Identifying Modified Streams in the Southern California Xeric Region

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Classifying Streams

- **Many ways to classify**
  - Temperature (warm, cool, cold)
  - Gradient (high, low)
  - Salinity (freshwater, brackish, saltwater)
  - Tidal status (non-tidal, tidal)
  - Flow status (perennial/non-perennial)
  - Modification status (physically modified, hydrologically modified, not modified)

- **Most relevant classification factors in southern California may be flow and modification status as well as gradient and natural conductivity/TDS regime**

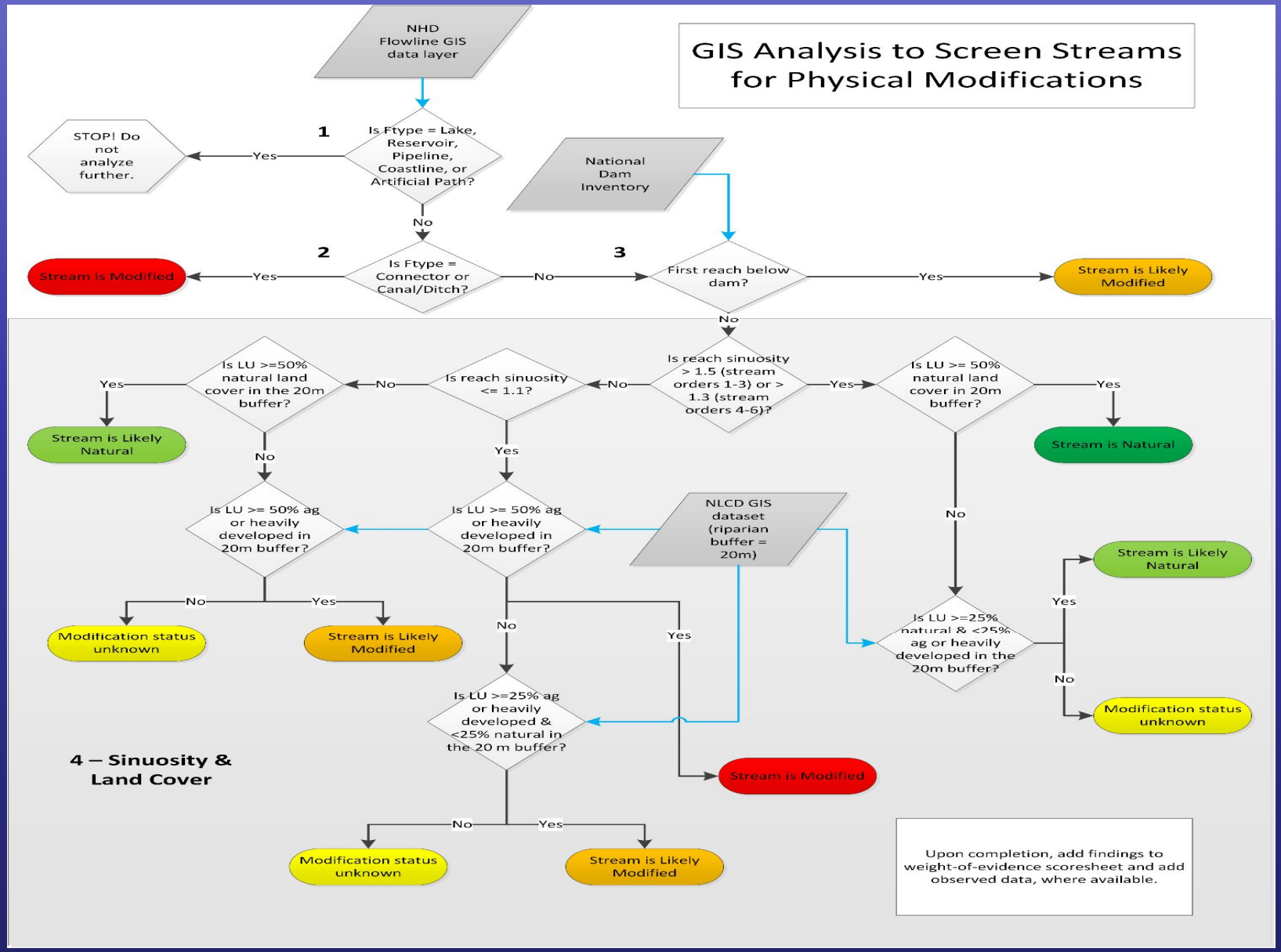
Types of Modifications

- **Physical modifications**
  - Dams
  - Flood control
    - Armored streams
    - Dredged channels
  - Land development (changes in riparian buffer)
    - Wetland drainage
    - Conversion to agricultural or urban land
- **Hydrological modifications**
  - All of the above, plus
  - Water transfer for municipal water supplies
  - Water withdrawals for irrigation
  - Urban runoff

Study Scope

- **Ecoregion 85 – Southern California Xeric ecoregion**
- **Two methods:**
  - GIS-based desktop analysis of all reaches using NHD+ version 2
  - Site-based analysis of SWAMP sampling sites that have physical/habitat data

Modified Streams – GIS Method



Downstream of Dam

- **First Reach below a major dam**
  - Normal storage capacity ≥ 5,000 acre-ft, or
  - Max storage capacity ≥ 25,000 acre-ft
- **355 stream km**

Data source: National Dam Inventory

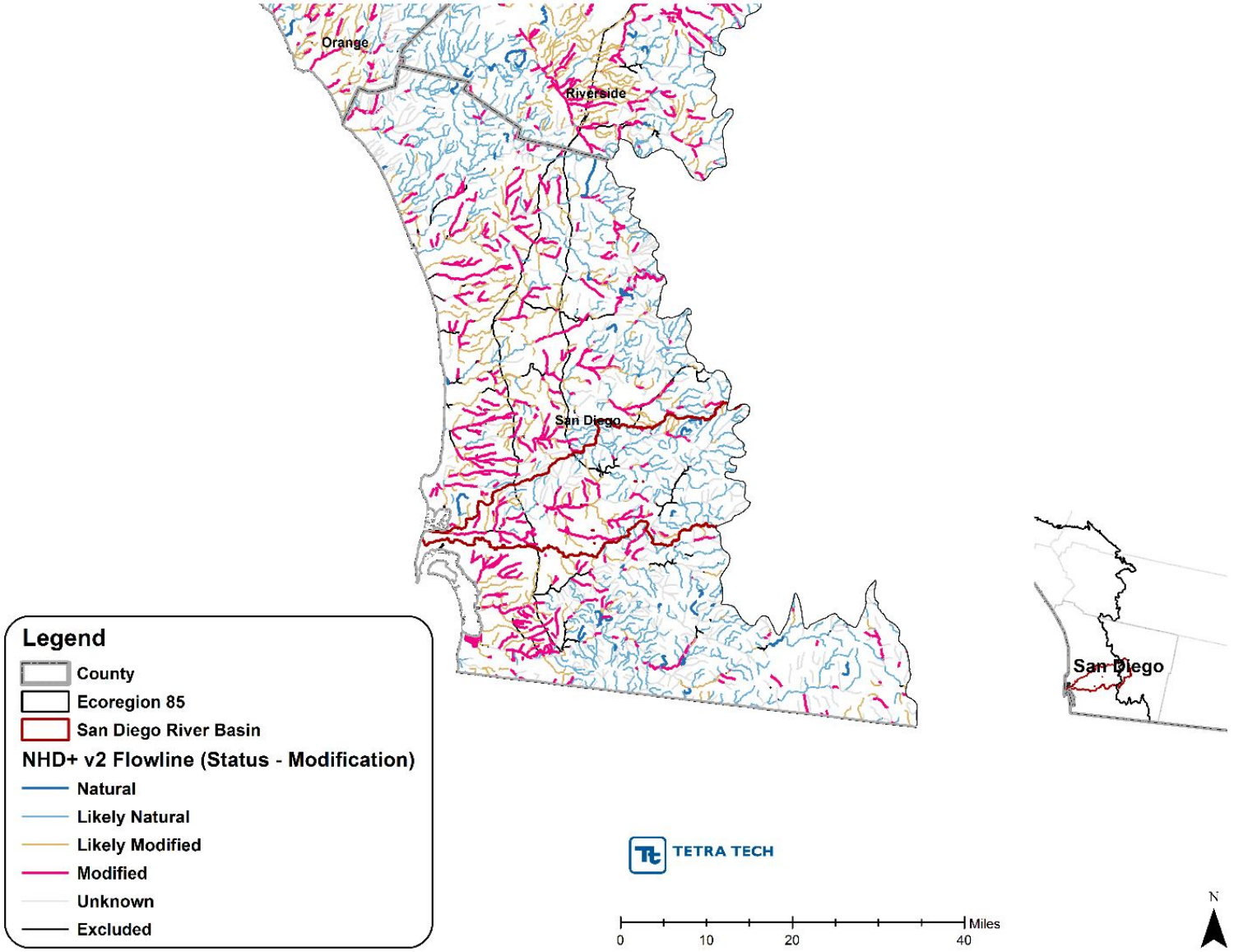
Factors used to identify modified streams

- Sinuosity changes
- Land cover changes
- Erosion, bank stability, and sedimentation changes
- Effect of spatial scale (local, riparian buffer, catchment) on analysis framework

Criteria for evaluating stream reach modification status

Sinuosity (stream order 1-3)	Sinuosity (stream order 4-6)	Land Cover in 20m Buffer	Modification Narrative	# Stream km	% Total Stream km
> 1.5	> 1.3	>= 50% natural	Natural	303	1.7
		>= 25% natural & <25% ag or developed	Likely Natural	6	0.03
		Other	Unknown	285	1.6
> 1.1 and <= 1.5	> 1.1 and <= 1.3	>= 50% natural	Likely Natural	4,896	28
		>= 50% ag or developed	Likely Modified	4,328	25
		Other	Unknown	78	0.44
<= 1.1	<= 1.1	>= 50% ag or developed	Modified	3,531	20
		>= 25% ag or developed & < 25% natural	Likely modified	33	0.19
		Other	Unknown	2,685	15

Modification status of streams in Ecoregion 85



Summary of GIS-based desktop screening

Modification Status	Reach Length (km)	% of Total Reach Length
Natural	319	2%
Likely Natural	5,223	30%
Likely Modified	4,350	25%
Modified	4,311	25%
Uncertain	3,342	19%

Modified Streams – Site Method Weight-of-evidence approach

- **Site-based PHAB data**

Metric	Modification Narrative			
	Natural	Likely Natural	Likely Modified	Modified
Channel alteration (0 - 20)	16 to 20	11 to 15	6 to 10	1 to 5
Sediment deposition (0 - 20)	16 to 20	11 to 15	6 to 10	1 to 5
Embeddedness (%)	0 – 25%	25 – 50%	50 – 75%	75 – 100%
Dominant land cover in the area of the site	Forest, rangeland	Suburb/town; agriculture (status unknown)		Urban/ industrial

Modified Streams – Site Method

Reach-based data

Metric	Modification Narrative			
	Natural	Likely Natural	Likely modified	Modified
Reach type	N/A	N/A	N/A	Canal/ditch, connector, artificial path*
Sinuosity	> 1.5 (stream orders 1-3) > 1.3 (stream orders 4-6)	> 1.3 and <= 1.5 (stream orders 1-3)	> 1.1 and <= 1.3 (stream orders 1-3)	<= 1.1 (stream orders 1-6)
Land cover in 20-m riparian buffer	>= 50% natural	>= 25% natural and < 25% ag or developed	>= 25% ag or developed and < 25% natural	>= 50% ag or developed
Dams present	N/A	N/A	Dam on the same reach as the site	Dam within 250 m of the site
MS4 channel material	N/A	N/A	N/A	Concrete or rock basket

Converting data to scores

- Each data category receives a category score based on its modification narrative
- Category scores are summed to create an aggregate site score
- Aggregate scores are broken into classifications based on natural breaks

Converting data to scores

Modification Narrative	Category Score	Aggregate Site Score
Natural	-1	< -0.5
Likely Natural	-0.5	0 and >= -0.5
Uncertain	0	>= 0 and < 2.5
Likely Modified	0.5	>= 2.5 and < 4
Modified	1	>= 4

Example Site Score

Metric	Value	Modification Narrative	Category Score
Channel alteration	15	Likely natural	-0.5
Sediment deposition	6	Likely modified	0.5
Embeddedness	90	Modified	1
Dominant land cover in the area of the site	Suburb	Likely modified	0.5
Reach type	Stream/River	Likely natural	-0.5
Sinuosity	1.11	Likely modified	0.5
Land cover in 20-m riparian buffer	54% natural 46% disturbed	Natural	-1
Dams present	No dams	Likely natural	-0.5
MS4 channel material	Rip rap	Modified	1
TOTAL (Aggregate Site Score)			1.0 (Uncertain)

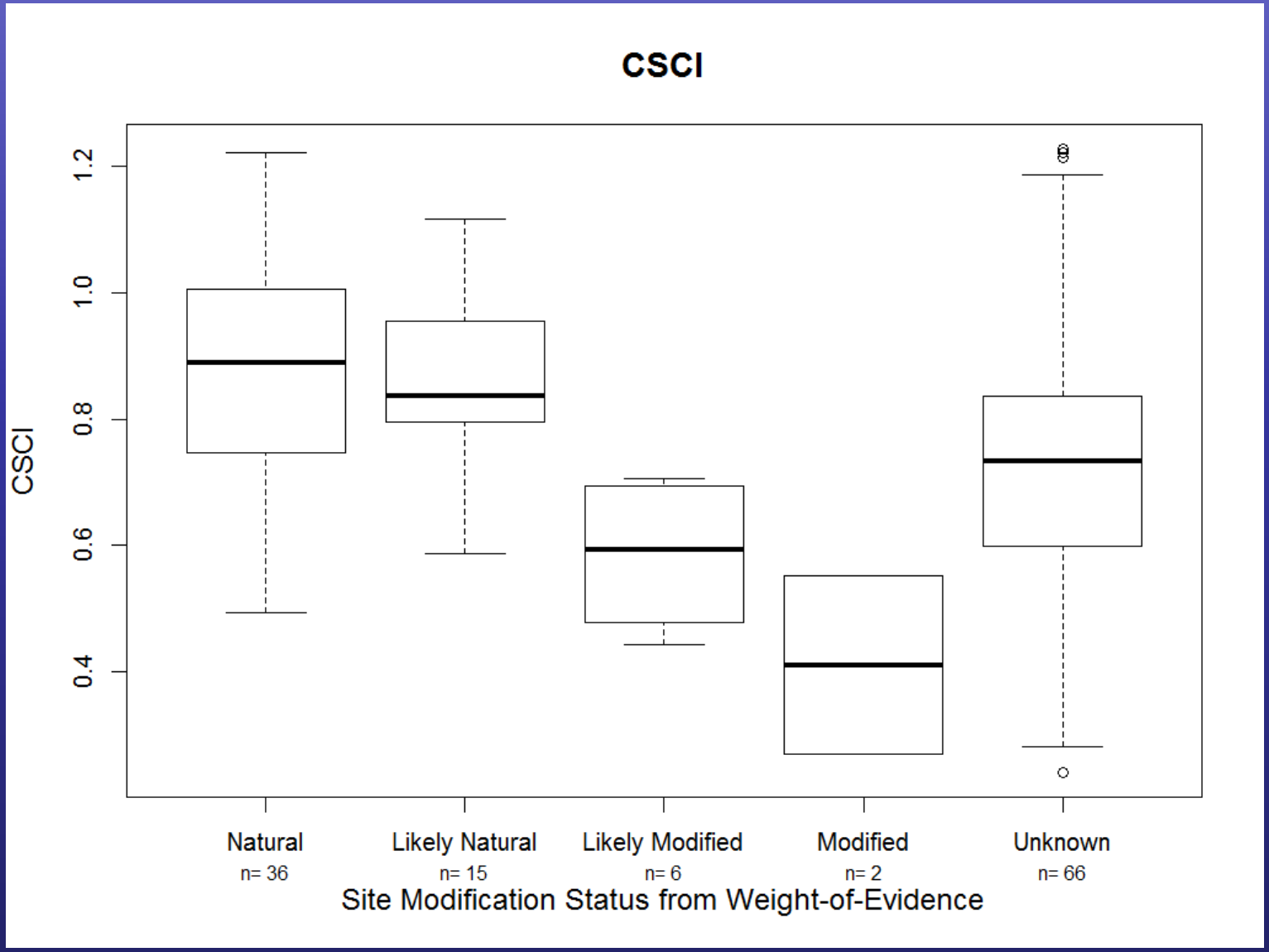
Overall site classifications

Modification Narrative	Aggregate Site Score	# of Sites
Natural	<= -0.5	87
Likely Natural	>= -0.5 and < 0	51
Likely Modified	>= 2.5 and < 4	39
Modified	>= 4	7
Uncertain (cannot be classified based on available data)	>= 0 and < 2.5	201

General agreement between methods used

Reach Modification Narrative	Site-Specific Modification				
	Natural	Likely Natural	Likely Modified	Modified	Uncertain
Natural	**9**	1	0	0	1
Likely Natural	44	**35**	0	0	17
Likely Modified	4	6	**18**	0	61
Modified	0	0	16	**6**	83
Uncertain	24	8	1	0	**33**

Macroinvertebrate Condition vs Modification Status



Next Steps

- Evaluate the most accurate indicators of stream modification status: riparian buffer changes, catchment changes, or a combination of both?
- Evaluate taxonomic- and trait-specific responses to physical modifications
- Determine “Best Attainable Condition” for modified streams – do we need to further refine classes of modified streams?