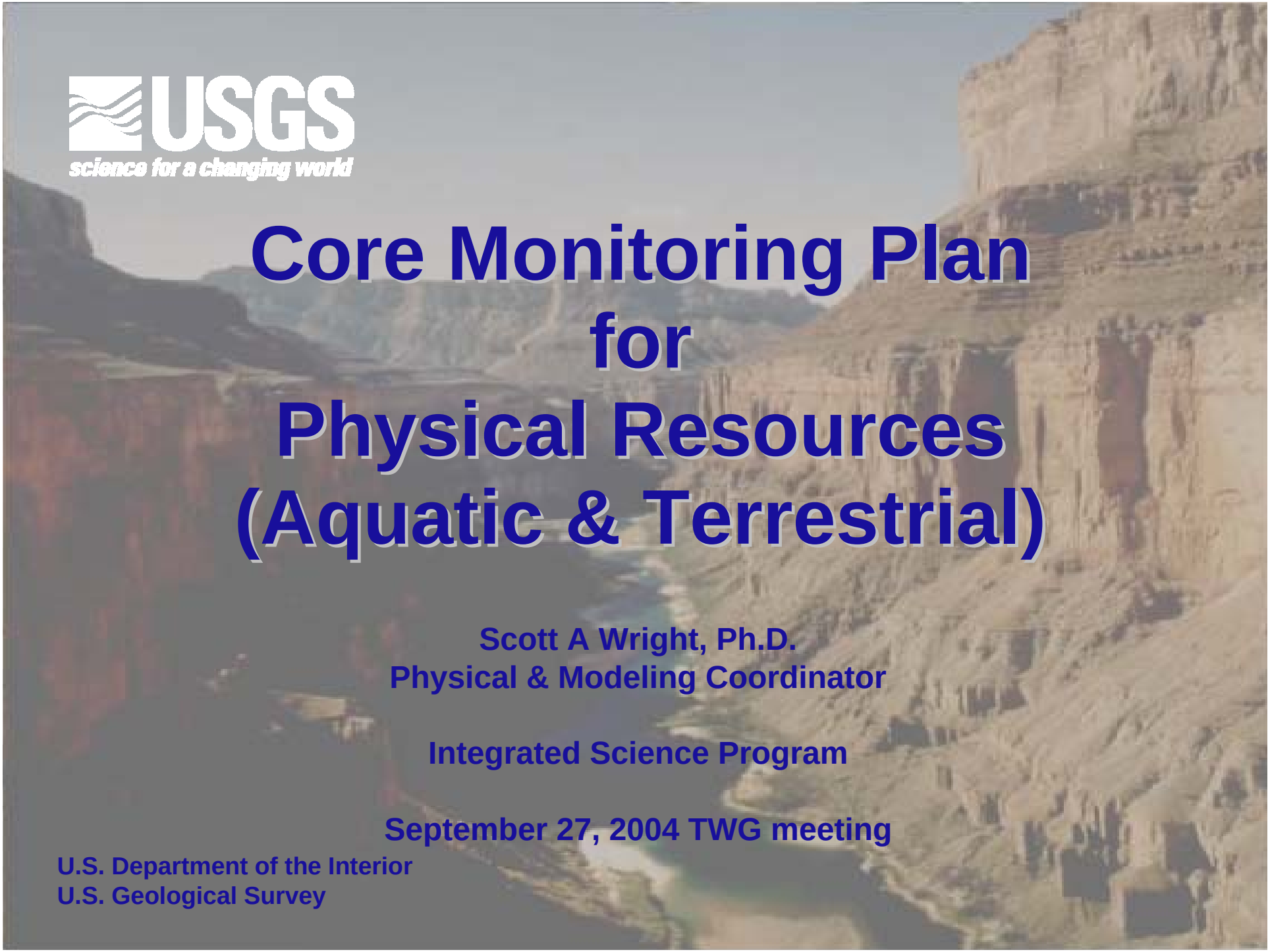
Current Core Monitoring
&
Research and Development for Long-Term Monitoring Protocols

U.S. Department of the Interior
U.S. Geological Survey



Core Monitoring Plan for Physical Resources (Aquatic & Terrestrial)

Scott A Wright, Ph.D.
Physical & Modeling Coordinator

Integrated Science Program

September 27, 2004 TWG meeting

U.S. Department of the Interior
U.S. Geological Survey

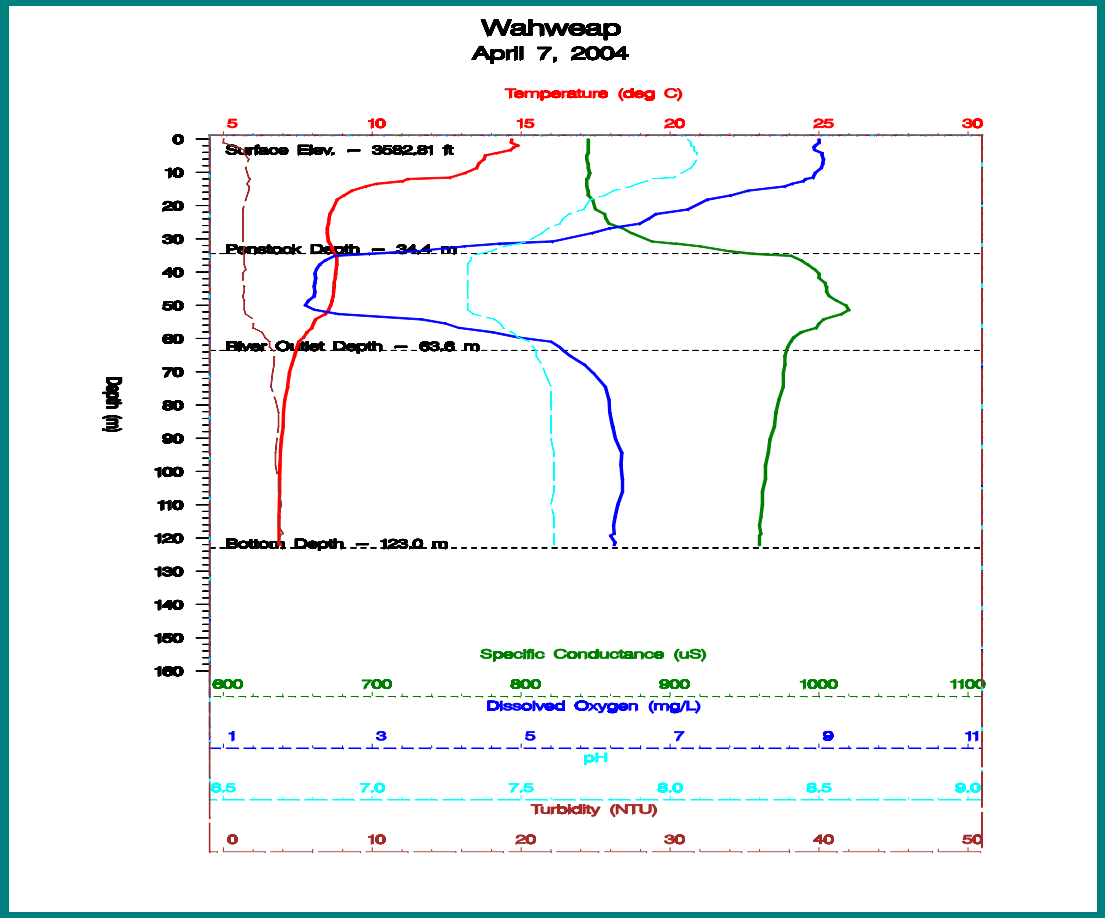
CM – Lake Powell Forebay

- **CMIN tasks/questions (7.3.1): What are the status and trends of water quality releases from Glen Canyon Dam?**
- **Data Acquisition:**
  - **Monthly fore bay sampling of water temperature, conductivity, dissolved oxygen, turbidity, nutrients, major ions, total and dissolved organic carbon, chlorophyll, phytoplankton, and zooplankton.**
  - **15-minute water temperature at 4 sites in the fore bay.**
- **Data Management, Analysis, Dissemination**
  - **Monthly web-based reports. Annual WY open file reports. Results incorporated into SCORE**
  - **Data accessioned into GCMRC Database**

Budget = $110,000/yr (forebay)
$100,000/yr (lake-wide)

USGS

CM – Lake Powell Forebay



USGS

CM – Surface Water

- **CMIN tasks/questions (7.4.1, 7.4.2):**
  - Determine and track releases from Glen Canyon Dam under all operating conditions.
  - Determine and track flow releases from Glen Canyon Dam, particularly related to flow duration, upramp, and downramp.
- **Data Acquisition:**
  - 15-minute stage and discharge on the mainstem at Lees Ferry, 30-mile, 61-mile, 87-mile, 166-mile and 226-mile.
  - 15-minute stage and discharge on key tributaries: Paria, Little Colorado, Moenkopi Wash, Havasu, and Kanab.
- **Data Management, Analysis, Dissemination**
  - Telemetry and real-time reporting to the web and transfer to GCMRC Oracle database.
  - Annual reporting in the Arizona Data Report published by WRD.

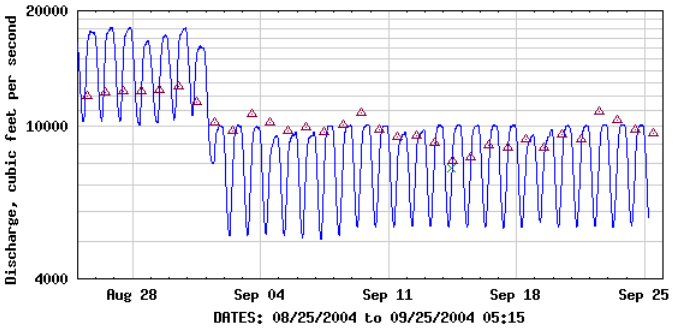
Budget = $220,000/yr

USGS

CM – Surface Water
Examples

USGS

USGS 09380000 COLORADO RIVER AT LEES FERRY, AZ

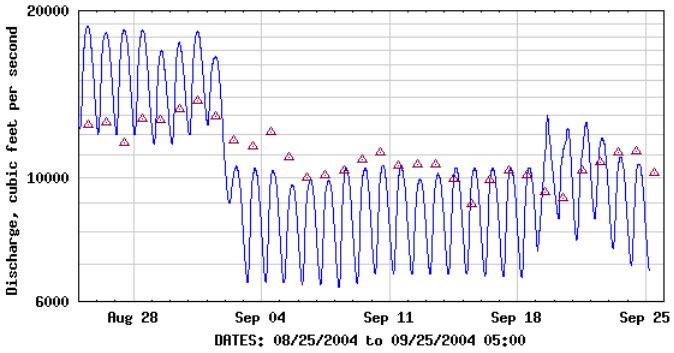


EXPLANATION
DISCHARGE
MEDIAN DAILY STREAMFLOW BASED ON 82 YEARS OF RECORD
MEASURED Discharge

Provisional Data Subject to Revision

USGS

USGS 09402500 COLORADO RIVER NEAR GRAND CANYON, AZ

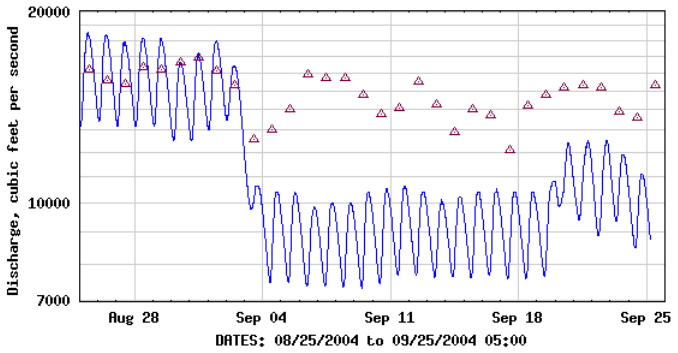


EXPLANATION
DISCHARGE
MEDIAN DAILY STREAMFLOW BASED ON 81 YEARS OF RECORD

Provisional Data Subject to Revision

USGS

JSGS 09404200 COLORADO RIVER ABOVE DIAMOND CREEK NR PEACH SPRINC



EXPLANATION
DISCHARGE
MEDIAN DAILY STREAMFLOW BASED ON 15 YEARS OF RECORD

Provisional Data Subject to Revision

USGS

CM – Quality of Water

- CMIN tasks/questions (8.1.2, 8.1.3, 7.1.1, 7.2.1, 7.3.1):
  - What are the monthly sand and silt/clay -export volumes and grain-size characteristics, by reach, as measured at Lees Ferry, Lower Marble Canyon, Grand Canyon, and Diamond Creek Stations?
  - Track, as appropriate, the monthly sand and silt/clay -input volumes and grain-size characteristics, by reach, as measured or estimated at the Paria and Little Colorado River stations, other major tributaries like Kanab and Havasu creeks, and "lesser" tributaries.
  - Determine the water temperature dynamics in the main channel, tributaries (as appropriate), backwaters, and near-shore areas throughout the Colorado River ecosystem.
  - Determine the seasonal and yearly trends in turbidity, water temperature, conductivity, DO, and pH changes in the main channel throughout the Colorado River ecosystem.
  - What are the status and trends of water quality releases from Glen Canyon Dam?

USGS

CM – Quality of Water

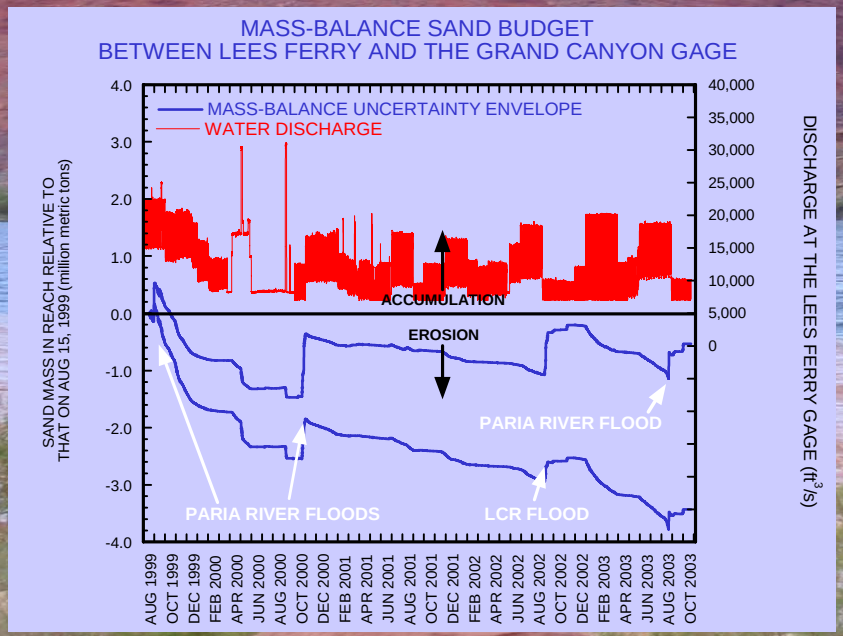
- **Data Acquisition**
  - 15-minute optical and acoustic data, combined with ~monthly water samples, to provide 15-minute sand and silt/clay loads on the mainstem at 30-mile, 61-mile, 87-mile, 166-mile, and 226-mile.
  - Event-based water sampling to provide tributary sand and silt/clay inputs from the Paria and Little Colorado Rivers, Kanab and Havasu Creeks. Water temperature every 15-minutes at sites.
  - 15-minute water temperature and conductivity measurements on the mainstem at GCD, Lees Ferry, 30-mile, 61-mile, 87-mile, 166-mile, and 226-mile.
  - 15-minute dissolved oxygen and pH measurements at Glen Canyon Dam and Lees Ferry.
  - Monthly nutrient and major ion samples at GCD and LF.
- **Data Management, Analysis, Dissemination**
  - All data served through GCMRC Oracle database.
  - Sediment data analyzed to provide "mass balance" updates.
  - Analyses and data published in annual open-file reports, SCORE, and scientific journals.

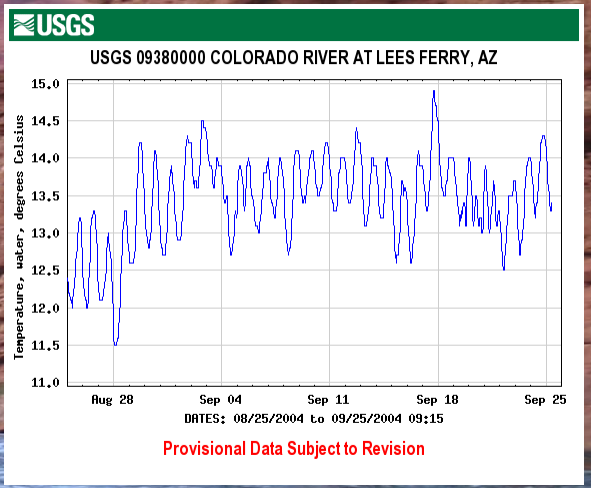
USGS

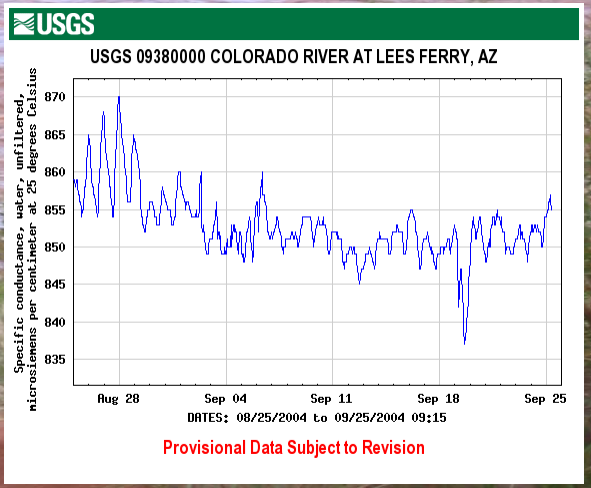
Budget = $720,000/yr

CM – Quality of Water

Examples







USGS

CM – Quality of Water
In development

- **Lesser tributary inputs**
  - Currently evaluating methods for measuring sediment inputs from smaller tributaries in Marble Canyon.
  - Some tributaries could be become part of core monitoring in the future.
- **Nearshore and backwater temperatures**
  - Currently evaluating methods for monitoring water temperatures in these areas. Should become part of core monitoring very soon.
- **Further monitoring of mainstem and tributary temperature, conductivity, oxygen, major ions, nutrients, carbon**
  - To be developed in coordination with the aquatic food base and downstream fish programs.

USGS

Budget = $120,000/yr

CM – Fine sediment storage
In development

- **CMIN tasks/questions (8.1.1, 8.1.2, 8.1.3, 8.1.4, 8.5.1):**
  - Determine and track the biennial fine-sediment, volume, and grain-size changes below 5,000 cfs stage, by reach.
  - Track, as appropriate, the biennial sand bar area, volume and grain-size changes outside of eddies between 5,000 and 25,000 cfs stage, by reach
  - Track, as appropriate, the biennial sand bar area, volume and grain-size changes within eddies below 5,000 cfs stage, by reach
  - Track, as appropriate, the annual sand bar area, volume and grain-size changes within eddies between 5,000 and 25,000 cfs stage, by reach
  - Track, as appropriate, the biennial sand bar area, volume and grain-size changes above 25,000 cfs stage, by reach
- **Data Acquisition**
  - Digital imagery and biennial field visits – Changes in high elevation exposed sand area.
  - Currently evaluating reach-based approach for monitoring sandbars in the fluctuating zone and below through the "FIST" project.

Budget = $200,000/yr

USGS

CM – Coarse Sediment Inputs
In development

- CMIN tasks/questions (8.6.1):
  - Determine and track the change in coarse sediment abundance and distribution.

- Data Acquisition
  - Digital imagery and biennial field visits – Monitoring of debris flow activity.
  - Other methods for monitoring debris flow activity and coarse-sediment inputs will be evaulated pending FY05 review of the coarse-sediment inputs research project.
  - FIST project may also yield methods for monitoring coarse sediment in representative reaches below 8,000 cfs.

Budget = $60,000/yr

USGS

Core Monitoring Plan for Biological Resources (Aquatic & Terrestrial)

Barbara Ralston, Ph.D.
Biology Coordinator (Acting)

Integrated Science Program

September 27, 2004 TWG meeting

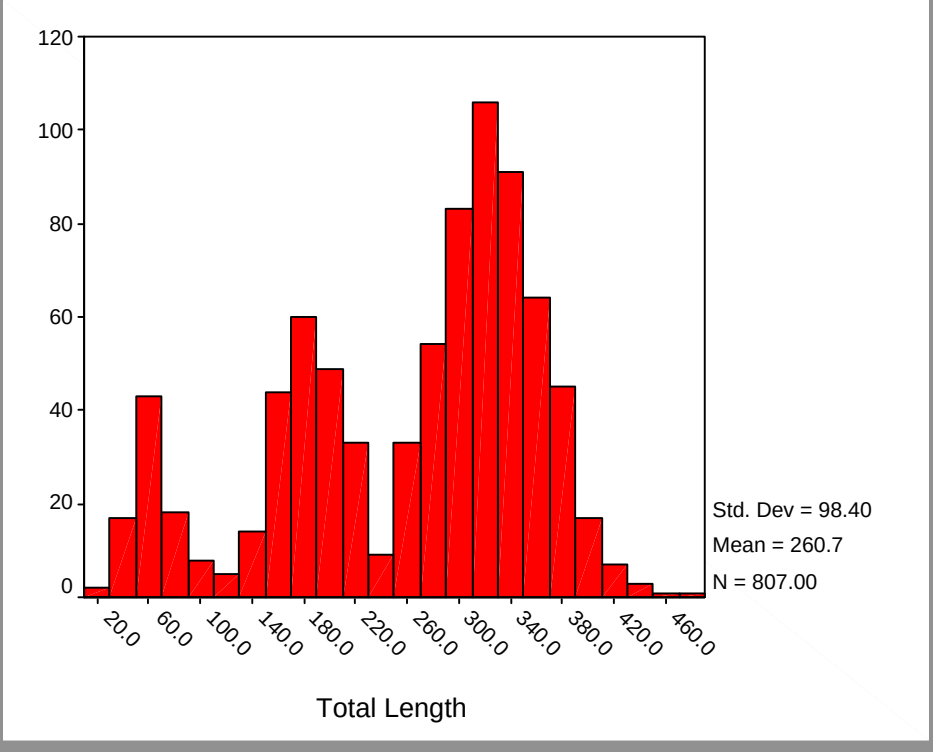
U.S. Department of the Interior
U.S. Geological Survey

CM - Lees Ferry trout monitoring

- CMIN tasks/questions (4.1.1-4.1.7): Determine…pop est. age II +; Proportional stock density; growth rate; +/- whirling disease; spawning habitat quality/quantity; % natural recruitment.
- Acquisition:
  - Creel program – angler use, catch and harvest (surragate for abundance) CMIN 4.1
    - Monthly sampling
  - Electrofishing – size composition, relative abundance, condition, whirling disease samples. CMIN 4.1.2, 3, 4, 5
    - 3 times/year, 9 fixed and 27 stratified random sample sites.
    - Detects 6-10% linear change in abundance over 5-years.
- Data Mgmt, Analysis, Dissemination
  - Annual reports from principle investigator, results incorporated into SCORE
  - Data accessioned into GCMRC Database
- FY06 $160,000

USGS

CM - Lees Ferry trout monitoring



Length-frequency histogram of all Rainbow trout captured in the July 2004 Lee's Ferry sampling effort.

USGS

CM – Downstream Native Fish: humpback chub

- CMIN tasks/questions (2.1.1, 2.1.2): Determine and track year class strength of HBC between 51-150 mm, and Determine abundance and distribution of in LCR and mainstem of all size classes of HBC.

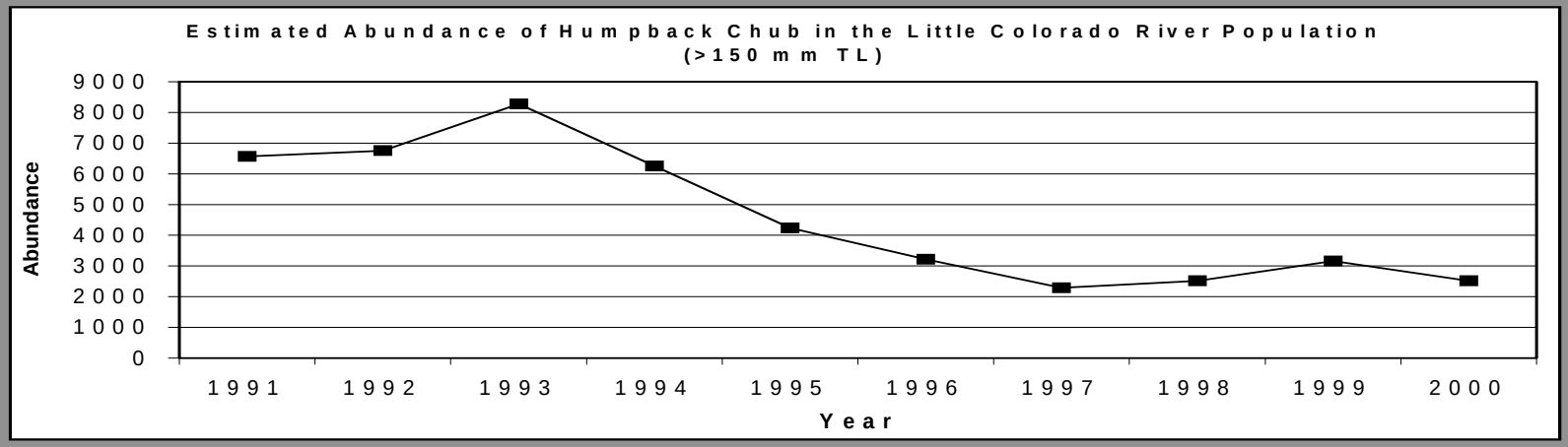
- Acquisition:
  - Spring/Fall abundance estimates in LCR –
    - 15 km w/hoop nets (fish > 150 mm)
    - Mark recapture ASMR model input
  - Spring relative abundance estimates in LCR
    - Lower 1200 m w/ hoopnets
    - All size classes
  - Spring relative abundance estimates in LCR inflow - mainstem
    - 57-65.4 rm w/trammel and hoop nets
    - Mark-recapture data for ASMR model input

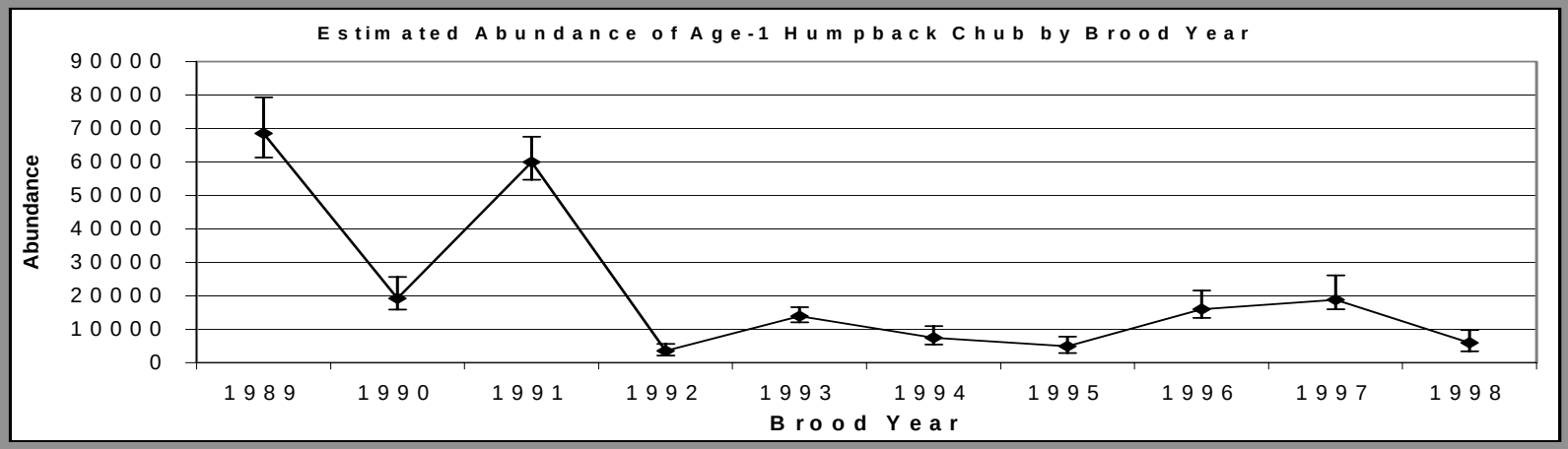
- Data Mgmt, Analysis, Dissemination
    - Annual reporting, incorporation into ASMR, SCORE report

- FY06 $315,000

USGS

CM – Downstream Native Fish: humpback chub





USGS

R&D – Downstream HBC and Other Native fish

- CMIN tasks/questions (2.1.1, 2.1.2, 2.6.1): Determine and track abundance and distribution of flannelmouth suckers, bluehead suckers and speckle dace populations in the CRE.

Problem: Non-abundant species and inefficient sampling methods

- Objective:
  - Investigate techniques and technologies to assess abundance and distribution to meet CMINs
    - Sonar and acoustic devices for enumeration
    - Modifying electrofishing gear for warmer water species
    - Add below Diamond Creek as sampling area

- Duration
  - 2-3 years depending on resource availability
- FY06 825,000

USGS

R&D – Non-native fish

- CMIN tasks/questions (2.4.1): Determine and track abundance and distribution of non-native predatory fish species in the CRE and their impacts to native fish

Problem: Efficient sampling methods for cold water predators, but inefficient sampling for warmer water species.

- Objective:
  - Investigate techniques and technologies to assess abundance and distribution to meet CMINs
    - Sonar and acoustic devices for enumeration
    - Modifying electrofishing gear for warmer water species
    - Current approach is sufficient for cold water species to track 10% change In relative abundance over 5 years
    - Add reach below Diamond Creek to sampling area.
    - Disease & parasite monitoring development
- Duration
  - 2-3 years depending on resource availability
- FY06 $825,000 – combined with DS native fish budgets

USGS

R&D – Aquatic food base

- CMIN tasks/questions (1.1.1 – 1.5.1): Determine and track composition and biomass of primary producers, benthic invertebrates and drift in Glen Canyon and below the Paria in the CRE.

Problem: Determine if food is limiting to fish community in CRE

What are the primary sources of food energy

Necessary step to food base monitoring development

- Objective:
  - Define food web dynamics in the CRE for fisheries in Glen Canyon and below the Paria including terrestrial invertebrate contribution.
  - Following linkage identification, develop monitoring methods that are biologically meaningfull, cost effective and meet AMP needs.

- Duration
  - 2-3 years of research and monitoring development iterations.
  - 1 year for implementation process.
  - FY06 $300,000

USGS

Terrestrial Vegetation Monitoring (in review)

CMIN tasks/questions (6.1.1-6.7.1): Determine and track abundance, composition, distribution and area of marsh, NHWZ, OHWZ, beach, seep and spring communities, and non-native species. Determine and track abundance and distribution and reproductive success of SWWF in the CRE.

Acquisition:

- Yearly vegetation dynamics surveys – cover, species diversity, species richness, native: non-native ratio by stage level
- Yearly or biennial structure data for terrestrial habitat – SWWF, riparian birds
- 5 year interval for vegetation mapping – area, large scale change – for indentified communities.
  - Tied to sediment overflight schedule.

- Data Mgmt, Analysis, Dissemination
  - Annual reports from principle invegstigator, incorporation into SCORE
  - GIS layer available on IMS
  - Implementation in 2006
- FY06 $250,000

USGS

Kanab Ambersnail Monitoring R&D

CMIN tasks/questions (5.5.1, 5.2.1): Determine and track abundance and distribution of KAS @ Vasey's Paradise. Determine and track size and composition of habitat at Vasey's Paradise

Acquisition:

- Biannual surveys – overwinter survivorship, yearly reproduction
  - Ground survey habitat
  - Count snails using small plots and adaptive sampling methods
  - Assess less invasive methods for habitat
  - Review long-term data set for population model development for monitoring program

Data Mgmt, Analysis, Dissemination

- Annual reports from principle invegstigator, incorporation into SCORE
- GIS layer available on IMS
- Implementation in 2006

FY06 $25,000

USGS

SWWF and Riparian breeding birds

CMIN tasks/questions (6.7.1): Determine and track abundance, distribution and reproductive success of southwestern willow flycatcher in the CRE

Acquisition:

- Annual surveys –
  - 3 times/year during designated SWWF protocol periods
  - Additional surveys/year at SWWF sites if pairs found for reproductive information
  - Measure Vegetation Structure for bird habitat
  - Combine with breeding bird surveys
    - >64 sites/year + waterfowl in winter
    - Fixed and Randomized
    - Sites tied to vegetation map – areas surveys, point count stations.

Data Mgmt, Analysis, Dissemination

- Annual reports from principle invegstigator, incorporation into SCORE
- GIS layer available on IMS
- Implementation in 2006

FY06 $115,000/ 30,000 just SWWF

USGS

Wildlife

Goal 6: Protect and improve the biotic riparian and spring communities, including T & E species and their critical habitat.

CMIN tasks/questions (6.7.1): Determine and track abundance, distribution and reproductive success of southwestern willow flycatcher in the CRE

Previous efforts were focused on integrated sampling for multiple species.

USGS

Remote Sensing Support for Core Monitoring (Aquatic & Terrestrial)

Thomas Gushue, GIS Coordinator
Integrated Science Program

September 27, 2004 TWG meeting

U.S. Department of the Interior
U.S. Geological Survey

Remote Sensing Support for Core Monitoring

Multi-spectral, System-wide Overflight

Similar to May 2002 Mission (ISTAR)

Digital sensors collect Red, Green, Blue, Near-Infrared and Panchromatic Data

Pixel Resolutions of 44 cm and 22 cm

DSM – Digital Surface Model
- 1-meter resolution
- Elevation values for surface including vegetation tops

Core Monitoring Uses for Digital Imagery Data

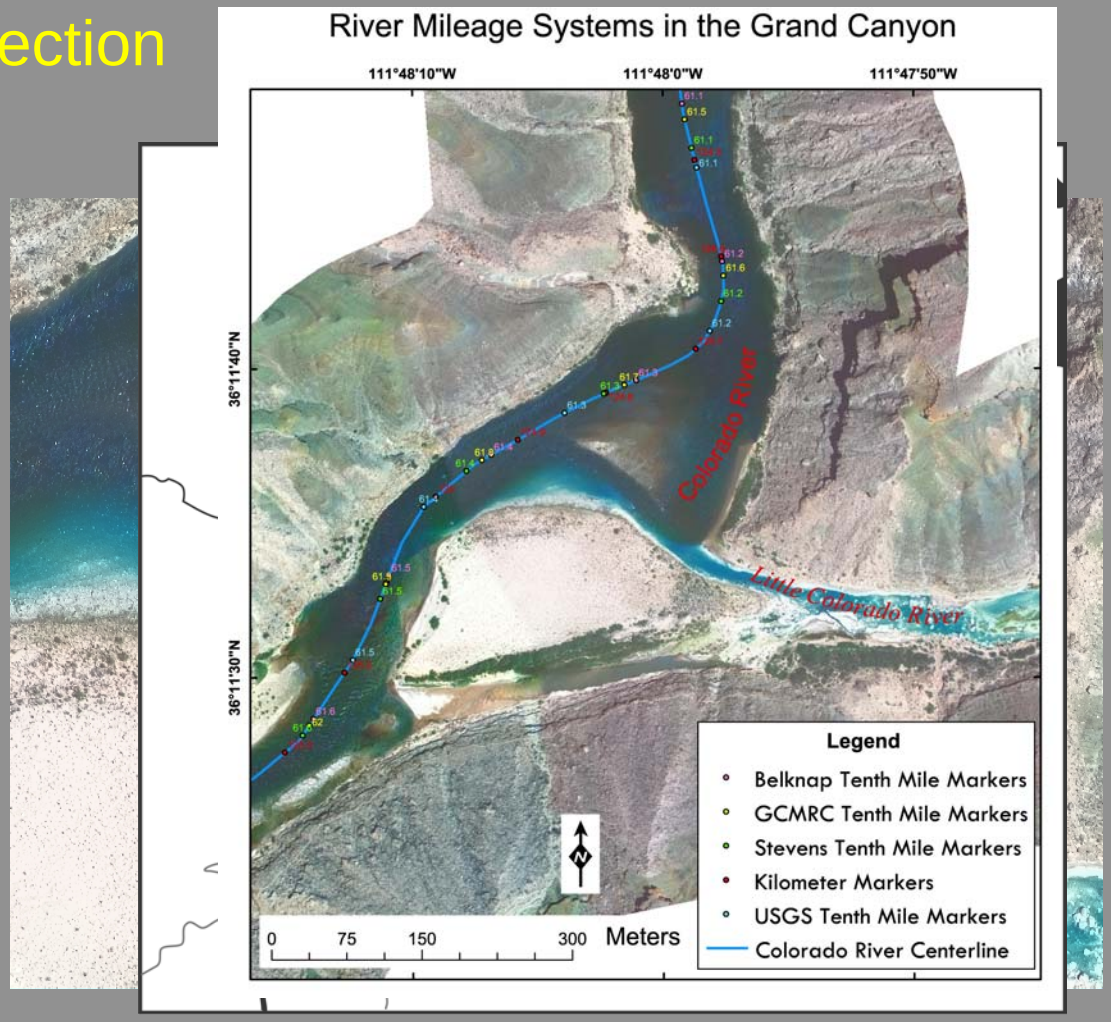
Base Imagery for GIS / Mapping Applications

Maps for Field Data Collection

Source for New Layers

Lees Ferry Trout

LCR HBC Monitoring



Additional Uses for Digital Imagery Data

Downstream Water Quality Sites

FIST

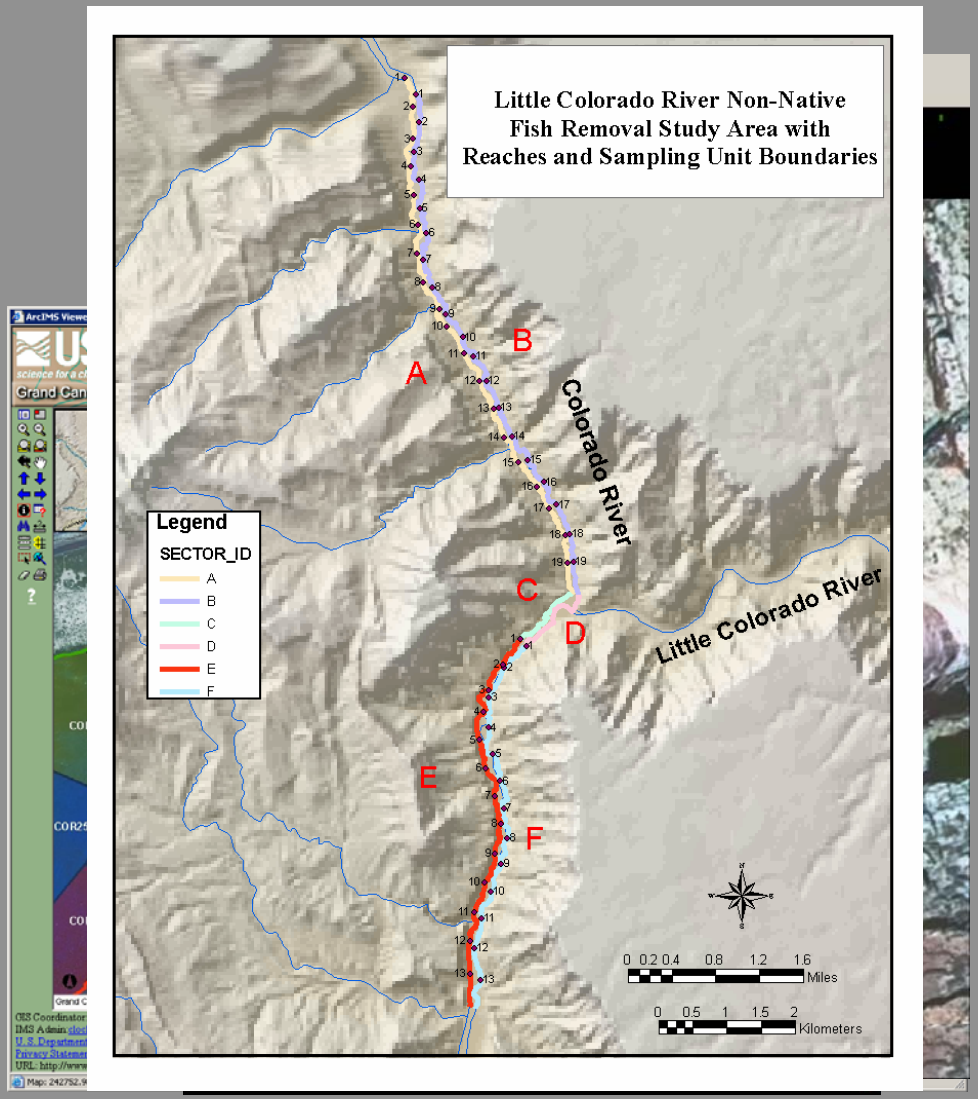
Exposed Sand Area

Campsite Identification

Vegetation Mapping

Downstream Fish Sampling

Mechanical Fish Removal

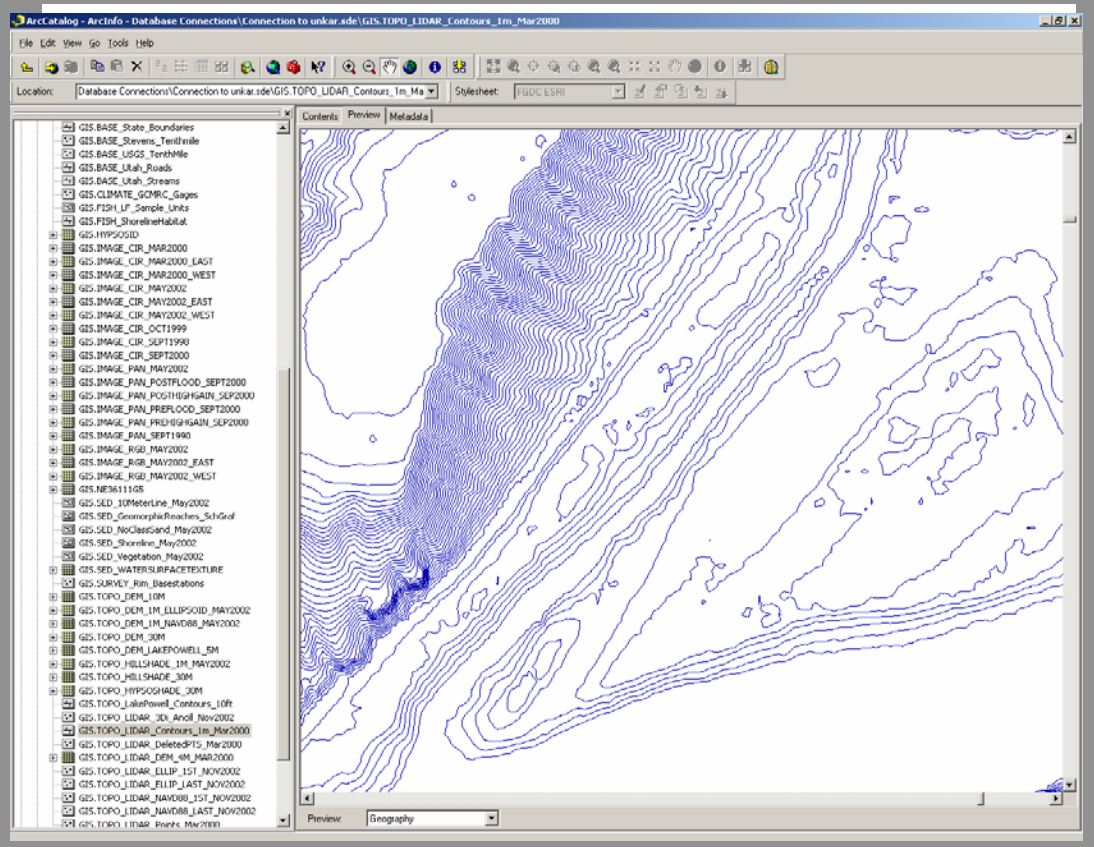


Other Remote Sensing technologies

Topographic Data Acquisition

High Resolution LiDAR used to support FIST activities

Very High Resolution LiDAR for Archeological Site Monitoring



Bathymetric Data

Multi-beam sonar to map channel geometry of Colorado River

Used by FIST and other modeling efforts

USGS

DASA

"Data Acquisition, Storage, and Analysis"

Remote Sensing Operations

Aerial overflights, LiDAR missions, Multi-beam sonar

Database Management

Oracle Server

Spatial Database Engine (SDE)

Analysis & Mapping

GIS

Support for Modeling

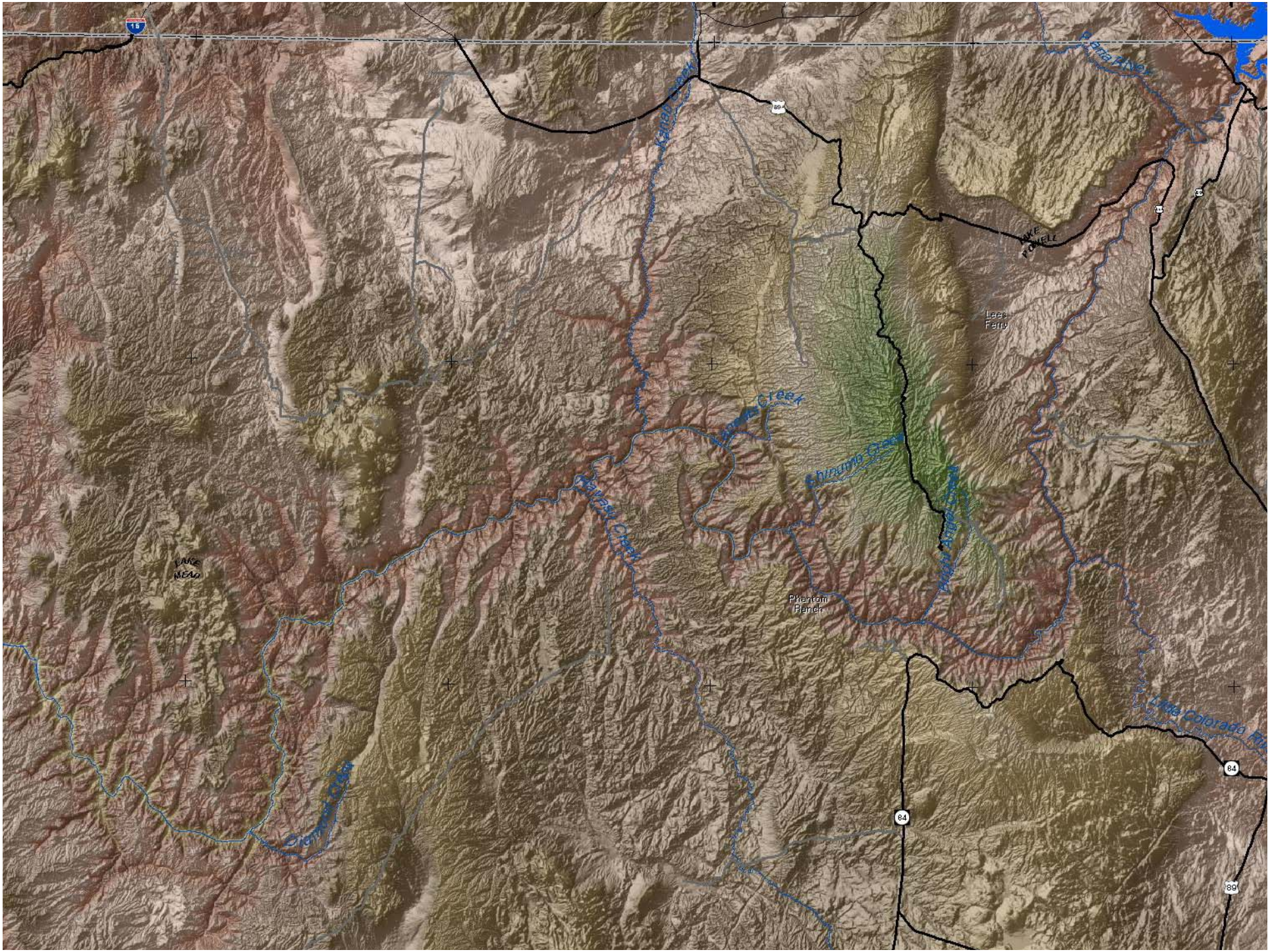
Data Access and Availability

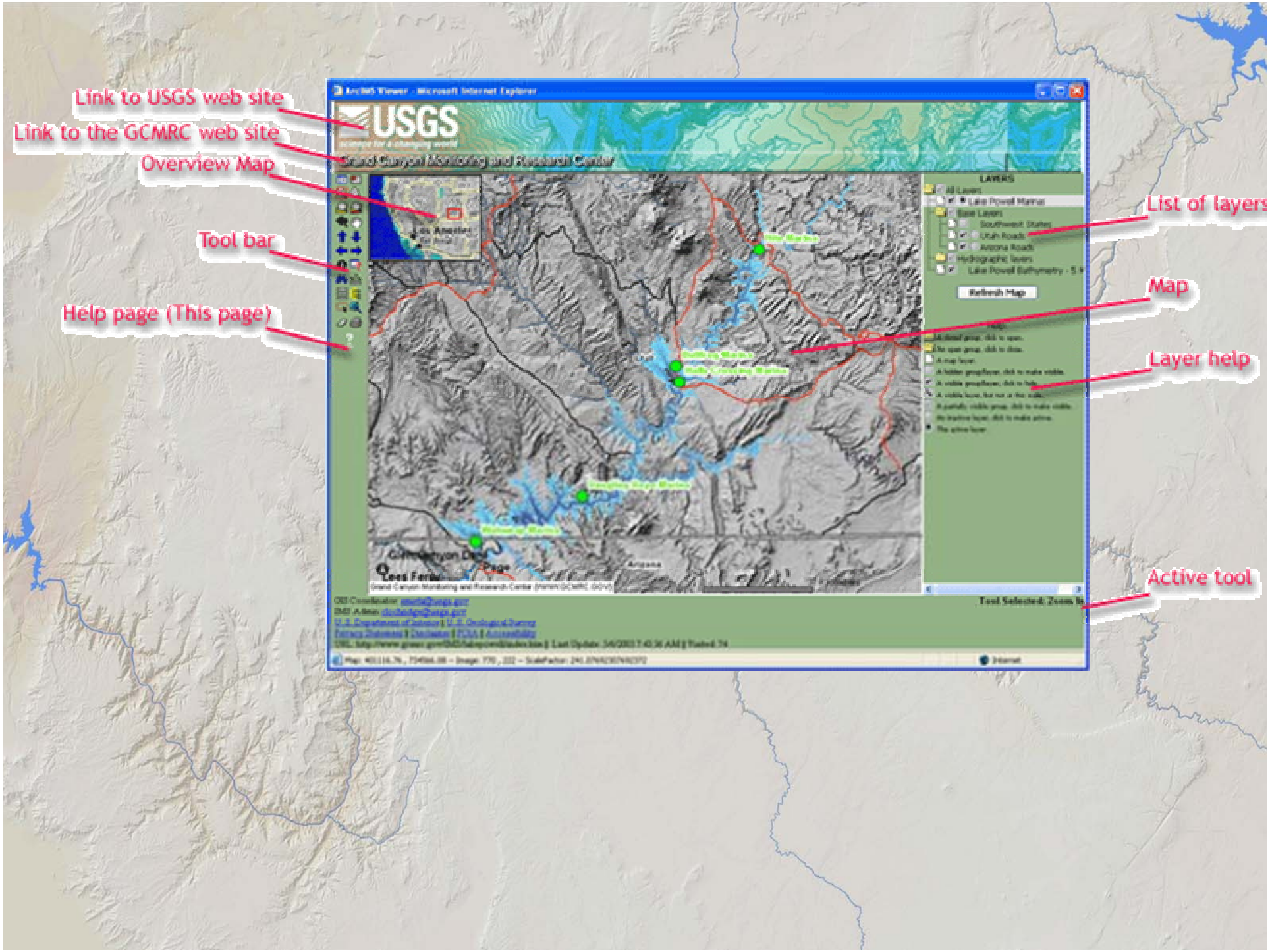
Internet Map Server (IMS)

GCMRC IMS Web Page

Surface water data downloadable from web site

Discharge Data Web Page


15
89
Paria River
Kanab Creek
LAKE POWELL
Lees Ferry
Havasu Creek
Shinumo Creek
Bright Angel Creek
LAKE MEAD
Phantom Ranch
Little Colorado River
Grand Wash
84
89


Link to USGS web site
Link to the GCMRC web site
Overview Map
Tool bar
Help page (This page)
List of layers
Map
Layer help
Active tool
USGS
LAYERS
Refresh Map