National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

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RFC 201

Development of a Reference Site Screening Approach

Part 1

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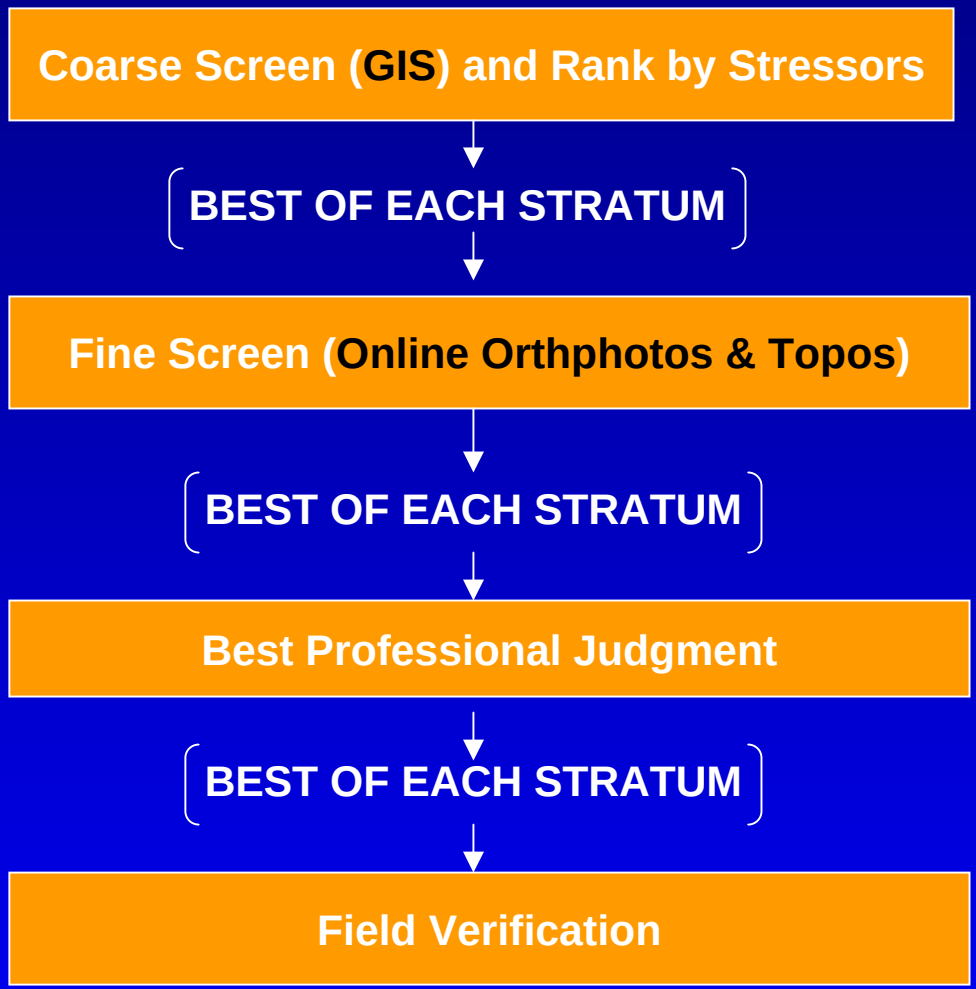
Project objectives

- Develop a ‘top-down’ reference stream reach screening approach for states/regions
- Identify ‘least disturbed’ reference sites in any biophysical stratum
- Keys: practical, based on readily available data, reproducible, regionally flexible

Operational Definition of Reference Condition Used in Approach

- 'Least Disturbed Condition' – found in conjunction with the best available physical, chemical, and biological habitat given today's state of the landscape

Conceptual Approach



(REACHES)

Hundreds of thousands

Hundreds

Tens to hundreds

Tens

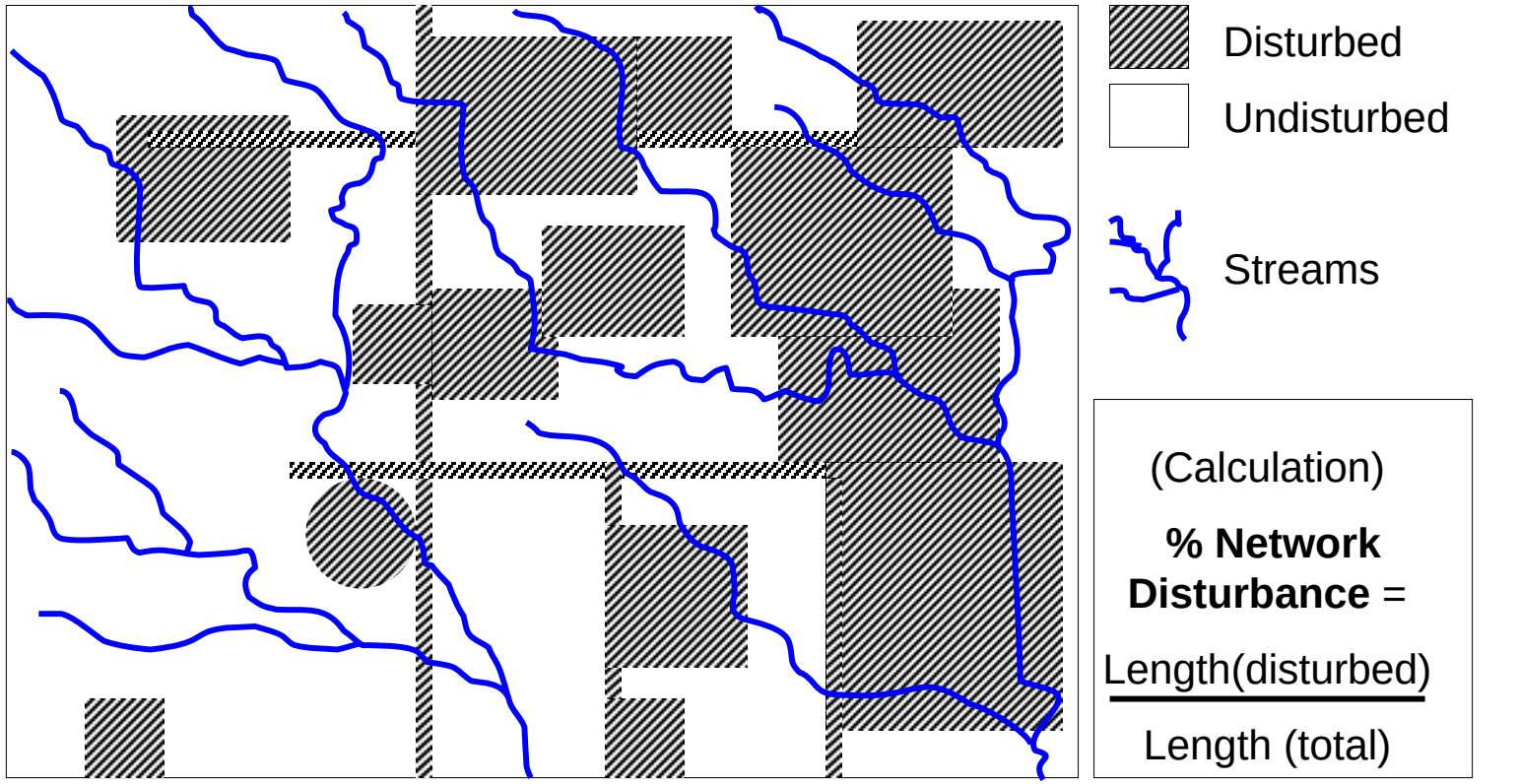
Coarse Screening

- Definition: Screening of *all* potential stream reaches using available GIS data layers, to create a ranked list by estimated level of stressors in the network, stratified by ecoregion and stream order

Main Elements:

- Nested network coding – to organize stressors
- Estimation of stressor level by network
- Organization of landscape into biophysical strata
- Determine dominant ecoregion by network

Goal: Calculate the Proportion of Each Network Potentially Impacted by Disturbances



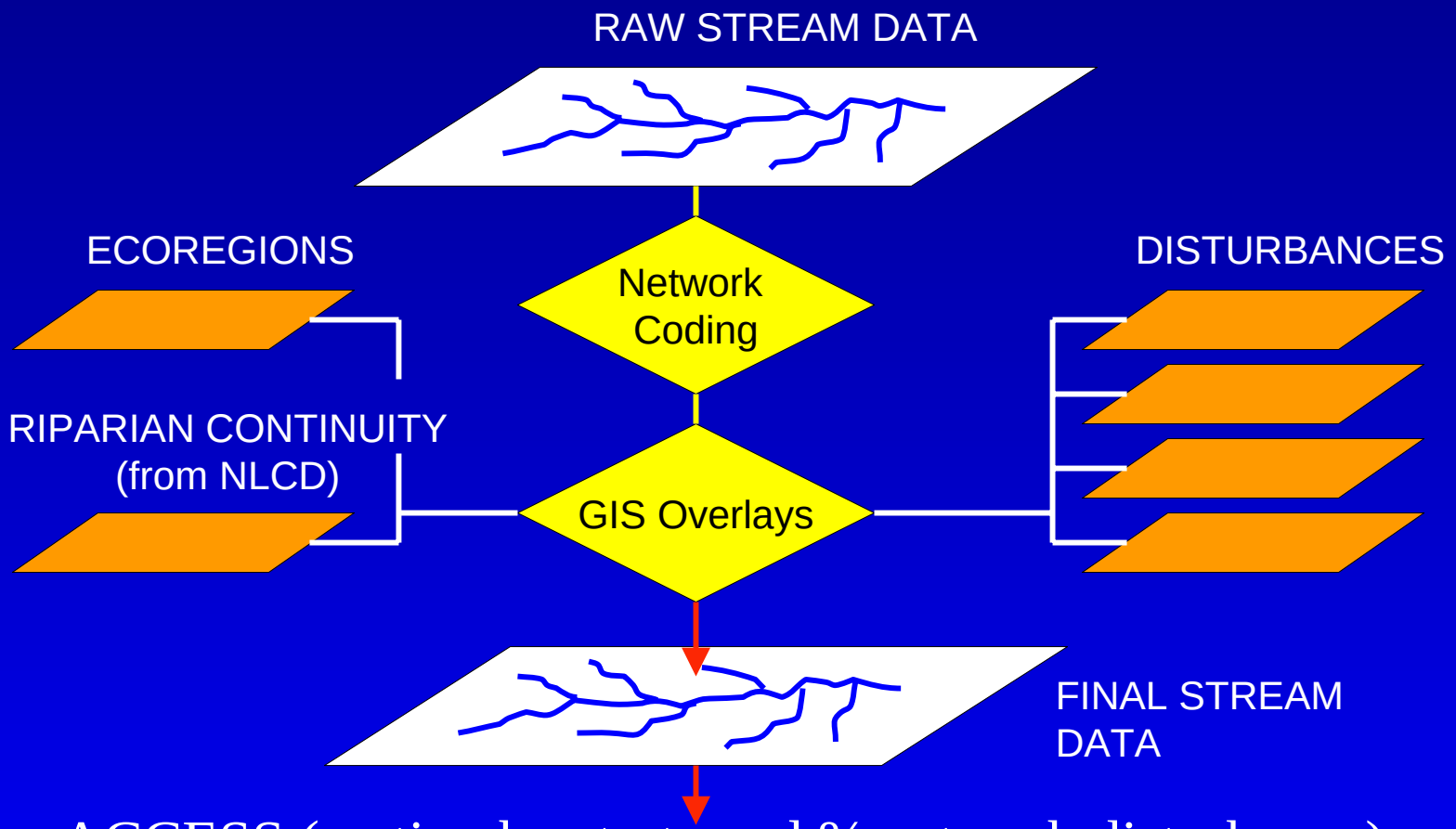
Why Nested Networks?

- Facilitates iterative, multi-scale searches
- More thorough than large watersheds or Hydrological Unit Codes (HUCs)
- More hydrologically meaningful than HUCs
- And a convenient unit for estimating human activity/stressor levels with coarse data (as opposed to reaches)

Underlying Assumption

- Networks with low Coarse Screen Disturbance Scores will generally be less impacted by human disturbance than networks with high Coarse Screen Disturbance Scores.

Overview of Coarse Screening Process



ACCESS (sorting by strata and % network disturbance)

Selection of Stream Data

- Type of data (RF3, National Hydrological Dataset (NHD), or other stream data)
- Preliminary screening
  - ✓ Intermittent and perennial to capture as many potential pathways to perennial waters as possible
- Final Screening (after calculating % disturbance)
  - ✓ Eliminate non-candidate stream classifications during candidate sorting.

Nested Networks - Example

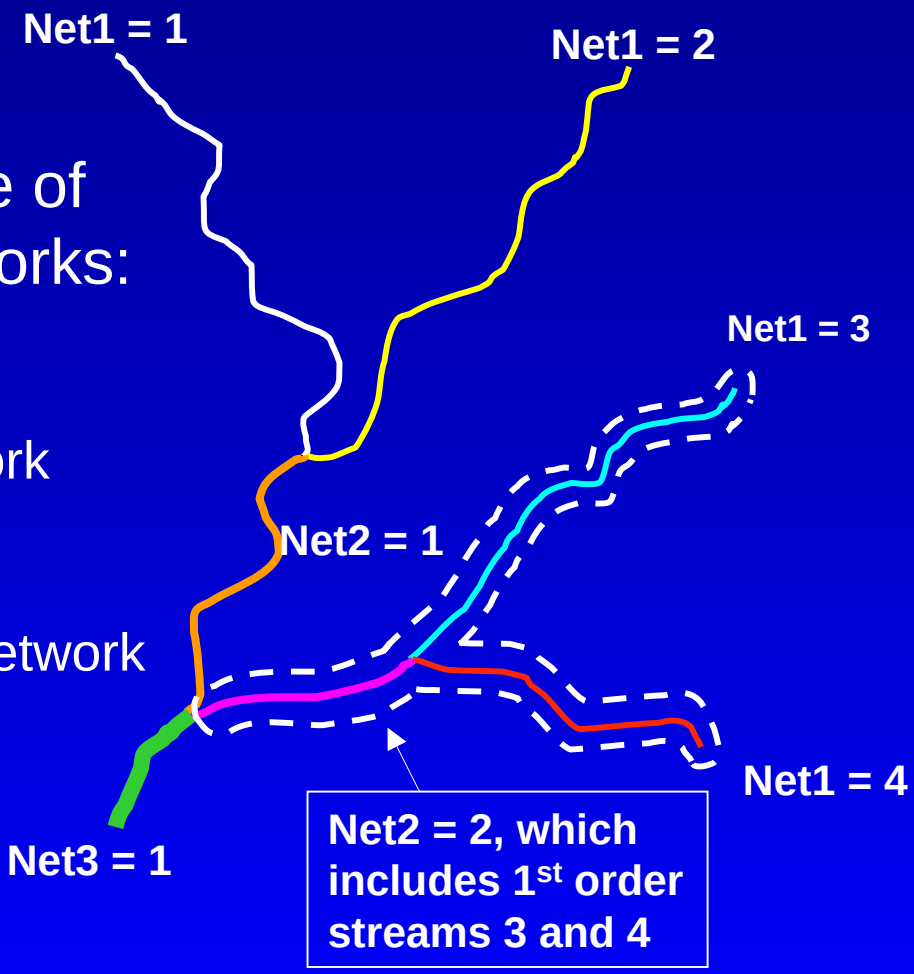
Organizational structure of reaches in nested networks:

Net1 = First Order Network

Net2 = Second Order Network

Net3 = Third Order Network

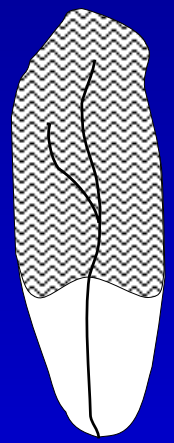
= example 2nd order network



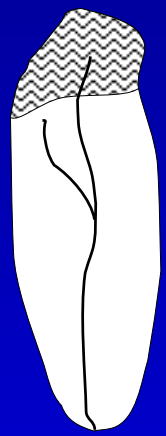
Example *A Priori* Biophysical Strata

- Strahler Order;
- Geographic Strata (e.g. Omernik Level IV Ecoregions)

Coarse Screening Helps Identify Networks Dominated By One Stratum



Drainage 1



Drainage 2

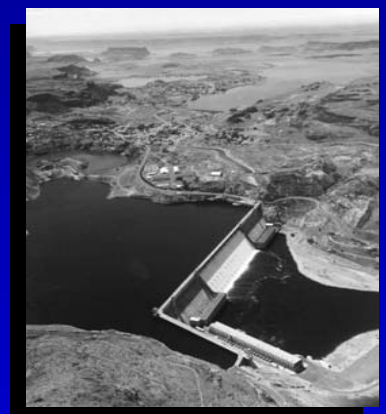
Ecoregion A

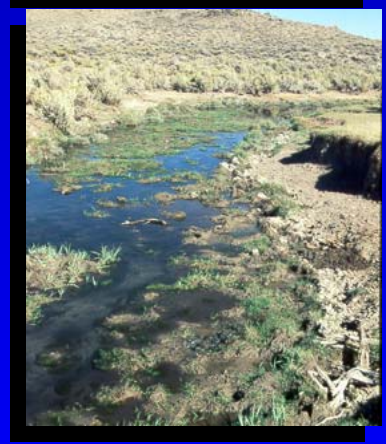
Ecoregion B

Example: Drainage 1 has more stream length in Ecoregion B, while Drainage 2 has more stream length in Ecoregion A. For Stratum 2nd Order X Ecoregion A, reaches in Drainage 2 would be preferred.

Disturbances

- Why focus on disturbances?
  To avoid the circularity problem.
- Derived from readily available sources
  - ✓ Land Cover/Land Use (National Land Cover Data -NLCD)
  - ✓ Transportation (TIGER, other)
  - ✓ Point sources (EPA, USGS)
  - ✓ Estimates of livestock density
  - ✓ Census data
  - ✓ Dams/impoundments
- Other state/regional data

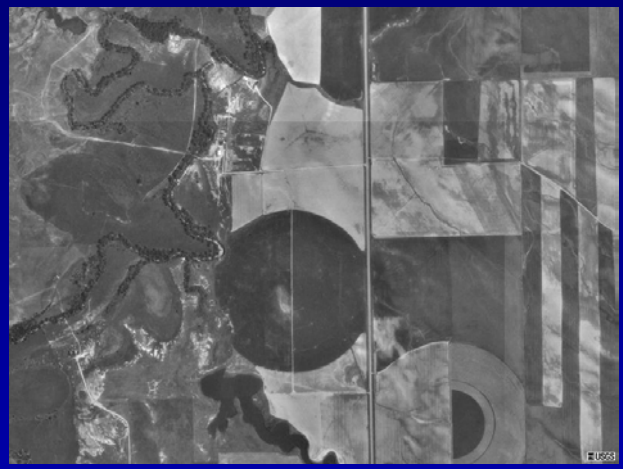




Representing Disturbances

- GIS Buffers created around human activities / stressors (e.g., roads, agriculture)
- Buffer widths *crudely* represent zone of potential impacts on streams depicted at a certain scale, recognizing that:
  - ✓ focus is to identify least disturbed candidates
  - ✓ stream data is coarse
  - ✓ stressor data is coarse
  - ✓ misclassification and misregistration errors are common
- Based on literature and Best Professional Judgment
- Keep in mind… it is a very coarse screen, and just the first step in the process

Typical Disturbances



AGRICULTURE

MINING

LIVESTOCK

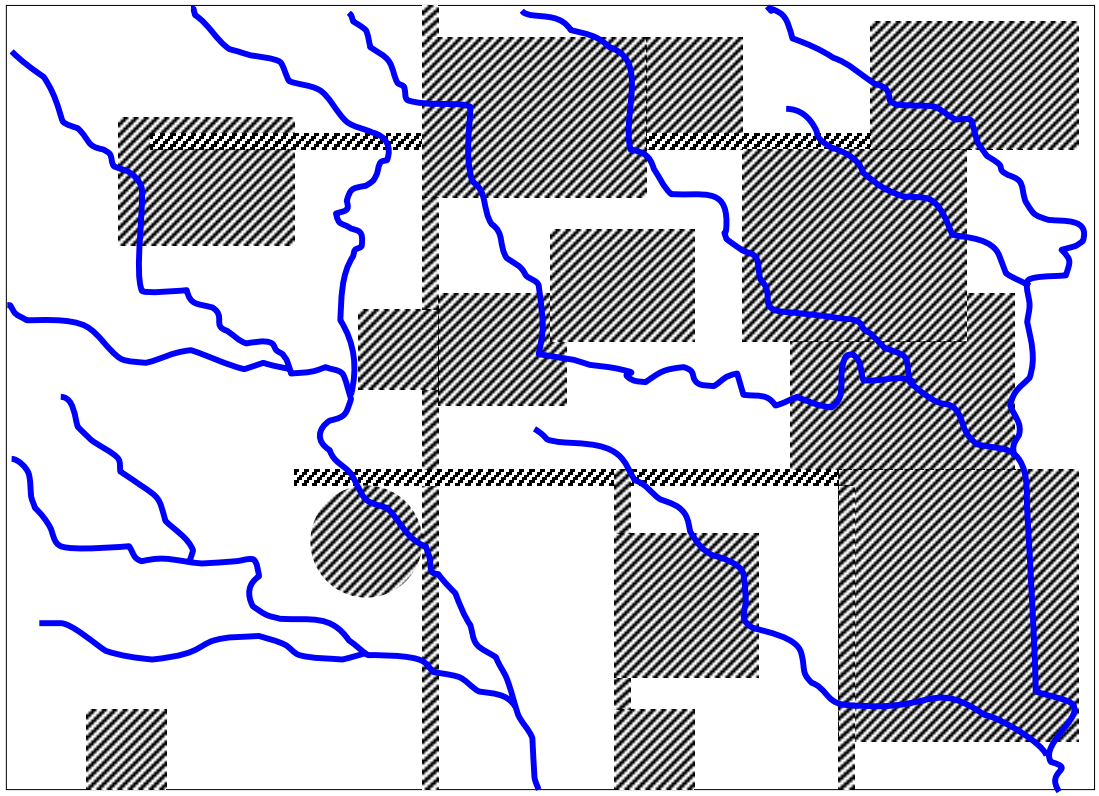
ORTHOPHOTO IMAGES (TerraServer)

DEVELOPMENT

Example of Disturbance Buffers for Potential Use with 1:100,000 Scale Stream Data

- (1000m) High density development
- (1000m) Commercial/industrial zones
- (1000m) Major mines (e.g., coal, metal ore, etc.)
- (1000m) Point sources
- (300m) Agriculture
- (300m) Minor mines (sand & gravel)
- (250m) Low density development
- (150m) Urban/recreational grasses
- (100m) Silviculture
- (45m) Roads

Buffered Disturbances with Stream Networks



Disturbed

Undisturbed

Streams

(Calculation)

% Network Disturbance =

$$\frac{\text{Length(disturbed)}}{\text{Length (total)}}$$

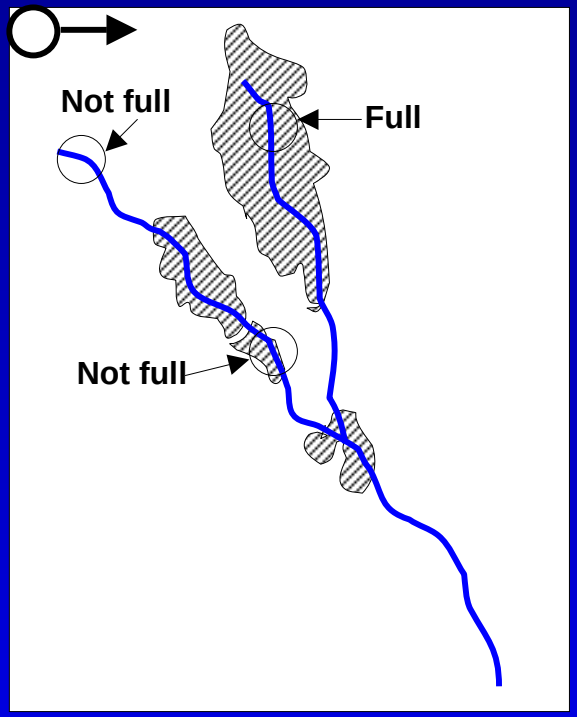
Riparian Continuity – (A Potential Alternative to % Disturbance in Highly Disturbed Landscapes)

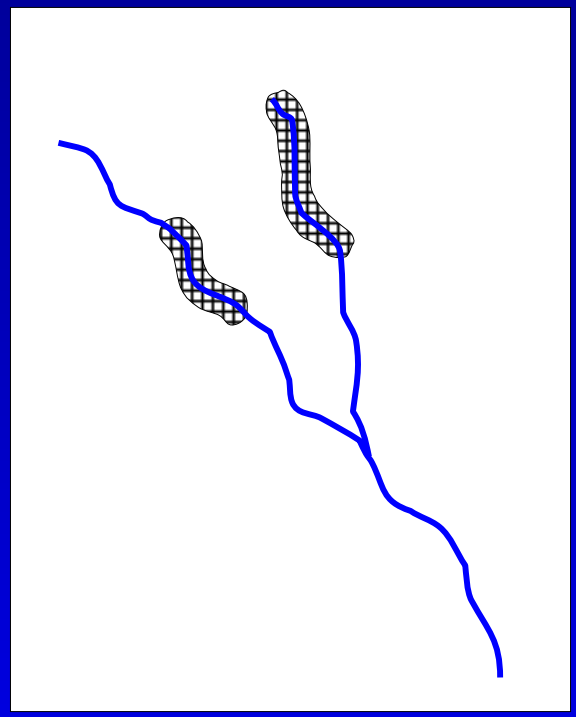
- GIS 'moving window' analysis is used to sum the number of pixels of 'unmanaged' landcover types within a defined neighborhood of each pixel
- Calculate percent of each network with intact riparian landcover
- *Problem:* Issues related to classification local accuracy of NLCD data

Riparian Continuity

(Proportion of Network Length Inside a Full Window)

(MOVING WINDOW) → Locations of Full Windows





Riparian Continuity (prcntRIP)

Calculation:

length (FULL)/ length total

In this example:

prcntRIP ~ 15%

Circular 'moving window' passed over raster image and sum of natural vegetation recorded

Full window

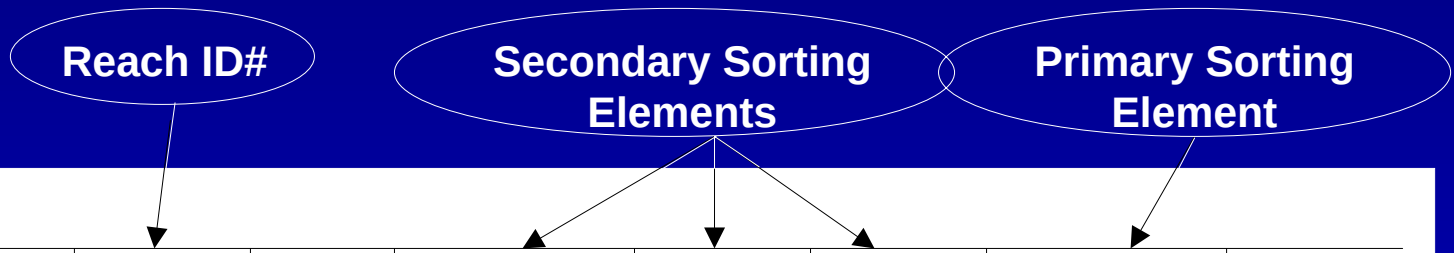
Not full

The Final Inventory – All Networks

Each Reach is:

- Coded by flow status
- Coded as inside or outside of a stressor buffer zone
- Stratified by:
  - ✓ Biophysical strata (example: stream order x ecoregion)
  - ✓ Ranked by ascending percent disturbance
- Ancillary data provided for building database queries:
  - ✓ Presence of impoundments in the network
  - ✓ Presence of mines close to the network
  - ✓ Approximate livestock density at the HUC level
  - ✓ Riparian continuity

Example Coarse Screen Database



NET_ID3	RCH_ID	ECO	majECO	Mines	Dam	prcntDIST	prcntRIP
19880	236376	43i	43i			11.8%	94.7%
19880	236710	43i	43i			11.8%	94.7%
19901	237047	43i	43i	y		17.9%	89.5%
19875	236113	43i	43i			28.5%	82.2%
10231	115701	43a	43a	y		30.5%	70.8%
10231	115870	43a	43a	y		30.5%	70.8%
19830	240675	43i	43i			35.0%	72.7%
3486	39898	43a	43a		y	41.5%	80.5%
3486	40459	43a	43a		y	41.5%	80.5%
6410	67300	43a	43a		y	47.2%	67.1%

Coarse Screening – example criteria

- Perennial flow
- Reach outside stressor buffer zone
- Stratified by stream order and ecoregion
- Meets length criteria (e.g. > 1 km)
- Reach ecoregion same as dominant network ecoregion
- Exclusionary criteria absent:
  - ✓ No major upstream impoundments
  - ✓ No major upstream mining operations
  - ✓ No upstream point sources
- Low percent network disturbance

How is the Reach Inventory Used?

- For each reference stream reach desired within a stratum:
  - ✓ ~ 10 networks should be Fine Screened
  - ✓ More may be required if 3 – 4 potential reference candidates are not identified. Samples are drawn in order of ascending percent disturbance.

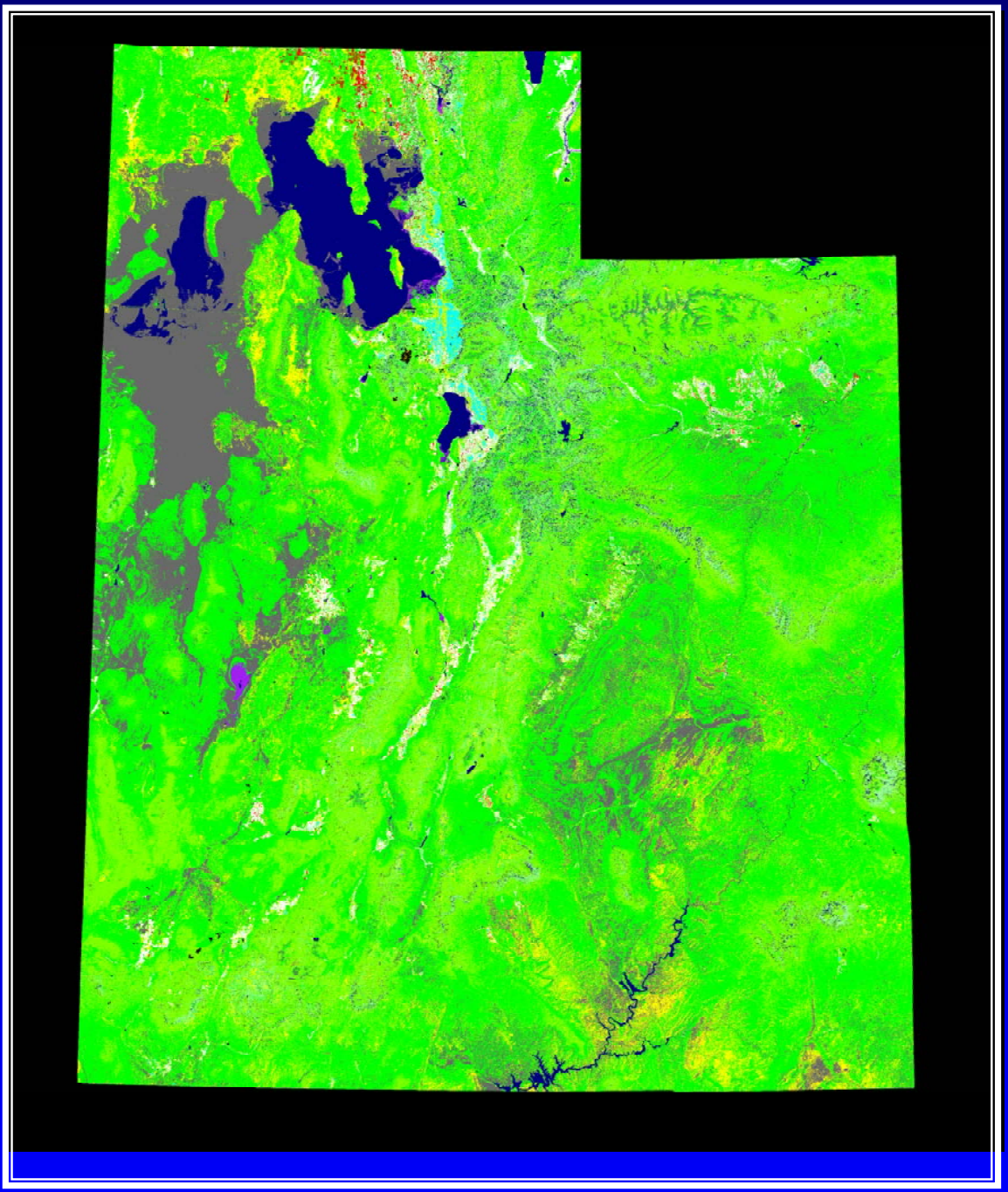
What if the Query is too restrictive?

- Flexibility permits relaxation of query restrictions from region to region, and between strata (e.g., elimination of the exclusionary or ancillary criteria for larger stream systems), or

- *Percent Riparian Continuity* may be evaluated in place of, or in addition to *Percent Disturbance* as the primary sorting factor

Transferability of Approach

- Skills required:
  - ✓ GIS (raster and vector), database and spreadsheet proficiency
  - ✓ Photointerpretation skills (Fine Screening)
- Macro transferability:
  - ✓ Need to be able to handle both raster and vector data
  - ✓ Pilot used ARC/INFO AML language
- Adaptation to other areas:
  - ✓ Identification of types of characteristic disturbances
  - ✓ Relative rankings of disturbances
  - ✓ Local data accuracy / availability issues
  - ✓ Adaptations to handle complex water routing issues



Utah State Pilot

(2001 – 2002)

Coarse Screen Step:

- 122,000 km perennial & intermittent streams
- 28 Stream order / ecoregion strata with perennial streams
- 400 reaches drawn for Fine Screening

- Summary -

- Multi-stage, top-down process of increasingly refined evaluations
- GIS-based Coarse Screening
- Aerial photo-based Fine Screening
- All reaches ranked by % disturbance
- Stratified by underlying environmental gradients
- Flexible design, accommodates different ambient levels of human disturbance
- Uses readily available data
- Reproducible results

➢ *… Continued in* Part 2