment Units



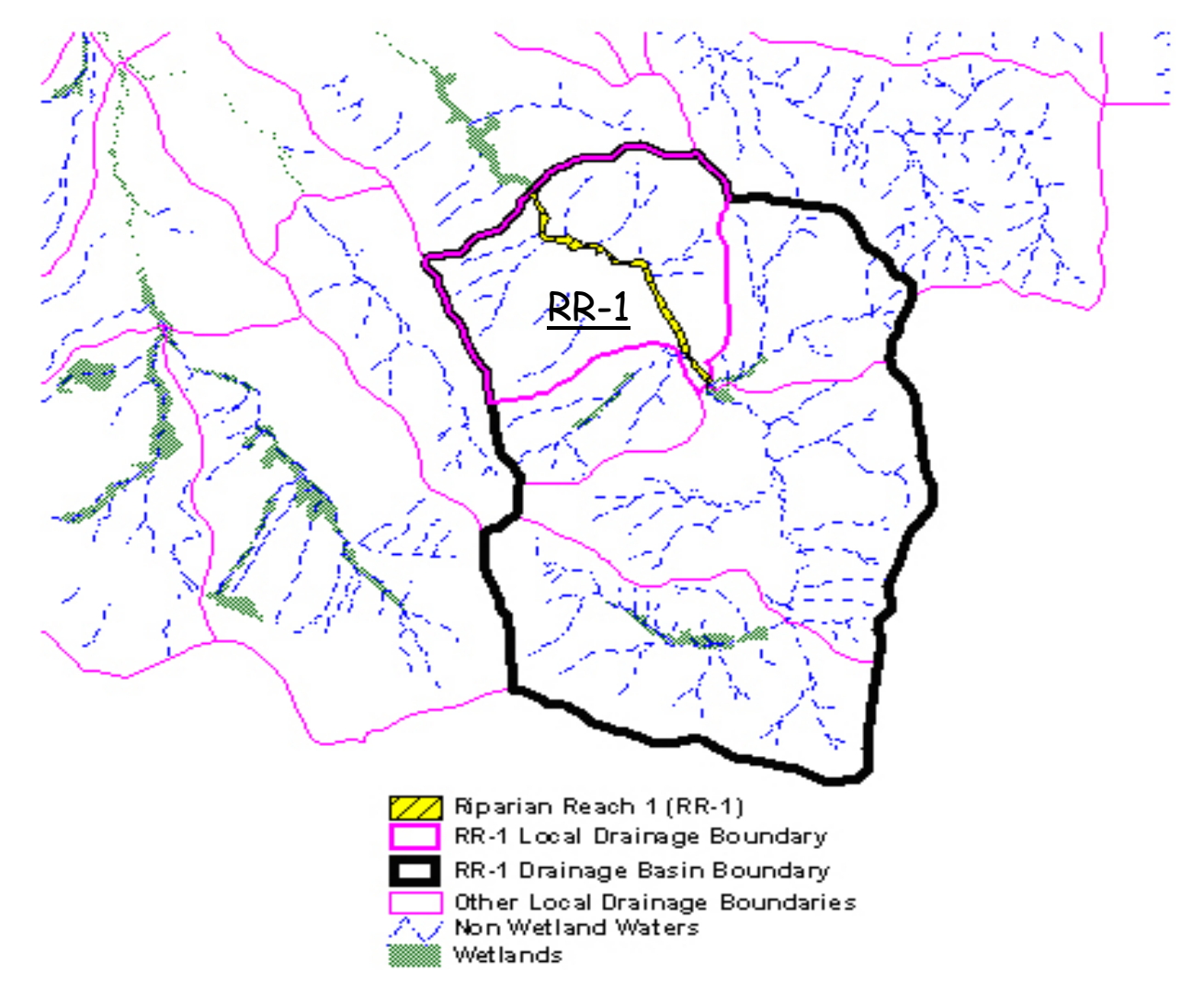
Number of Riparian Reaches



Assessment Indicators

- "Indicators" are used to assess the attributes and characteristic that influence riparian ecosystem integrity
- Indicators capture information at three spatial scales
  - Riparian reach (riparian ecosystem proper)
  - Local drainage
  - Drainage basin

Spatial Scales of Assessment



Hydrologic Indicators

Hydrologic indicators reflect:

- The frequency, magnitude, and temporal distribution of stream discharge
- Interaction between the stream channel and the floodplain

Hydrologic Indicators

- Hydrologic indicators include:
  - Extent of Impervious Surfaces
  - Altered Hydraulic Conveyance
  - Surface Water Retention in lakes, reservoirs, and ponds
  - Perennialized Stream Flow
  - Hydrologic Interaction between stream channel and floodplain
  - Import, Export, and Diversion of Surface Water




Water Quality Indicators

- Water quality indicators reflect:
  - Land use in a drainage basin with respect to the potential increase in non-point pollutants at multiple spatial scales
  - The stream delivery system in terms of magnitude, frequency, and temporal distribution
  - Hydrologic interaction between stream channel and floodplain

Water Quality Indicators

- Water quality indicators include:
  - Altered Hydraulic Conveyance – Reach Scale
  - Altered Hydraulic Conveyance - DB Scale
  - Surface Water Retention
  - Perennialized Stream Flow
  - Import, Export, or Diversion of Surface Water
  - Floodplain Interaction
  - Sediment Regime
  - Extent of Riparian Plant Communities
  - Land Use/Land Cover - Nutrient Increase
  - Land Use/Land Cover – Pesticide Increase
  - Land Use/Land Cover – Hydrocarbon Increase
  - Land Use /Land Cover – Sediment Increase

Habitat Indicators

Habitat indicators reflect:

- Spatial extent and quality of riparian habitat
- "Continuity / Connectedness" of riparian habitat at multiple spatial scales
- Spatial extent and quality of adjacent non-riparian habitat (i.e., uplands)

Habitat Indicators

- Extent and Condition of Riparian Plant Communities
- Extent of Exotic Plant Species
- Riparian Corridor Continuity – Riparian Reach Scale
- Riparian Corridor Continuity – Drainage Basin Scale
- Land Use / Land Cover – Riparian/Upland Boundary
- Land Use / Land Cover – Upland Buffer




Indicator Scores

- Indicators, and other variety of other characteristics, are measured in the field or from aerial photos
- Indicator are assigned a score from 0-100 reflecting the degree of deflection from the culturally unaltered "reference condition", for example:
  - percent of culturally unaltered land use / land cover
  - percent of culturally unaltered stream channel
- Selected indicator scores are then aggregated into hydrologic, water quality and habitat integrity indices

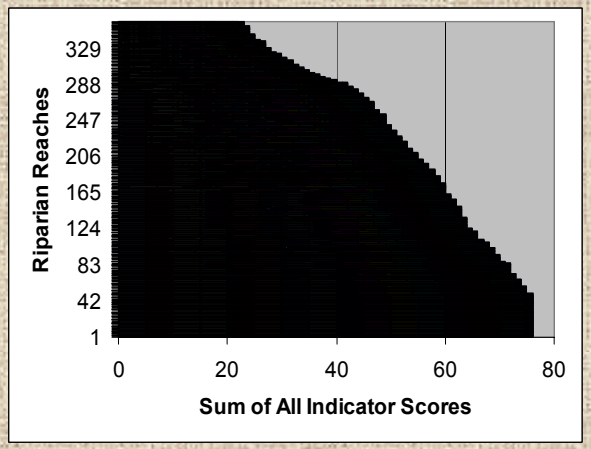
Integrity Indices

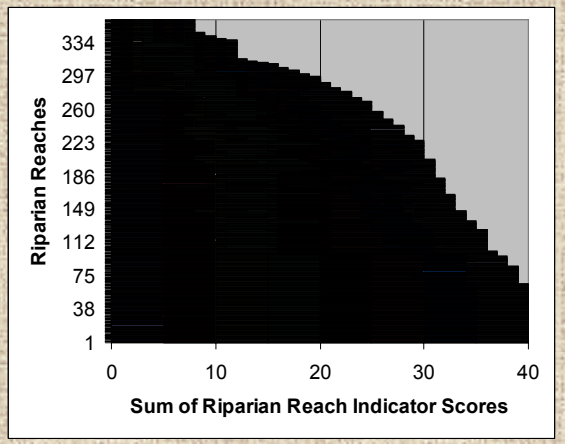
- Integrity indices are relative measure of deflection from reference condition not an absolute measure of ecosystem integrity
- Integrity indices also provide are relative estimate of cumulative impacts
- Integrity index * area of riparian reach results in integrity units

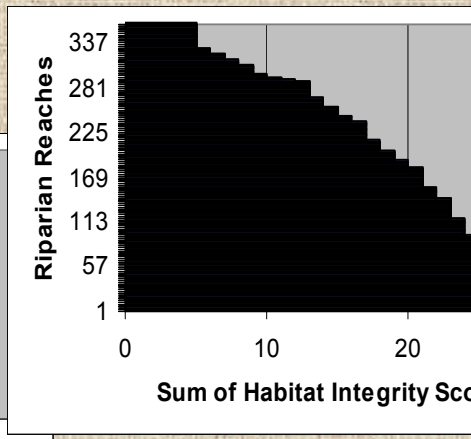
Range of Indicator Scores

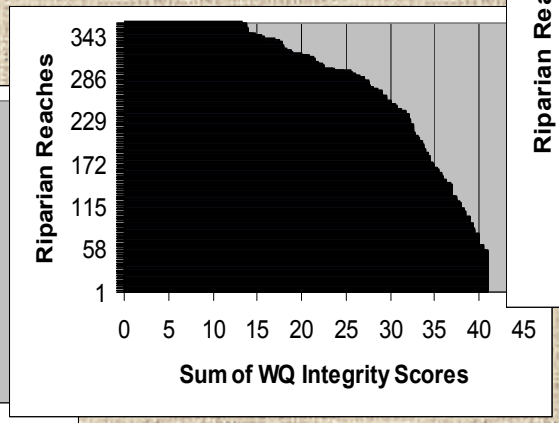
The range of scores for individual indicators and integrity indices exhibit an even distribution

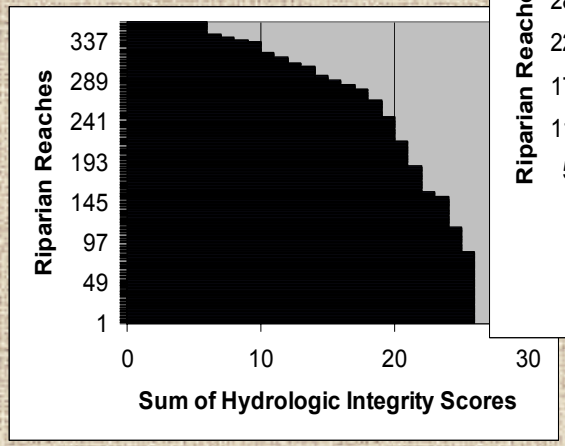
This result is consistent with the range of conditions exhibited in the watersheds



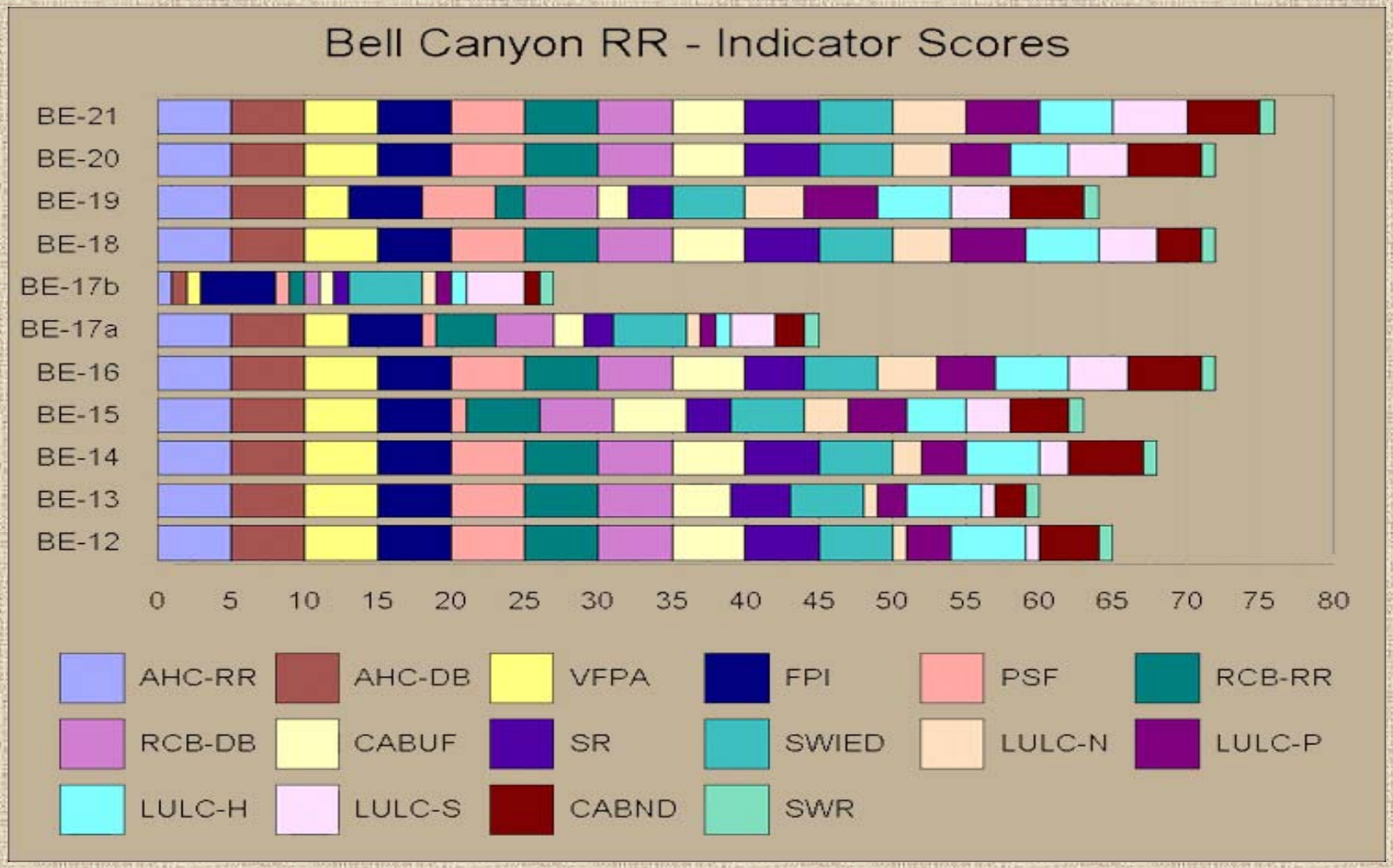




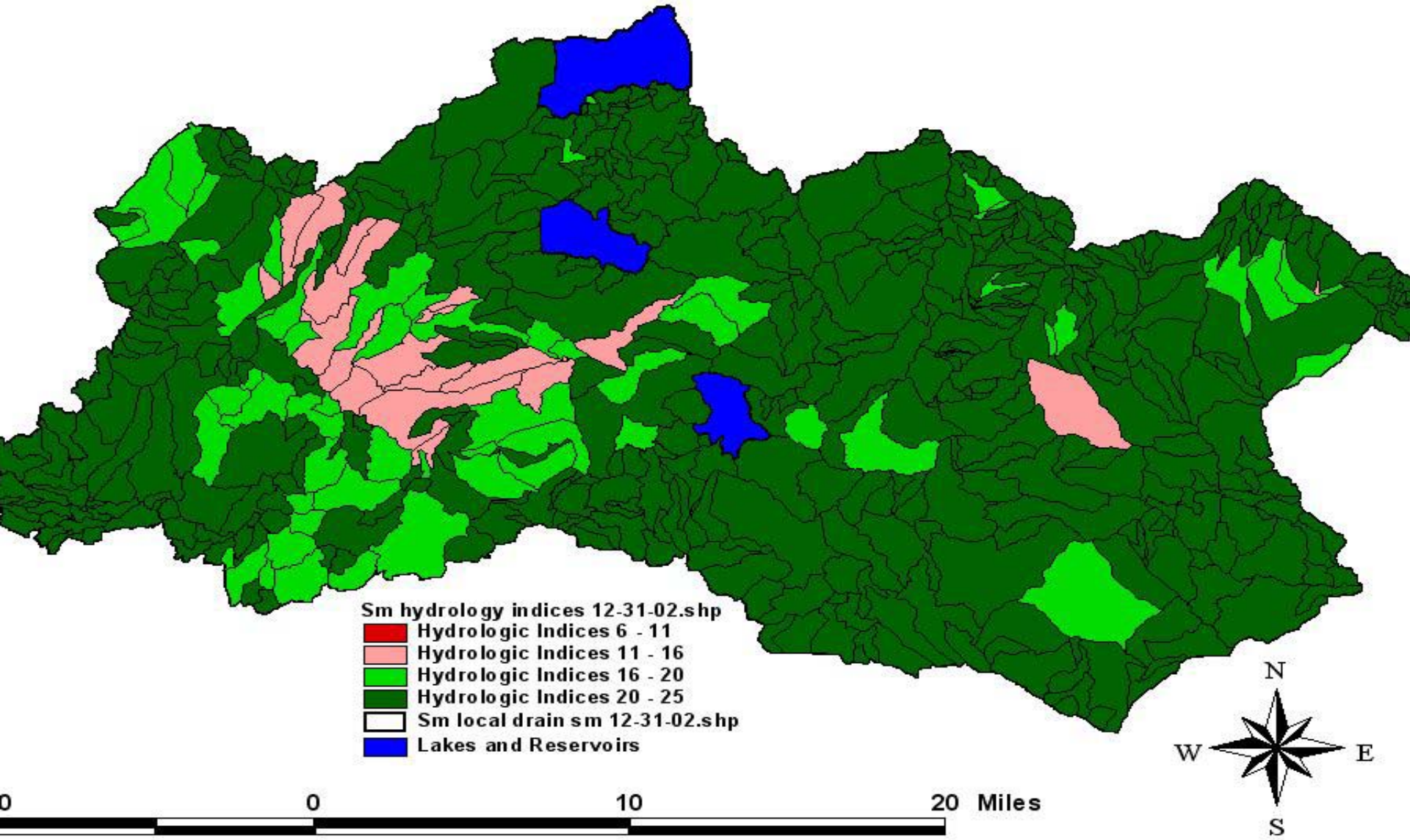




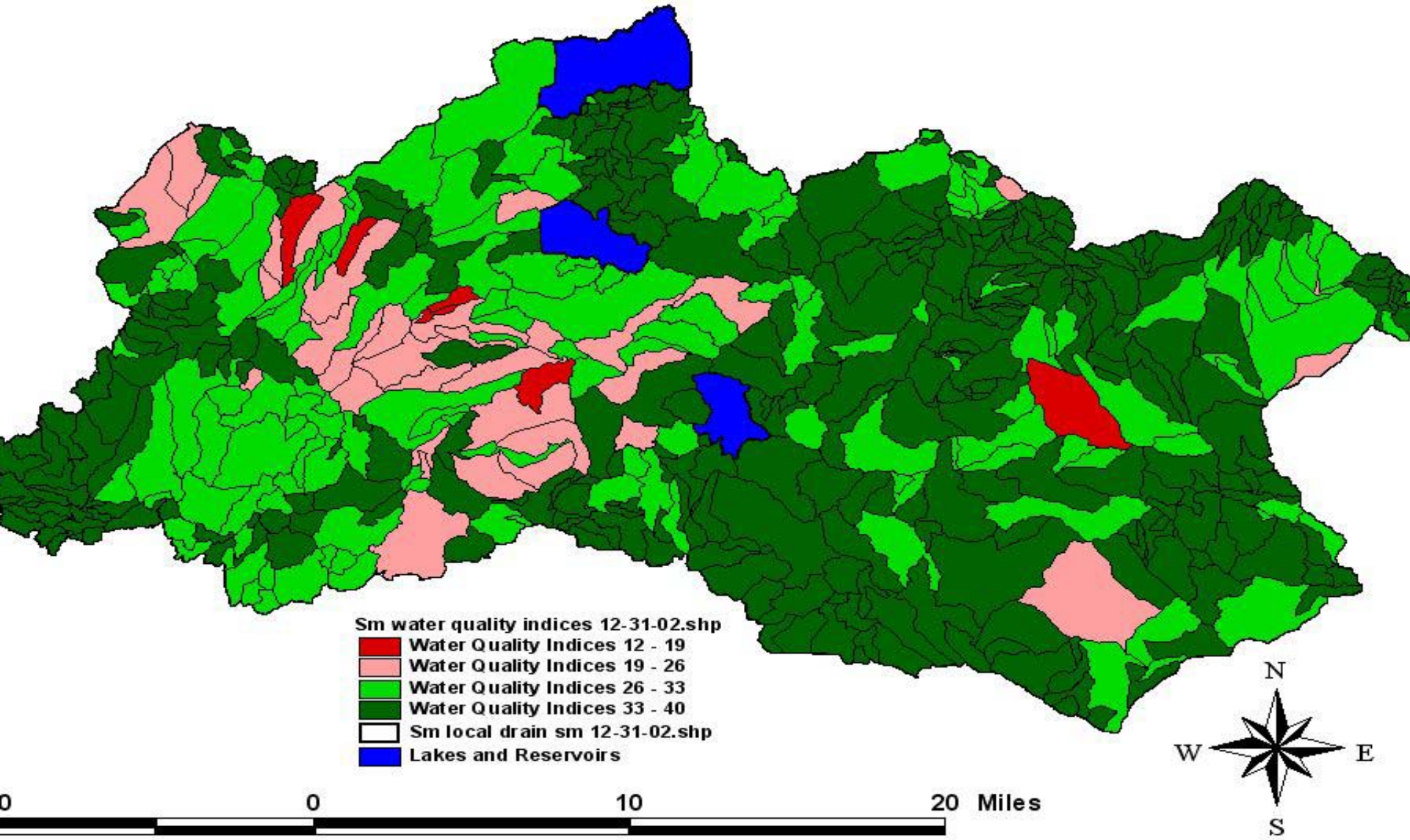
Summary of Indictor Scores



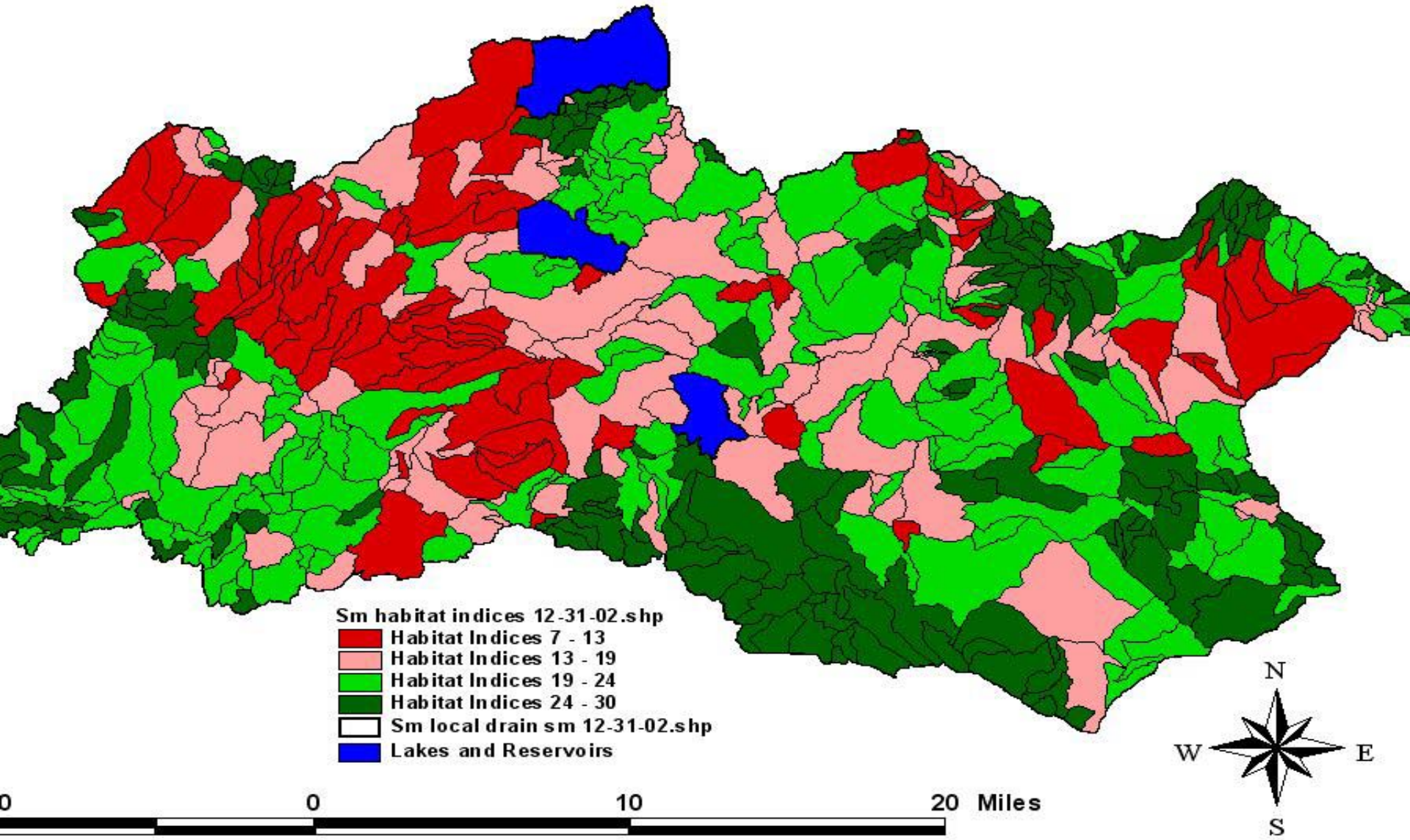
anta Margarita Watershed - Hydrologic Integrity Indice



Santa Margarita Watershed - Water Quality Integrity Indic

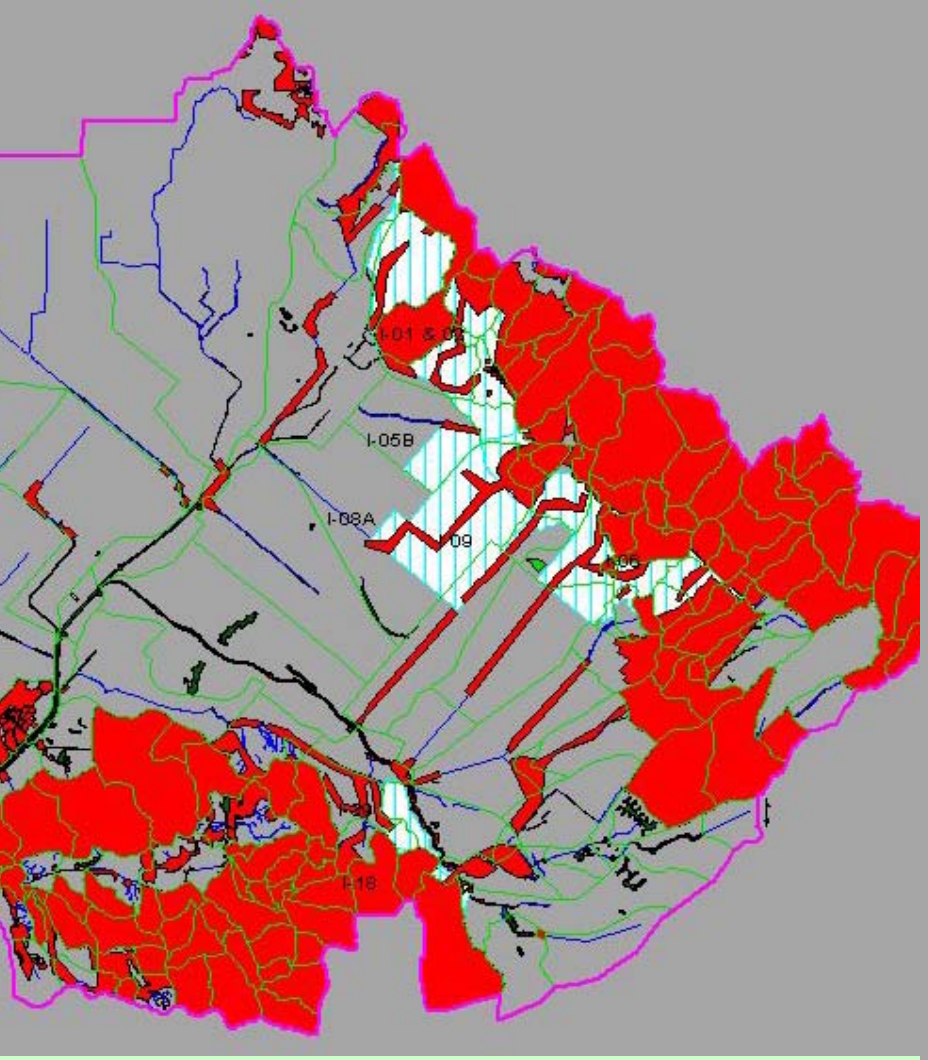


Santa Margarita Watershed - Habitat Integrity Indices



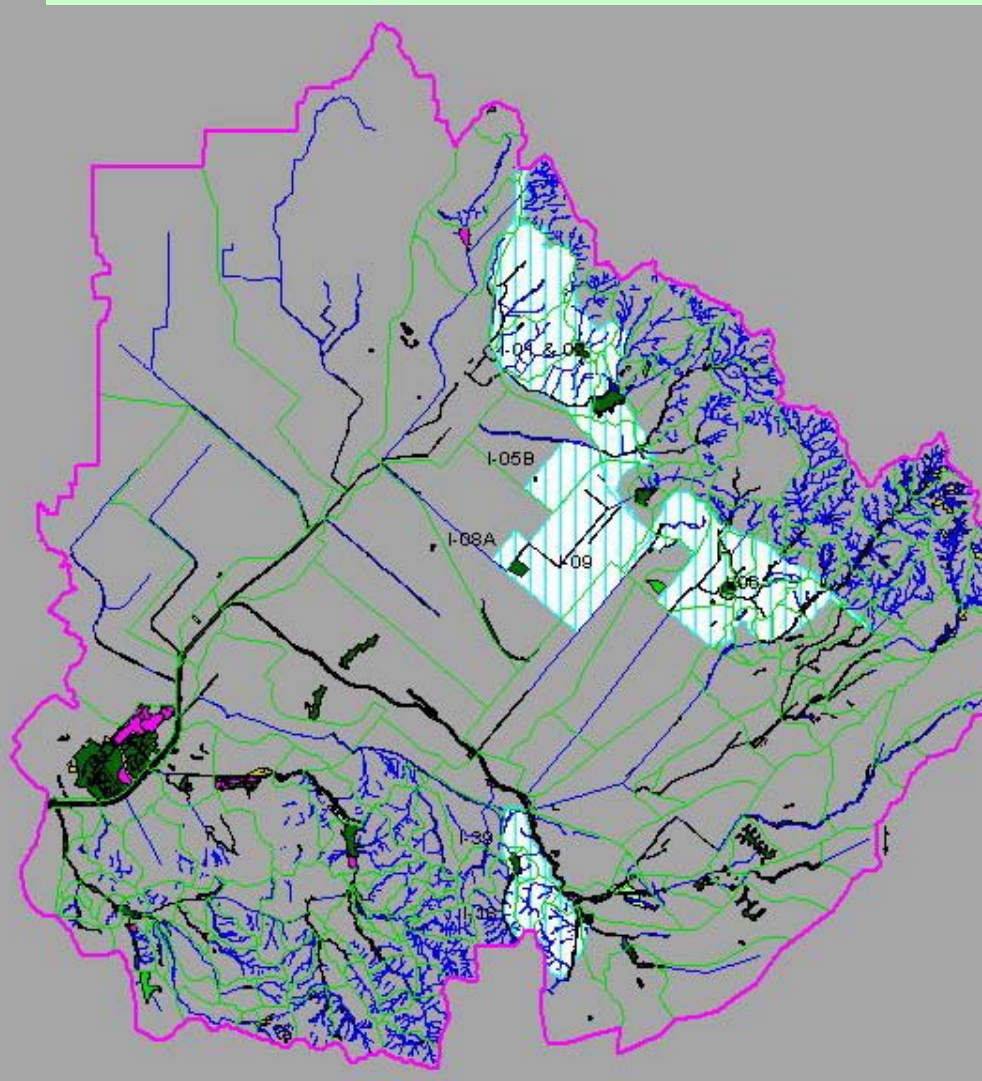
Phase 3: Alternatives Analysis

- Objectives
  - Develop a "preferred" alternative using baseline assessment results and other criteria:
    - Medium to high integrity indices
    - Corridors connecting existing large patches
    - Supporting threatened, endangered, or sensitive species
    - Critical habitats and management, conservation, or research reserve areas
  - Assess direct and indirect impacts of all alternatives
    - Simulate direct and indirect effects of each alternative on indicators
    - Recalculate integrity indices and integrity units
    - Compare baseline to simulated results using selected criteria

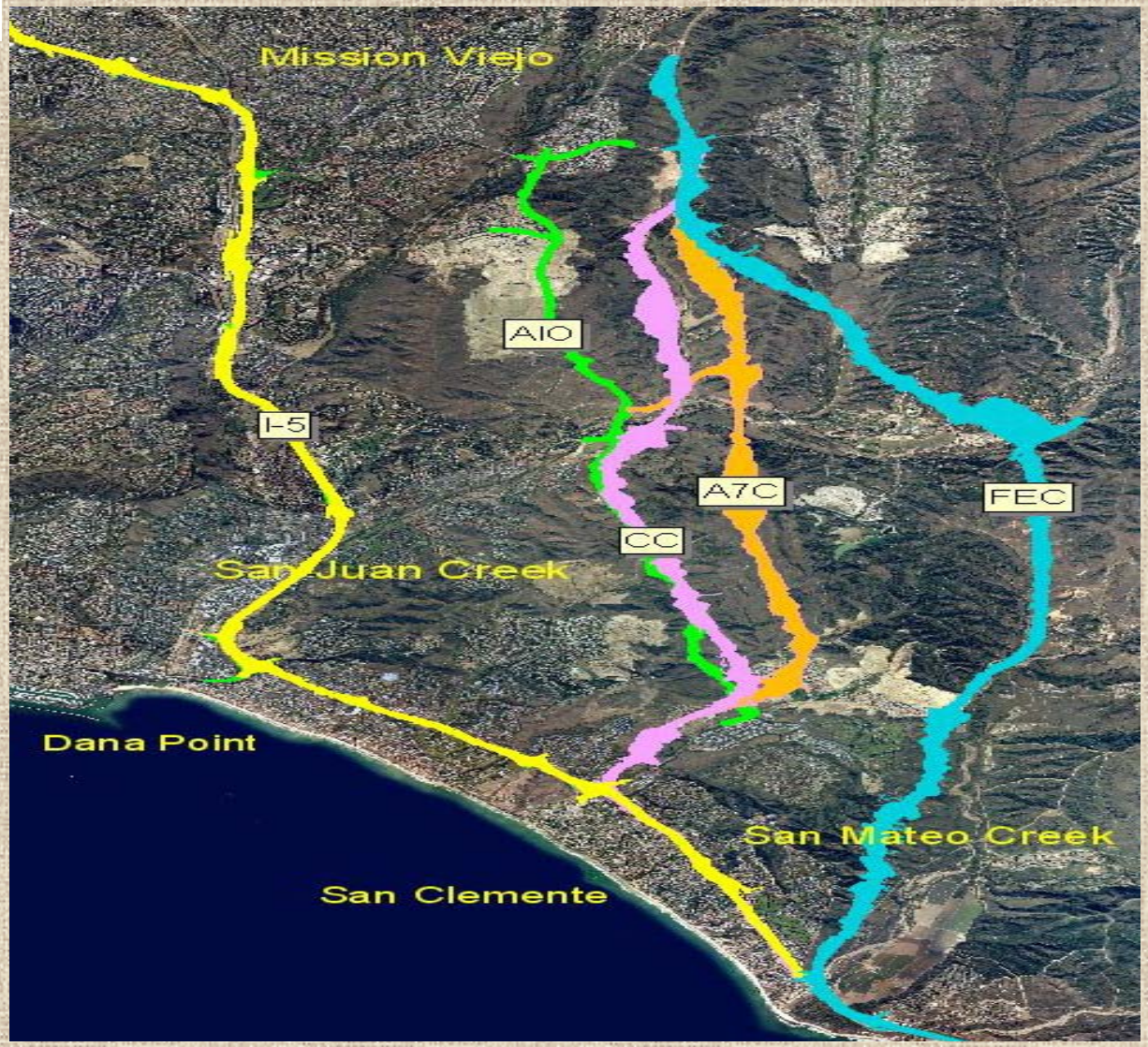


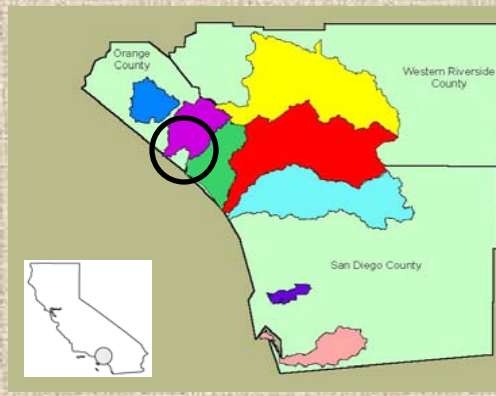
Resource Based Alternative
"Avoidance Area"

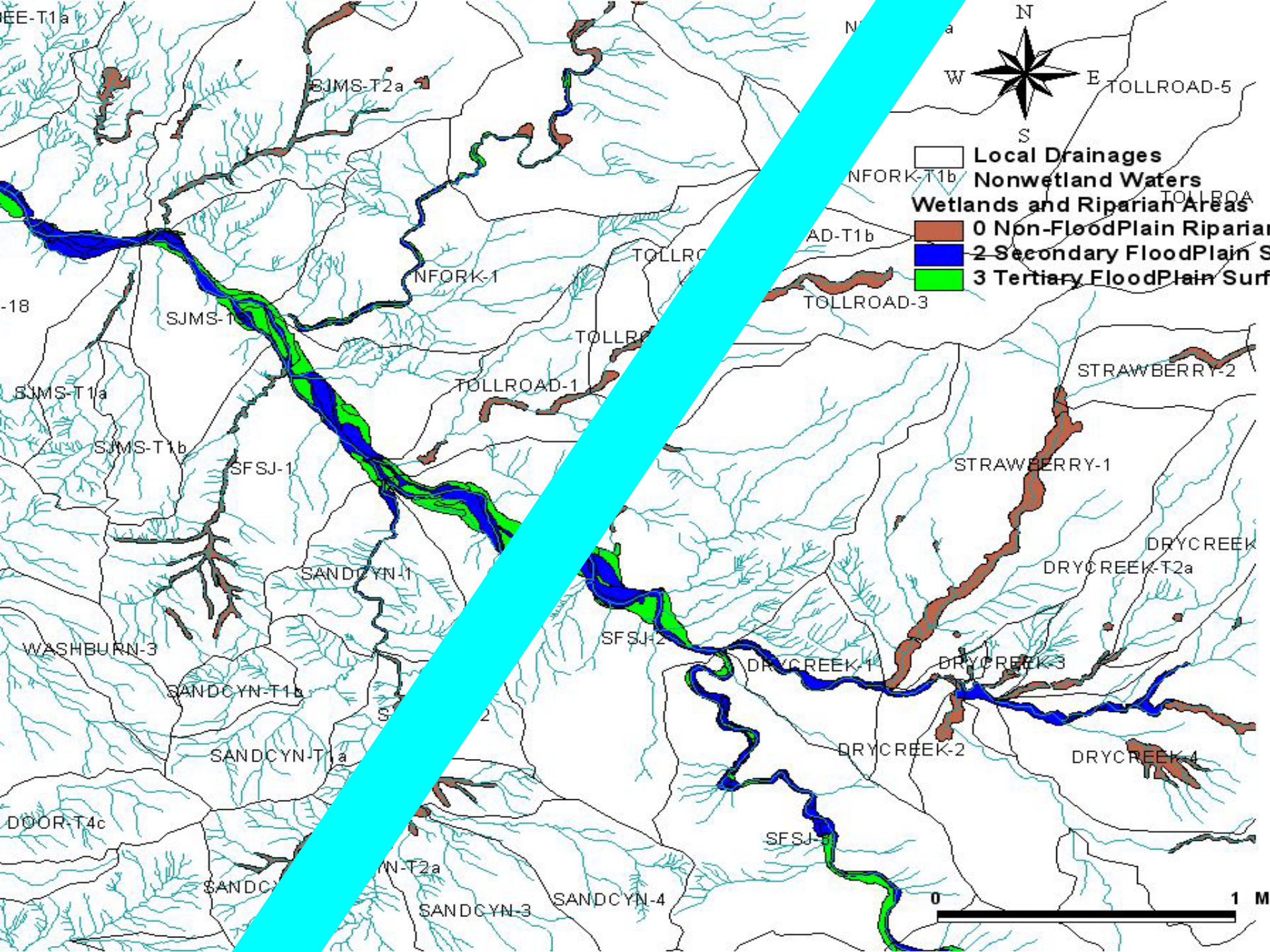
General Land Use Plan
Alternative
"Impact Area"



Alternative Transportation Corridors



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W
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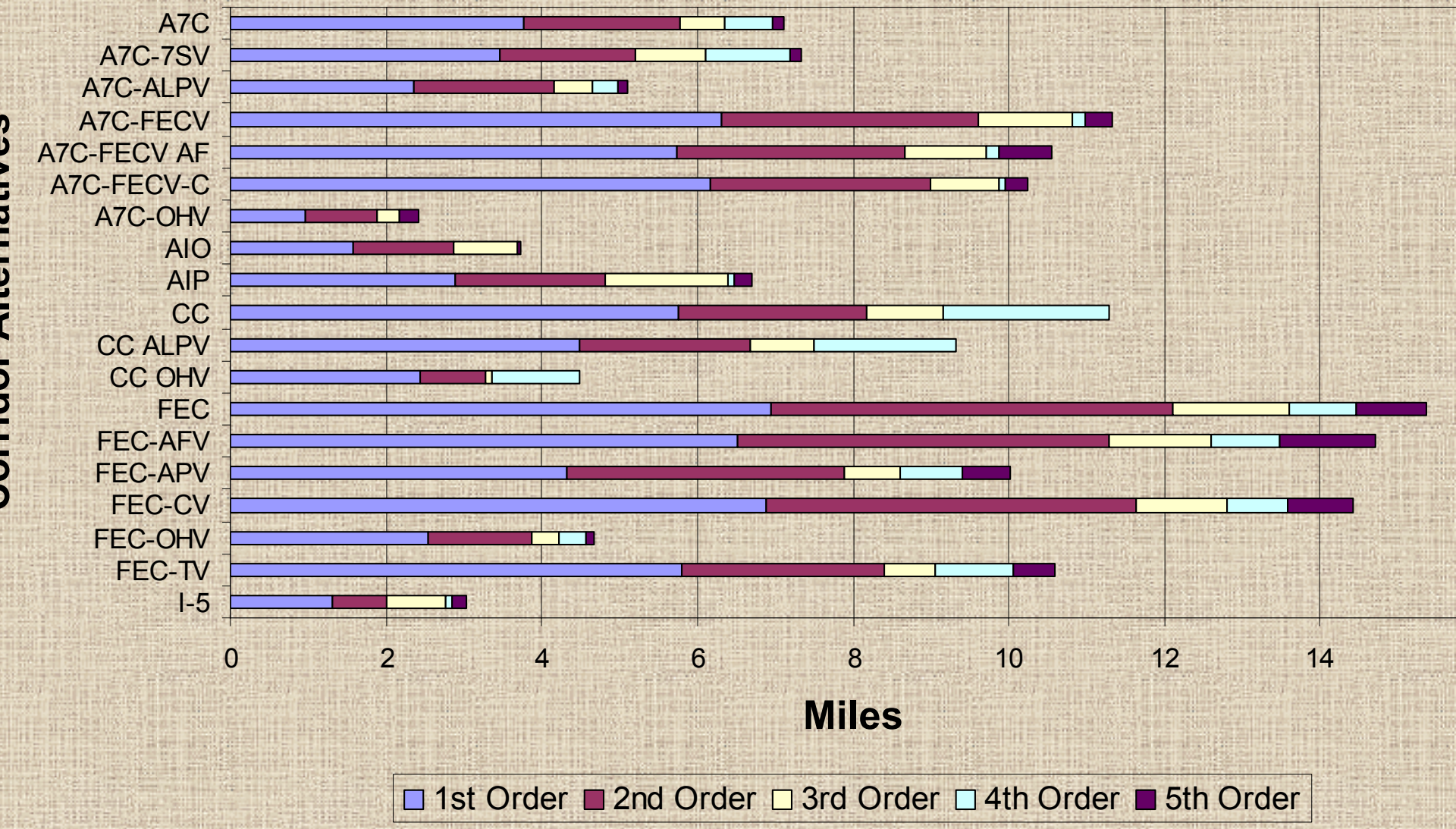
Local Drainages
Nonwetland Waters
Wetlands and Riparian Areas
0 Non-FloodPlain Riparian
2 Secondary FloodPlain S
3 Tertiary FloodPlain Surf
SJMS-T2a
NFORK-1
SJMS-1
SJMS-T1a
SJMS-T1b
SFSJ-1
TOLLROAD-1
TOLLROAD-3
TOLLROAD-5
STRAWBERRY-2
STRAWBERRY-1
DRYCREEK
DRYCREEK-T2a
DRYCREEK-1
DRYCREEK-3
DRYCREEK-2
DRYCREEK-4
SFSJ-2
SANDCYN-1
SANDCYN-T1b
SANDCYN-T1a
SANDCYN-3
SANDCYN-4
WASHBURN-3
DOOR-T4c
0
1 M

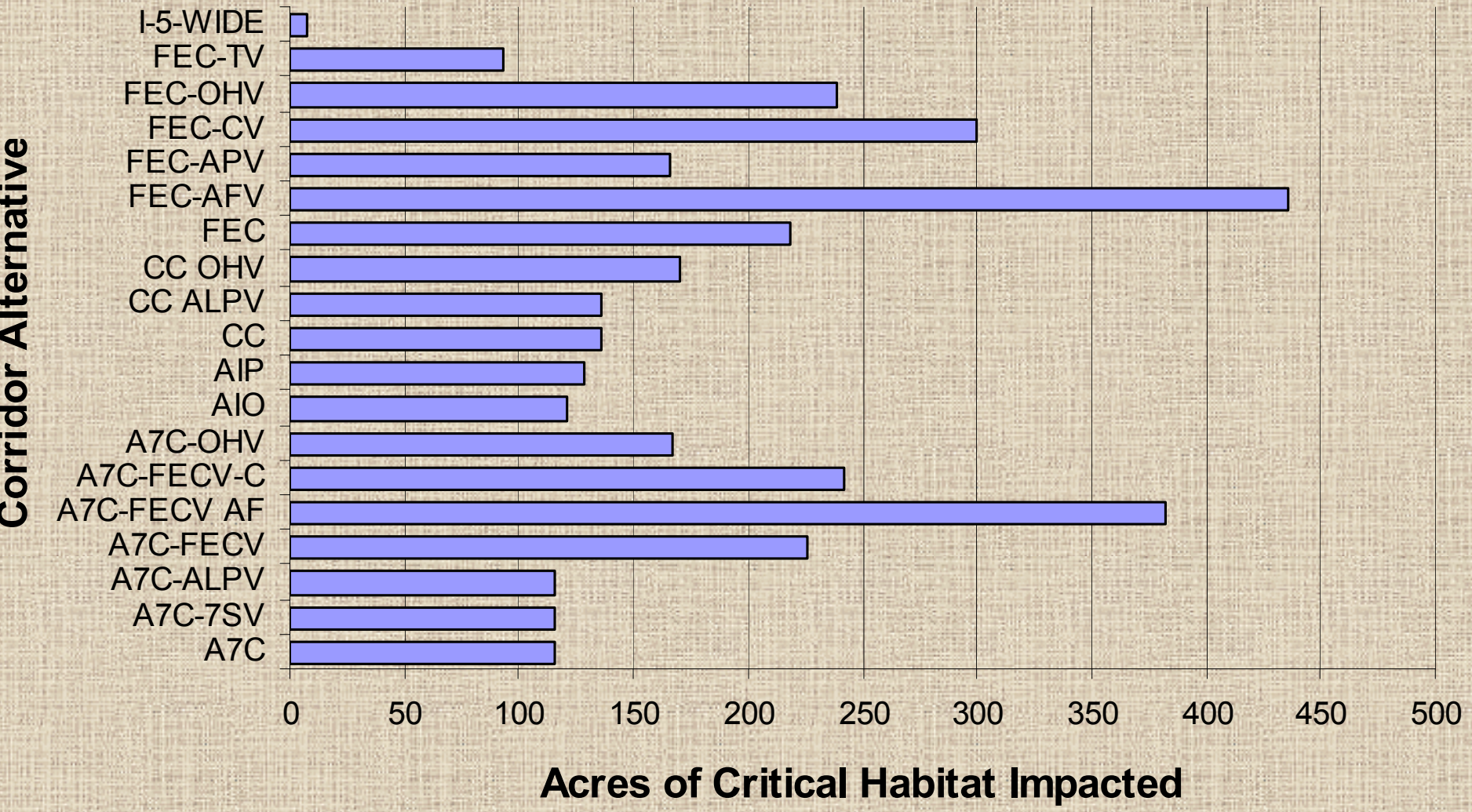
Criteria for Comparing Alternatives

- WoUS directly and indirectly impacted (area / length)
- Riparian ecosystems directly and indirectly impacted (area)
- Critical habitat of threatened, endangered, and sensitive species directly impacted (area)
- Quantity of hydrologic, water quality, and habitat integrity units for riparian ecosystems directly and indirectly impacted
- Change in hydrologic, water quality, and habitat integrity units for riparian ecosystems directly and indirectly impacted

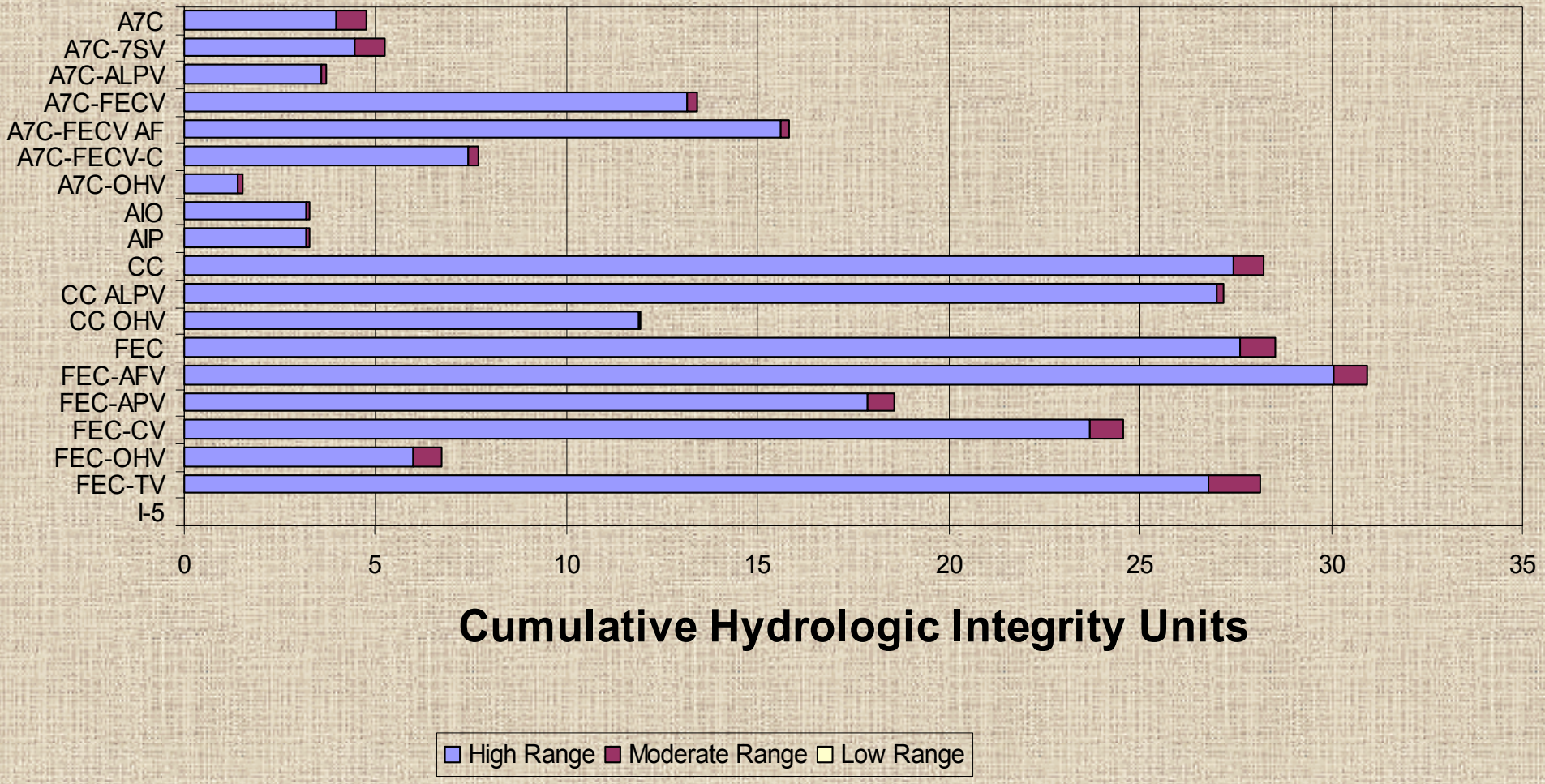
Miles of Stream Channel Directly Impacted (Ultimate Corridor Footprints)



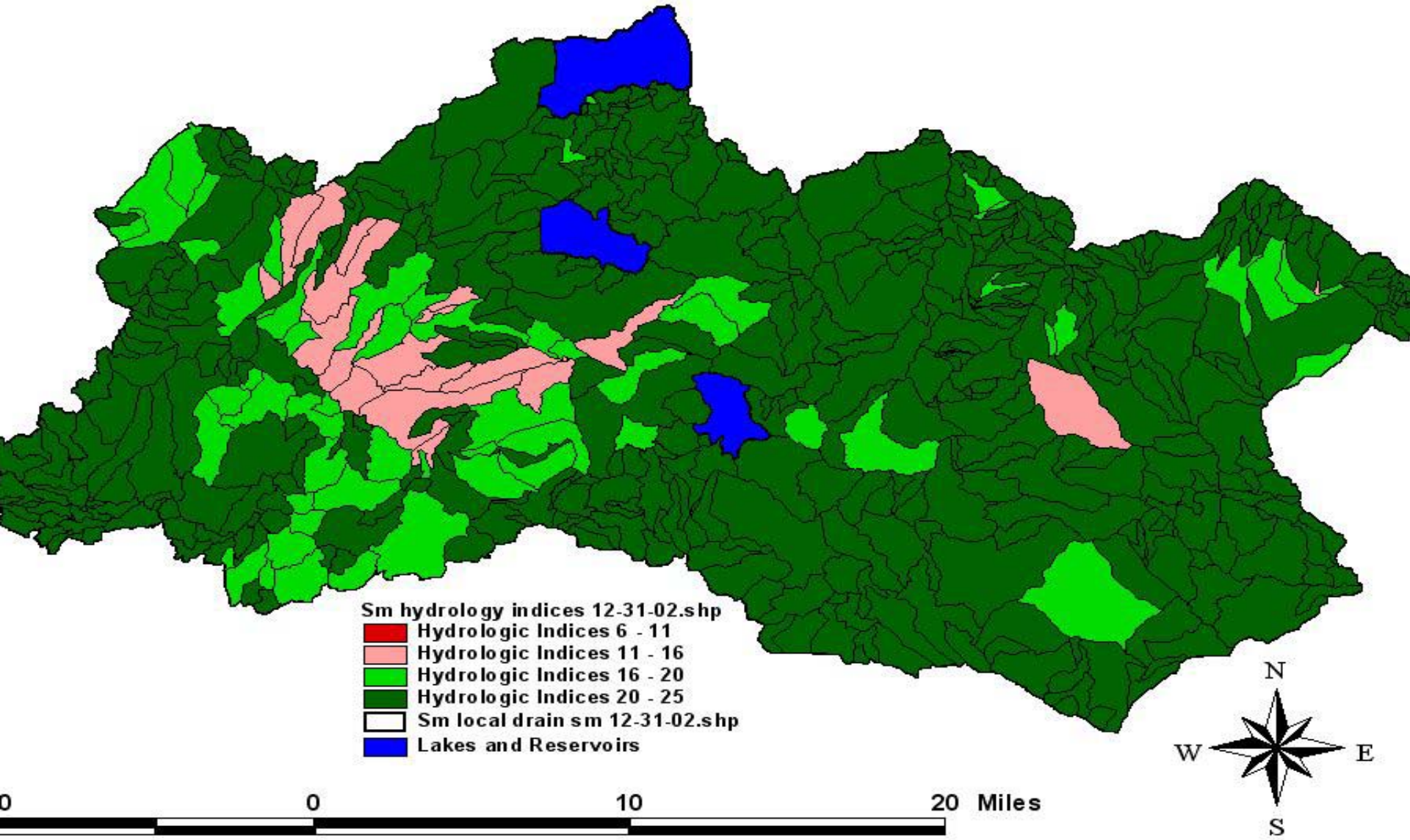
Arroyo Toad Critical Habitat



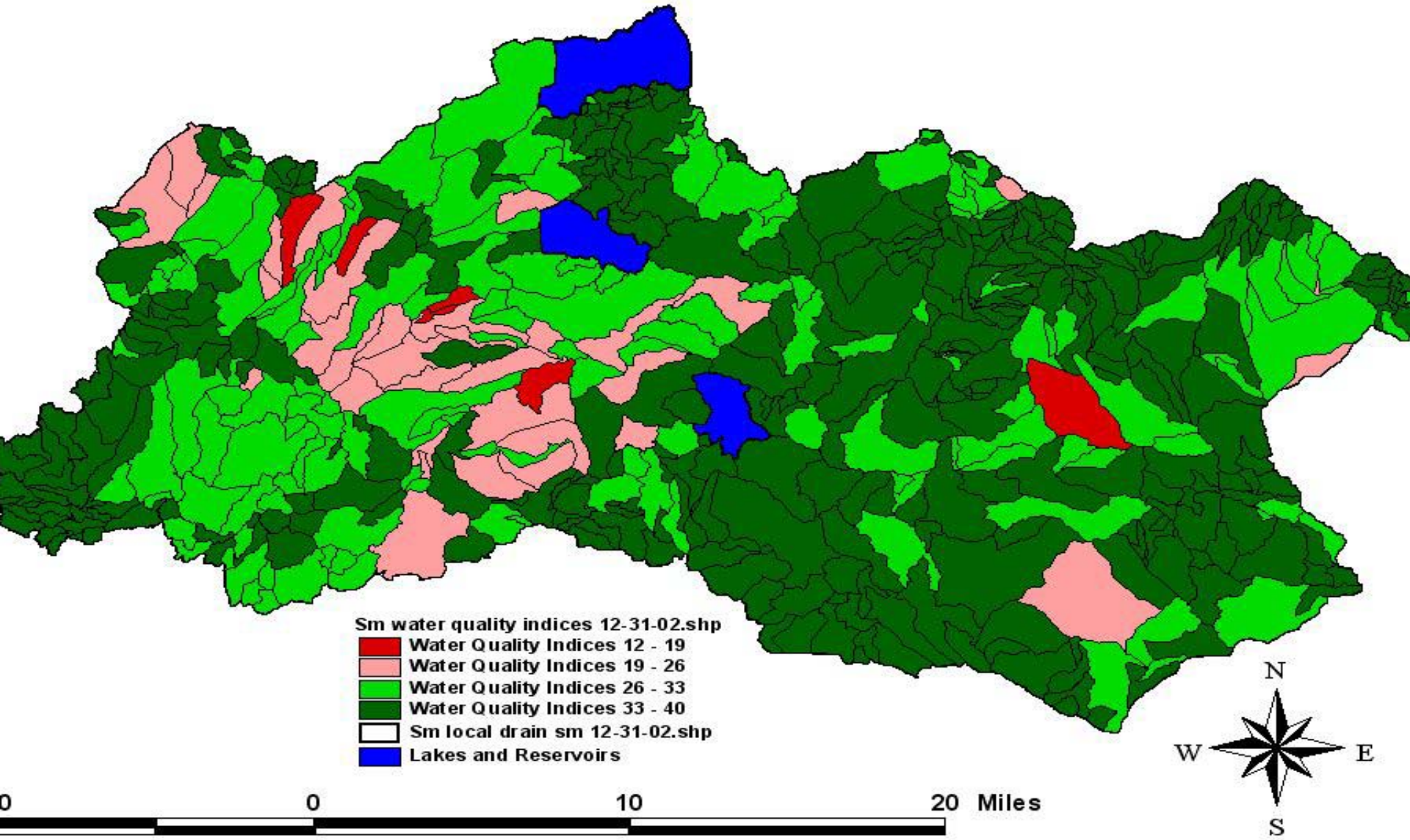
Loss of Water Quality Integrity Units in Directly Impacted Riparian Ecosystems (Ultimate Corridor Footprints)



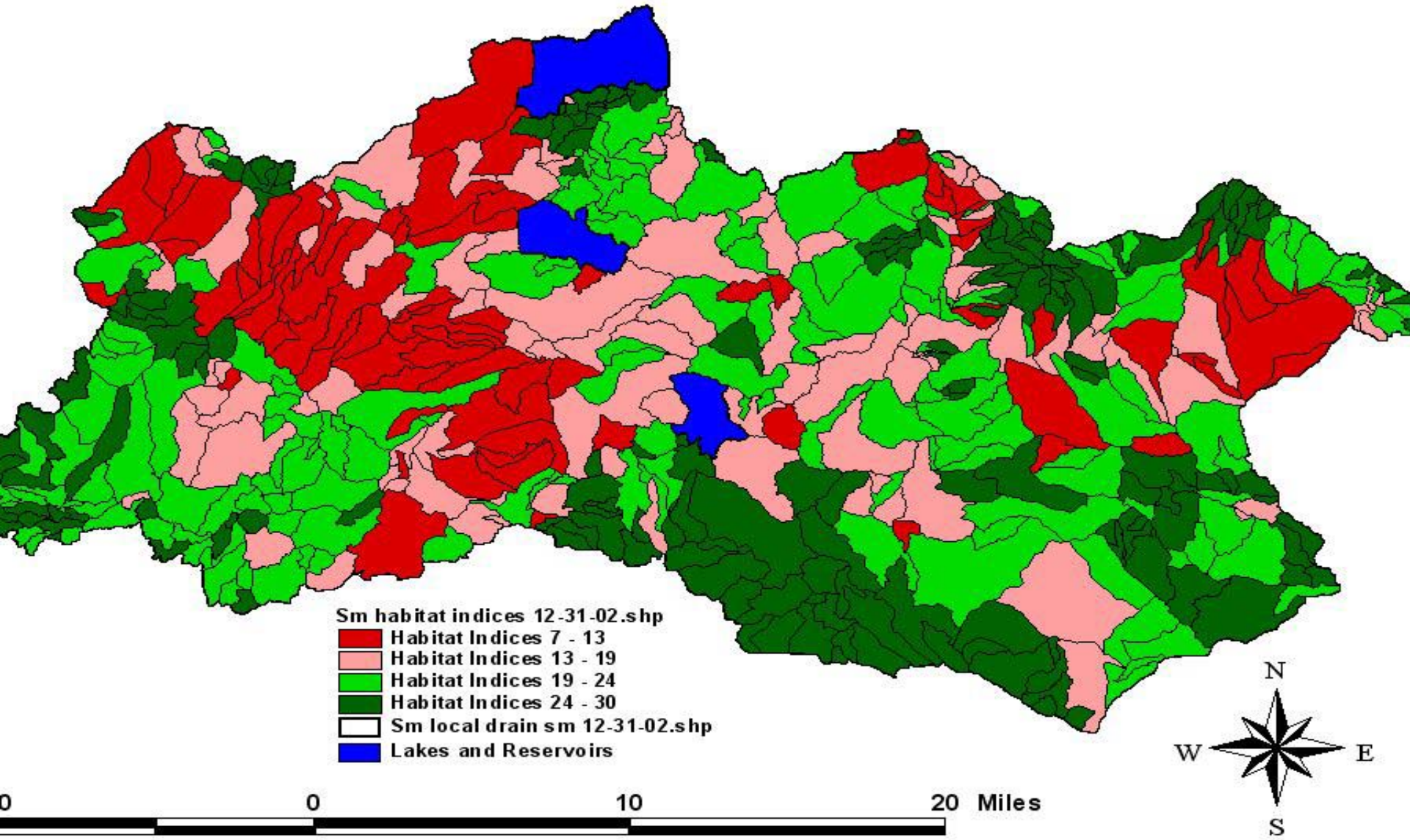
anta Margarita Watershed - Hydrologic Integrity Indice



Santa Margarita Watershed - Water Quality Integrity Indic



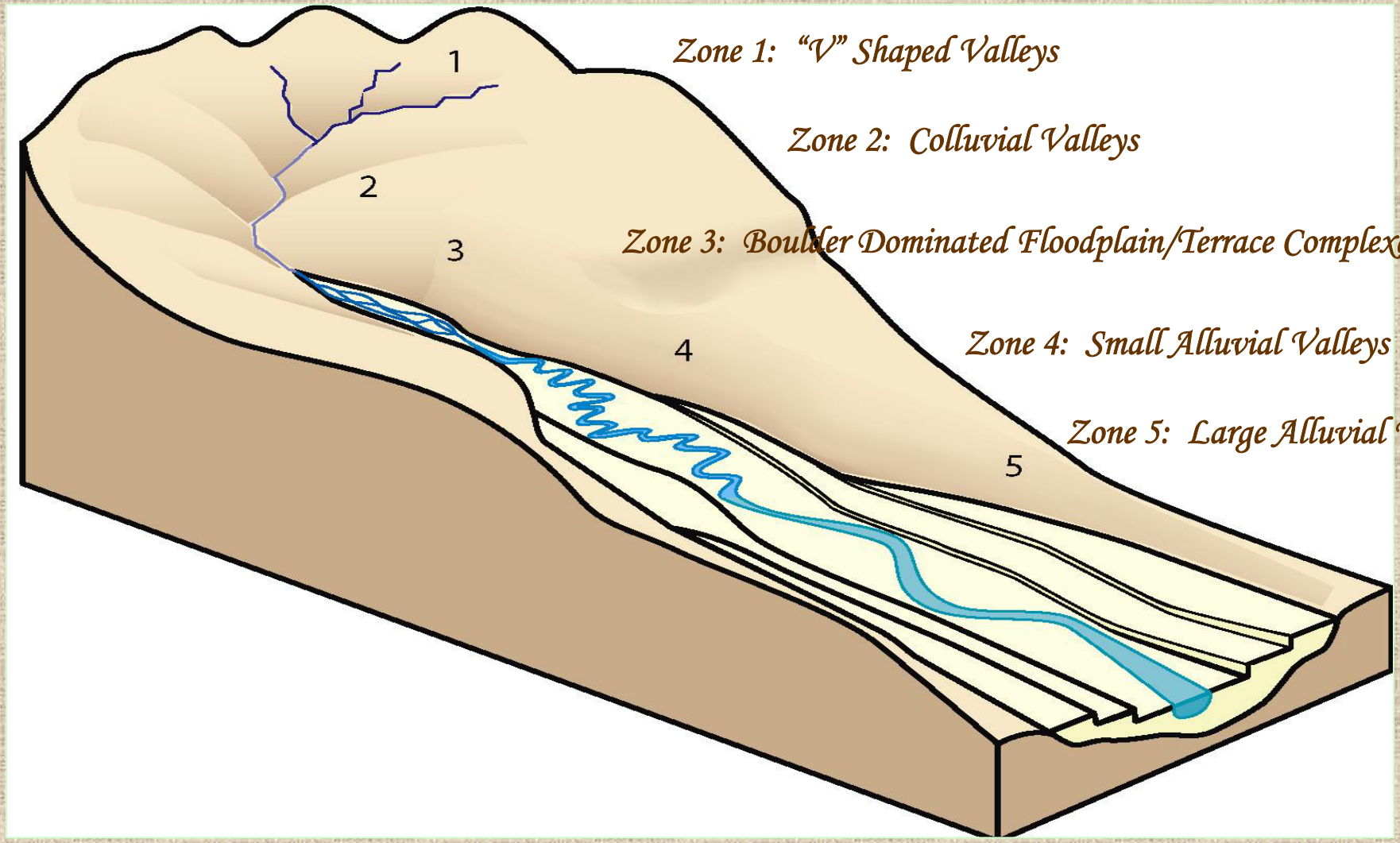
Santa Margarita Watershed - Habitat Integrity Indices



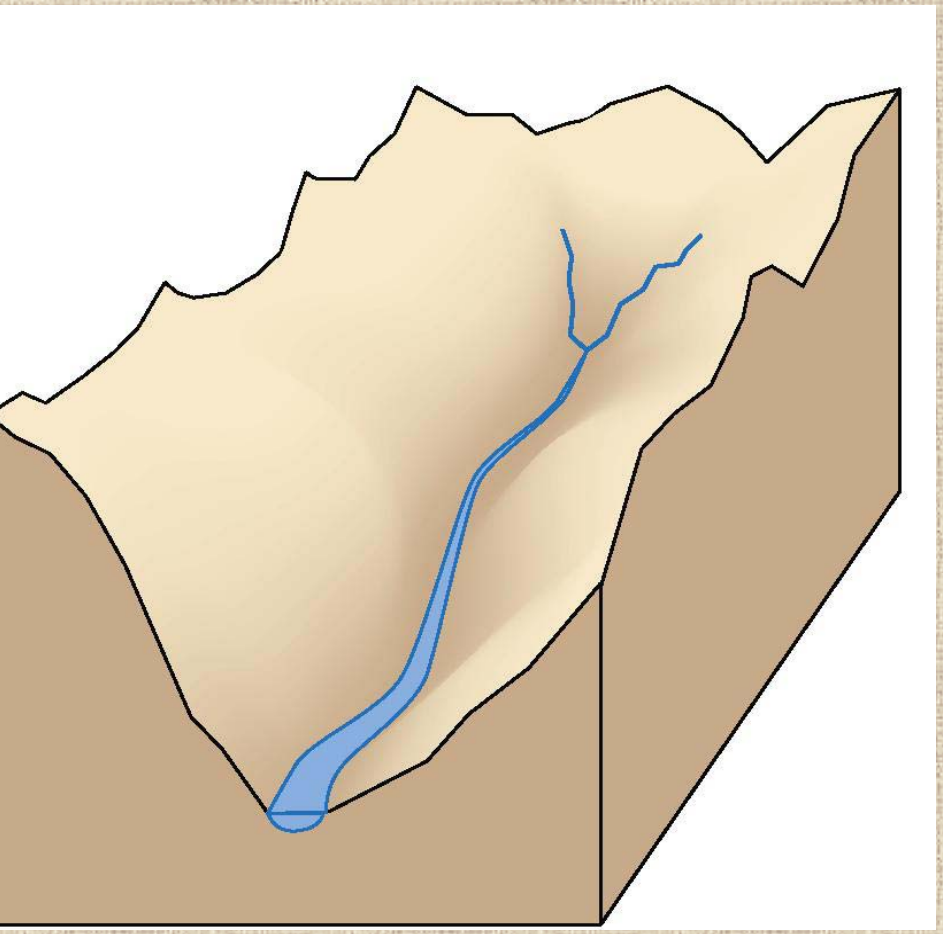
Phase 4: Watershed Restoration Plan

- Objective
  - Develop watershed wide restoration plan that establishes restoration templates and priorities for riparian ecosystems
- Approach
  - Classify each riparian reach by geomorphic zone
  - Identify current condition of each riparian reach
  - Determine appropriate restoration template based on condition
  - Estimate relative level of effort required for restoration
  - Simulate the change in hydrologic, water quality, and habitat indices following application of restoration template
  - Identify priority restoration areas based on selected criteria

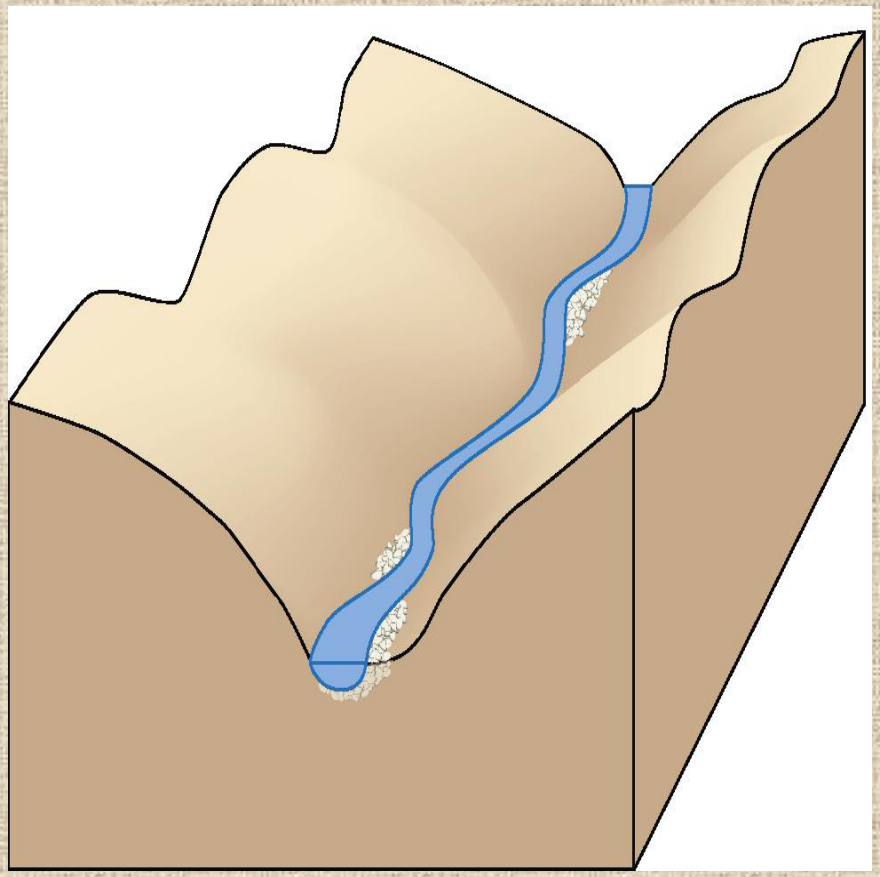
Geomorphic Zones



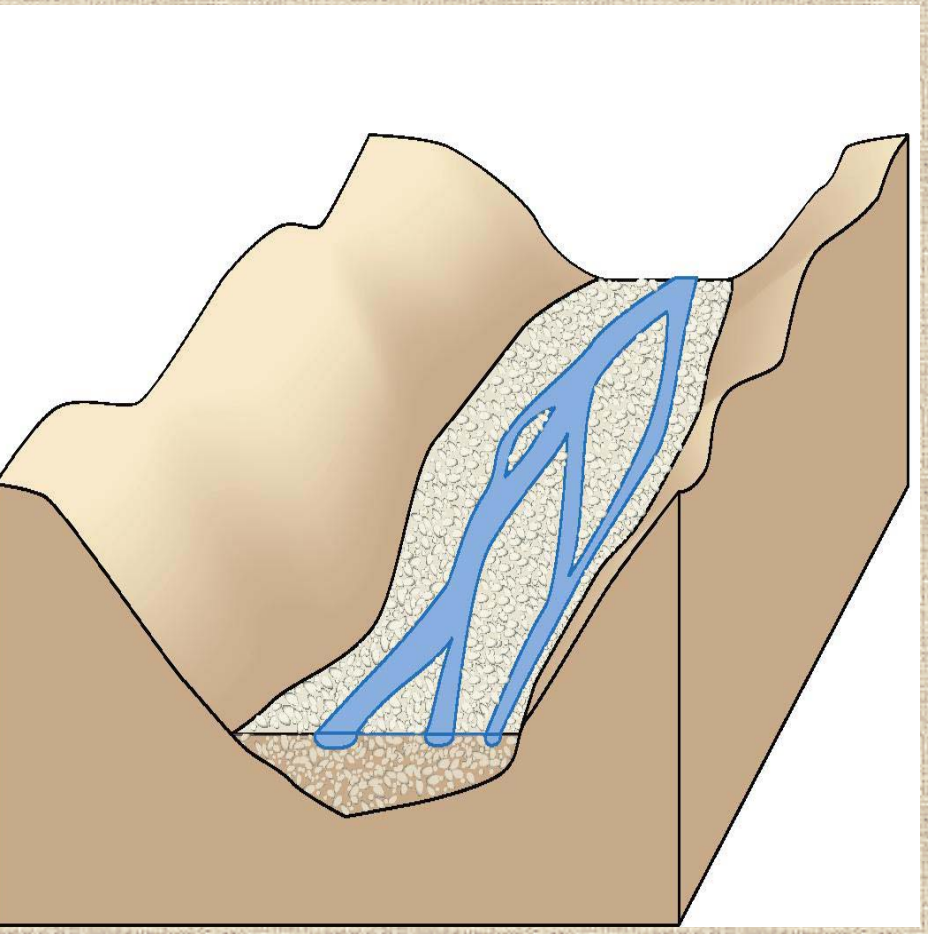
Zone 1: "V" Shaped Valleys



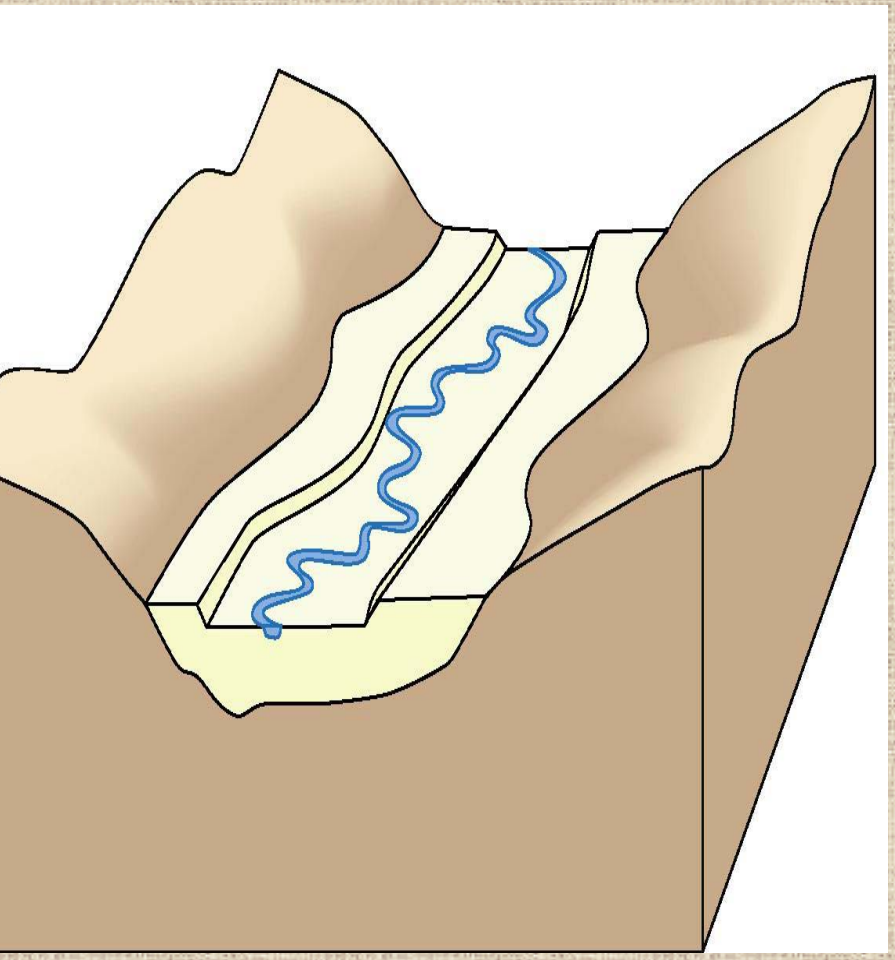
Zone 2: Colluvial Valleys



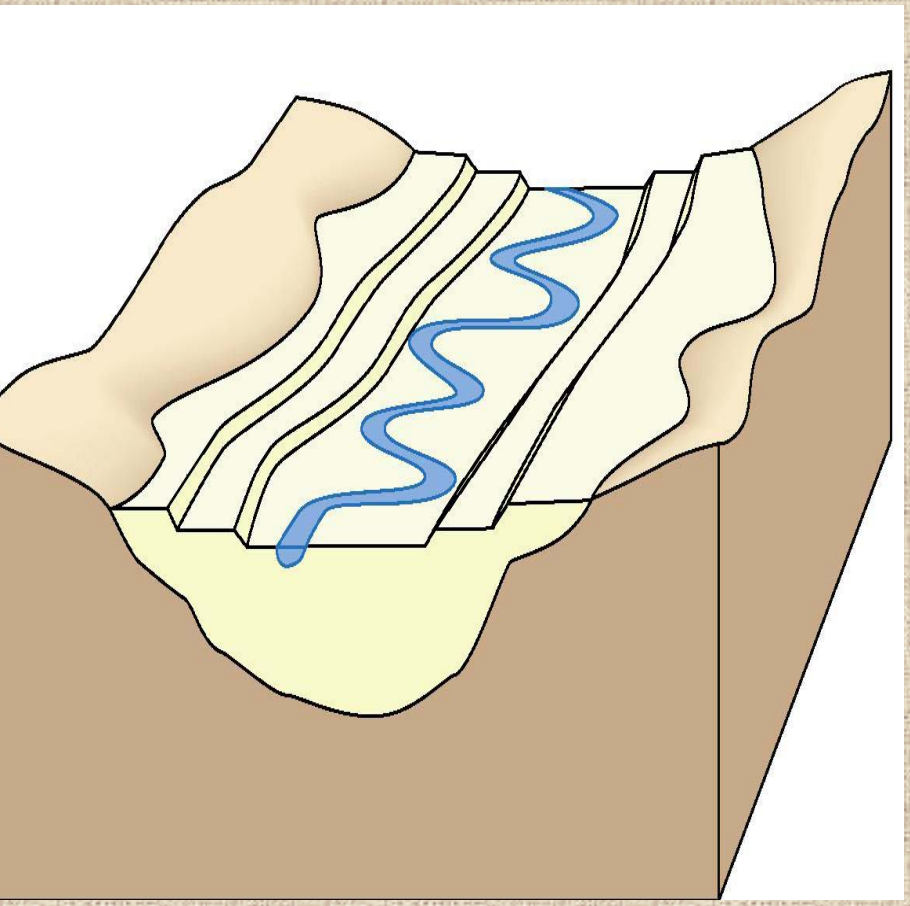
Zone 3: Boulder Dominated Floodplain/Terrace Complexes



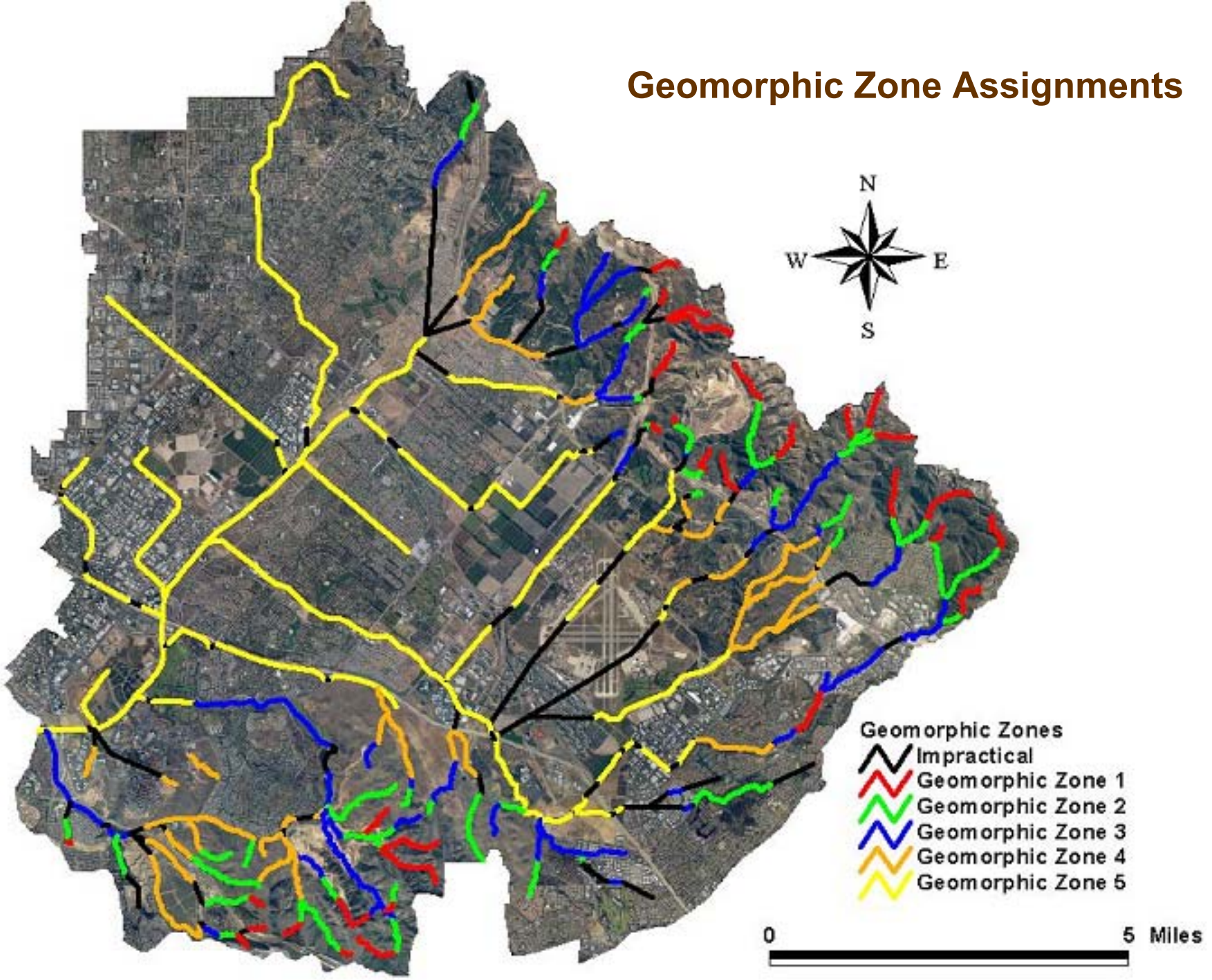
Zone 4: Small Alluvial Valleys



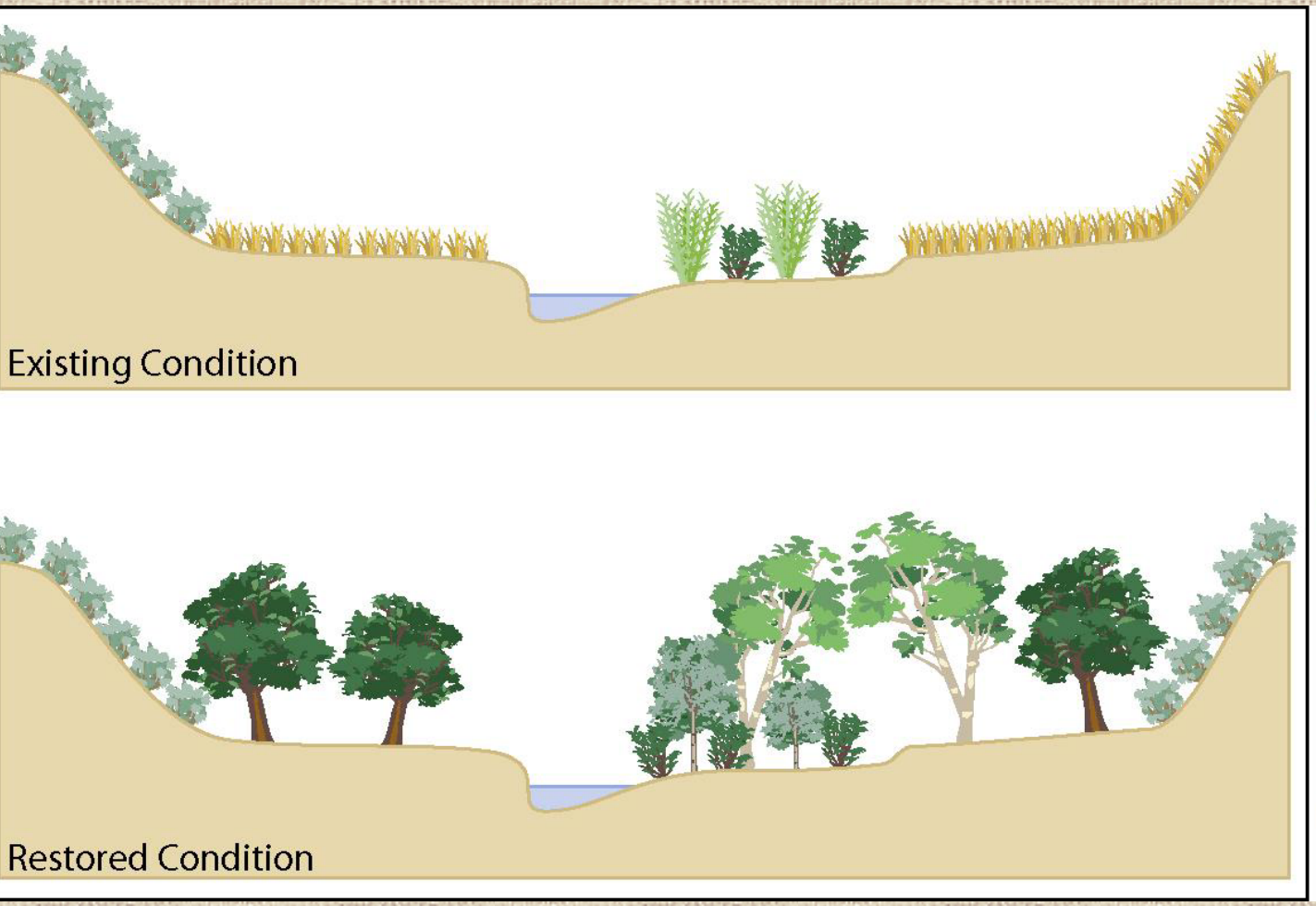
Zone 5: Large Alluvial Valleys



Geomorphic Zone Assignments



Natural Restoration Template

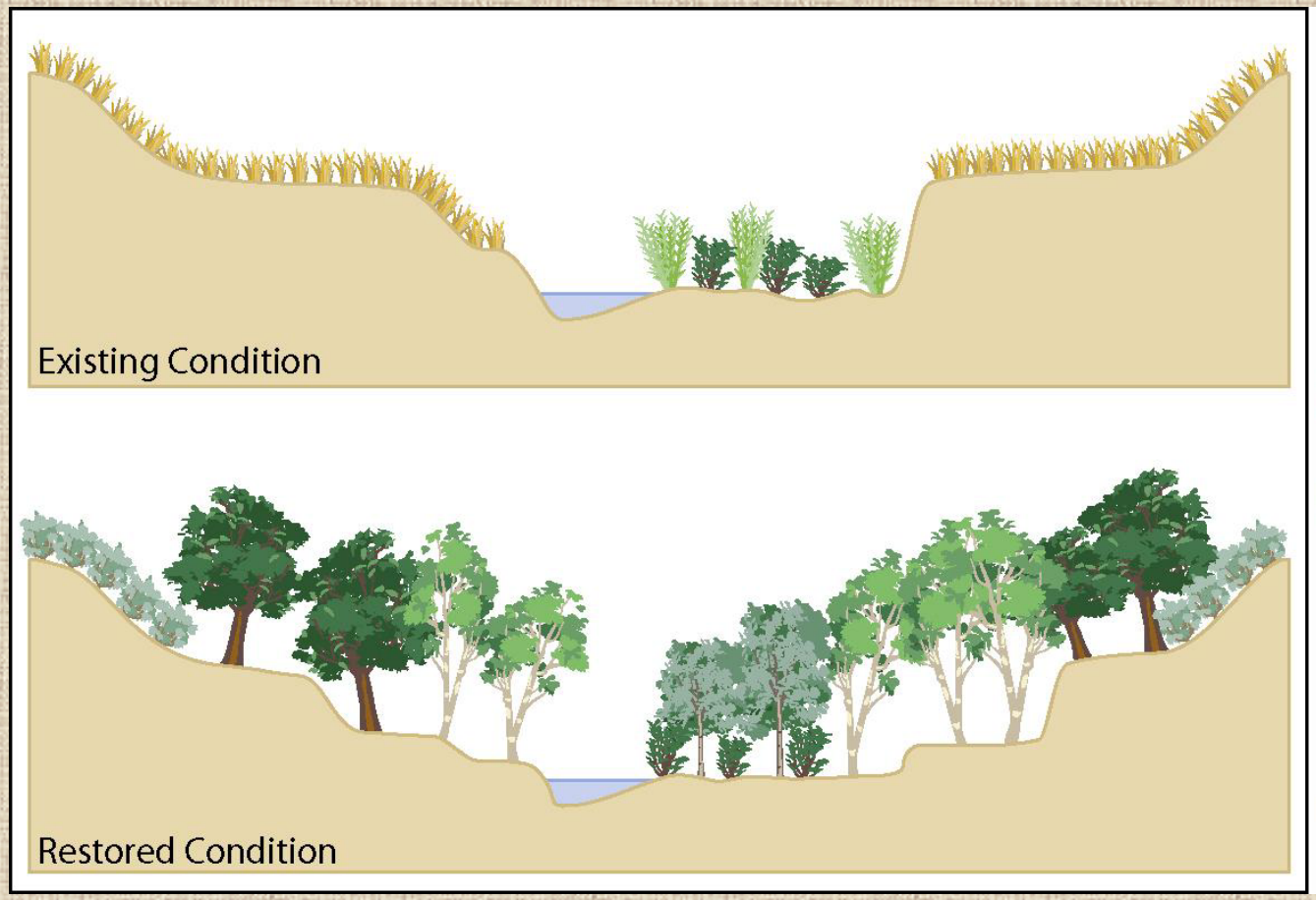


LEGEND

Characteristic Species/ Community Types

- Rangeland (annual grasses & forbs)
- Coastal sage-scrub or chaparral
- Oak woodland
- Sycamore
- Willow
- Mulefat
- Arundo and other exotics

Incised Restoration Template



LEGEND

Characteristic Species/ Community Types

- Rangeland (annual grasses & forbs)
- Coastal sage-scrub or chaparral
- Oak woodland
- Sycamore
- Willow
- Mulefat
- Arundo and other exotics

ankfull Width: 1.5 m

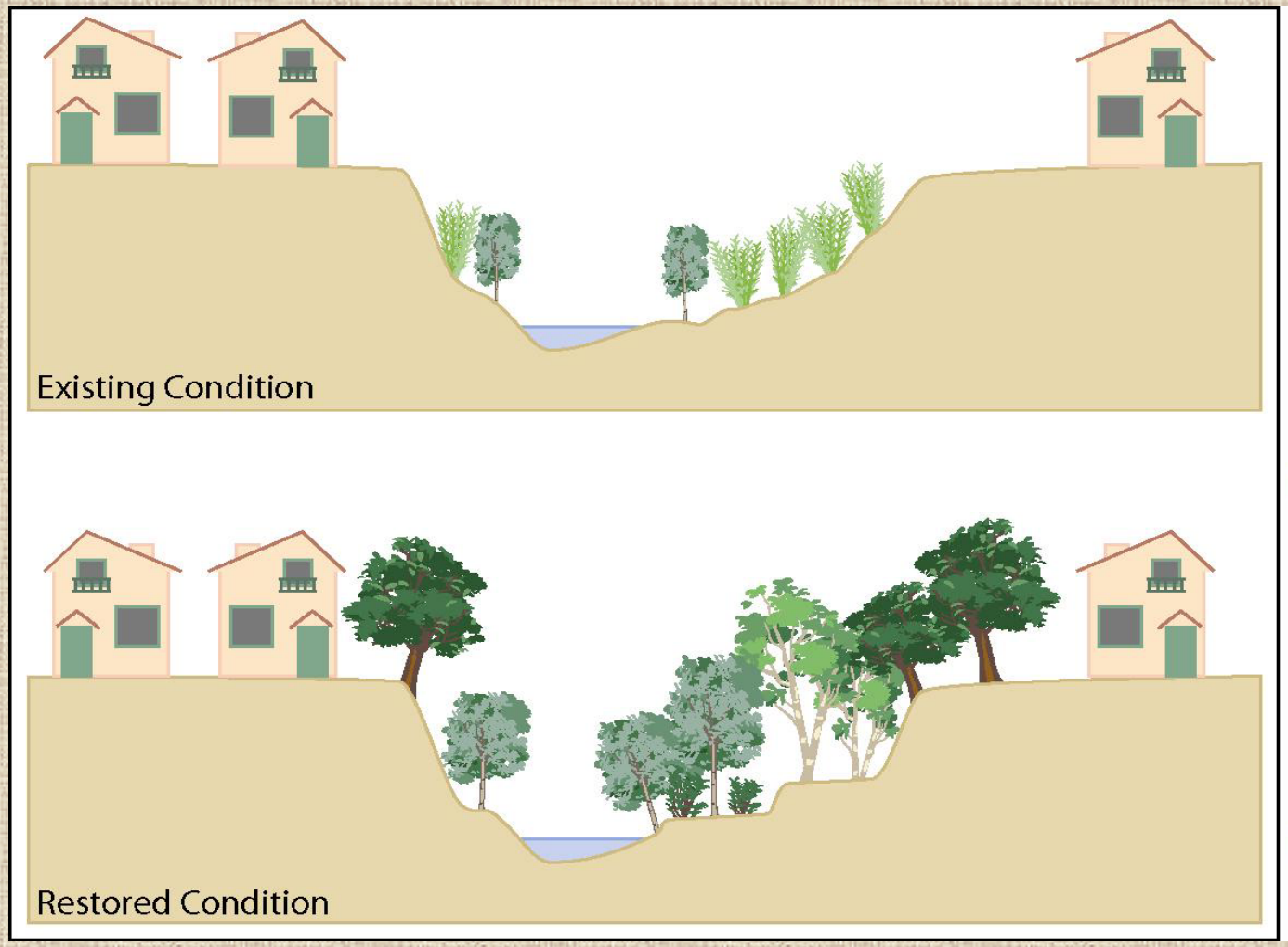
Bankfull Depth : 0.15 m

Floodprone Width: 2.4 m

First Terrace
Width: 1.8 m
Height above Bankfull: 0.45 m

Second Terrace
Width: NA
Height Above Bankfull: NA

Constrained Restoration Template

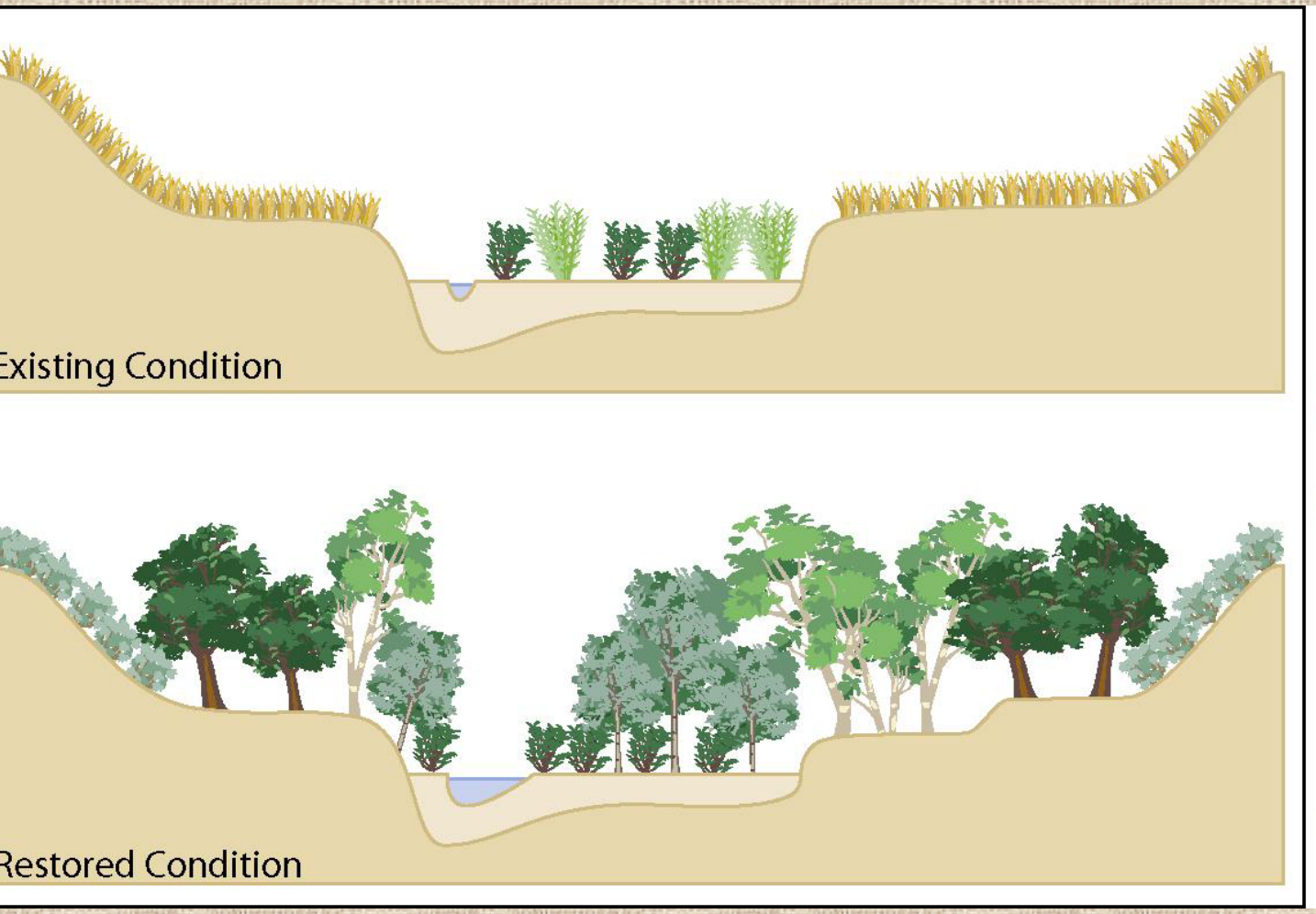


LEGEND

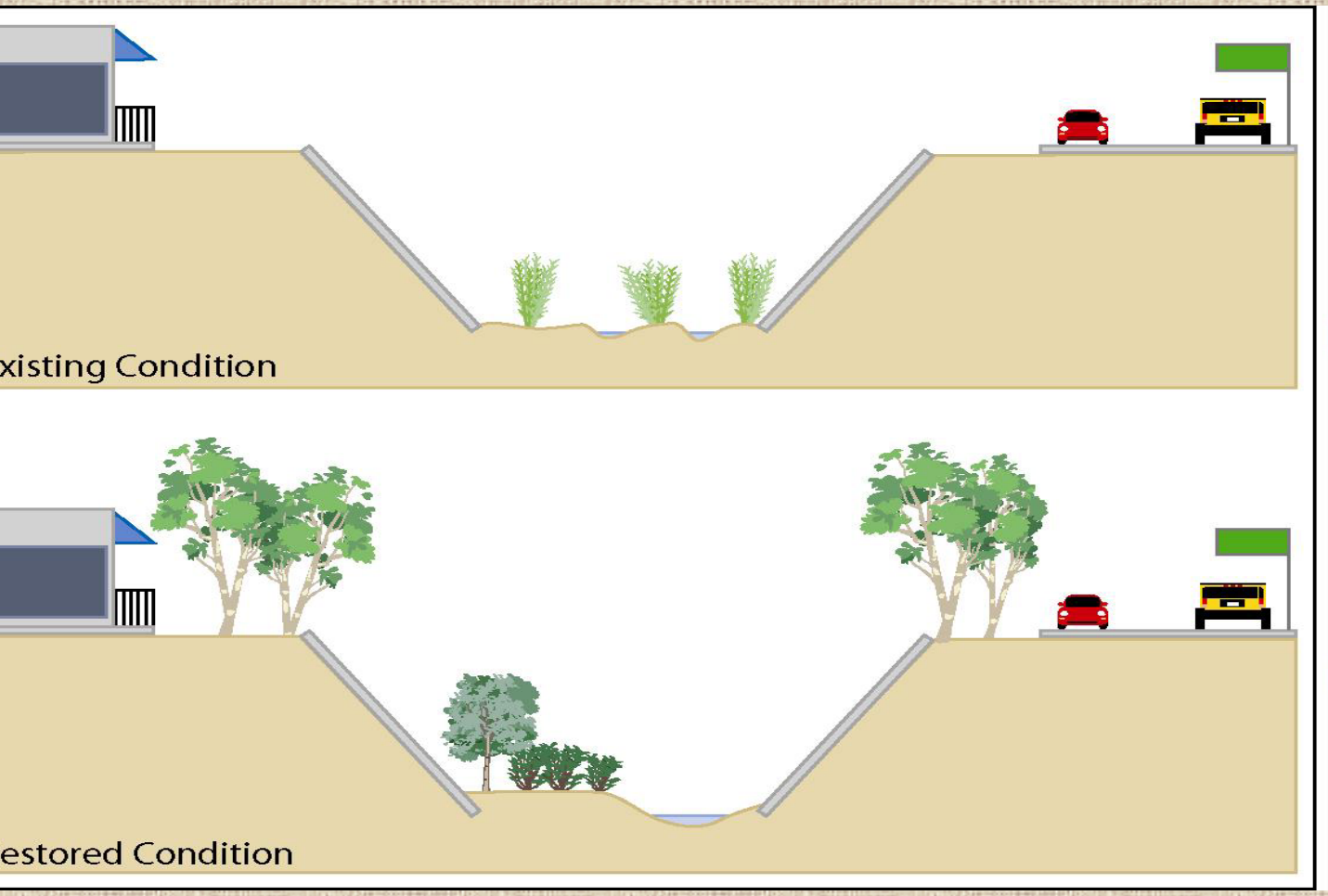
Characteristic Species/ Community Types

- Oak woodland
- Sycamore
- Willow
- Mulefat
- Arundo and other exotics

Aggraded Restoration Template



Engineered Restoration Template



LEGEND

Characteristic Species/ Community Types

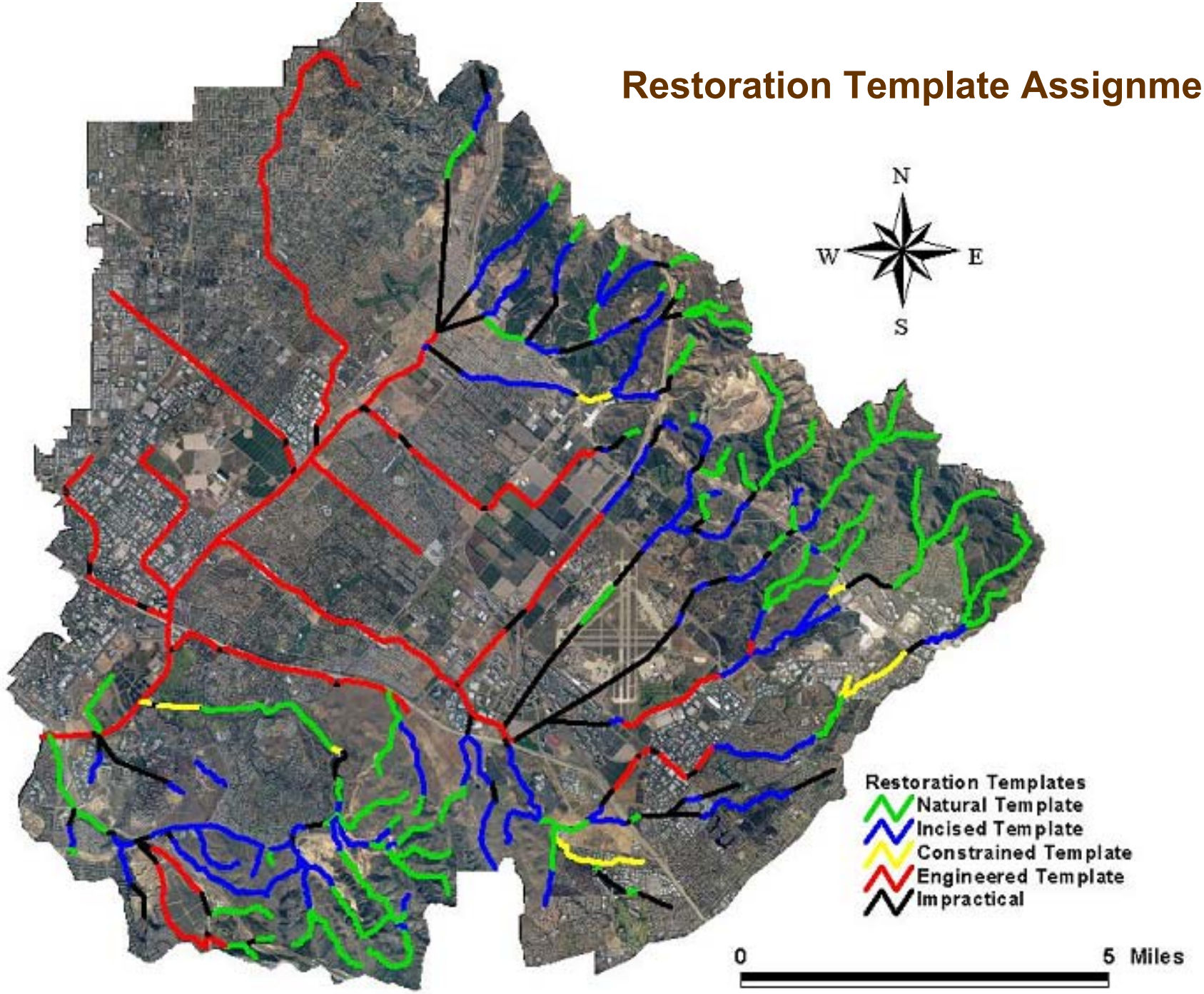
Sycamore

Willow

Mulefat

Arundo and other exotics

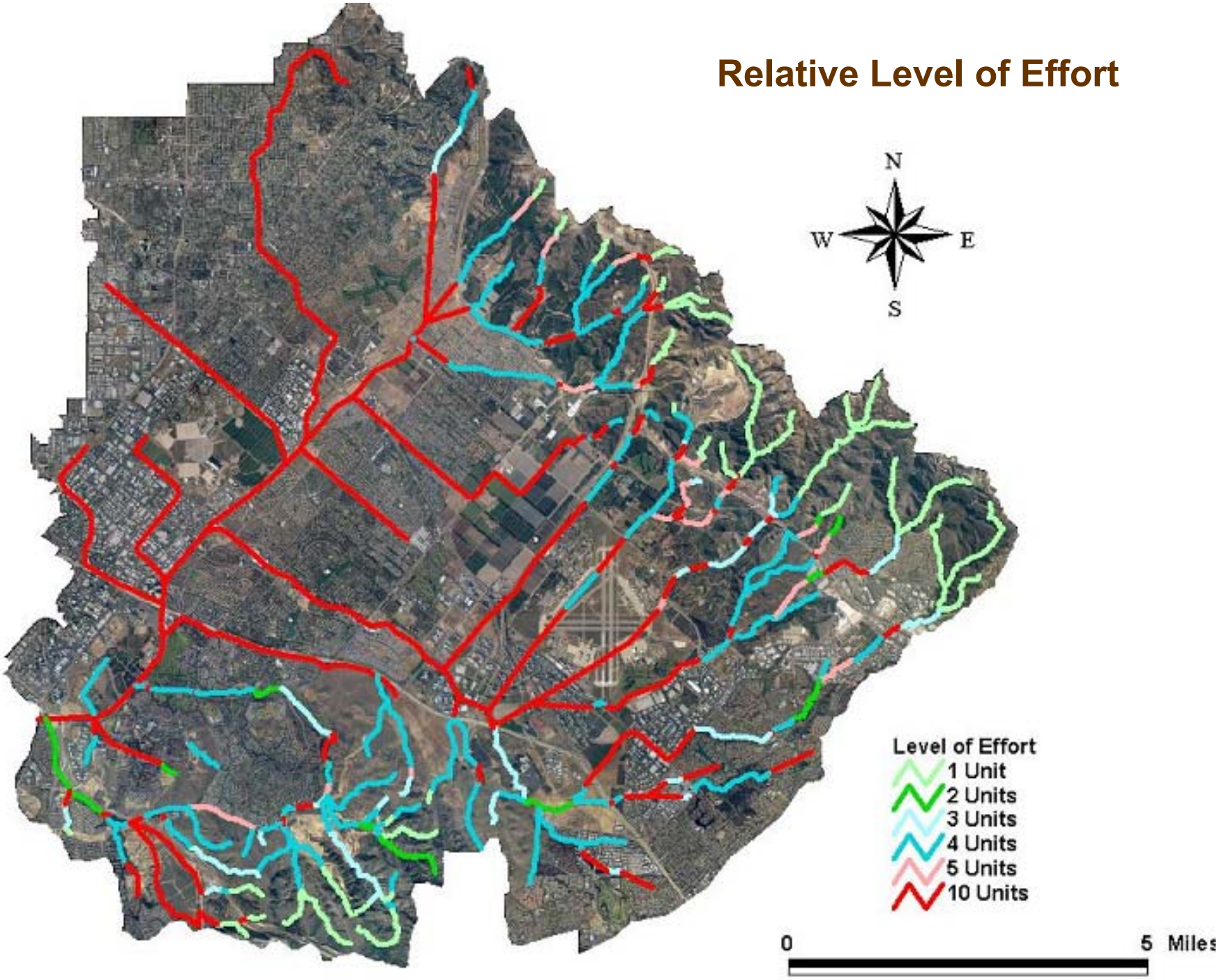
Restoration Template Assignments



Relative Level of Effort

- Level of Effort – None (1)
- Level of Effort – Light Planting (3)
- Level of Effort – Light Earthwork / Moderate to Heavy Planting (6)
- Level of Effort – Moderate Earthwork / Heavy Planting (8)
- Level of Effort – Heavy Earthwork / Heavy Planting (10)

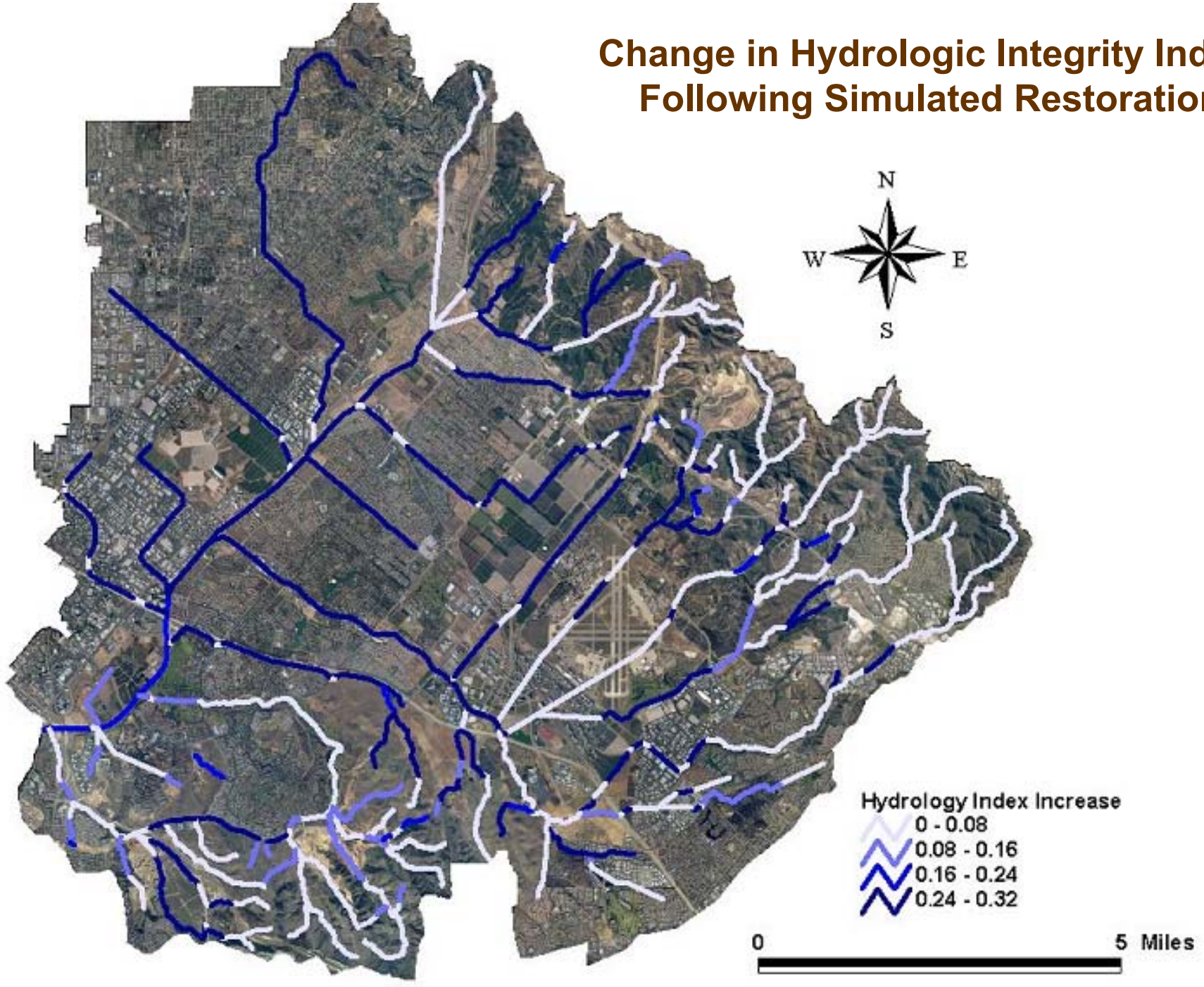
Relative Level of Effort



Phase 4: Watershed Restoration Plan

- Objective
  - Develop watershed wide restoration plan that establishes restoration templates and priorities for riparian ecosystems
- Approach
  - Classify each riparian reach by geomorphic zone
  - Identify current condition of each riparian reach
  - Assign appropriate restoration template based on condition
  - Estimate relative level of effort required for restoration
  - Simulate the change in hydrologic, water quality, and habitat indices following application of restoration template
  - Identify priority restoration areas based on selected criteria

Change in Hydrologic Integrity Index Following Simulated Restoration



Change in Hydrologic Integrity Index / Level of Effort Following Simulated Restoration