Appendix 3

Infrastructure Conveyance and Hydraulics

Contents

Infrastructure Conveyance and Hydraulics

Theme Subcommittee Members

The Flood-MAR Infrastructure Conveyance and Hydraulics Subcommittee consists of two co-chairs, six subcommittee members, and a theme coordinator. Subcommittee members are listed by name, title, and affiliation below.

Position	Name and Title	Affiliation	Email
State Co-Chair	Yiguo Liang, Chief, Hydrology & Hydraulic Analysis Section	California Department of Water Resources (DWR)	Yiguo.Liang@water.ca.gov
Non-State Co-Chair	Shyamal Chowdhury	U.S. Army Corps of Engineers (USACE)	Shyamal.B.Chowdhury@usace.army.mil
Sub-committee Member	John DeGeorge, Principal, Project Manager	RMA	jfdegeorge@rmanet.com
Sub-Committee Member	Tom Molls, Principal Hydraulic Engineer	HDR/David Ford	tmolls@ford-consulting.com
Sub-committee Member	Tom Plumer, President	Civil Engineering Solutions	thomasplummer@civilsolutions.org
Sub-committee Member	John Pritchard, Program Manager	ESA	jpritchard@esassoc.com
Sub-committee Member	Cordie R Qualle, Industry Faculty Fellow	California State University, Fresno	cqualle@csufresno.edu
Sub-committee Member	William Fleenor, Professional Research Engineer	University of California, Davis	wefleenor@ucdavis.edu
Theme Coordinator	David Arrate, Senior Water Resources Engineer	DWR	David.Arrate@water.ca.gov

Engagement Process

The subcommittee's objective was to identify the existing information and gaps related to the use of conveyance (i.e., canals, pipelines, ditches, turnouts) during flood-period operations and for the use of Flood-MAR operations.

The State and non-State co-chairs were proposed by the DWR Flood-MAR team. Both co-chairs were selected based on their leadership skills and well-known expertise and experience in the corresponding fields and organizations. The subcommittee includes individuals selected from a list of potential members identified by the co-chairs in collaboration with the DWR Flood-MAR team.

The subcommittee members attended a two-hour in-person meeting, from which initial concepts on research gap topics were formulated. After this initial meeting, subcommittee members continued communication by email and phone calls.

Available Research, Data, and Tools

The tables below summarize the available research, data, and tools related to the Infrastructure Conveyance and Hydraulics theme. This information presented is based on subcommittee members suggestions.

Table 1 Central Valley Floodplain Evaluation and Delineation Program HEC-RAS Model

Category: Tool

Scale: Regional/Local

Availability: Available

Public Benefits Informed By:

Flood risk reductions, climate change adaptation

Description, including Connection to Flood-MAR:

The HEC-RAS model of the Central Valley includes the Sacramento and San Joaquin rivers and many major and minor tributaries that feed into each main river. This model can be used to model flood risk for baseline and with Flood-MAR project scenarios.

Website: http://webdev01.geiconsultants.com/lom/
Contact: Yiguo Liang
Email: yiguo.liang@water.ca.gov

Table 2 Various Hydraulic Models

Category: Tool

Scale: State

Availability: Available/Gap

Public Benefits Informed By:

Flood risk reductions, climate change adaptation

Description, including Connection to Flood-MAR:

Many state and local agencies, as wells as non-governmental organizations, academia, and consultants, have existing hydraulic models that could be used for Flood-MAR studies. A database that catalogues these models for potential public and private use would help stakeholders determine what specific models are available for Flood-MAR studies.

Website:

Contact:
Email:

Table 3 Design and Construction Costs

Category: Tool Scale: State Availability: Available/Gap
Public Benefits Informed By: Flood risk reductions, climate change adaptation
Description, including Connection to Flood-MAR: Many public and private entities have developed design and construction cost estimates for conveyance systems. A catalogue or database of typical cost estimates would help stakeholders better estimate Flood-MAR project costs.
Website: Contact: Email:

Research Needs and Gaps

The tables below summarize needs and gaps in research, data, and tools related to the infrastructure conveyance and hydraulics theme. These needs and gaps were determined by subcommittee members.

Table 4 Build a Statewide Conveyance Database

Category: Data Scale: State Availability: Gap
Other Themes That Will Benefit: 4. Crop Suitability 5. Soils, Geology and Aquifer Characterization 6. Land Use Management 9. Environment 10. People and Water 11. Economic Analysis 13. Tool and Application Development
Implementation Factors: Primary – 4. Conveyance Secondary – 5. Site Suitability 8. Feasibility Analysis
Description, including Connection to Flood-MAR: A standardized statewide GIS database of conveyance networks (i.e., canals, pipelines, ditches, turnouts) that could potentially be used for Flood-MAR projects. The development of the database information would be prioritized toward most likely Flood-MAR project areas using information such as water available, soil and aquifer characteristics, land use, crop suitability, water rights, maintenance schedules, and other criteria.

Table 5 Investigate Sediment Transport Impacts on Conveyance and Streams

Category: Research

Scale: State

Availability: Gap

Other Themes That Will Benefit:

7. Water Quality
8. Recharge and Extraction Methods and Measures
9. Environment

Implementation Factors:

Primary – 4. Conveyance

Secondary – 3. Source Water
5. Site Suitability
6. Recharge Method
8. Feasibility Analysis

Description, including Connection to Flood-MAR:

Flood-MAR operations usually will use flood waters for recharge. Flood water potentially can carry large amounts of sediment and debris that typically would not go through local irrigation conveyance systems. The effect of this sediment and debris on the conveyance networks would need to be studied to determine possible impacts on operations and maintenance of the conveyance network and quality of the water as it is transported to the recharge areas, and how will Flood-MAR operations and sediment transport impact the maintenance schedules of irrigation conveyance. Also, the sediment transport and bedload movement dynamics and characteristics in streams that have Flood-MAR diversions may change because of difference in sediment volume or upstream flow and velocity. Part of this research may include assessing impacts of Flood-MAR operations on sediment and debris of Flood-MAR conveyance and looking at ways to mitigate the impacts.

Table 6 Develop LiDAR, Topography, and Bathymetry Data

Category: Research Scale: State Availability: Gap
Other Themes That Will Benefit: 6. Land Use Management 9. Environment 13. Tool and Application Development
Implementation Factors: Primary – 4. Conveyance Secondary – 5. Site Suitability
Description, including Connection to Flood-MAR: From the Statewide Conveyance Database, there may be areas that are determined to have potential for Flood-MAR projects but lack sufficient conveyance. High resolution LiDAR, topography, and bathymetry data could then be used to enhance the Statewide Conveyance Database and build hydraulic models and information for Flood-MAR projects. Development of this data would be prioritized toward most likely Flood-MAR project as determined by the Statewide Conveyance Database.

Table 7 Integrate Models for Analyzing Flood-MAR

Category: Tool

Scale: Sate/Regional/Local

Availability: Gap

Other Themes That Will Benefit:

1. Hydrology Observation and Prediction
2. Reservoir Operation
7. Water Quality
9. Environment
11. Economic Analysis
13. Tool and Application Development

Implementation Factors:

Primary – 4. Conveyance

Secondary – 8. Feasibility Analysis

Description, including Connection to Flood-MAR:

Integration of conveyance and hydraulics models with other models such as hydrologic, reservoir operation, water quality, groundwater flow, agricultural demand, environmental, and economic models. HEC-WAT potentially could be used to integrate these models onto a single platform to simplify and expedite the modeling process for Flood-MAR studies.

Table 8 Research Channel Erosion Potential because of Flood-MAR Operations

Category: Research Scale: State Availability: Gap
Other Themes That Will Benefit: 9. Environment 10. People and Water 12. Local, State, Federal Policies and Other Legal Constraints
Implementation Factors: Primary – 4. Conveyance Secondary – 8. Feasibility Analysis
Description, including Connection to Flood-MAR: With increased usage of irrigation conveyance for Flood-MAR, unlined canals and ditches may experience an increased potential for erosion. This project can help understand the potential erosion caused by Flood-MAR operations and recommend mitigation measures.

Prioritization Process

Criteria and Prioritization: Conveyance is one of the fundamental factors for implementing Flood-MAR. To that end, the research topics were prioritized based on importance toward implementation of Flood-MAR projects and shared benefit to other themes.

Top Three Research, Data, and Tools Actions

Priority 1: Build a Statewide Conveyance Database

Table 9 Build a Statewide Conveyance Database

Category: Data Scale: State Availability: Gap
Other Themes That Will Benefit: 4. Crop Suitability 5. Soils, Geology, and Aquifer Characterization 6. Land Use Management 9. Environment 10. People and Water 11. Economic Analysis 13. Tool and Application Development
Implementation Factors: Primary – 4. Conveyance Secondary – 5. Site Suitability 8. Feasibility Analysis
Description and Connection to Flood-MAR: A standardized statewide GIS database of conveyance networks (i.e., canals, pipelines, ditches, turnouts) that could potentially be used for Flood-MAR projects. The development of the database information would be prioritized toward most likely Flood-MAR project areas using information such as water available, soil and aquifer characteristics, land use, crop suitability, water rights, maintenance schedules, and other criteria. As conveyance is one of the implementation factors for Flood-MAR, a conveyance database would be essential to help inform implementors for Flood-MAR projects what potential conveyance is available to use and the characteristics of that conveyance. Data from this database could also be used to inform other themes of research and factors. A substantial amount of useful data for flood-mar projects could be filtered and contained in this database.

Draft Strategy for Implementation:

Product: A statewide GIS conveyance database prioritized by potential Flood-MAR implementation areas.

Implementation Lead: DWR.

Implementation Partners: USACE, counties, cities, other local agencies, and water districts. This work will need to be closely coordinated with other themes listed above to prioritize for the areas most suitable for the Flood-MAR implementation.

Estimated Timeline: 1 year for create of database; periodic maintenance and update to database afterward.

Draft Cost Estimate:

Coordination and Outreach: $10,000

Conveyance Data Collection: $40,000

Conveyance Database Development: $500,000

Total: $550,000

Priority 2: Investigate Sediment Transport Impacts on Conveyance and Streams

Table 10 Investigate Sediment Transport Impacts on Conveyance and Streams

Category: Research

Scale: State

Availability: Gap

Other Themes That Will Benefit:

7. Water Quality
8. Recharge and Extraction Methods and Measures
9. Environment

Implementation Factors:

Primary – 4. Conveyance

Secondary – 3. Source Water
5. Site Suitability
6. Recharge Method
8. Feasibility Analysis

Description and Connection to Flood-MAR:

Flood-MAR operations usually will use flood waters for recharge. Flood water potentially can carry large amounts of sediment and debris that typically would not go through local irrigation conveyance systems. The effect of this sediment and debris on the conveyance networks would need to be studied to determine possible impacts on operations and maintenance of the conveyance network and quality of the water as it is transported to the recharge areas, and how will Flood-MAR operations and sediment transport impact the maintenance schedules of irrigation conveyance. Also, the sediment transport and bedload movement dynamics and characteristics in streams that have Flood-MAR diversions may change because of difference in sediment volume or upstream flow and velocity. Beyond that, potential impacts to water quality, recharge methods, and land use created by increased sediment loads on agricultural lands and working landscapes would be to be considered. Part of this research may need to examine ways to remove the sediment and debris from the water before or during Flood-MAR operations.

Draft Strategy for Implementation:

Product: A report or data on sediment transport impacts resulting from Flood-MAR operations.

Implementation Lead: Academia or local agencies.

Implementation Partners: DWR, USACE, local agencies, academia.

Estimated Timeline: 6 to 12 months per specific research location.

As a research topic, this action could be undertaken by academia looking at general effects of sediment transport. Or this action could be undertaken by local agencies investigating sediment transport on their specific streams and conveyance systems. Pilot studies for a few representative conveyance channels need to be conducted.

Draft Cost Estimate:

Select pilot conveyance channels (coordination with willing local agencies): $10,000

Monitor and collect data: $50,000

Assess sediment and debris impact: $50,000

Develop mitigation measures: $10,000

Total: $120,000

Priority 3: Develop LiDAR, Topography, and Bathymetry Data

Table 11 Develop LiDAR, Topography, and Bathymetry Data

Category: Data Scale: State Availability: Gap
Other Themes That Will Benefit: 6. Land Use Management 9. Environment 13. Tool and Application Development.
Implementation Factors: Primary – 4. Conveyance Secondary – 5. Site Suitability
Description and Connection to Flood-MAR: As determined by the Statewide Conveyance Database, areas may have potential for Flood-MAR projects but lack sufficient conveyance. High-resolution light detection and ranging (LiDAR), topography, and bathymetry data could then be used to enhance the Statewide Conveyance Database and build hydraulic models and information for Flood-MAR projects. Development of this data would be prioritized toward most likely Flood-MAR project as determined by the Statewide Conveyance Database.
Draft Strategy for Implementation: Product: LiDAR, topography, and bathymetry data prioritized by potential Flood-MAR implementation areas. Implementation Lead: Local agencies Implementation Partners: DWR, USACE, Bureau of Land Management Estimated Timeline: Multi-year effort This effort most likely would be implemented by a local agency or stakeholder. It would be specific to a proposed location and Flood-MAR project, and data collection would need to be implemented by the local agency or stakeholders. Local agencies or stakeholder could partner with a state agency, other local agencies, and academia to share the data collected and costs.
Draft Cost Estimate: LiDAR data collection and processing: $500,000 (assuming $1,000/square mile for 500 square miles). Bathymetric Data Collection and Processing: $500,000 (assuming 2,000 x-sections) **Total: $1,000,000**