FMA 2008 ANNUAL CONFERENCE

Floodplain Sustainability:
Integrating Flood Risk, Land Use and Environmental Stewardship
September 2-5, 2008
Paradise Point Resort, San Diego

ABSTRACTS
In Chronological Order

WEDNESDAY SEPTEMBER 3

10:15-12:00 Environmental Restoration and Flood Damage Reduction

MULTIPURPOSE STREAM RESTORATION: FISH, EROSION AND FLOOD CONTROL

Thomas R. Smythe
Lake County Department of Public Works

The Clear Lake Hitch, a California Species of Special Concern, have declined sgnificantly in population over the past century. One cause of the decline is loss of spawning habitat in the tributaries of Clear Lake. Channel downcutting in the Middle Creek Flood Control Project and the construction of a concrete weir for stream gaging purposes have removed over ten miles of viable spawning habitat in the Middle Creek watershed. Downcutting had also increased erosion, over-steepened banks, and caused significant bank failures. As the Clear Lake Hitch are not salmonids, limited funding is available for their protection and habitat restoration. A series of four rock weirs were constructed in the bed of Middle Creek within the Flood Control Project to adjust the stream gradient to remove the barrier for fish passage. Design considerations included limited swimming abilities of the hitch, maintaining capacity within the Flood Control Project, and not disturbing other listed species. Construction occurred in 2005, which was immediately followed by a 200-250 year flood event which damaged the weirs, then a drought year. Finally, in Spring 2008, thirty hitch were observed in Middle Creek upstream of the barrier within streambed which had been cutoff over forty years earlier.

WHY CALIFORNIA'S FLOOD PLANNING EFFORT NEEDS TO CONSIDER ACTIVATION FLOWS

Elizabeth S. Andrews, Philip B. Williams, Eric Ginney, Andrew Collison, and E. Setenay Bozkurt
Philip Williams & Associates, Ltd.

Without a focused effort, setting back levees and creating or enlarging flood bypasses is unlikely to achieve key ecological floodplain functions: food web support and native fish habitat. Recent research has demonstrated the key role certain floodplains can play in this regard. Floodplains that provide these kinds of ecological services are "activated," and are seasonally inundated for extended periods, on a frequent basis interannually. For some native fish species, including splittail and salmon, these increasingly rare habitats may have a pivotal role to play in population support and/or recovery. At a broader level, activated floodplains serve as productivity powerhouses supporting the food web downstream (e.g, the Delta).

Our prior work indicates that opportunities to create activated floodplains are probably quite limited due to substantial anthropogenic changes in flows and river morphology. A concerted effort must be made to identify the most feasible areas for restoration of activated floodplain and integrate them into our system-wide flood management planning. Without such an effort, our newly "restored" floodplains will fail to

realize their potential to support native and endangered species both directly (habitat) and indirectly (food web support) and a unique opportunity will be lost.

In this presentation, we will describe how a particular inundation regime, that provided by "activation flows," can be applied to address multi-objective flood management planning needs. This tool can be used in a variety of ways to facilitate restoration and enhancement planning within such a context: large-scale goal-setting, planning, project design, and monitoring for adaptive management.

RESTORATION PROJECTS ALONG THE TRUCKEE RIVER

Danielle Henderson
Truckee River Flood Project, Washoe County, Nevada

The Truckee River represents one of the most unique ecosystems in Nevada, connecting Lake Tahoe and Pyramid Lake - both environmental treasures in their own right. Blasting, dredging, and straightening the river over the last 150 years, and constructing more than 30 dams and water supply diversion structures have deteriorated the river's ecosystem. Native vegetation has been significantly reduced and water levels lowered, eliminating critical habitat and impeding fish spawning in the river. Today, approximately 90% of the riparian forest that existed along the river at the beginning of the 20th century has been lost, along with 70% of the 100's of nesting bird species once common along the river.

Restoration of the Truckee River serves multiple goals, including flood control, improved water quality, improved habitat for fish and wildlife, and recreation. Washoe County, the City of Reno and the City of Sparks are serving jointly as the non-federal (local) sponsor of the Flood Project, under which river restoration is an important component.

The Flood Project has identified 11 sites along the Truckee River as potential sites for ecosystem restoration. Some of the methods of restoration being utilized are: land acquisition to reestablish sinuous river bed, planting of riparian vegetation, construction of fish ladders and removing diversion dams, and providing dedicated instream flow. An example project includes the 102 Ranch Restoration in which the non-profit Nature Conservancy was selected as a partner. This project will also allow supplemental funding through the Bureau of Reclamation's Desert Terminal Lakes program.

BULL CREEK CHANNEL ECOSYSTEM RESTORATION PROJECT

Ike Pace, P.E.
Tetra Tech

The project includes approximately 2,050 linear feet of the lower Bull Creek Channel from Victory Boulevard to the Lake Balboa Access Road, within the Sepulveda Dam Flood Control Basin in Van Nuys, California. The restored area covers approximately 22.2 acres. It includes grading of the existing channel between Victory Boulevard and the Lake Balboa Access Road; addition of an oxbow channel, thereby creating an island; and inclusion of concrete weirs and rock lined scour holes to aid in the natural development of pools, riffles and point bars. Erosion control of channel embankments will be provided using coir fabric, turf reinforcement mat (TRM), and riprap. Existing riprap protection upstream of the oxbow channel will be removed and reinstalled to match the new channel geometry. Recreation and maintenance access will be provided with the addition of four pedestrian and light vehicle access bridges. Riparian and upland plantings will be provided. A trash rack will be located upstream of the oxbow channel. Water will be diverted from Lake Balboa to increase the stream flow. Decomposed granite paths with simulated-wood concrete fencing will be provided, with four turnaround areas and interpretive nodes and signage.

Excess excavated material will be partially disposed of on-site with the remainder being hauled off-site. The construction bid for this plan is $4,512,000. The construction and planting will be accomplished over a sixteen month period starting in April of 2008.

10:15-12:00 Levees – Inventory Development and Applications

BUILDING THE CALIFORNIA LEVEE DATABASE

Ann Redington, P.E., CFM, PBS&J; Marc Cavallaro, PBS&J; Yiguo Liang, PhD, P.E., California Department of Water Resources

DWR with internal and FEMA funding is currently building the California Levee Database. Data collection began in 2005 with the statewide capture of geographic levee features including both federal and non-federal levee reaches. A data framework was established for the capture of stream stationing, flooding sources, maintenance and ownership information, and other data specific to the levees. The population of these attributes is ongoing. Newly created features have been developed as part of the levee information system including corporate boundary layers, best available floodplain mapping, populations protected by levees, borehole location layer, and National Levee Database collected data. A major component in the development of the levee database is for attributing technical data captured in studies, surveys, inspections, and construction drawings to their associated levee segments within the Statewide Levee Database. The documents located at these agencies were first reviewed for their relevancy to providing pertinent information along Central Valley levee segments. Relevant documents were spatially related to levee segments and recorded for the risk factor information types. Information has been gathered on topographical, hydrology, hydraulic, geotechnical, historical data, inspection and maintenance information, construction data, and planning alternatives. A web viewer has been developed for accessing gathered data.

IMPROVING HAZUS-MH GENERATED LOSS ESTIMATION BY COMBINING MIDTERM LEVEE INVENTORY AND DFIRM DATA

Michael J. Bishop and Stefan Zink
Michael Baker Jr. Inc.

A tremendous amount of resources are being invested into the inventory of infrastructure related to flood damage reduction. FEMA, responsible for the National Flood Insurance Program (NFIP), is currently executing its Map Modernization Program intended to transform, standardize, and update the historically printed paper FIRM panels into a digital format (DFIRM) based on GIS technology. The California Department of Water Resources (DWR) and US Army Corps of Engineers (USACE) are also developing digital databases of levees. Collaborative efforts among FEMA, DWR, and USACE all contribute to a growing, detailed inventory of levees. The national effort by USACE to gather project data is called the National Levee Database (NLD). FEMA's efforts distinguish between levees certified to meet the requirements of the NFIP from levees which do not meet these requirements. They are recorded in the Midterm Levee Inventory (MLI), a direct subset of the USACE NLD. Although the programs are still in progress, there is sufficient data to begin discussing and designing uses for these data. HAZUS-MH is a loss estimation software by FEMA that is capable of calculating flood loss estimates based on out of-the-box and user-provided data. By combining MLI and DFIRM data, this presentation outlines a procedure to improve the standard loss estimation by HAZUS. An example of a low relief area in the California Central Valley, the Natomas Basin, is used to demonstrate the broad applicability of this methodology.

INTERAGENCY COOPERATION AND TECHNOLOGY EXCHANGE: THE USACE NATIONAL LEVEE DATABASE, DWR CALIFORNIA LEVEE DATABASE, AND FEMA MID-TERM LEVEE INVENTORY

Dan Henderson, GISP, CFM, and Marc Cavallaro, CFM
PBS&J

DWR, FEMA, and USACE are currently working together to develop data design, management, and exchange protocols for their levee databases. This effort will help to ensure that all information collected by each agency can be integrated into all data models and databases in perpetuity for levee and floodplain management. This effort includes knowledge transfer between agencies and contractors, spatial database design, exchange and integration of GIS feature classes, and assessing available data. Exchange of ideas and information has occurred through biannual levee summits between all agencies and contractors which allow revisions to database design as well as establishing the accuracy of levee data. Efforts on this project range from high level policy discussion to detailed technical revisions to database models. This process has enabled all agencies to realize time and cost savings through elimination of redundant effort. As a relatively unique partnership, lessons learned from this process can be applied to other interagency exchanges at a variety of levels of government.

2:00-3:45 Estimating and Mitigating Flood Risk – Part I

A SURVEY OF THE RETURN PERIODS COMMONLY USED IN DESIGN OF CIVIL ENGINEERING PROJECTS IN SOUTHERN CALIFORNIA

Cory LaNeave, P.E.
Infrastructure Engineering Corporation

This survey proposes to generalize the characteristics that affect the selection of a return period used to design for flood protection by looking at existing governing standards in several jurisdictions within the climatologically, geographically, and environmentally similar region of Southern California. The hydrologic and hydraulic regulations for flood control structures from several cities and counties will be evaluated to focus on the following questions:

- why does urban drainage typically require shorter return periods;
- what return periods govern roadway design;
- what return periods govern bridge designs;
- should storms larger than a 100-year return period be considered for designs other than dams?

Ultimately, this survey would like to answer the question of what legal and ethical choices does a civil engineer make when choosing a return period to engineer terra firma.

ECONOMIC IMPACTS OF RAINFALL MEASUREMENT SYSTEMS

David C. Curtis, Ph.D.
Carlton Engineering

In 2007, more than $1.1 trillion was spent on constructed facilities in the United States, according to the US Census Bureau. Nearly every dollar spent on construction is impacted in some way by rainfall and the quality of recorded rainfall data plays an important role in project design. Rainfall related design choices can effect multi-million dollar changes in project costs. As an example, a change in the assumed size and shape of a design storm led to a reduction in required stormwater treatment capacity from more than 300 million

gallons per day (MGD) to less than 250 MGD. Individual project benefits on the order of tens of millions of dollars are easily identifiable on many projects.

On the cost side of the equation, an individual rain gage often costs on the order of $500 per gage per month to own, operate, and maintain. Unfortunately, many rain gage networks are ill-designed, not only from a network perspective, but individual site selection as well. When gage networks are poorly conceived and poorly sited, the data are unreliable. In a recent rain gage network evaluation, the author observed more than 20 locations in one network that were entirely unsuited for consistent rainfall observations. Data from these stations had to be discarded after a four year study period. At $500 per gage per month, approximately $120,000 in gage costs was lost annually or about $480,000 over four years.

This paper will present several examples of both the benefits and costs of rainfall data. Examples include project design considerations as well as rainfall observation system operation.

HAWAII DAM FAILURE INUNDATION STUDIES

Martin J. Teal, P.E.
WEST Consultants

Beginning around February 20, 2006, the Hawaiian Islands experienced unusually severe rain showers that caused severe flooding throughout the State. On 14 March 2006, the privately-owned Kaloko Dam on the island of Kauai failed sending a wall of water downstream that overtopped the Morita Dam, damaged Kuhio Highway, and swept away homes. An Act was passed by Congress in June of 2006 containing funding for the Hawaii Water System Technical Studies for the conduct of dam break analyses to evaluate the likely downstream inundation area in the case of a dam failure below selected dams.

The objective of this work was to conduct sufficient hydrologic and hydraulic analysis primarily through computer modeling to determine dam break floodplains below a selected list of regulated dams in the State of Hawaii. This work included the use of GIS tools to process topographic data for both the hydrology and the hydraulic analyses. A detailed terrain model was developed for the identified hazard areas using current and new topographic data. Both hydrologic and hydraulic models were developed to generate inflows from the 100-year and Probable Maximum Flood (PMF) events and route flows downstream. The HEC-HMS and HEC-RAS models were used to simulate and map a number of Dam Failure scenarios ranging from "full pool sunny day" to the Probable Maximum Flood (PMF) event. In the interest of time, the focus of the presentation will be on the hydraulic and dam failure modeling. Interesting model difficulties and their resolution will be discussed.

EVALUATION OF SANITARY SEWER PUMPING SYSTEM FOR FLOODING MITIGATION IN JEFFERSON PARISH, LOUISIANA

Jessica L. Watts, P.E., CFM, CDM; Manish Mardia, P.E., Priyo Majumdar, P.E., and Ryan Foster, E.I., Hartman Engineering, Inc.; Durund Elzey, P.E., U.S. Army Corps of Engineers

In the wake of Hurricane Katrina, Jefferson Parish suffered significant damage to its infrastructure. Southern Louisiana has unique geologic, topographic, and climate conditions which facilitates the need for over 500 sewage lift stations. The large number of disabled sewer pump stations required extensive resources to inspect and repair, at a time when manpower and supplies were inadequate at best. Because of the complex hierarchy of the pumping system, the sporadic operation of the stations crippled enough of the system to render it nonfunctional. The inoperability of the pump stations was one of the most lingering issues to hinder the Jefferson Parish recovery effort and re-entry of residents.

The purpose of this study is to provide Jefferson Parish with a comprehensive planning document on the best methods to mitigate future flood damage to sewerage infrastructure. The two main objectives of this study are to, first, assess the level of flood vulnerability for each station and, second, identify mitigation scenarios to reduce future impacts. The damages considered in this study are both the direct and consequential damages that could arise due to flooding of components of the system. Flooding scenarios for each station were conducted and the associated costs developed. This analysis identified the specific stations as being most vulnerable to flooding.

Mitigation scenarios for the 0.2% rainfall event for the primary stations and 1% rainfall event for the secondary and lower stations and were created. Structural, mechanical, and electrical mitigation measures as well as consolidation alternatives were recommended.

2:00-3:45 Levees – Evaluating, Managing and Communicating Flood Hazards

LEVEES – A PROPOSED NATIONAL MANAGEMENT STRATEGY

Don Armour, PE
Stantec Consulting Inc.

Levees are a critical part of the nation's infrastructure. They manage the flood risk for billions, possibly trillions of dollars of investment and economic activity and millions of individuals. As recent failures in New Orleans, Nevada, and Missouri have demonstrated, levees can and do fail and when they do, not only are public and private property at risk, but public safety as well. The nation faces many issues with levees including:

- General lack of knowledge by the public regarding levee risk (many who live behind levees don't even know that they do).
- Some communities who are responsible for maintaining and operating levees either don't have the funds to do so, or have prioritized those funds for other reasons.
- All levees are not inspected routinely, either due to lack of funds or other competing priorities.
- Levees are accredited on an occasional, rather than planned periodic basis.

This presentation will propose a National Levee Management Strategy. This strategy, while not perfect, places requirements on levee owners and operators that are commensurate with the risks inherent in levee design, operation, and maintenance. It includes a federal role consistent with other major public health and safety programs and allows for states to take responsibility for the federal role, providing specified criteria are continually met. The presentation is likely to raise as many questions as it answers and the audience is encouraged to provide feedback.

SENSITIVITY ANALYSIS ON UPSTREAM LEVEE FAILURE ASSUMPTION

Nathan Pingel, PE, David Ford Consulting Engineers, Inc.
Tom Molls, PE PhD, David Ford Consulting Engineers, Inc.
Mike Archer, PE, MBK Engineers

In support of ongoing floodplain management activities in the Central Valley, levee performance and flood risk are being re-evaluated. The standard approach for evaluating project performance and risk is to follow the procedures developed by the US Army Corps of Engineers; the so-called risk and uncertainty procedures. Following these procedures we can estimate the risk that a specific area will be inundated and the damage expected as a result of the inundation. To complete the analysis, we must develop channel water surface

elevation-probability functions, levee reliability functions, inundated area depths, and inundation depth-damage functions. Development of such functions in a simple watershed case is well documented.

However, development of these functions in a leveed system is complicated and standard procedures are not well documented. In this presentation, we will focus specifically on the development of the channel water surface elevation-frequency functions and the sensitivity of that function to upstream levee failure scenarios. For example, what if we presume that upstream levees do not fail? What if they fail when overtopped? What if they fail a specified distance from the top of the levee? What impact does this assumption have on the frequency functions as well as assessments of probability of flooding behind the levee? We will show the potential impact at locations within the Sacramento River watershed levee system in terms of stage and annual probability using different upstream levee failure assumptions. For this, we will available hydrologic and hydraulic information of the system.

THE DEVELOPMENT OF PIPING IN LEVEE FOUNDATIONS

George Sills, USACE Engineer Research and Development Center, and Christopher Groves, Shannon & Wilson, Inc.

The occurrence of a sand boil during a flood indicates a serious condition that could lead to levee instability. This feature is often treated by ringing the sand boil with sand bags and monitoring the flow and the conditions around the sand boil. The sand bag ring reduces the gradient and mitigates the erosion of fines. What is not well known or studied is how this event may compromise the subsurface conditions and could lead to more serious erosion during future flood events.

Experience shows that the levee foundation is damaged when a sand boil occurs and a similar or more severe sand boil may occur under similar or even less severe conditions in the future. The mechanics of this problem appear to be related to the degradation of the soil around the pipe that develops during the piping erosion. It is well understood that the seepage gradient in the soil increases as the piping progresses from the protected side to the unprotected side of the levee. As the gradient increases, the flow to the pipe increases, and the rate of erosion and soil transport increases unless the sand boil is ringed with sand bags and the gradient thereby reduced. As the water recedes, and with time, there appears to be further degradation of the soil around the pipe. This degradation may lead to a more rapid development of the sand boil during future floods.

Several case histories of rapidly developing sand boils will be presented and discussed.

LEVEE RISK – COMMUNICATING IT AT THE LOCAL LEVEL

Don Armour, PE
Stantec Consulting Inc.

Levees are a critical flood risk management strategy throughout the United States and particularly in California's Central Valley. Yet many, including local political leaders and the public who live behind the levees, do not fully understand the risks they have undertaken and the consequences of levee failure. Many who live behind levees don't even know they are at risk. Some build levees for economic development purposes alone without understanding or managing the additional risk they undertake. Communicating this risk to a non technical audience has many challenges including the technical nature of the communications; engineer's tendency to speak in engineering terms; and the public's perception that they are "protected" by the levee structure and that a levee failure won't or can't happen in their back yard. This presentation will attempt to address some of these challenges by providing a model for communicating the flooding risk

associated with levees and the critical decisions local leaders must make in building, operating, and maintaining levee systems.

LEVEE STATUS CHANGES AND FLOOD INSURANCE: NEW COMMUNICATION TOOLS

Bruce A. Bender and Kamer Davis
FloodSmart Marketing Team

As efforts to address the flood risks posed by California's aging levees are ramping up, so are the questions being asked of floodplain managers. Elected officials, community and neighborhood leaders, lending and real estate professionals, insurance agents and the public all have concerns about changing flood risks, changing flood maps and changing flood insurance requirements. Are you prepared to answer their questions?

This session will share examples of map change and levee communications, and introduce a new set of communication templates from the NFIP FloodSmart program. You will walk away with a CD of fact sheets, letters, press materials and planning guides to help in communicating about accredited, provisionally accredited and de-accredited levees. These valuable resources will bolster your efforts to promote public safety and flood protection.

4:15-6:00 Estimating and Managing Flood Risk – Part II

A NEW FLOOD RISK PARADIGM: MAPPING THE GEOLOGIC FLOODPLAIN

John E. Hays, E.I.T., CFM, Floodplain Coordinator
Santa Cruz County Flood Control District

Floodplain management focuses on reducing and preventing damages from flooding sources. However, the current paradigm, especially along riverine systems, is to provide this protection within the predicted 100-year floodplain. This is a floodplain occupying that portion of the geologic floodplain that will be inundated by flows from an event with a one percent chance of occurring in any given year. However, the delineation of this floodplain relies upon the assumption the channel and floodplain geometries and dynamics remain constant over a period of time. The problem is that it is more common for flood events, even minor ones, to result in alterations in channel and floodplain geometries and dynamics which result in changes to the mapped floodplains. These alterations can include the degradation or aggradation and/or migration of the channel. Some times, even minor changes can have radical effects on how a flood event will affect a given area. Conversely, the geologic floodplain represents the area adjacent to a channel where the flow of water has been active over the past several thousand years. In mature riverine systems, the geologic floodplain is typically wider than the 100-year floodplain, while in younger riverine systems the two can be coincidental.

This discrepancy in floodplain limits typically results in a false sense of security in area residents who mistakenly believe that because they are not located in the federally mapped Special Flood Hazard Areas (aka 100-year floodplain) there is no risk for flooding or flood related damages on their property. However, as is all too common, events larger than the currently calculated 100-year flood occur and predictions of what areas will be inundated by a specific size flood miss the mark due to changes in the system since the original study. In addition, it is not unheard of for a flood event to be demoted from the status of a 100-year flood event a couple of months to years after it occurs based on new hydrology resulting from the data collected from said flood event.

Therefore, it is necessary to question whether or not the paradigm of the 100-year flood event is one that should be continued, or abandoned. Do we continue to provide mapping and protection for areas within the 100-year floodplain, or do we shift our paradigm to one where we map the entire geologic floodplain associated with any watershed? It is time to consider mapping and regulating the geologic floodplain and creation of zones of risk from low risk (the geologic floodplain boundaries) to severe risk (the floodway at a six inch rise) instead of limiting our vision to one specific event. By doing so, we can account for flood events larger than the 100-year event, and also take into account changes in channel location and morphology without needing to perform expensive detailed studies that are only valid as long as nothing changes in the region.

REPETITIVE LOSS AREA ANALYSES A CASE STUDY IN THE COUNTY OF SAN DIEGO

Maggie Mathis, CFM, Dewberry
Gitanjali Shinde, CFM, County of San Diego
Berry Williams, CFM, Berry A. Williams and Associates, Inc.
Brendan Hastie, P.E., Rick Engineering

In order to join FEMA's Community Rating System (CRS), communities must meet several prerequisites. One of these prerequisites requires communities with 10 or more repetitive loss properties to adopt a floodplain management plan or prepare area analyses for its repetitive loss areas. Repetitive loss properties are those properties for which two or more claims of more than $1,000 have been paid by the NFIP within any 10-year period since 1978 (e.g., two claims during the periods 1978–1987, 1979–1988, etc.) The plan and analyses must be submitted with the community's CRS Application. Further, as part of addressing the repetitive loss areas, the community must implement an annual outreach project to the properties in the mapped repetitive loss areas and include a copy of the project with its application. This presentation will:

- present an overview of the CRS program requirements;
- explain FEMA's expectations for repetitive loss area analyses including the identification of both identified repetitive loss properties, as well as, other properties in the vicinity subject to the same flood risk;
- discuss outreach strategies; and,
- share experiences and the results of the analyses conducted in the County of San Diego.

FOSTERING RESILIENCE TO NATURAL HAZARDS WITH THE NFIP'S COMMUNITY RATING SYSTEM

Berry A Williams, CFM, Berry A Williams and Associates, Inc.

Rising populations and poorly planned development are increasing the vulnerability of people and property to hurricanes, flooding, shoreline erosion, tsunamis, and earthquakes. In addition, climate change may lead to more frequent storms and sea-level rise, both of which increase the susceptibility of property to repetitive losses. Not only can natural hazards have devastating impacts on people and property, but they may also have deleterious effects on the environment, particularly sensitive habitats. The National Flood Insurance Program's Community Rating System (CRS) and its principles of No Adverse Impact provide financial incentives and offer practical actions communities may take to increase their resilience from natural hazards.

CRS encourages comprehensive floodplain management to reduce flood damage to insurable buildings. It encourages multi-hazard mitigation planning and strong building codes to reduce losses from other natural hazards. This presentation will review some of the research on CRS activities and illustrate how they

contribute to making communities hazard resilient. Research findings on the following activities will be included in the presentation:

- Coastal regulations
- Foundation and Enclosure regulations
- Open space preservation
- Wetlands preservation
- Floodplain mapping
- Flood warning and response

4:15-6:00 Levees – Certification, Inspection and Rehabilitation

LEVEE RECERTIFICATION IN SOUTHERN CALIFORNIA COUNTIES

Raymond T. Lenaburg, FEMA Region IX
John M. Hoffman, CFM, Dewberry
Dave Turk, CFM, URS

FEMA is deeply concerned about the risk to human life and public safety, as well as the potentially devastating financial consequences for uninsured or underinsured properties, which may result from levee failure. Therefore, in August 2005, FEMA issued Procedure Memorandum 34, Interim Guidance for Studies Involving Levees. Procedure Memorandum 34 implemented a nationwide policy under Map Modernization to verify the certification status of all levees currently depicted on the effective FIRMs as providing protection from the base (1% annual chance) flood. The regulatory requirements for accrediting levees as providing base flood protection on FIRMs is found in Title 44 of the Code of Federal Regulations (CFR), Section 65.10 (44 CFR 65.10). These criteria include design criteria (e.g., freeboard, closures, embankment protection, embankment and foundation stability, settlement, interior drainage) as well as operation and maintenance plans. In addition, in September 2006, FEMA issued Procedure Memorandum 43, Guidelines for Identifying Provisionally Accredited Levees.

This presentation will overview the latest status of the levee certification process for on-going Countywide Digital DFIRM update projects in southern California.

CHALLENGES OF LEVEE CERTIFICATION FROM A LOCAL AGENCY PERSPECTIVE

Scott Berkebile, PE, CFM, and Scott Lyle, PE, CFM
Nolte Associates, Inc.

From a local agency and community perspective, the responsibility and undertaking of levee certification has brought many challenges. The current requirement of levee certification as implemented by FEMA within Map Modernization has placed levee safety front and center. Additionally, the events in New Orleans as a result of Hurricane Katrina was a difficult reminder that disasters strike without warning, adding a new weight and urgency to addressing the risks associated with levees throughout the nation. Within Map Modernization, during the process of developing new digital FIRMs (DFIRMs), FEMA is requesting that communities provide evidence to demonstrate that levees meet the minimum requirements established in Title 44, Chapter 1 of the Code of Federal Regulations, Section 65.10. Areas shown on effective FIRMs as protected from flooding by levees for which the required information is not provided will be remapped by FEMA and designated as special flood hazard areas (SFHA). Significant impacts will result from instances in which areas behind levees that are shown to be protected on the effective FIRMs are revised to be designated as SFHA. If these areas are designated as SFHA there will be new limitations for construction and requirements for flood insurance. Every community that relies on levees for flood protection faces a

difficult balance between the responsibility to identify risk to people and property and public pressure to maintain current conditions in areas behind levees, even if the costs of levee certification and continued operation and maintenance exceed reasonable benefit cost ratios.

The responsibility and burden on local communities to undertake levee certification has been significant. Based on experiences in Riverside County, California, levee certification involved a number of aspects beyond technical requirements. As with most public agencies, Riverside County was surprised by the time frame and effort associated with levee certification, which required financial commitment, resource allocation and political support. Even with FEMA's 24-month provisional accreditation, the task of redirecting funds and resources to complete levee certification within a public agency budgeting process was daunting. Without question, the need to certify levees resulted in resetting of priorities that resulted in delay of planned facility improvement and maintenance projects. Additionally, many communities will face difficult decisions in the unfortunate event of discovering deficiencies that prevent certification, as the cost of levee repair will typically exceed the cost of certification by an order of magnitude.

WHEN MAPMOD MEETS COE INSPECTION: THE POTOMAC PARK LEVEE SYSTEM

Patti Sexton, P.E.
Tetra Tech, Inc.

DFIRMs were issued for Washington DC on October 5, 2007. Earlier in the year the USACE (Baltimore District) had issued an unacceptable inspection rating to the levee in Washington DC between the Lincoln Memorial and the Washington Monument. The inspection rating was issued as a result of trees that had been planted along the levee and the operational requirements of the 17th Street closure. The trees were removed by the National Park Service (the federal sponsor for the Potomac Park Levee) but the closure issue remained. The DFIRMS reflected the failed condition of the closure which inundated a large area of Washington DC, including the Federal Triangle Area. The Federal Triangle includes the Smithsonian museums, national monuments, and numerous federal buildings.

FEMA and DC agreed to an expedited schedule of design, review and construction that would allow for improvements of the closure and a delay to the final issuance of the DFIRMs. This process includes the environmental review process, design of 5 alternatives, landscape architect overlays for all alternatives and construction. Construction of the project is anticipated to begin in early February, days after the Presidential inauguration is complete.

SAN JOAQUIN RIVER BASIN LEVEE REHABILITATION PRIORITIZATION METHODOLOGY

Wilbur Huang PE, CFM, and Ahmed Bayoumi, Ph.D.
URS Corporation

The California Department of Water Resources (DWR) and URS has recently developed a methodology to aid in prioritizing repairs to at-risk levee sites as part of the Critical Levee Repair Program. This methodology included hydrologic and hydraulic analysis, a determination of the potential mechanism of failure, analysis of mechanisms of potential failure including erosion and stability analyses, and the development of fragility curves. Hydrology and Hydraulics - The flows, durations, and river stages necessary to complete the fragility curves were determined from a variety of methods, depending on available data. Additionally, the area of inundation was determined for each site for input to the economic analysis.

Geotechnical characteristics of the levee, hydrology and hydraulics of the considered reach of the water way, presence of natural or artificial erosion protection, and levee and foundation geometry are used to evaluate failure due to erosion. A custom probabilistic toolbox under development for the US Army Corps of Engineers (USACE) by URS is used for this purpose. Fragility curves provide a qualitative and quantitative visual evaluation of the existing levee condition and further support decisions with regard to type, and cost of the required mitigation. The probability of levee failure is determined for a range of flood stages, including the 10-, 50-, 100-, and 500-year events for each potential mechanism of failure. To support decision making an overall (combined) fragility curve is generated for each of the 15 sites.

FEMA ACCREDITATION OF AN INTERSTATE TRANSPORTATION CORRIDOR

Shawn Gooch, P.E., CFM, Sparks Public Works Department
and Eric Simmons, CFM, FEMA Region IX, Mitigation Division

In 2007, a portion of Interstate 80 within the City of Sparks, Nevada was identified by FEMA during the Flood Map Modernization Program (Map Mod) for Washoe County, Nevada as a levee-like structure. This structure was previously accredited as providing flood protection with a LOMR in July 2005. This portion of Interstate 80 is located in the City of Sparks, Washoe County, Nevada, adjacent to and east of the Sparks Marina Lake. The land side of the Interstate was under aggressive development as a commercial retail center that was considered vital to the financial viability of the City. The reversion to a Special Flood Hazard Area could have jeopardized construction and development loans for the area that were on the order of one billion dollars. The interstate is owned, operated and maintained by the Nevada Department of Transportation (NDOT) as a federal highway. However, as a levee-like structure, maintenance and operations of this section of the highway must satisfy Title 44 CFR 65.10.

This paper outlines the process and steps that were taken by the City and its consultants to comply with City requirements, 44 CFR 65.10, NDOT and FEMA to certify the structure as providing 1% annual protection and ultimately attaining FEMA accreditation.

4:15-6:00 Hydraulic Modeling Tools and Applications

DOES UNSTEADY MODELING YIELD "STEADY" RESULTS?

Michael Nowlan, P.E., Shyamal Chowdhury, PhD. CFM, and John Pritchard, P.E.
Wood Rodgers, Inc.

Currently the hydraulic community utilizes a number of numerical modeling programs to determine future flooding potential along streams throughout the United States and the world. These modeling programs often are assumed to provide similar results and are rarely compared side-by-side since modeling the same stream twice under a single project is often considered inefficient and unnecessary by the entities paying for the studies. Sometimes modeling complex systems such as storage areas with levee breaching require the modeler to migrate from one program to another.

This presentation will provide a detailed comparison of differences in program approaches and results between the HEC-RAS software, developed by the US Army Corps of Engineers, and the MIKE11 software, developed by the Danish Hydraulic Institute. Both softwares are accepted by the Federal Emergency Management Agency for defining the Base Flood Elevations associated with the 1% Annual Chance Event. The discussion will also focus on the importance of recognizing the uncertainty in these methods and other commonly used programs.

1D AND 2D HYDRAULIC EVALUATION IN THE CITY OF PETALUMA USING XP-SWMM

David S. Smith, P.E., CFM, D.WRE
WEST Consultants, Inc.

Abstract: This presentation is a case study describing the calibration of a city-wide XP-SWMM model for the Petaluma, CA based on the New Year's Storm of 2005-2006. XP-SWMM version 10.6.1 was used with approximately 30,000 cells in the 2D module and 1000 links in the 1D model. Data used for the calibration included stream gage data as well as a flooding map prepared by the City representing a compilation of eye witness accounts of flooding extents and video taken from a helicopter near the peak of the flooding. An overview of the model calibration is presented emphasizing the usefulness of a model that combines hydrology and hydraulics (both 1D and 2D) for calibration of a complex flooding situation.

THE TROUBLE WITH LEGACY: CONVERTING UNET TO UNSTEADY HEC-RAS

Daniela Todesco, EIT, and Martin Teal, PE
WEST Consultants, Inc.

With the release of new versions of HEC-RAS, legacy UNET models have become outdated and it has become necessary to update the models to incorporate the improved hydraulic modeling capabilities of newer HEC software. However, the conversion process often turns out to be difficult and time-consuming, especially for complex systems that include a large number of interconnected reaches, storage areas, structures, gates, and pump stations. It is therefore important to recognize common causes of errors and instabilities and to quickly develop strategies on how to address them.

WEST Consultants converted the UNET model developed by the U.S. Army Corps of Engineers for the Southeast Louisiana Urban Flood Damage Reduction Project, St. Tammany Parish Feasibility Study, into an unsteady HEC-RAS model. The model includes 86 bridges/culverts, 48 lateral/inline structures, 28 storage areas, 23 reaches and 463 cross sections (plus 671 interpolated). When converting the model, WEST corrected errors, implemented channel modifications and introduced gates and pump stations. Simulations ranged from 1-year to 500-year events and different downstream boundary conditions were tested.

The new HEC-RAS model proved to be extremely useful for evaluating alternatives to reduce flooding in one of the fastest growing communities near Lake Ponchartrain after Hurricane Katrina. Lessons learned from this project will be presented and should be very useful for any complex unsteady flow modeling performed using HEC-RAS.

NO ADVERSE IMPACTS: THE USE OF HYDRAULIC COMPUTER MODELS TO INSURE PLANNED CHANNEL AND FLOODPLAIN MODIFICATIONS ARE FLOOD NEUTRAL

Thomas W. Smith, PE, GE
Ayres Associates Inc.

With ever increasing pressures to green-up many of our aging flood control channels and bypasses, we need to assure the project owners and the general public that the "greening" or other modifications will not affect flood capacity or freeboard. We need to be able to confidently show that any planned improvement within the system are flood neutral or will not effect the stated level of protection. While level of protection may be the most important issue, there are other effects that need to be addressed and they include changes in velocity which (can effect erosion and sedimentation patterns), seepage pressures, redistribution of flow paths within the floodplain and cumulative effects outside the project reach. This presentation will

demonstrate through several case studies how different modeling techniques can be used to analyze these issues and which models work best in communication the results to the project sponsors and the general public.

The first study used a 1-dimensional hydraulic model (HEC-RAS) to review the impacts of riparian restoration plantings within a relatively straight reach of the Sacramento River near Butte City. The client was the Nature Conservancy and the results were used as documentation for required permits and environmental documentation. While HEC-RAS is a relatively inexpensive model to build and run, it has limitations in that the output only shows flow patterns in one dimension (perpendicular to each cross section) and the output is in the form of charts and graphs. Case study number two involves the use of a 2-dimensional hydraulic model (CCHE-2D) and was used to measure water surface and velocity changes where bank erosion repairs were planned along the Sacramento River. The Client was the US Army Corps of Engineers. While more time consuming to develop and run, this model provides more accurate results and output plots of differential velocity and water surface can be produced in plan view which can make communication the results and the exact locations of any differentials quite easy. The final case shows the use of an RMA-2V hydraulic model (2-dimensional) along a 20 mile reach of the Sacramento River between Colusa and Princeton. The Client was The Nature Conservancy. There were eight restorations planned along this reach and demonstrating cumulative effects from one restoration to the next upstream site was an important consideration. Compared to the other two models previously discussed, this is the most detailed to construct and requires the most effort. However, the quality of the output and graphical options make this the most effective when dealing with the public and non engineering review boards and agencies.

APPLICATIONS OF MULTIPLE-SCALE, TWO-DIMENSIONAL COUPLED HYDRAULIC MODELING FOR ESTIMATING FLOOD EXTENTS IN THE CALIFORNIA BAY-DELTA AREA.

David A. Jaffe, PhD, PE and Blaine Jones, MS, PH
Pacific Advanced Civil Engineering

The study area consists of residential and commercial development with man-made lake water quality and conveyance systems located in San Joaquin County, California, contributing to the Bay-Delta system. The study area and adjacent parcels reside on historic agricultural lands with mild bedslopes. The project is bounded by Duck Creek to the north, North Little Johns Creek to the south, and a raised railroad berm to the west. The contributing drainage area for the project site is Aw= 270 sqmi. Two-dimensional hydraulic modeling using the FLO-2D numerical model was undertaken as part of the effort to appropriately size the treatment lakes and on-site stream channels, and to characterize floodplain areas within the project site. FLO-2D was chosen because it is accepted by FEMA, US ACOE and other regulatory agencies for two-dimensional floodplain modeling. Because of the large size of the contributing watershed area and the lack of topographic variation within the upstream drainage area, a single numerical model with realistic run times and sufficient resolution is not possible.

Specific modeling techniques were employed to successfully couple models at different horizontal resolutions to estimate floodplain hydraulics at sufficient run-time and horizontal scales. The models were effectively coupled by grid cell discharge so that the downstream boundary condition of the coarser resolution model serves as the upstream boundary condition for the finer resolution model by distributing the coarse model discharges into finer cells. Model results comparing the existing and proposed conditions on-site model show that multiple-scale two-dimensional modeling sufficiently resolves high-resolution, on-site hydraulic responses to model topography. Moreover, the upstream coarse-resolution models provide the distribution of discharges to the downstream fine-resolution models with greater accuracy than lumped parameter hydrology models or one-dimensional hydraulic models.

THURSDAY SEPTEMBER 4

8:00-9:45 Flood Mapping and Innovative GIS Mapping Tools

STATE LEGISLATURE REQUIREMENTS FOR SENATE BILL NO. 5 - BEST AVAILABLE MAPS

Javier "Alex" Yescas, P.E., CFM, PBS&J
Ricardo Pineda, P.E., CFM, California Department of Water Resources

Senate Bill Number 5, which was introduced by California Senator Michael Machado of District 5, set forth requirements for the state to raise awareness of the potential risks associated with flood hazards in the Sacramento – San Joaquin Valley. The bill defines the Sacramento – San Joaquin Valley as any lands in the bed or along or near the banks of the Sacramento River or San Joaquin River, or any of their tributaries or connected therewith, or upon any land adjacent thereto, or within any of the overflow basins thereof, or upon any land susceptible to overflow therefrom. The valley boundary as defined by the bill includes over 30 counties and over 90 incorporated cities.

The bill requires that the California Department of Water Resources (DWR) develop preliminary maps indentifying 100- and 200-year floodplains based on best available data. Multiple set of floodplains were utilized to develop the maps. Data from DWR, Federal Emergency Management Agency (FEMA), and United States Army Corps of Engineers (USACE) were gathered and compiled into composite floodplains. The composite floodplains were overlaid onto Unites States Geological Society (USGS) 100K Quadrangles for every county determined to be in the valley boundary as defined by the bill. This task was the first step to fulfill the requirements as stated by Senate Bill Number 5.

THE FLOOD MAP MODERNIZATION MID-COURSE ADJUSTMENT – RESULTING CHALLENGES AND OPPORTUNITIES

Bruce Ferguson, EIT, Scott Berkebile, PE, CFM and Scott Lyle, PE, CFM
Nolte Associates, Inc.

Map Modernization is a multiyear Presidential initiative supported by Congress that is directed at improving and updating the Nation's flood hazard identification maps. Near the half way point, FEMA performed a mid-program evaluation that resulted in changes to put greater emphasis on higher priority areas while increasing the accuracy of the product. Rather than simply converting paper maps to digital form, flood boundaries are being matched to the best available topographic information and merging both into a digital format. The paper discusses the challenging and flexible process of incorporating the various data together into an enhanced product. Opportunities for new, innovative uses of the digital system are illustrated. These modernized flood maps will more accurately portray flood hazards so the risks to life and property can be reduced.

DELINEATION OF AWARENESS FLOODPLAIN ZONES FOR THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Iwan M. Thomas and Leo R. Kreymborg, P.E.
PBS&J

A Rapid Floodplain Delineation (RFD) tool has been created to provide approximate delineations of floodplains from GIS inputs. The creation of this command-line script was detailed in the article and presentation "Rapid Floodplain Delineation Using GIS" (FMA Conference Proceedings, 2006) by Leo R.

Kreymborg, P.E., David T. Williams, Ph.D., P.E., and Iwan M. Thomas. In practice the tool provided to be invaluable in providing awareness floodplain delineations for the Flood Control District of Maricopa County (FCDMC), Arizona. Topography for the areas studied is similar to that of much of the southwestern U.S. with braided stream channels that convey flow only during storm events and are often unable to contain flow for large storm events provided numerous challenges to accurate delineation. As a result of these challenges additional functionality has been added to RFD since its creation to allow the tool to function in a manner more similar to a detailed hydraulic model without sacrifice of the GIS integration that inspired its development. Improved functionality includes accurate floodplain delineation in backwater areas, improvement of ineffective flow area designation, and advanced methods for incorporation and modification of hydrologic data inputs. As a result of this study the RFD tool has proven to be useful and effective in rapid determination of approximate floodplain delineations. Furthermore, this study also required the generation of GIS representation in raster format of appropriate USGS regression equations for input into RFD, utilizing a process that can be applied throughout much of the southwest U.S.

GEOLOGIC DATABASE FOR THE SACRAMENTO – SAN JOAQUIN DELTA AND SURROUNDING AREAS

Timothy Dawson, George Saucedo, and Chris Wills
California Geological Survey

The California Geological Survey is preparing geologic maps of the Lodi and Stockton 30 x 60 minute quadrangles. These regional geologic maps cover the eastern San Francisco Bay Area and the Central Valley of northern California and include the Sacramento – San Joaquin Delta, an area characterized by rapid urbanization, as well as critical habitat and infrastructure critical to the distribution of water within California. Geologic materials in the delta region are described by their age and environment of deposition, both of which correlate with engineering properties of the materials. These maps and associated GIS database provides a basic data layer for analysis of levee stability, seismic hazards, and other engineering issues in this critical area. Also shown on the maps are several important active fault systems relevant to the seismic hazards of the Delta region including the Hayward, Calaveras, and Greenville fault zones, as well as several blind thrust fault systems such as the Mt. Diablo and Great Valley fault systems.

These maps are a synthesis of existing geologic mapping and include recent 1:24,000 scale mapping of Quaternary deposits by the U.S. Geological Survey, the California Geological Survey, and William Lettis and Associates, as well as older 1:24,000 and 1:62,500 scale geologic mapping. This new compilation also presents a regionally consistent treatment of Quaternary surficial units for the Delta. We anticipate that this data will form a consistent base layer that provides context for more site-specific evaluations of the safety and impacts of existing and proposed infrastructure in this critical area.

HIGH RESOLUTION MULTI-SPECTRAL IMAGERY FOR ANALYSIS OF FLOODPLAIN VEGETATION

Sr. Project Manager, HJW GeoSpatial, Inc.

HJW will provide a technical overview of Multi-spectral imagery for analysis of floodplain vegetation. New digital sensors offer added dimensions to image data through increased dynamic range (16-bit vs. 8-bit) and spectral range (simultaneous CIR collection). The Color Infrared imagery is useful in providing analysis of areas affecting Coastal Inundation and Riparian Habitat Restoration, such as information on permeability and vegetation stress or vigor. We will present three case studies to demonstrate the usefulness of multispectral imagery:

1. Invasive Spartina - The imagery was acquired during low tide and used to develop a classification algorithm that would recognize and distinguish the species of Spartina that is the object of an eradication program.
2. McCloud Pit River – Color Infrared imagery was acquired and orthorectified for analysis of vegetation stress and vigor as part of the environmental monitoring of the riparian habitat.
3. Edwards AFB – Multispectral imagery was acquired, georectified and integrated with a LiDAR terrain model for floodplain modeling and desert vegetation management. The data will also be utilized for a spectral analysis of ground surface materials, including permeable vs. impermeable surface.

10:15-12:00 Flood Control and the Sacramento-San Joaquin Delta

RIPARIAN HABITAT RESTORATION IN THE SACRAMENTO-SAN JOAQUIN DELTA

Chamberlin, J. and Showers, D.
California Department of Water Resources

The Delta Levees Program is partnership between the Department of Water Resources and the Department of Fish and Game to improve the flood protection and ecosystem resources of the Delta Levee System. The state sponsors local levee districts, which undertake various improvement projects to achieve these ends for the benefit of Delta landowners, State Water Project contractors, and the ecological communities that depend on natural habitats in the Delta and portions of the Suisun Marsh. During the past few years the Program has undertaken a number of habitat development/restoration projects within the Delta and Suisun Marsh. Several of these projects are experimental in nature and illustrate the need for adaptive management to ensure success. The lessons learned from these projects will guide the development of future program activities.

We use the example of a thirty-acre restoration project on Decker Island to illustrate the restoration opportunities, partnership-based approaches, and lessons learned in the Delta Levees Program. Decker Island in the Sacramento-San Joaquin Delta, presented a rare opportunity to develop habitat that existed prior to dredging the Sacramento River. It also provided material necessary for levee reinforcement on several western Delta Islands. Decker Island is approximately 20 feet above sea level, and consists of spoils that were deposited on the original marshland when the Sacramento River was dredged and straightened at Horseshoe Bend between 1917-1937. Exotic weeds and grasses developed on the dry upland site providing little habitat value. The project's two phases developed 26 acres of native plant communities and wildlife habitats. Phase I was completed in December 2000 and created approximately 13.5 acres of habitat while Phase 2 was constructed in 2004 and created 12 additional acres of similar habitat. Approximately 600,000 cubic yards of material excavated from Decker Island was barged to various Delta islands to improve threatened levees. The completed Project has created a mosaic of plant communities with varying canopy layers, vegetation type edges, and water/land interfaces. The Project has restored tidal perennial aquatic, tidal freshwater emergent, valley/foothill riparian, upland scrub, and grassland habitats. Together, these habitats are designed to function within the Delta's natural hydrodynamic processes.

LOCAL PERSPECTIVE ON LEVEE PROGRAM IN THE DELTA

Gilbert Cosio
MBK Engineers

This year marks the 20th anniversary of SB 34 (1988) the landmark legislation that began a highly successful program to rehabilitate Delta levees. Although there is much current discussion on the dilapidated state of the Delta levees, the levees are in much better condition than they were twenty years ago. During these first

20 years of the Delta Levees Program (Program), Delta reclamation districts have focused on raising crown elevations. This work resulted in avoidance of severe overtopping during recent floods. The next stage of the Program is to maintain freeboard, and increase the static factor of safety to provide levees with risk of failure adequate for agricultural protection. The floods of 1980, 1982, 1983 and 1986 took a heavy toll on Delta levees and exposed the fact that unless additional funds were put into the levees, FEMA emergency assistance and the existence of the Delta were at risk. In addition to funding for levee rehabilitation, SB 34 fostered a uniquely cooperative program between the Department of Fish and Game, the Department of Water Resources and local reclamation districts. As a result, the Delta Levees Program (Program) has economically rehabilitated levees, at the same time enhancing habitat values in the Delta. The local reclamation districts have used the Program to focus on levee crown elevation, in some instances raising levees nearly 3-feet. Without the Program, overtop failures would have occurred during the floods of 1995, 1997, 1998 and 2006. The next stage of levee rehabilitation is to increase the static factor of safety against design flood levels. The Federal PL-99 standard has been chosen as the minimum standard. Many historic levee failures were structural failures, so this will be a key component. This work is being funded by Proposition 84 (2006) funds earmarked for the Program. In addition to reducing the risk to individual islands, levee rehabilitation will reduce flood risk to neighboring islands.

This presentation will describe the completed work and the work currently under way to stabilize the levees to the PL-99 minimum standard. The presentation will also described level of cooperation between local reclamation districts, DWR and DFG. This cooperation is unprecedented and has been the critical factor in the success of the Program.

10:15-12:00 Post-Fire Flood Modeling and Mapping

EMERGENCY FLOOD MAPPING FOR 2007 WILDFIRES

Jason Sokol, HDR Engineering Inc. and Raymond Lenaburg, FEMA Region IX

In November of 2007, HDR was given the opportunity to work with FEMA and various other agencies to provide emergency flood hazard mapping in the areas affected by wildfires in Los Angeles and San Diego counties. This was a very fast-paced project with a 10 day turnaround time. HDR coordinated with the BAER Team to obtain LiDAR data for the newly burnt areas. Our approach was to use GIS to identify the high, medium, and low priority streams to be studied in the affected areas. We did this using GIS to analyze soil types, soil burn severity, and land use data to assess the severity of potential flooding for each stream. With the priority now set, we used the LiDAR data with HEC and GeoRAS to determine the new post-fire, 5-year and 100-year flood limits for each stream. The resulting data from these models was a bit coarse so we again used GIS to smooth out the data and QC the final deliverable shape files. The data was compiled and distributed to the public via the internet with maps of the new potential flood areas available for home owners to view. Two days later, during the first major post fire storm event, this data was used to issue reverse 911 calls to people in the affected areas.

POST-FIRE HYDROLOGIC AND HYDRAULIC ANALYSIS

Raymond T. Lenaburg, FEMA Region IX, Jeff Smith, P.E., CFM, Dewberry and Dave Turk, CFM, URS

October 2007 wildfires in southern California caused large-scale evacuations along with significant environmental damage and economic costs. Several wildfires burned hundreds of thousands of acres, potentially increasing flood potential in and downstream of burned areas. In order to assess the impact of the wildfires on flood potential, FEMA conducted approximate analyses of pre- and post-fire flood potential in

key locations impacted by the wildfires. The approximate analyses considered the impact of wildfires on both hydrology and hydraulics.

Wildfires may impact various aspects of hydrology of a watershed, to include increased runoff due to denuding of vegetation and burned soils and "bulking" of runoff due to increased sediment loads. In response to the need for a method to estimate the post-fire peak discharges for the areas impacted by the 2007 California wildfires, a simplified calculation procedure was developed, indirectly using NRCS TR-55. Similarly, wildfires may also impact the hydraulic characteristics of the floodplain, particularly in areas directly burned; changes in floodplain 'roughness' as well as increased likelihood of flow obstructions are some of the factors that impact floodplain hydraulics following wildfires.

Approaches used to evaluate the impact of wildfires to hydrology and hydraulics will be discussed, to include specific examples. Further, example results will be discussed, to include comparison of pre- and post-fire flood potential for several example flood sources.

HYDROLOGY, HYDRAULIC AND SEDIMENTATION MODELING FOR SESPE CREEK, VENTURA COUNTY, CALIFORNIA INCLUDING THE EFFECTS OF THE DAY FIRE

Tony Donigian, P.E., D.WRE, AQUA TERRA Consultants, Howard Barndt, MS, P.E., RBF Consulting, and John McCarthy, CFM, P.E., RBF Consulting

In September 2006, the Day Fire swept through more than a third of the Sespe Creek watershed, burning the natural vegetation. The extensive burn has changed the land cover and soil properties of the area and, as a result, has changed the watershed hydrology and hydraulics of the lower Sespe Creek. The above change, the increased threat of debris flows, and other concerns has raised Ventura County Watershed Protection District (District) concerns regarding the current level of flood protection the Sespe Creek Levee provides to the City of Fillmore. Consequently, the District has committed to a comprehensive re-evaluation of the Sespe Creek watershed to focus on identifying necessary improvements and maintenance needs to sustain the desired channel capacities of the mainstem Sespe Creek. This re-evaluation includes a modeling effort.

The hydrologic modeling of Sespe Creek is based on the Hydrologic Simulation Program-Fortran (HSPF) watershed modeling of the entire Santa Clara River (SCR), which includes the Sespe Creek Watershed, as part of the SCR Watershed Management effort. This is a joint project of the District, the Los Angeles County Department of Public Works, and the U.S. Army Corp of Engineer's Los Angeles District to develop a comprehensive watershed hydrologic model for watershed planning, resource assessment, and ultimately, water quality management purposes. Hydrology, hydraulic, and sediment transport modeling scenarios for Sespe Creek representing Baseline (current) conditions, Natural (pre-development) conditions, and the Post-Day Fire conditions, were developed and executed with long-term meteorologic data spanning WYs 1960 to 2005.

POST-WILDFIRE FLOOD ANALYSIS

Michael Parenti, URS

Wildfires in California and other Western States often create soil and vegetation conditions that can result in extreme flood events that damage or destroy property and public and private infrastructure and create public safety hazards and emergencies in flood zones. Flood hazards can be accurately identified using a method that derives empirically based runoff coefficients from post-fire satellite imagery and utilizes the coefficients as inputs to a GIS runoff model. Cross sections are surveyed at key locations and discharge elevations are compared to elevations of infrastructure and public and private property. The result of this process is the

identification of a "trigger" storm event that has the potential to create a public safety emergency. The flood analysis results are used to develop a tiered flood emergency response plan in cooperation with emergency management agencies. Another method for identifying the "trigger" storm event is to analyze rainfall records and flood elevations from historical events. An example of this method for the "Christmas Storm" of 2003 in Waterman Canyon San Bernardino County, CA will be presented.

10:15-12:00 Collaborative Partnerships and Cost-Sharing

INTEGRATING MULTIPLE FUNDING SOURCES: GRANT WRITING SUCCESS ELEMENTS

David G. Dickson, Senior Consultant, MIG, Inc.

Ultimately, the best floodplain management projects require millions of dollars to implement. Grant writing is a key component of any community's floodplain restoration strategy. Spend some time with David Dickson of MIG, Inc., a leading financial strategist for multiple objective flood management projects, with a focus on California and Nevada. He will outline the range of grants available and focus on the key elements for success to help you compete for those grants.

For example:

- Over $520 million in funding assembled for Napa's watershed wide "Living River" Flood Protection and Watershed Improvement Program, from a local sales tax, the Army Corps of Engineers, FEMA's Hazard Mitigation Gant Program (HMGP), California's River Parkways, the Urban Stream Restoration Grant Program, DWR's Flood Protection Corridor Grant program, the State Water Resources Control Board's SRF loan program, Federal and State Highway funding, CALFED, California Coastal Conservancy and State Lands Commission environmental restoration funding.
- A 4-county IRWMP for the Pajaro River watershed, to construct the firs-ever flood protection element in an IRWMP, resulting in a first round $8 million Proposition 50 grant.

- The award-wining San Gabriel River Master Plan outlines hundreds of funding and grant opportunities. The County of Los Angeles is using this approach to implement over 180 river projects for flood protection, river restoration and recreation.

LOCAL FINANCING CAMPAIGNS: DO'S, DON'TS AND MUSTS

Joyce Vollmer, Director, MIG, Inc.

Mosquito and vector control districts have long asked voters for a tiny pittance, then hoped that few people would take the time to object to a mere $5 a year. But floodplain projects need to raise millions of dollars and typically ask for $50 to $150 a year per single-family residential parcel. With those amounts, the "no" vote will come out and they will be loud. As a floodplain manager or director of public works, you're now being asked to act as a campaign manager: go out and find some money for your projects. We'll explore how to prepare and run a local revenue campaign and ensure the five "musts" are in place before you ask people for money: your financial house is transparent, the right elements are in the package that people will vote on, your messages are compelling, you ask for what people will support, and you make your case.

Every community is unique, so what's right for you? We'll look at successful strategies, potential pitfalls and the rise of negative campaigns. How can polling and surveys help you? What role should community members play? What can public agencies do and say during a campaign? What's the role of an advocacy campaign committee—how do you develop and fund one? We'll take a look at storm drain user fees, benefit assessments, sales and parcel taxes, and bond measures. What did other cities/agencies do right, what did

they do wrong? And, finally, we'll explore how you can apply the appropriate strategies to your floodplain needs.

INNOVATIVE PROCESS OF MULTI-INTERDISCIPLINARY COLLABORATION TO DEVELOP THE EL CHARRO SPECIFIC PLAN AREA WHILE IMPLEMENTING THE FIRST PHASE OF THE ZONE 7 REGIONAL FLOOD CONTROL DIVERSION IN LIVERMORE CALIFORNIA

Pamela G. Lung, P.E.,CFM, City of Livermore
Daniel J. Schaaf, P.E., Schaaf & Wheeler

In 2005, Prime Outlets approached the City of Livermore to propose a retail outlet mall along the western edge of the City. This met the City's long standing objective to provide enhanced local shopping opportunities. The outlet mall promised 450,000 square feet of high end retail and was projected to bring in several millions in sales tax revenues each year. This area, located on the western edge of the City, had remained undeveloped for many reasons. Bounded by the quarries, City Airport, City Golf Course, County Unincorporated land and City of Pleasanton, 40% of the El Charro Specific Plan Area sat in the floodplain and lacked any basic infrastructure needed to support development. Additionally, this area was identified in the Zone 7 Water Agency's Stream Management Master Plan to divert and store 5,000 acre-ft of floodwater to alleviate flooding and severe bank and bed cutting downstream. The City Council identified this project as a top priority and City staff with the developer and assistance of multiple consultants, took on the preparation of an EIR and Specific Plan for the area. The presenter will discuss the multiple facets of interdisciplinary collaboration necessary to prepare the required documents within one year and continue this interdisciplinary collaboration to complete final design and environmental permitting of the $74 million project infrastructure by the end of this year. Collaboration within and between the Community Development Department, Public Works Department, Zone 7 Water Agency, Property Owners, Alameda County, Pleasanton, the quarry operators and other multiple agencies continues to be necessary to meet the aggressive schedule while meeting the local development and required floodplain management objectives.

THE BEST WAY TO FINANCE STORMWATER PROGRAMS?

C. Warren Campbell, Hall Professor of Civil Engineering
Western Kentucky University

Most communities finance stormwater programs through the community's general fund. However, a growing number of communities are developing Storm Water Utilities (SWU). The SWU charges a fee to maintain and expand stormwater systems. The fee may be calculated in several ways including: 1) fee based on the number and sizes of water meters, 2) based on tiers that may be determined by property zoning, 3) based on the number of Equivalent Residential Units (ERUs), or 4) based on the number of Residential Equivalent Units (REFs). ERU fees are determined from a parcel's square feet of impervious area compared to that of an average single family residential property. The number of REFs are defined as the ratio of runoff during a design storm to the runoff from an average single family residential parcel. The volume of runoff is strongly correlated to the number of ERUs, so the ERU method is a volume-based method. REFs are often calculated using runoff coefficients and is an intensity-based method. In most communities, stormwater systems are designed for runoff intensity for a design storm. Consequently, the REF system may be more appropriate, however the calculation of the number of REFs is more complex than that of a tier system. Desirable characteristics of stormwater fees are : 1) easy to calculate, 2) proportional to the actual benefit derived, and 3) bulletproof in court. Tiers are recommended for smaller communities and the REF system for others. Water meter-based fees are not recommended because of potential legal challenges.

THE LITTLE FLOOD CONTROL DISTRICTS THAT COULD!
CASE STUDIES OF SPECIAL OPERATIONAL AND FUNDING CHALLENGES, AND SUCCESSES, OF SMALL RECLAMATION DISTRICTS IN CALIFORNIA

John W. Bliss, P.E. and Thomas Brightbill, P.E.
SCI Consulting Group

A significant portion of California levees are owned, maintained and operated by small and medium-sized Reclamation Districts. These districts have special challenges concerning levee replacement, maintenance, engineering, and operational issues, as well as a need for increased and reliable funding. A variety of historical approaches have been used, relying on local landowners to "volunteer" maintenance services and local citizens to set policy and oversee operations.

As Federal and State agencies improve and increase the requirements for California levees, these Reclamation Districts must rapidly become even more sophisticated and move into the 21st century. Many of the small districts have shown tremendous resourcefulness across a variety of responsibilities…and larger Districts could benefit from their lessons learned.

Case Studies will be presented including Reclamation District 10 (Yuba County) and Reclamation Districts 2044 and 2029 (San Joaquin County), illustrating their approaches to these challenges.

Funding for annual maintenance and operations of small levee districts and other floodplain management agencies is available through the creation of a Proposition 218-compliant benefit assessments (a.k.a. special assessments) on properties within the district boundaries. The benefit assessment implementation process is legally rigorous, straightforward, and has been used successfully by a number of levee districts. It typically requires an engineering study; a survey; printing, mailing and tabulating of ballots and community outreach. This approach must carefully balance legal requirements, technical needs and political realities.

2:00-3:45 Technical Session: Water Quality, Hydromodification and BMP Design

CHARACTERIZING URBAN RUNOFF FROM SELECTED LAND USES IN THE LAKE TAHOE BASIN

Melissa Larsen, P.E. and David Curtis, Ph.D.
Carlton Engineering

The eutrophication of Lake Tahoe has increased in recent years as result of the increased nutrient loading on the lake due growing anthropogenic influence in the Lake Tahoe Basin (Basin). A quantification of the nutrient loading to the lake by various land uses within the Basin will be used to develop a better understanding of the contribution of those land uses to the decline of water quality in Lake Tahoe. Nineteen monitoring sites have been established throughout the basin, from which two years of discharge measurements and nutrient and sediment concentrations have been collected. These data were compared to concentrations reported in national stormwater databases and found to be significantly different. Discharge-weighted mean concentrations for each monitoring site were related to watershed characteristics and land use through multiple linear regression analysis. Particulate species of nitrogen and phosphorus were the most abundant sources of nutrients in stormwater, and they were especially high in commercial land uses. The concentrations of all nutrients and sediment were enhanced significantly by localized summer thunderstorms. Population density and residential yard maintenance play a key role in nutrient and sediment concentrations for residential land uses.

HYDROLOGIC AND WATER QUALITY BENEFITS OF LOW IMPACT DESIGN: A CASE STUDY

Sarah A. McIlroy, PE, LEED® AP
Stantec Consulting Inc.

As part of a residential street re-construction project, a portion of an existing asphalt street was re-constructed using porous pavers. A 3 to 3.5 foot wide section of each side of the roadway was replaced for approximately 1,500 linear feet with porous pavers and an adjacent vegetated swale. In an effort to quantify the hydrologic and water quality benefit of the porous pavers, the USEPA Storm Water Management Model (SWMM) was used to calibrate existing conditions and to simulate and verify post project conditions. The hydrologic benefit was computed for the 2-, 10-, and 100-year storm events. Wet weather monitoring was completed using an ISCO model 3700 automatic sampler and the samples were flow-weighted prior to sending to the lab for analysis. Sample parameters included total suspended solids, total phosphorus, orthophosphate, copper, and zinc. This presentation will discuss model techniques, lessons learned, and the estimated benefit of using porous pavers as a best management practice.

IMPACT OF LOCAL VARIABLES ON BMP SIZING FOR HYDROMODIFICATION – A STATEWIDE COMPARATIVE ANALYSIS FOR CALIFORNIA

Richard Lucera, PE, CFM and Braeden MacGuire
RBF Consulting

The presentation/paper will discuss the impacts of local precipitation, climate, and soils upon sizing of Best Management Practices (BMP) for hydromodification mitigation. Recent hydromodification studies on projects that propose additional impervious surface throughout California have indicated a substantial variation in BMP sizing between regions with distinctly different climatic and soil conditions. The timing and volume of precipitation-runoff processes and the values assigned to soil parameters – Upper Zone Storage, Lower Zone Storage, and Infiltration Rate – are the primary factors in determining if a given design will successfully mitigate hydromodification. Additionally, the BMP sizing and the ramifications of "point of compliance" selection in relation to run-on and offsite area will be explored.

HYDROMODIFICATION COMPUTER MODELING

Douglas Beyerlein, P.E.
Clear Creek Solutions, Inc.

Hydromodification is the change in runoff volume, magnitude, and duration caused by changes in land use. To prevent degradation to natural stream systems and to meet the requirements of the federal Clean Water Act municipal stormwater discharge permits are required for NPDES Phase I and II communities. These discharge permits include the development of Hydromodification Management Plans (HMPs). Accurate computer modeling of the impacts of hydromodification and the sizing of mitigation facilities is critical to prevent further degradation to natural stream systems and to meet Clean Water Act goals. The hydromodification control standard requires that post-project runoff shall not exceed pre-project rates and/or durations, over a defined range of storm event sizes. Research has shown that the changes in a project site's hydrology cannot be evaluated for a single storm event with traditional design storm approaches. The change in hydrology must be evaluated over a longer time frame using a continuous simulation hydrologic model, and the results used to size mitigation facilities to match pre-project flow duration patterns. This paper and presentation focuses on the continuous simulation hydrologic modeling approach used in multiple jurisdictions in California and Washington and how it can be applied anywhere in the country.

The continuous simulation hydrologic modeling approach uses EPA's HSPF as its computational engine within an easy-to-use Windows environment. This hydro-modification computer modeling software was originally developed by Clear Creek Solutions for the Washington State Department of Ecology and is known as the Western Washington Hydrology Model (WWHM). Today versions also exist for the San Francisco Bay Area (BAHM) and San Diego County (SDHM). The hydromodification model consists of a user-friendly graphical interface through which the user inputs information about the project and desired mitigation facility (e.g., stormwater pond or underground vault); an engine that automatically loads appropriate parameters and meteorological data and runs the continuous simulation model HSPF to generate flow duration curves; a module that sizes the mitigation facility to achieve the hydromodification control standard; and a reporting module. BMPs and water quality facilities such as green roofs, bioretention, sand filters, rain gardens, planter boxes, compost amended soil, and permeable pavement are included in the model and can be used to reduce stormwater runoff. Results from the hydromodification computer modeling quantitatively identify the important analysis considerations that must be kept in mind when designing stormwater mitigation facilities in an urban environment and the practical effectiveness of implementing these facilities and practices to protect private property and public resources.

4:16-6:00 Revitalizing Communities and Resources Through Multi-Objective Strategies

THE LIVING TRUCKEE RIVER

Naomi Duerr and Paul Urban, PE
Truckee River Flood Project, Washoe County, Nevada

The Truckee River Flood Project is a joint effort between the cities of Reno and Sparks, Washoe County, the US Army Corps of Engineers and numerous stakeholders. The project's mission is the management of flood waters and floodplains to protect life and property; reducing flooding by using environmentally sound practices; enhancing water quality, riparian habitat and wetlands; and improved access to the river for recreation.

Local organizations and the public were encouraged to participate in developing the Truckee River Flood Management Plan. It was and is paramount that our community aim to reach consensus and create a plan that will reflect the diverse interests of the community, while also providing the best possible flood management. The recommendations created by the working groups are the basis of the preliminary flood management plan.

- Community Safety and Well-Being: Protect public and private property from flood damage.
- River Restoration: Create a living river that supports fish and wildlife habitat, improves
- water quality, and restores and preserves natural characteristics of the river.
- Downstream Mitigation: Ensure that any increases in downstream flood flows are
- mitigated.
- River Parkway: Create scenic, accessible, multi-use, fish-friendly river parkways
- where possible.
- Floodplain Management: Ensure the plan works long-term through responsible
- management of the adjacent floodplain. Protect the community's investment in
- flood protection.
- Financial Feasibility: Ensure that the plan is financially suitable for the community
- and stays within allowed project costs.

CASE STUDY: ECONOMIC REVITALIZATION THROUGH IMPLEMENTING A STATE-OF-THE-ART MULTI-OBJECTIVE FLOOD PROTECTION PROJECT

Steve Kokotas, Director of Technology, MIG

On April 25, 1998, a "New York Times" front-page headline read: "For a Flood-Weary Napa Valley, A Vote to Let the River Run Wild." Napa County residents had just passed a sales tax to fund a multi-objective, "Living River" strategy for flood protection. In the Times article, the president of The Friends of the Napa River said, "The test for Napa will come 10 years or so down the road, when the Living River plan is complete…You will see a Living River, a restored river downtown, with marshes and wildlife on one side and latte and wine on the other. Now, 10 years later, has the auspicious Napa Living River Plan lived up to the exceptionally high expectations of the community and planning participants? On December 10, 2006, a "Napa Valley Register" headline read: "Downtown Napa Gets Its Mojo Back," citing "the greatest construction surge in downtown's history." Take trip to Napa Valley to experience the transformative $460 million in economic (and environmental) benefits of this ground-breaking flood protection project (perhaps while sipping a latte or glass of wine) on the once abandoned and flood prone Napa River. With lower insurance rates, economic development, eco-tourism, and restored natural areas, residents of the City of Napa—who just a few years ago were demoralized by continual flooding and the bleak economic outlook it had caused—are now experiencing a tremendous improvement in their quality of life.

FLOODPLAIN STUDY OF AN URBAN REDEVELOPMENT AREA

Tyler J. Schemper and Tory R. Walker, Tory R. Walker Engineering, Inc.

A floodplain study was performed for the City of Vista on the Santa Fe Redevelopment Area, located in Vista, California. The redevelopment area is mapped as Zone AE on the FIRM, limiting both improvements to the existing businesses and redevelopment opportunities. A comprehensive floodplain study was performed to identify existing constraints and to identify and evaluate opportunities for reducing flood risks. The hydrology for the vicinity was analyzed using a unit hydrograph model to determine how peak flows are routed through the watershed and redevelopment area. Drainage inlets in the vicinity were analyzed to determine how the peak flows were split between the existing storm drain system and overland flow. Results of the initial modeling indicated that the main storm drain system was underutilized, resulting in excess flows in the street. However, since there was not capacity for the 100-year flow, the conveyance capacity needed to be increased, or the flows decreased, to remove the redevelopment area from the floodplain.

The solution adopted by the City was to optimize existing detention basins, increase inlet capacity, and add a detention basin at a critical junction in the watershed. By decreasing the peak flow rates and adding more inlet capacity, the existing storm drain was optimized and the redevelopment area was removed from the floodplain. The ultimate benefit of the project will be revitalization of a blighted business district.

THE LOS ANGELES RIVER REVITALIZATION MASTER PLAN

Kathleen Bullard, Los Angeles Program Manager and Ira Mark Artz, Divisional Vice President, Tetra Tech

The Los Angeles River Revitalization Master Plan is an inspirational plan to revitalize 32-miles of the River corridor within the City of Los Angeles. Transforming primarily a concrete-lined flood control channel into a natural and social amenity, the plan represents a blueprint to meet the following objectives:

- Improve water quality, water resources, wildlife habitat, and ecological functioning of the River environment.

- Establish environmentally-sensitive urban design and land use guidelines for the River zone.
- Provide significant recreation, open space, and new trails.
- Create community amenities and economic development opportunities by providing open space, housing, retail spaces, and educational facilities.
- Preserve and enhance the flood control features of the River.
- Foster growth in community awareness of and civic pride in the Los Angeles River.
- Continuous public engagement throughout planning and implementation.

Design typologies that illustrate the objectives above were created to be implemented in 20 opportunity sites along the River. Individual projects are moving forward for implementation while governance structures are being created to spur investment, raise funds, and streamline governmental processes. This paper will provide an overview of the plan, the challenges it raised in maintaining flood protection while changing the basic character of the infrastructure, and how implementation is proceeding along a number of fronts from developing projects through creating governance structures. The Plan was prepared for the City of Los Angeles. The Tetra Tech team included 11 subconsultants.

4:15-6:00 Climate Change and Flood Management

RESERVOIR OPERATIONS ASSESSMENT FOR CHANGING CLIMATE

Stu Townsley, USACE-Sacramento; Ann Fissekis, USACE-Sacramento; Rolf Olsen, USACE-IWR; Dr. Kate White, USACE-CRREL

Warming temperatures in the West are leading to observable changes in hydrology such as the timing of spring snow melt and runoff. Warm winters could lead to less snow pack, a major source of water storage for the Western states. Reservoir operating plans have been based on a short hydrologic record and this record may not be representative of future hydrology. Some projections of future climate in California show that winter floods may become more severe as more precipitation falls as rain instead of snow. Summers may be warmer and drier, which implies a need for more water to be stored prior to the summer. California water managers expressed an interest in making reservoir operating rules more flexible and adaptable to new conditions.

Sacramento District Water Management is conducting a pilot study to evaluate if climate influenced changes to the hydrologic regime may require modifying reservoir operating rules. Results of this pilot project may show the need for reallocation studies or major revisions to operating plans to maintain existing flood risk and to ensure reliable water supplies.

ADAPTING TO CLIMATE CHANGE THROUGH MITIGATION PLANNING

Jerry W. Sparks, P.E., CFM
Dewberry

Scientists have reached near consensus that the world is warming and, as a consequence, anticipated climate change over the next century may exacerbate inland and coastal flooding throughout the United States. All states and many communities have prepared and maintain natural hazard mitigation plans to meet the requirements of the Disaster Mitigation Act of 2000. These plans typically identify specific mitigation projects and lay out broader objectives that support the identification of additional projects when funding becomes available. The author believes that mitigation plans can also be the springboard for an orderly, graceful adaptation to the long-term potential impacts of climate change on natural hazards, such as flooding. Through understanding the potential impacts of climate change now, optimal state and local land use

processes can be designed to minimize social disruption and private and public costs of long-term climate change in a deliberate, orderly manner. If we continue to focus only on near term hazards, the only choice will be to be to implement costly structural or retrofit solutions (that may not be viable over the long term) and/or deal with the physical deterioration of the land and infrastructure and the accompanying economic consequences. This paper will overview the potential impacts of long-term climate change on natural hazards (with emphasis on flooding) as well as present some of the climate change adaptation strategies available. Lastly, an overview of available resources for mitigation planners to understand and address climate change will also be presented.

DUTCH-CALIFORNIAN STRATEGY DEVELOPMENT FOR CLIMATE ADAPTATION IN DELTAS

Piet Dircke, ARCADIS in the Netherlands
Eddy Moors, Alterra, Wageningen University Research Centre, the Netherlands
Peter Wijsman, ARCADIS, the Netherlands

By many delta and coastal communities around the world are considered the most vulnerable areas to the impacts of climate change. The expectation is that the Netherlands, with over 60 percent of its land surface below sea level, will be severely impacted as well. Sea level rise, rising temperatures, changing river discharge regimes, changing rainfall patterns, higher extremes in floods and droughts are all consequences that call for adaptive strategies and management. These same impacts could be mentioned for the Sacramento-San Joaquin Delta in California. There are a number of striking similarities as well differences that make comparison of policies and best practices and of these two areas of great interest. Also, exchange of knowledge between the Dutch and Californians, as well as joint research is considered to bring new insights in new sustainable ways to deal with climate adaptation.

Recently the Dutch government has launched a multi million Euro public-private research program for development of adaptive strategies in order to make the Netherlands climate proof. This program also contains a component where international cooperation is sought for joint strategy development. California has been identified as being on of these areas. Currently a first assessment takes place in which existing expertise and research questions are identified and linked. Areas in which expertise on climate adaptation is shared include.

- Impacts of sea level rise on delta management
- Flood protection and flood plain management
- Oxidation of organic soils
- Salt water intrusion
- Spatial planning and land use changes
- Regional downscaling of climate change models
- Institutional setting needed to achieve desired adaptation changes
- Risk assessment and combined cost-benefit analyses to support the assessment of adaptation strategies

Furthermore valuable lessons on institutional and economical approaches to climate change will be discussed.

A SPATIALLY-DISTRIBUTED APPROACH TO EVALUATING SOURCE AREA RESPONSE TO CLIMATE CHANGE AND ITS POTENTIAL BENEFITS TO CURRENT FLOOD CONTROL AND ASSOCIATED MANAGEMENT STRATEGIES

Kellie Vache, Ph.D., Institute for Landscape Ecology and Resources Management (ILR)
Justus-Liebig-University Giessen, Germany
Robert Shibatani, M.Sc., The SHIBATANI GROUP, Inc.
Jeffrey McDonnell, Ph.D., Richardson Chair in Watershed Hydrology, Oregon State University

We present a spatially-distributed hydrologic modeling framework developed to provide new insights into upper basin (source area) reservoir inflows, under a variety of forcing conditions, including a changing climate. The model operates over a variety of time scales, from minutes to decades, and can be utilized to simulate a variety of watershed responses, including flood flows, subsurface flows, and groundwater movement. We outline the model operation using the HJ Andrews Long Term Ecological Research site as a test-bed, and through a variety of examples, outline the utility of computationally intensive spatially detailed simulation frameworks in helping define the flood response from source area watersheds, relative to historical observations. We discuss some of the physical processes most affected by forecasted climate perturbations and note their importance in the timing and magnitude of the annual flood hydrograph. We offer recent insights into contemporary empirical techniques, readily implementable by today's flood/water managers that will help refine model prediction through a better understanding of the factors that will drive rapid quickflow response in an environment where the temporal/spatial hydroclimatological variables (e.g., snow accumulation, snowmelt energy balance, and REA or, representative elementary area) are shifting. Future flood control management strategies must be based on a solid appreciation of not only these shifts, but also the manner with which source area watersheds will physically respond to these anticipated climatic modifications.

The presentation concludes with suggestions for new directions in the use of models by flood managers facing uncertain future climate perturbations. These will include; the transferability of results from disparate watersheds, the potential long-term downstream implications to the CVP/SWP and Bay-Delta, scaling issues regarding the trade-offs between output resolution and geographic coverage, and how flood control and other resource management objectives can best be integrated in a model construct serving multiple purposes.

INCORPORATING CLIMATE CHANGE INTO THE CENTRAL VALLEY LEVEE AND FLOOD EVALUATIONS

Ricardo Pineda, PE, CFM, California DWR and Michael DePue, PE, CFM, PBS&J

The State of California Department of Water Resources has embarked on an ambitious plan to evaluate levees and flood limits within the Central Valley as a result of several key pieces of legislation. Included in the legislation is direction to consider the impacts of Climate Change on this process. This presentation will discuss the policy and technical considerations and implications and discuss the current proposal for how Climate Change will be incorporated.

FRIDAY SEPTEMBER 5

8:00-9:45 Erosion and Geomorphic Processes

COMPLEX PIER SCOUR FOR BRIDGES

Sunit Deo, M.S., EIT, CFM and Brian Doeing, P.E., CPESC
HDR, Inc.

This presentation is intended to provide an insight into complex pier scour process for bridges and present an easy spreadsheet method to calculate the pier scour based on FHWA's HEC-18.
Pier scour is a process that occurs due to obstruction caused by piers to the water flow and is one of the leading causes of bridge failure. Pileup of water upstream of the obstruction and subsequent acceleration of the flow around the pier nose form horseshoe vortices causing erosion. The main factors affecting pier scour include characteristics of bed material, flow and most importantly, pier geometry. When the pier is not a uniform stem but is composed of pier stem, pile cap and/or pile group, it is called a complex pier. It behaves differently for scour than a solid stem only when one or more of its components are exposed to water flow. Due to the complex nature of flow field and sediment transport processes near complex pier components, the predictive equations rely heavily on laboratory data. There are various methods that include either computing effective pier diameter or superimposing the scour calculated for each component separately. One of the widely accepted methods, outlined in HEC-18, calculates scour for each component and adds them together for total pier scour after correction. This method is very complex to follow due to different possible cases. The solution for each case is slightly different. The spreadsheet by HDR will simplify the process of calculating complex pier scour.

ESTIMATION OF STREMBANK LATERAL MIGRATION AND EROSION HAZARD BOUNDARIES

Bruce M. Phillips, Pacific Advanced Civil Engineering, Inc.

It is desirable for floodplain management to be able to define erosion hazard boundaries in addition to flood hazards as a distinct land management tool along river corridors for assessing risks to public safety. This is particularly important now with more stringent environmental regulations limiting construction of streambank protection measures, so instead erosion buffers must be implemented. However, rivers are dynamic features, constantly adjusting their banks, beds, and floodplains in response to flood events or human activities which makes lateral erosion prediction difficult. The stability assessment procedures for an alluvial stream system utilize a combination of geomorphic and hydraulic engineering analyses in order to quantify the predicted future amount of stream bank retreat. New technology based river migration applications are now available that have been developed based on advanced computer mapping procedures including GIS based tools and digital aerial comparative mapping techniques. The recommended methodologies incorporate both qualitative geomorphic techniques along with the application fluvial engineering analysis.

This comprehensive design procedure utilizes the different results from a variety of analyses to predict the lateral erosion through: (1) river reach hydraulic assessments, (2) horizontal velocity distribution within the floodplain, (3) measured lateral erosion rates through historic aerial photographic comparison, (4) geomorphic analyses predictions, (5) channel morphology trends and characteristics, (6) geologic conditions, (7) field observations, (8) historical channel changes, (9) stream classification data, (10) longitudinal profiles, (11) expected channel pattern, (12) stable bank slopes, (13) expected lateral erosion mechanism,

(14) armoring potential, (15) equilibrium channel slope, (16) floodplain hydraulic modeling, (17) allowable velocity estimates, (18) channel morphology relationships – regime equations and hydraulic geometry, and (19) sediment transport modeling continuous series of events with lateral erosion analysis. The predicted streambank erosion buffer requires evaluation of both the single short event and the cumulative long term impacts on the lateral erosion in order to adequately identify a suitable buffer for the different erosion mechanisms. A case study of a successful application of this technique for defining lateral erosion buffers is reviewed for a portion of the 110 square mile San Juan Creek watershed in Orange County, California.

GEOMORPHIC ASSESSMENT AND MODIFICATION ALTERNATIVES FOR ORESTIMBA CREEK AND ITS FLOODPLAIN

Su Mishra, PHD, PE
Ayres Associates Inc.

The Orestimba Creek study area is located on the western margin of the San Joaquin Valley near the city of Newman, California. The watershed consists of approximately 185 square miles with a large portion of the area being very productive irrigated cropland. The largest community in the study area is the city of Newman, which is located along Highway 33. Orestimba Creek drains from the east side of the Coast Range and flows into the "west side" of the San Joaquin Valley. The segment of the coast Range drained by these streams is called the Diablo Range. The creek is traversed by U.S. Interstate Freeway 5, the California Aqueduct, the Delta Mendota Canal, State Highway 33, and the Northern California Railroad. Orestimba Creek is ephemeral, with high flows normally occurring in late winter, and irrigation drainage accounting for low flows during the summer months. Orestimba Creek flows in an east-northeasterly direction through steep mountain canyons until it emerges at the foothill line onto a broad, shallow sloped alluvial fan. Here on the relatively gentle slopes, the existing channel is perched and insufficient to carry large flood flows, and floodwaters overflow generally east onto the alluvial fan surface.

Orestimba Creek can be considered ephemeral, depending on location and time of year. High flows normally occur in late winter. In the upper part of the study area, there is little or no flow in the summer months. However, in the lower part of the study area, irrigation drainage return accounts for low flows in the channel during the summer months. Irrigation drainage to the creek, primarily downstream of State Highway 33, increases in the downstream direction and is significant at it's confluence with the San Joaquin River. A qualitative geomorphic and channel stability assessment of Orestimba Creek has been conducted by Ayres Associates and USACE, Sacramento District. The assessment is based on observations at road crossings and other access points along the channel of Orestimba Creek between the confluence with the San Joaquin River and the California Aqueduct just upstream of Interstate 5. Ayres Associates is charged with developing a design to modify the existing Orestimba Creek channel from approximately Jorgensen Road downstream to the San Joaquin River to safely convey a design flows of 3,000 cfs, 6000 cfs, and 12000 cfs. The channel modifications shall be designed to maximize both flood damage reduction and ecosystem restoration benefits, and to minimize construction, real estate acquisition and operation/maintenance costs. Potential channel modification features include: levees, setback levees, channel widening, floodplain excavation and bypass channels. The cost benefit ratio will give an opportunity to adopt an alternative.

BANK STABILIZATION BY REDIRECTING THE SANTA CLARA RIVER

Javier "Alex" Yescas, P.E., CFM, PBS&J
Kirk Norman, P.E., Ventura County Watershed Protection District

The Santa Clara River is one of the largest river systems (and the largest free flowing) in southern California. It flows about 100 miles from the headwater at Pacifico Mountain in the San Gabriel Mountains toward the

Oxnard Plain before discharging into the Pacific Ocean near the Ventura Marina. In January 2005, a flood that was close to the 50-year flood event (136,000 cfs at the Montalvo gage) occurred and severely eroded portions of the Santa Clara River. The Santa Clara River has a significant bend approximately 3,000 feet downstream of the Highway 101 Bridge.

PBS&J is currently designing redirective structures to train the Santa Clara River to flow away from the southern bank of the river. The redirective structures chosen by Ventura County Watershed Protection District and PBS&J are Bendway Weirs. Bendway Weirs are low-profile structures built up from large boulders. The weirs are placed perpendicular to the bank of river and angled upstream. The angle upstream is the key to providing the stabilization to the bank as the flow in the river is directed away from the bank. The redirection allows for sediments to deposit and minimize toe scour along the bank. The project is intended to protect three existing historic landfill sites, adjacent to the river, from erosion.

SAN ANTONIO CREEK STREAM RESTORATION PROJECT: A CASE STUDY

Justin S. Rogers, P.E., CFM, and Brian J. Doeing, P.E., CPESC
HDR Engineering

San Antonio Creek is located in the California central coast area within Vandenberg Air Force Base. The creek is actively adjusting its profile and channel geometry and has experienced significant erosion (degradation), deposition (aggradation), channel widening, and bend migration during the recent past. The results of several studies indicate that this trend is expected to continue. The effects of this instability have led to a degraded stream channel environment and hydrologic disconnection of the stream from the surrounding floodplain. In addition, local infrastructure such as utilities and highways, habitat, wetlands, and cultural resources are threatened. The purpose of this project was to address these concerns and to restore form and function to San Antonio Creek within the project area.

HDR Engineering worked in conjunction with the U.S. Air Force, U.S. Army Corps of Engineers, David Derrick (USACE Waterways Experiment Station), John McCullah (Salix Earthcare), and others to develop a proposed design. The proposed design incorporates seven rock riffle grade control structures that will mitigate the lowering of the channel, provide pool and riffle features, and also provide for fish passage. Additionally, bank toe and slope protection will be provided at key areas. Habitat will be restored with the use of environmentally sensitive streambank stabilization and restoration methods. This is expected to provide enhanced habitat for several endangered species within the creek as well as other species. Additionally, cutting point bars and reshaping the channel will allow for a more natural channel shape with a restored historical flood terrace.

8:00-9:45 Multi-Hazard Risk Assessment and Uncertainty Analysis

RU READY FOR RISK AND UNCERTAINTY ANALYSIS?

David T. Williams, Ph.D., P.E., P.H., D.WRE, PBS&J
Joseph D. Countryman, P.E., D.WRE, MBK Engineers

Uncertainties in hydrologic and hydraulic models and boundary conditions (topography) can have a significant influence on floodplain management. This presentation describes the basic concepts of risk and uncertainty (RU) analysis as practiced by the U.S. Army Corps of Engineers (COE). It also examines how RU is used by the Corps to determine if a levee can be certified as meeting FEMA base flood requirements.

The design of a flood control structure utilizing uncertainty analysis involves quantification of the variability inherent in estimating hydrology, hydraulics, damage relationships, geotechnical performance and operations. For instance, in the development of a probability distribution for peak discharges, there is significant uncertainty because of the small data set available in comparison to the projected frequency event that is often used. The estimation of hydraulic profiles and damageable property also has significant uncertainty associated with their respective estimates. What has changed is that these uncertainties, as can be estimated by the range of input parameters, are included in the design of projects.

Levee certification is a well established deterministic process for which FEMA has specific guidance. The Corps has developed a parallel RU procedure for levee certification. How well do these two very different methods match up and what are the areas requiring guidance before full implementation of RU can be completed? Welcome to the uncertain world of Risk and Uncertainty!

COUNTYWIDE DFIRM UPDATE IN CONJUNCTION WITH A HAZUS®MH ESSENTIAL FACILITIES RISK ASSESSMENT FOR SOUTHERN CALIFORNIA STUDIES

Raymond T. Lenaburg, FEMA Region IX and John M. Hoffman, CFM, Dewberry

The Federal Emergency Management Agency (FEMA) has embarked upon Map Modernization updates of countywide Digital Flood Insurance Rate Maps (DFIRMs) in conjunction with a HAZUS®MH (HAZards U.S., Multi-Hazard) essential facilities risk assessment for three Southern California counties: Orange, San Bernardino, and Riverside. Because the DFIRM updates will produce an improved, countywide flood hazard GIS data layer, this was an optimum opportunity to encourage these communities to update their Multi-Hazard Mitigation Plans. FEMA's HAZUS®MH – a GIS, standardized, nationally applicable natural hazard loss estimation methodology – is a key tool used in a community's Multi-Hazard Mitigation Plan. A accepted Multi-Hazard Mitigation Plan allows communities to be eligible for Mitigation and Disaster Relief funding.

FEMA will provide funding to create several flood and earthquake HAZUS scenarios for these counties, each of which represents approximately 80 incorporated communities and a population of over 7 million people. Upon completion of this project, FEMA intends to have an updated DFIRM for each county as well as material required to update the county's Multi-Hazard Mitigation Plan. In addition, the project will have created a forum to encourage ongoing cross-community sharing of data and information related to hazard mitigation. The HAZUS-MH projects were initiated in the spring of 2007 and significant progress has been made in the data collection and modeling input. FEMA would like to use this opportunity to also present some "lessons learned" from the formation of the Community Executive Committee(s) as well as the specific data needed to obtain the best results from the HAZUS models.

RISK INFORMED DECISION MAKING – WHY THIS NEW APPROACH IS NEEDED IN CALIFORNIA'S CENTRAL VALLEY

Boniface (Boni) Bigornia, ARCADIS

This presentation will outline the new approach that our nation is taking to managing flood risk, and demonstrate its use in the context of flood risk management of California's Central Valley. This approach is very different from the traditional (NED) analysis which focused on structural solutions, such as levees. The lessons learned from Hurricanes Katrina and Rita taught us that there are many interrelated complex issues in flood risk management. Structural reliability, and system resiliency and robustness require a spectrum of measures that need to be more comprehensive, including evacuation plans, flood warning systems, contingency planning, and risk communication. Loss of life consequences, other social and cultural impacts,

vegetation management, endangered species, etc. contribute to a complicated problem that is no longer solvable by traditional cost-benefit calculations. Furthermore, the added complexities of dealing with an existing infrastructure, environment, policies, and laws result in conflicting objectives that will require non-traditional analyses and solutions. Risk informed decision making is needed to address those complexities with a new analysis that allows decision-makers and stakeholders to better understand the impacts of alternative plans on different objectives, including loss of life. This presentation will examine the new analyses being carried out for New Orleans with the Louisiana Coastal Protection and Restoration (LaCPR) project and explore how that might be translated to address flood risk management in the California Central Valley.

8:00-9:45 Alluvial Fans – Flood Hazard and Sediment Analysis

ALLUVIAL FAN FLOOD HAZARD ANALYSIS: CASE STUDY FOR A THREE-STAGE APPROACH TO MAP FLOOD HAZARDS ON AN ALLUVIAL FAN

John McCarthy, CFM, P.E., RBF Consulting and Jon Fuller, PE, RG, PH, MS, CFM, JE Fuller/Hydrology and Geomorphology, Inc.

The Federal Emergency Management Agency (FEMA) provides guidance for the identification and mapping of flood hazards occurring on alluvial fans in Appendix G: Guidance for Alluvial Fan Flooding Analysis and Mapping of the FEMA Guidelines and Specifications for Flood Hazard Mapping Partners. As development continues to encroach onto alluvial fans and the adjacent areas, consistent application of the FEMA guidelines becomes increasingly important in the identification and mitigation of the potential flood hazards. This presentation will discuss the use of an integrated multi-discipline approach to following the FEMA three-stage guidelines for flood hazard assessment on an alluvial fan. Topics will include the use of geology, geomorphology, historical data, and numerical modeling to accurately assess the potential flood hazards on and downstream of the fan.

The three-stage alluvial fan floodplain delineation methodology adopted by FEMA was recently applied on an urbanizing area in eastern Coachella Valley, California. This presentation discusses the technical studies relating to application of the FEMA guidelines, and presents a case study for the site-specific evaluation of the Martinez Canyon alluvial fan in the Coachella Valley.

SEDIMENT DELIVERY CALCULATIONS ON ALLUVIAL FLOODPLAINS USING TWO DIMENSIONAL HYDRAULIC ANALYSES

Andrew Ronnau PhD, PE
Pacific Advanced Civil Engineering

A two dimension model for sediment delivery on alluvial floodplains is obtained by utilizing results from FLO-2D hydraulic analysis with a sediment discharge model obtained from the current literature. The model was conceived to accurately determine the actual sediment delivery that could be expected at a project site on an alluvial floodplain near Rosamond, California. By incorporating the hydraulic results from a two dimensional analysis, varying effects of the sediment delivery capacity at various points throughout the flow field could be accounted for in the overall sediment delivery calculation. A sediment discharge relationship is chosen which utilizes a simple set of hydraulic parameters (velocity, depth, shear velocity) which are readily available as part of a two dimensional hydraulic analysis. The flow hydrograph approaching the upstream boundary of the project site is discretized in time, and each of the relevant hydraulic parameters is sampled at each discrete time, for each one of the FLO-2D grid cells along the upstream project boundary. A

discretized sediment discharge hydrograph is created for each of the FLO-2D grid cells tributary to the project site. Total sediment delivery to the project site is obtained from individual tributary sediment hydrographs.

SEDIMENT/DEBRIS BULKING METHODS FOR CALIFORNIA'S DESERT REGIONS

Jake Gusman, P.E., and Martin J. Teal, P.E., P.H., WEST Consultants, Inc.; Bruce Swanger, P.E., Caltrans

Caltrans recognized the need for sediment/debris bulking methods for use in California's desert regions. Bulking methods used by various agencies were reviewed and their applicability to California's desert regions was assessed. These included bulking methods from Los Angeles, Riverside, and San Bernardino Counties, Corps of Engineers (Los Angeles District), FEMA, and the Interagency Burned Area Emergency Response teams.

The bulking potential depends on the type of sediment-laden flow expected in the watershed, which may be determined by field reconnaissance, data collection, and agency consultations. Locations having a greater potential for debris-flow hazards include areas near the upper points of alluvial fans or within alluvial fans, at or near the foot of a steep slope (especially slopes of 26 degrees (1V:2H) or steeper), and at or near the junctions of ravines with canyons. Wildfires can also have a major impact on debris flows, although the extent of this impact depends on the density of the desert vegetation and the resulting soil burn severity. Based on data collected for the watershed, engineering judgment and geomorphic experience should then be used to determine an appropriate bulking factor. For hydraulic design, the main purpose of using bulked flows is to introduce a factor of safety when computing the required bridge opening or channel dimensions. Therefore, the selected bulking factor may not be strictly based on the expected maximum sediment concentration in the flow. A flow chart was developed that outlines the recommended bulking factor selection process for California's desert regions.

MODELING ALLUVIAL FAN FLOOD HAZARDS FROM GEOLOGIC MAPS: INTEGRATING RECENT QUATERNARY GEOLOGIC MAPPING WITH FEMA ALLUVIAL FAN FLOODING GUIDELINES

Jeremy T. Lancaster, Thomas E. Spittler and William R. Short
California Geological Survey

As Southern California populations increase, so do development pressures on alluvial fans. Unfortunately, the factors that make alluvial fans desirable – relatively planar slopes, good surface drainage characteristics, and often excellent views – are formed by floods and debris flows that can negatively affect people and property. Modeling the areal extent and relative magnitude of alluvial fan hazards from geologic maps that differentiate Quaternary age alluvial units can assist in avoiding hazardous areas and designing proper flood and debris flow management facilities. For example, the California Geological Survey (CGS) is integrating geologic maps that use Southern California Aerial Mapping Project (SCAMP) classifications of alluvial fan deposits with Federal Emergency Management Agency (FEMA) Guidelines and Specifications for Mapping Partners (FEMA Appendix G, 2003). This integration is designed to assist in minimizing the effects of alluvial fan hazards, and facilitate participation in the National Flood Insurance Program (NFIP).

A CGS-developed relative hazard index for Quaternary age alluvial units based on this nomenclature models active, potentially active and inactive alluvial fan surfaces; very young units ≈ active fan surfaces, old and young units ≈ potentially active fan surfaces, and very old units ≈ inactive fan surfaces; all with respect to alluvial fan flooding. Quaternary geologic mapping combined with debris flow, avulsion potential, and flow path uncertainty maps could produce composite alluvial fan hazards maps that may be used in hydraulic

studies to assist developers, reviewers, and the public in evaluating potential hazards to alluvial fan developments and in amending local alluvial fan hazards zones into FEMA defined flood zones.

SIMULATING AN ACTUAL DEBRIS FLOW FROM NEXRAD RAINFALL DATA WITH THE FLO-2D MODEL

Jim O'Brien, FLO-2D Software, Inc.

The Soldier Canyon urbanized alluvial fan was subject to severe rainfall and debris flow flooding on July 31, 2006. The Pima County Regional Flood Control District (PCRFCD) supported a study that included replication of the July 31 flood. This alluvial fan flood hazarde delineation had four components:

- Hydrologic analysis – design storm selection;
- Model calibration using the July 31, 2006 flood event;
- Sediment loading estimates and hydrograph bulking;
- Flood hazard delineation - mapping.

The FLO-2D model of the Soldier Canyon July 31, 2006 flood event was calibrated using post-flood event aerial photos, Next-Generation Radar (NEXRAD) rain data, observations of the flood stage at the Catalina Highway culvert, and the Pima County Regional Flood Control District (PCRFCD) estimates of sediment yield. A frequency analysis was conducted to analyze the design storm total rainfall. The FLO-2D NEXRAD rainfall simulation of the July 31, 2006 storm was based on the spatial (100 ft grid element) and temporal (15 minute intervals) discretization of the NEXRAD data base. The sediment load was estimated by PCRFCD (~30% average concentration by volume based on the simulated NEXRAD rainfall volume). Combined with the NEXRAD rainfall, this generated a very accurate prediction of the total flood volume. The resulting flood hazard maps for the debris flow closely replicated the aerial photo taken on the morning of July 31, 2006. Assuming that the NEXRAD data is reasonably accurate, this flood replication is essentially the highest resolution flood simulation can be accomplished given the available DTM data base and 15 minute temporal discretization of the NEXRAD data.

10:15-12:00 Coastal Erosion, Coastal Flood and Sediment Management

CALIFORNIA'S COASTAL SEDIMENT MASTER PLAN- MANAGING SEDIMENT TO ADDRESS COASTAL EROSION

Clifton W. Davenport, California Geological Survey and Project Manager, Coastal Sediment Management Workgroup

California Resource Agency and member Departments have joined together with federal and local agencies and other organizations to form the Coastal Sediment Management Workgroup (CSMW), whose mission is to implement Regional Sediment Management (RSM) as a holistic means to address sediment deficit/excess imbalances along coastal California. Anthropomorphic alterations within coastal watersheds and coastline have reduced beach-compatible sediment reaching the coast while simultaneously wetlands, estuaries and harbors are being inundated with sediment. CSMW developed and is implementing a Sediment Master Plan (SMP) which includes tools and informational documents targeted at specific issues related to sediment management and outreach and education to assist coastal managers in identifying and addressing sediment supply issues. Several Coastal RSM Plans currently under development with regional partners target beneficial reuse and coastal erosion issues specific to those regions. Other tools/documents include: web-based GIS database and mapping viewer; Sand Budgets for Major Littoral Cells; "Mud Budget"; Beach Restoration Regulatory Guide; Biological Impacts Analysis; Loss of Sediment from Dam Impoundment; reuse of upland materials for beach nourishment; Coastal References Database; economics of transport from

harbors and flood control structures. All are available through CSMWs website http://www.dbw.ca.gov/csmw/default.aspx. Outreach includes both technical and public interactive workshops. Coastal RSM Plans target potential sediment sources, critical erosion areas, potential stockpile locations, transport options/pathways, potentially-impacted biota and habitat, onshore and nearshore placement locations and volume/rate restrictions, regulatory considerations, economic analyses, and recommendations on how governance can be improved to ensure utilization of the Coastal RSM Plan when sediment management activities are envisioned.

INTEGRATING FLOOD MANAGEMENT AND TIDAL MARSH RESTORATION

Vince Geronimo, PE, CFM. and Matt Wickland
Philip Williams & Associates, Ltd.

Multi-objective riverine and coastal management projects can successfully integrate tidal marsh restoration while protecting from coastal and fluvial flood hazards. PWA will present a case study from Alameda County, CA showing the potential flood management benefits resulting from restoring coastal environments in the San Francisco Bay. The integrated flood management and restoration design project includes channel levee breaching, channel flow diversion, changes in sea levels, and coastal levee construction. An integrated one- and two-dimensional hydrodynamic model (MIKE- FLOOD) was used to assess the response of peak Special Project Flood levels and marsh drainage patterns to the restoration design. The 2-d hydrodynamic modeling incorporates the projected long-term geomorphic evolution of the tidal river channel and (future) restored marsh areas. We will present a comparison of the modeling results for with and without project evolution. We will include several other examples of rivers draining to our bays and ocean to show the significance of incorporating tidal processes and channel morphology into flood management and restoration projects in these areas.

RESPONSE-BASED ANALYSES OF COASTAL FLOOD AND EROSION HAZARDS

Nicholas J. Garrity, P.E., Robert Battalio, P.E.,and David Revell
Philip Williams & Associates (PWA)

Coastal flooding and erosion hazards on the Pacific Coast of the US are responses to the joint occurrence of extreme water levels and waves and local shoreline topography (Garrity et al. 2006, FEMA 2005). Due to the joint probability of extreme water levels and waves, the probability of the hazard response is typically greater than the probability of a single forcing parameter. Increases in sea level, storm activity, and/or El Nino events due to climate change can amplify coastal hazard responses due to the coincident occurrence of these extreme forcing parameters (Revell et al. 2007, Ruggiero 2008, Vitousek et al. 2008, Allan and Komar 2006). One key concern is that the erosion response to sea level rise, including increased wave energy applied at higher elevations, is a greater potential flood hazard than the impact of higher water levels on existing topography (Allan and Komar 2006). Models of shoreline recession indicate that landward rates of erosion would be on the order of 10 to 100 times the vertical rise in sea level (Komar et al. 1999). FEMA Guidelines require consideration of erosion caused by the 100-year event (Event Based Erosion or EBE), as the morphologic response of the shore is a key consideration for flood hazard mapping, even if future conditions are not considered. However, climate change projections indicate that coastal hazards will increase more rapidly than in the past. This suggests that hazard mapping based on historic and existing conditions will always under-predict actual hazards.

10:15-12:00 Risk Communication, Public Involvement and Outreach

DE-MYSTIFYING GRANDFATHERING (AND OTHER FLOOD INSURANCE OPTIONS) -WHAT FLOODPLAIN MANAGERS SHOULD KNOW WHEN MAPS CHANGE-

Bruce A. Bender
Bender Consulting Services, Inc.

Map Modernization's affect on flood insurance has opened a whole new world to floodplain managers, community officials and other stakeholders, a mystifying world full of misconceptions and misperceptions. With over half of the population still to receive new effective DFIRMs, it is important that floodplain managers and others stay up-to-date on the effects of map changes on flood insurance, as well as what options are available. What choices do property owners have when their homes are mapped into or taken out of high risk zones? When can they grandfather in a new Base Flood Elevations (BFEs)? Can a change in vertical datums really affect the rates? What are the flood insurance options when levees are not accredited or become PALs? Is grandfathering always the best option?

This presentation will answer these and other questions as well as provide examples and handouts. As a result, floodplain managers and other participants will gain a better understanding of grandfathering and other available insurance options, and therefore, be better prepared to discuss them with the public.

THE NEW TECHNOLOGY FRONTIER, INFORMING THE PUBLIC OF FLOOD RISK

Travis Clark
Michael Baker Jr., Inc.

With the conversion of FEMA flood data into digital formats through the Map Modernization program, dramatic new possibilities have opened up in communicating flood risk to the public. One challenge faced by public agencies is how to most effectively communicate flood risk to the public at large in ways that are accessible, meaningful and easy to understand.

This presentation will review how dramatically the industry has changed in 10 short years. This session will also explore and demonstrate exciting new technologies that Baker is pioneering in accessing flood data and informing the public of risk in the Internet age. New visualization platforms such as 2D Internet mapping tools from Google Maps, Yahoo! Maps, and Microsoft Live Maps, as well as 3D earth visualization tools, such as Google Earth and Microsoft Live Maps 3D, offer simple and low-cost presentation alternatives to the standard FEMA DFIRM flood map panel. In addition, Baker is pioneering emerging wireless technologies that allow access to data anytime, anywhere from smartphone devices.

AN INTEGRATED APPROACH TO POST-PRELIMINARY OUTREACH

Lisa Messano and Michael Skowronek
Michael Baker Jr., Inc.

This presentation will provide an overview, highlights and lessons learned from outreach conducted by FEMA Region IX to facilitate community understanding, acceptance, adoption and use of modernized, countywide Flood Insurance Rate Maps (FIRMs) developed under Map Mod. The two main purposes of the outreach to be discussed were (1) to educate local-level stakeholders on the impacts of new special flood hazard areas resulting from levee deaccreditations, non-levee embankment map revisions, new engineering studies and other map changes; and (2) to inform end-users on the uses and benefits of digital flood hazard data within a Digital Flood Insurance Rate Map (DFIRM) database. The session will include a discussion of

outreach conducted for Provisionally Accredited Levees (PALs), insurance and grandfathering issues, and outreach strategies that communities can use to effectively inform property owners about map changes. The presenters will provide highlights from workshops conducted to demystify DFIRM databases and demonstrate how to use GIS and other state-of-the-art tools/technology to view, analyze and integrate DFIRM data into floodplain management and other local government applications.

INTERACTIVE COMMUNITY AND RIVER MASTER PLANNING USING GOOGLE EARTH PRO

Steve Kokotas
MIG

Come see how watershed mapping with integrated GIS and Google Earth is helping Alameda County develop a multi-objective, community-based river master plan for the San Lorenzo Creek watershed. Google Earth can support integrated GIS data—together with images, video and documents—creating a rich, multimedia virtual library for storing highly visual, site-specific planning and design information. Your virtual data is easy to access and share, resulting in increased participation in all phases of the planning process—from analysis of existing conditions to conceptual plan development to public outreach and education. The ability to annotate and easily incorporate new information in real-time, for example during a design charette or a public meeting, makes it an ideal tool for graphically recording the ideas, issues and opportunities that come up during planning meetings. The integration of valuable GIS data and 3D representation of the watershed in an easy-to-use user interface greatly supports public education of watershed issues and results in better decision making. Perhaps most importantly, this highly visual and interactive platform is fun and engaging, which helps fosters creative and robust multi-objective river master plans.

PARTNERING WITH THE COMMUNITY FOR FLOODPLAIN SOLUTIONS-4 CASE STUDIES

David G. Dickson and Joyce Vollmer
MIG, Inc.

Working with the community can lead to better, more innovative flood protection solutions—and often result in multiple funding sources. The key is negotiating and guiding their often passionate and divided interests. We'll look at four successful projects to show how you can apply the same strategy to your floodplain solutions. The Napa Living River Plan was the hard-won result of a long dialogue among the U.S. Army Corps of Engineers, river experts, local officials, architects, farmers, winery owners, business owners and 27 diverse stakeholder groups. The community itself developed a multi-objective solution to replace a rejected Army Corps project—a solution now almost completely built. The Pajaro River Task Force is composed of residents, business, agricultural, environmental, local government, labor, education, health, and other groups. It is developing community-wide consensus for operation and maintenance and local share funding of the Lower Pajaro River Levee Reconstruction Project, as well as upper watershed stewardship and restoration. The Army Corps abandoned project on Marin County's Corte Madera Creek in the 1960s, when the community objected to concrete channelization. Forty years later, after a devastating flood, diverse community groups, the original environmental groups, business, local technical experts, and regulatory agencies came together to resolve both technical and financial issues. The Truckee Living River Plan was the consensus-based result of 35 stakeholder groups and 24 resource and regulatory agencies. The Coalition put in more than 9,000 hours over eight months to develop a consensus for a flood management plan.