



# Flood & Coastal Storm Damage Reduction

## Geospatial Tools



### HQ Proponents:

- Harry Kitch
- Jerry Webb

### Management Team:

- Bill Curtis (CHL)
- Kate White (CRREL)
- Mike Deering (HEC)
- Darrell Nolton (IWR)
- Jeff Harris (HEC)
- Lisa Hubbard (CHL)
- Wayne Jones (ITL)

### Technical Directors:

- Jack Davis (CHL) - FDR
- Mike Sharp (GSL) - WRI



## F&CSDR R&D Program Objectives:

- **Provide capabilities to sustainably balance water resource projects that serve multiple purposes** (e.g. flood and coastal storm damage reduction, water supply, and recreation)
- **Provide capabilities for efficient, effective emergency management**



## Additional Objectives:

- **Consistency with other business lines.** (For example: F&CSDR tools for balancing systems of water resource project objectives will be consistent with Navigation, EMMRP & SWWRP toolsets.)
- **Balance in core technical competencies** (e.g., ice, hydraulics & hydrology, geotech, coastal, structural, planning & economics)



## F&CSDR Technologies:

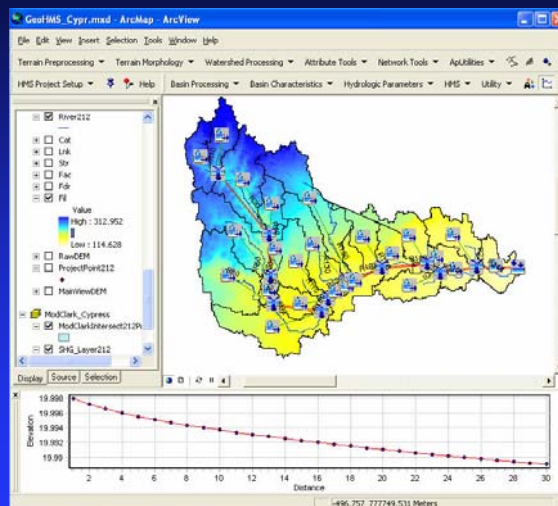
- **Develop Water Resources Planning Technologies** emphasizing the planning community's requirements;
- **Develop Engineering and Construction Technologies** - tools that provide greater capability for project design and performance;
- **Develop Project Operation and Management Technologies** – for optimizing water resource project O&M investments.



## HEC-GeoHMS



The current release version of HEC-GeoHMS is a beta version updated to the ArcGIS 9.2. This version is scheduled for release in FY08. Additional capabilities will include: enhanced terrain processing, extensive physical parameter extraction, hydrologic parameter estimation, data storage connection with HEC-DSS, and meteorological model support.



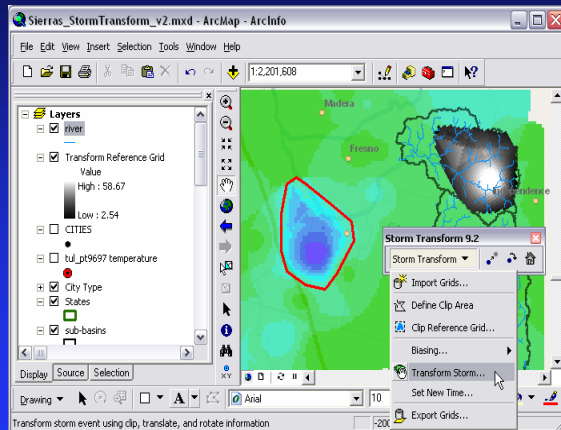
POC's: James H. Doan and Thomas A. Evans, HEC



## ERDC-CRREL Storm Transform



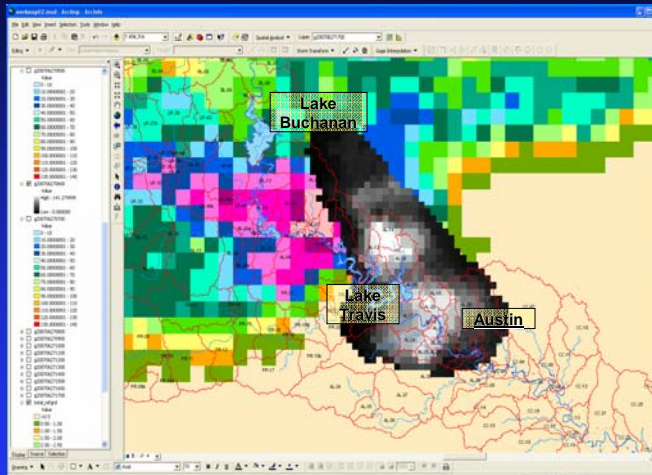
- ArcGIS Extension for transforming rain events spatially to create hypothetical storm scenarios for hydrologic modeling
- Provides unique capability of coupling Corps H&H databases to GIS to efficiently develop model scenarios
- Being used by Corps water control offices, the LCRA conservation district, and the private sector



POC: Elke Ochs, CRREL



## Operational Use of Storm Transform



• Storm Transform was used by the Lower Colorado River Authority for flooding drills, Spring 2008

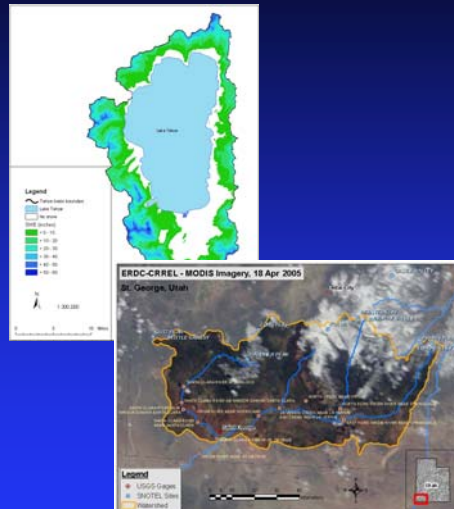
• These drills were in response to the June 2007 rain event of 18 inches in 6 hours above Lake Travis near Austin, TX



## Snow Hydrology



- Added Temperature Index Snow Model to HEC-HMS
- Developed automatic calibration procedure
- Retrospective snow analysis based on satellite data (AVHRR) and ground observations
- Combined satellite data, ground observations, and snow modeling for hydrologic analysis of flooding
- Developed historical data base of snow water equivalent for selected watersheds



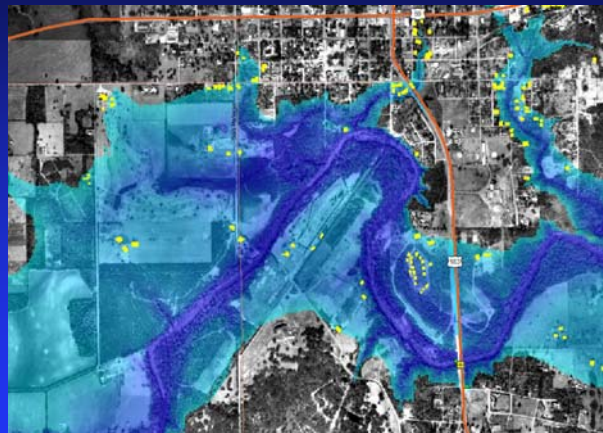
POC: Steve Daly, CRREL



## HEC-GeoRAS



HEC-GeoRAS is currently available for ArcGIS 9.1. New features are being tested for Version 4.2.91 for ArcGIS 9.1 and Version 4.2.92 for ArcGIS 9.2 that will provide improved floodplain delineation methods; interpolation and visualization of velocity and ice thickness results; and animation of inundation depths, boundaries, and velocities;



POC: Cam Ackerman, HEC

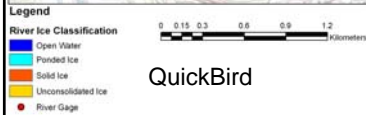


# Ice Hydraulics

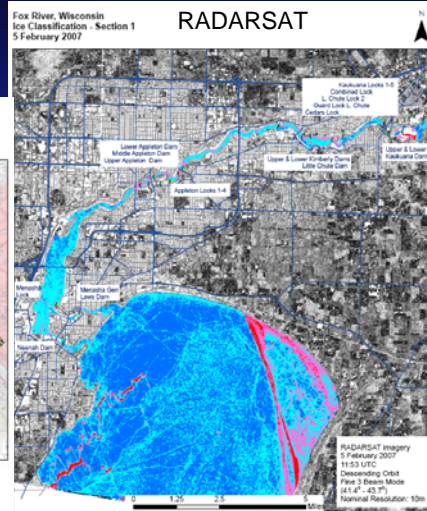


## Remote Sensing Classification Schemes

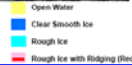
### Winooski River Montpelier, VT River Ice Classification



QuickBird



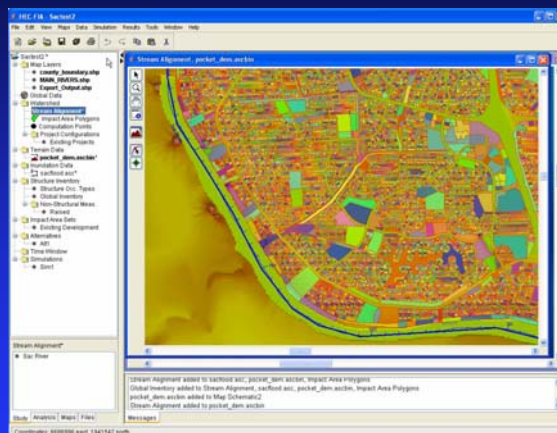
River Ice Analysis Using RADARSAT Imagery  
Steven F. Daly, Brian I. Tracy, Yves Gauthier  
Engineer Research and Development Center  
Cold Regions Research and Engineering Laboratory



# HEC-FIA and HEC-FDA



HEC-FIA 2.0 will contain capabilities that allow it to access and utilize the growing amount of GIS information available to efficiently perform flood damage related studies at all levels of detail. HEC-FDA 2.0 is also under development. The new interface will contain geographic information system (GIS) components that will greatly enhance the applicability of HEC-FDA for flood damage reduction studies. It will also contain features for evaluating and comparing nonstructural measures within a flood damage reduction study.



POC's: Bob Carl and Jason Needham, HEC



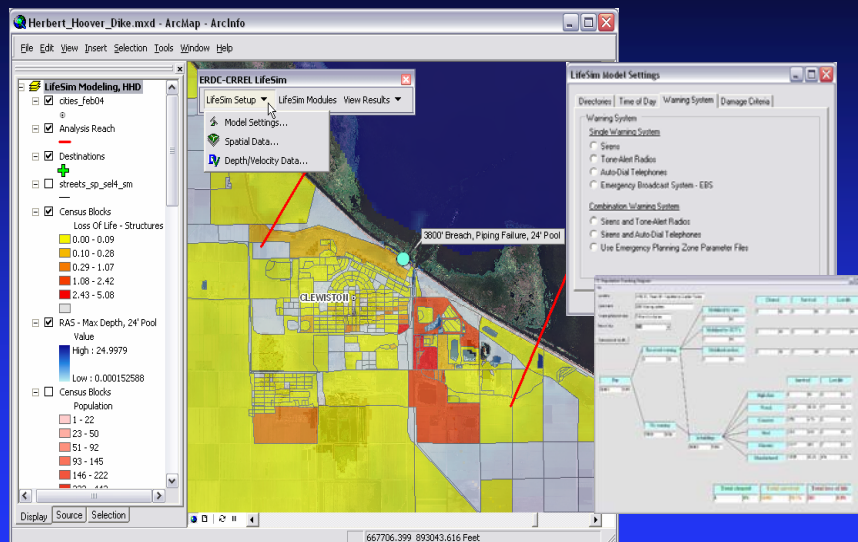
## LifeSim for ArcGIS



- Dam failure life loss modeling introducing use of geospatial technology
- New modeling capability for Corps offices provided as ArcGIS Extension
- Research begun by Utah State University, partnering with USU's Dr. David Bowles for Corps deployment efforts
- Coordinating with HEC/USBR to evaluate joint dam failure life loss modeling toolbox
- Component of Dam Safety Program



## ERDC-CRREL LifeSim for ArcGIS





## Emergency Management Technologies

- Provide capabilities for emergency planning, preparedness, response, and recovery.
- Provide capabilities for monitoring and instrumentation that supports EM.



## Prediction of Piping Erosion Under Levees Using Empirical Model

This research explores the use of an empirical model that uses traditional design variables in addition to previous levee performance and river geomorphology to identify locations most susceptible to piping during flood events. The model is applied using a Geospatial Information System (GIS) that defines selected levee properties, model parameters and the levee footprint, in real-world coordinates. The model run is performed within the GIS and results are displayed in map form for immediate use.



POC: Eileen Glynn, GSL





## Flood & Coastal Storm Damage Reduction Systems Monitoring – EMT Work Unit



### Objective

- Integrate current field-based R&D and real-time data collection technologies with database and web-centric tools into operational components that can be used to enhance management capabilities during emergency response and operational activities.

### Approach

- Assess, Design & Build, Deploy/Demonstrations, Analysis & Visualization through operational systems.

**Responsible PI:** David C. Finnegan, ERDC-CRREL

### Development Team

Christopher Williams, ERDC-CRREL  
 Bryan Baker, ERDC-CRREL  
 Greg Hanlon, USACE-NAE  
 Jose Llopis, ERDC-GSL

### Partnerships

Riegl USA Inc.  
 Local/Regional Levee Board  
 USFS – Tongass National Forest  
 US Army Corps of Engineers Districts – NAE & POA

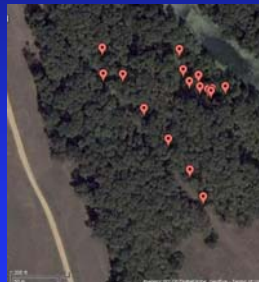


## Development of Real-time Monitoring Technology



### Levee Seepage Early Warning System

- Automated DC resistivity array
- Meteorological suite
- Water levels (monitoring wells)
- Imagery
- Soil temperature
- Volumetric water content
- Connected to CWMS



Buck Chute Bayou - Mississippi





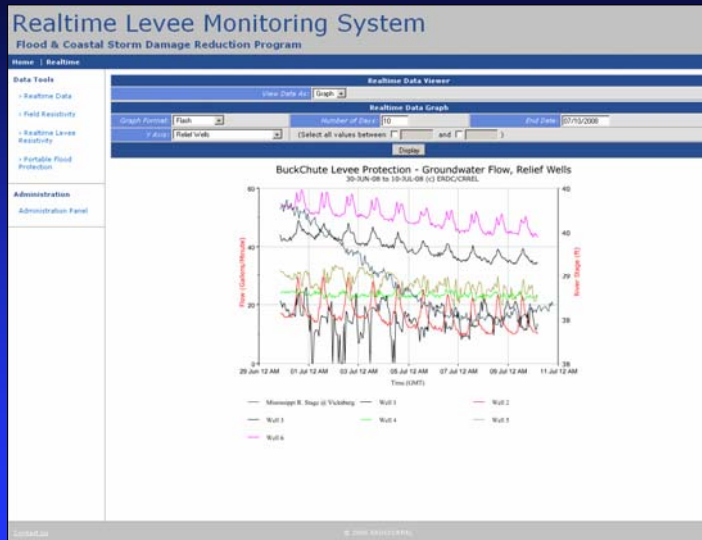
# Levee Seepage Early Warning System



- Automated DC Resistivity
- Measurements are made by injecting current into the ground through two current electrodes and measuring the resulting voltage difference at the two potential electrodes.
- True soil resistivity (ohm/meter) can be determined through mathematical analysis
- A change in soil resistivity will indicate water infiltration
  - 250 meter survey
  - 62 rods
  - Spaced 4 meters apart
  - 656 measurements
  - Estimated vertical penetration = 30 meters



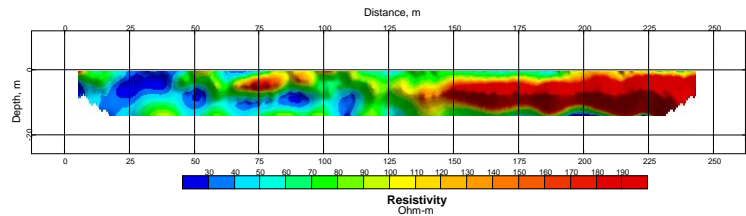
# Water Resources R&D



[http://www.crdm.usace.army.mil/levee\\_monitoring\\_early\\_warning\\_system](http://www.crdm.usace.army.mil/levee_monitoring_early_warning_system)



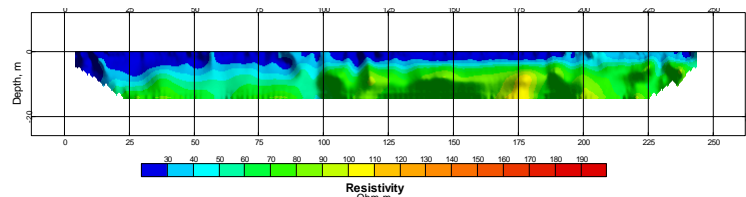
## Water Resources R&D Levee Seepage Early Warning System



Electrical Resistivity Survey

Buck Chute

22 Sept 2007 - Vicksburg - River Stage - 8.51 ft



Electrical Resistivity

Buck Chute

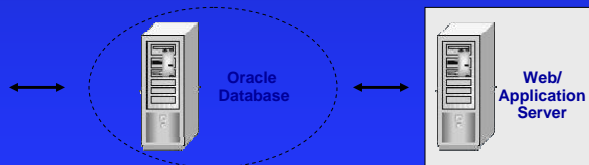
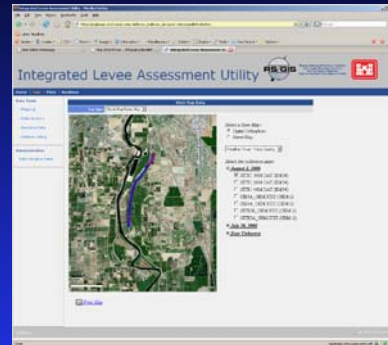
24-25 Apr 2008 - Vicksburg River Stage - 50.83 to 50.75 ft



## Water Resources R&D Integrated Levee Monitoring Utility



- Realtime analysis of spatially referenced field data
- Rapid visualization
- Rapid Analysis
- Geospatially linked to other spatial data
  - CorpsMap
  - NLD
  - EngLink





# Water Resources R&D Integrated Levee Monitoring Utility



### Realtime Levee Monitoring System

Flood & Coastal Storm Damage Reduction Program

Home | Realtime

**Data Tools**

- Realtime Data
- Field Resistivity
- Realtime Levee Resistivity
- Portable Flood Protection

**Administration**

Administration Panel

**View Map Data**

Map Type: Google Map

Map | Satellite | Hybrid

Feather River, Yuba County

Select the collection date

- 08/02/2006
  - SITE1\_I0M.DAT (EMC4)
  - SITE1\_20M.DAT (EMC4)
  - SITE1\_40M.DAT (EMC4)
  - SITE4\_SEM.EYE (SEM-2)
  - SITE4\_SEM.EYE (SEM-2)
  - SITE8\_SEM.EYE (SEM-2)
  - SITE8\_SEM.EYE (SEM-2)
- 08/26/2006
- 2m\_5Meters



# Water Resources R&D Integrated Levee Monitoring Utility



### Realtime Levee Monitoring System

Flood & Coastal Storm Damage Reduction Program

Home | Realtime

**Data Tools**

- Realtime Data
- Field Resistivity
- Realtime Levee Resistivity
- Portable Flood Protection

**Administration**

Administration Panel

**Field Resistivity Data**

Display Max/min Map | Google Map | View Data as Graph | View Data as Table | Dataset Listing

Location: Feather River, Yuba County

Collection Name: I0M EMC4 Data

Collection Number: 3

U-Attr: Northwing

V-Attr: Value

Date Collected: 08/02/2006

Display Format: Image (img)

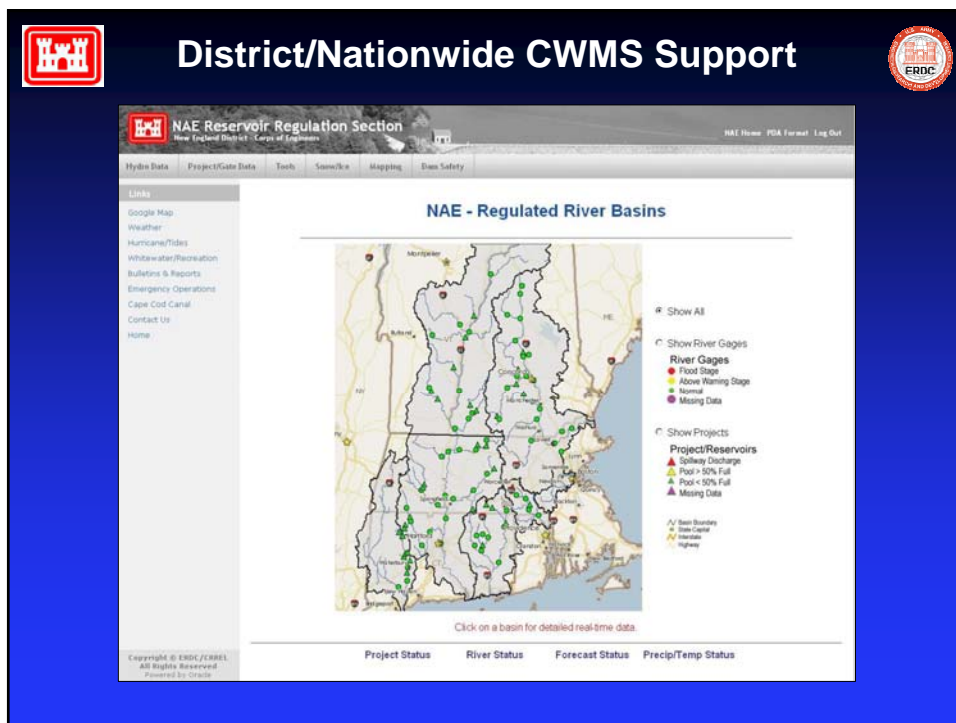
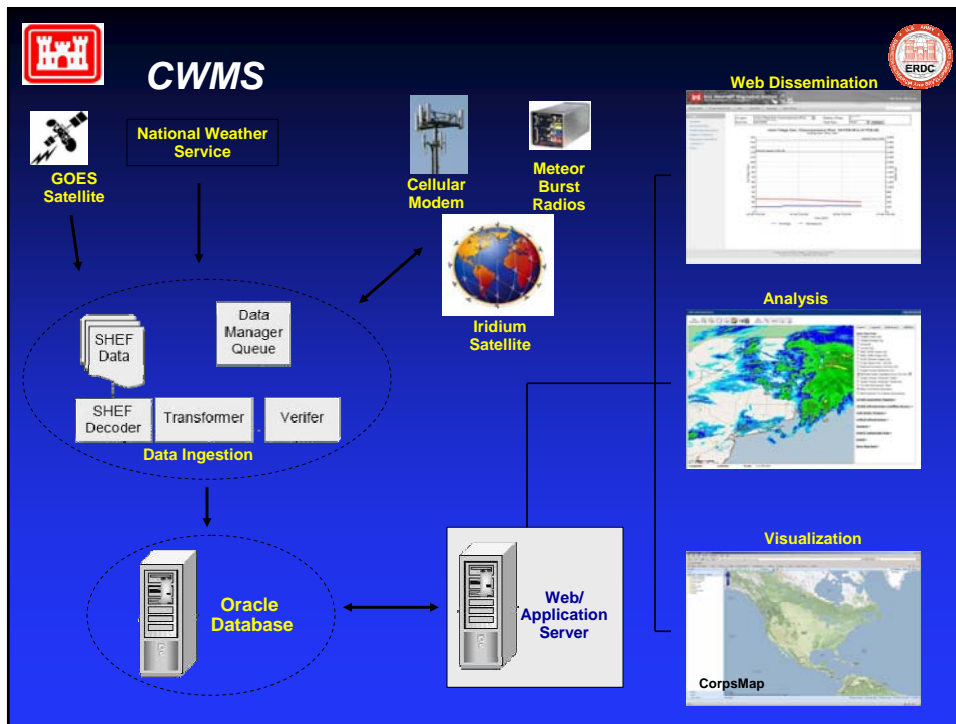
Select all values between [ ] and [ ]

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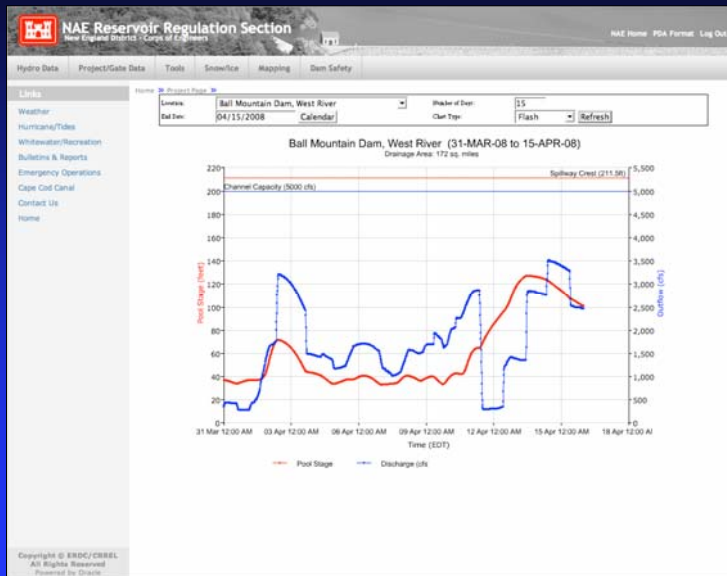
Feather River, Yuba County, 08/02/2006  
All EMC4 Data

UTM Northing (m)	SITE1_I0M.DAT (uS/cm)	SITE1_20M.DAT (uS/cm)	SITE1_40M.DAT (uS/cm)
4,322,000	~50	~50	~50
4,324,000	~50	~50	~50
4,326,000	~50	~50	~50
4,328,000	~300	~300	~300
4,330,000	~50	~50	~50





## District/Nationwide CWMS Support



## Levee Inspection System



- Research started with MVR idea coupled with TOWNS R&D effort; finalized in FCSDR program
- Standard approach/method to Levee Inspection using latest COE policy and geospatial technologies
- Integrated with National Levee Database
- Data exchange with the Levee Risk Assessment DX
- Partnered with MVR, LRL, NWO, ERDC, and COE HQ
- All USACE office trained in FY08; 3 States trained 2 interested
- HQ policy states that this is the only approved method for levee inspections and reports for all Federal Levees
- Allows for immediate inspection results
- Future modifications for post flood event collection, periodic dam inspection.



# Levee Inspection System: Data Collection - Points



The screenshot displays the 'Levee Inspection' software interface. On the left, a map shows a river system with a 'New Point' dialog box overlaid. On the right, the 'New Point...' form is open, containing the following fields:

- Inspection ID: USACE\_CEMVR\_SNY1\_2006\_s\_0001
- Project: Sny Island Levee Drainage District - Reach 1
- Feature: Levee Slope Only (R/S)
- Item: Burrows
- Remarks: Animal burrows on river side slope.
- Action: Relocate animals, fill, and re-seed slope.
- Rating: MA
- Status: Monitor
- Status Comments: (empty)
- Station: 9500+00
- Easting\_1: 91.3496503
- Northing\_1: 39.79190569

Buttons at the bottom include 'View Photos...', 'Submit', and 'Cancel'.



# USACE Standard Inspection Report



This collage features several key documents related to USACE flood control works:

- Levee Owner's Manual for Non-Federal Flood Control Works:** Published by the US Army Corps of Engineers in March 2006, this manual covers the Rehabilitation and Inspection Program under Public Law 84-99.
- Inspection Guide for Flood Control Works:** A document from the U.S. Army Corps of Engineers detailing inspection procedures.
- Inspection Report Forms:** Multiple overlapping forms showing data entry tables and descriptive text for various inspection categories.



Questions?