CALIFORNIA DEPARTMENT OF WATER RESOURCES

Modeling Study Protocols used by the California Department of Water Resources

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A Pilot Study Assessing Data and Tools Alignment in Integrated Watershed Programs of the California Department of Water Resources

can inform Modeling Study Protocols

Need for Data and Tools Alignment

- Advance integration of flood, water supply, and groundwater modeling & analyses
- Increase consistency of the Department's data and tools organization and analyses
- Improve program implementation by avoiding redundancies and leveraging expertise from the Department's diverse programs
- Provide consistent data, tools, and analyses to interested parties

A Pilot Study was conducted

to assess, understand, and explore opportunities for data and tools alignment within the Department's Integrated Watershed Programs:

- Discovery Process
- Findings
- Recommendations

Discovery Process

Five plan or program elements were assessed to explore opportunities for data and tools alignment:

Plan/Program Element	Purpose of Plan/Program Element
California Water Plan (CWP) Current Conditions Analysis	Develop annual statewide data on water supplies and water uses.
CWP Future Scenarios Analysis	Conduct strategic water resources assessment for the state.
Central Valley Flood Protection Plan (CVFPP)	Conduct flood risk (flood damage and life risk) evaluation and provide recommendations for project-level actions.
Conservation Strategy – CVFPP	Assess integration of ecological restoration with flood risk reduction projects.
DWR Climate Action Plan Phase III	Assess State Water Project's vulnerability and adaptation strategies for addressing climate change impacts.

Discovery Process

The assessment focused on four areas:

Focus Area	Topics
General Considerations	Purpose, Outcomes, Planning and Analysis Horizon, Geographic Domain of Analysis, Common Assumptions

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Data	Population, Land Use, Hydrology, Hydraulics, Soil and Geotechnical, Environmental, and Economics

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General Considerations	Purpose, Outcomes, Planning and Analysis Horizon, Geographic Domain of Analysis, Common Assumptions
Data	Population, Land Use, Hydrology, Hydraulics, Soil and Geotechnical, Environmental, and Economics
Model	Hydrologic, Hydraulic, Inland Climate Change and Sea Level Rise, Ecosystems, and Economics

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General Considerations	Purpose, Outcomes, Planning and Analysis Horizon, Geographic Domain of Analysis, Common Assumptions
Data	Population, Land Use, Hydrology, Hydraulics, Soil and Geotechnical, Environmental, and Economics
Model	Hydrologic, Hydraulic, Inland Climate Change and Sea Level Rise, Ecosystems, and Economics
Analyses	Water Supply, Water Use, Flood Flow, Groundwater, Ecosystem, Economics, Reporting of Results, and Common Recommendations

Findings: Illustrated through Assessment Examples on

- General Considerations
- Data
- Model
- Analyses

Findings: General Considerations Assessment Examples

Table A-1 General Considerations – Purpose and Outcomes

Plan or Program	Purpose	Outcomes
CWP Current Conditions	Develop annual statewide data on water supplies and water uses	Understanding recent statewide water supplies and uses
CWP Future Scenarios	Conduct strategic water resources assessment for the state	Planning for sustainability and resilience of future water resources
CVFPP	Conduct flood risk (flood damage and life risk) evaluation and provide a suite of recommendations for project-level actions	Mitigating flood risks
Conservation Strategy	Assess integration of ecological restoration with flood risk reduction projects	Enhancing ecosystem functions in floodplains
DWR Climate Action Plan Phase III	Assess SWP's vulnerability and adaptation strategies for addressing climate change impacts	Improving SWP's climate resilience (plan is broader but this is the focus for this effort)

Findings: General Considerations Assessment Examples

Table A-2 General Considerations — Planning and Analysis Horizon, Modeling Timestep, and Regional Scale

Plan or Program	Planning and Analysis Horizon	Modeling Timestep	Regional Scale
CWP Current Conditions	5 years (2015–2020) Past data available from 1998	Not Applicable	Statewide
CWP Future Scenarios	50 years (2020–2070)	Monthly	Sacramento River, San Joaquin River, Tulare Lake, & San Francisco Bay HRs
CVFPP	50 years (2022–2072)	Hourly or daily	Sacramento River & San Joaquin River HRs
Conservation Strategy	50 years (2022–2072)	Hourly or daily	Sacramento River & San Joaquin River HRs
DWR Climate Action Plan Phase III	65 years (2020–2085)	Monthly	Statewide (where SWP facilities are operated)

Table a-2 note: HR = hydrologic region

Findings: Data Assessment Examples

Table A-3 Data – Population

Plan or Program	Population Data
CWP Current Conditions, CWP Future Scenarios, CVFPP, Conservation Strategy	All use annual population data developed by the U.S. Census, the Department of Finance, American Community Survey data, and the Nielsen Clarita's method. DWR's demographer manages the four data sources.
DWR Climate Action Plan Phase III	Population data not used. It uses the CVP and SWP contractors' demands and full buildout conditions; the demands are fixed and do not change with population changes.

Plan or Program	Hydrology Data
CWP Current Conditions	• Precipitation from Parameter-elevation Regressions on Independent Slopes Model (PRISM). • Evapotranspiration from spatial California Irrigation Management Information System (CIMIS). • Stream flow and reservoir operations data. • Daily, monthly, and annual data are used in various combinations for determining the annual data used for analysis.
CWP Future Scenarios	1,100 years of tree-ring based Paleo-constructed monthly climate temperature and precipitation sequences perturbed on historical hydrology.
CVFPP	Historical hourly and daily stream gauge data for gauged watersheds. Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) simulated flow for ungauged watersheds. Monthly statistics of precipitation and temperature sequences from climate change scenarios are applied to the daily observed data to evaluate climate change.
Conservation Strategy	Indirectly uses the same hydrologic data set used in the CVFPP.
DWR Climate Action Plan Phase III	1,100 years of tree-ring based Paleo-constructed monthly climate temperature and precipitation sequences perturbed on historical hydrology.

Findings: Data Assessment Examples

Table A-7 Data — Soils and Geotechnical

Plan or Program	Soils and Geotechnical
CWP Current Conditions	Soil physical property data as input into the California Simulation of Evapotranspiration of Applied Water (Cal-SIMETAW) model for estimating agricultural water use.
CWP Future Scenarios	Soil physical property data as input into the Water Evaluation and Planning (WEAP) model for generating inflow to the Central Valley rim reservoirs.
CVFPP	• Levee-fragility curves based on the 2017 CVFPP Update used for existing (2022) conditions. • Levee-fragility curves based on future projects identified in 2017 CVFPP Update used for future (2072) conditions. Where available, more recent information is used to update these levee-fragility curves. • Soil properties data are used in the Variable Infiltration Capacity (VIC) model for generating inflow to the Central Valley rim reservoirs.
Conservation Strategy	Not applicable
DWR Climate Action Plan Phase III	Soil properties data as input into the Sacramento Soil Moisture Accounting (SAC-SMA) model to generate inflow to the Central Valley rim reservoirs.

Table A-8 Data — Ecosystem

Plan or Program	Ecosystem Data
CWP Current Conditions	Environmental flow requirements used for Wild and Scenic River flow, instream flow, and Bay-Delta outflow. Daily, monthly, and annual data are used in various combinations for ultimately using annual data for analysis.
CWP Future Scenarios	Monthly data for instream flow requirements and Bay-Delta standards.
CVFPP	Ecosystem data not used, covered in Conservation Strategy.
Conservation Strategy	Fine-scale riparian vegetation that is updated approximately every 10 years, with minimum mapping unit of one acre and average width of more than 10 meters.
DWR Climate Action Plan Phase III	Monthly data for instream flow requirements and Bay-Delta standards.

Findings: Model Assessment Examples

Plan or Program	Hydrologic Models
CWP Current Conditions	PRISM used for precipitation data. Cal-SIMETAW model used for agriculture water use and managed wetlands water use. DAYFLOW used for total Delta outflow calculation, and inflow-outflow water balance workbooks for developed water supply and use balances.
CWP Future Scenarios	WEAP model is used as an integrated watershed, operations, and groundwater model for simulating upper watersheds, reservoirs, streams, and the groundwater system.
CVFPP	Hydrologic Engineering Center Reservoir System Simulation (HEC-ResSim) operations model and the Hydrologic Engineering Center's River Analysis System (HEC-RAS) routing models used for translating unregulated to regulated flows. HEC-HMS used for ungauged watersheds. VIC used to evaluate the hydrologic response for existing (2022) and future (2072) low, medium, and high climate-change scenarios of precipitation and temperature.
Conservation Strategy	Hydrologic modeling results used from the CVFPP.
DWR Climate Action Plan Phase III	SAC-SMA used for simulating upper watersheds CalLite model is used for operations to assess SWP's vulnerability.

Findings: Model Assessment Examples

Table A-13 Models — Ecosystem

Plan or Program	Ecosystem Models
CWP Current Conditions	Not applicable.
CWP Future Scenarios	No dedicated ecosystem model is used. The WEAP model incorporates in-stream flow requirements, delivery to managed wetlands, and Bay-Delta flow objectives.
CVFPP	Ecosystem modeling not used, covered in Conservation Strategy.
Conservation Strategy	Floodplain inundation potential model used.
DWR Climate Action Plan Phase III	No dedicated ecosystem model is used. The CalLite model incorporates instream flow requirements and Bay-Delta flow objectives.

Table A-14 Models — Economics

Plan or Program	Economics Models
CWP Current Conditions	Economics modeling not used.
CWP Future Scenarios	Economics modeling not used.
CVFPP	HEC-FDA used for flood damage and life loss analyses. HEC-LifeSim used for life loss (urban areas and some small communities) analysis. Impact Analysis for Planning (IMPLAN) used for regional, secondary economic impacts analysis.
Conservation Strategy	Not applicable.
DWR Climate Action Plan Phase III	Economics modeling not used.

Findings: Analyses Assessment Examples

Table A-15 Analyses — Water Supply

Plan or Program	Water Supply Analyses
CWP Current Conditions	The analyses include estimation of dedicated and developed water supplies including surface water, groundwater, reused water, and recycled water.
CWP Future Scenarios	The water resource vulnerability metrics include sustainable supply, end of water year and stressed end of April surface water storage, and average surface-water-to-groundwater ratio.
CVFPP	Not applicable.
Conservation Strategy	Not applicable.
DWR Climate Action Plan Phase III	SWP vulnerability assessment includes SWP deliveries and reservoir storage in April and September.

Table A-17 Analyses — Flood Flow

Plan or Program	Flood Flow Analyses
CWP Current Conditions	No flood flow analysis is conducted.
CWP Future Scenarios	The flood risk vulnerability metrics include seasonal volume changes at control points.
CVFPP	Flood flow analyses include regulated riverine and Delta flow-frequency, flow-stage transforms, and stage-frequency relationships.
Conservation Strategy	Flood-flow inundation potential analysis is conducted.
DWR Climate Action Plan Phase III	No dedicated flood-flow analysis is conducted; in-lieu of that, a reference to related CVFPP 2017 flood-flow analysis is provided.

Findings: Analyses Assessment Examples

Table A-19 Analyses — Ecosystem

Plan or Program	Ecosystem Analyses
CWP Current Conditions	Ecosystem-related analyses consider water used to manage wetlands, minimum required Bay-Delta outflow, instream flow requirements, and flow for rivers and river-reaches designated Wild and Scenic.
CWP Future Scenarios	The vulnerability metrics include average March–September in-stream flow buffer and intensity of dry periods.
CVFPP	No ecosystem-related analysis is conducted.
Conservation Strategy	Ecosystem analysis to achieve measurable objectives for specific ecosystem functions and habitats is conducted.
DWR Climate Action Plan Phase III	Seasonal net Delta outflow is analyzed as a proxy to meet ecosystem flow targets and to conduct a qualitative assessment of exposure and sensitivity on ecosystems.

Table A-22 Analyses — Common Recommendations

Plan or Program	Common Recommendations
CWP Current Conditions	Program makes recommendations to improve data, tools, and analysis. Program does not make any policy recommendations.
CWP Future Scenarios	Program makes recommendations to improve data, tools, and analysis. It also informs the broad statewide and regional policy recommendations for sustainable and resilient water management included in the CWP. Program does not make any specific policy recommendations.
CVFPP	Plan includes recommendations on potential structural and non-structural measures that reduce flood risk while incorporating ecosystem and other benefits.
Conservation Strategy	Plan includes recommendations on how to achieve ecosystem benefits from flood projects.
DWR Climate Action Plan Phase III	Plan provides analysis, research, and evaluations to inform policy recommendations on SWP vulnerabilities and adaptation strategies. Plan does not make any specific policy recommendations.

Recommendations to Advance Alignment of Data and Tools

1. **Convene a Community of Practice**
2. Establish a communication structure
3. Develop and maintain a Catalogue of Information (body of knowledge)
4. Establish consistent standards and methods for using data and tools
5. Bridge the timestep gap between water supply and flood modeling
6. Pilot an Integrated Analyses Environment

Recommendations to Advance Alignment of Data and Tools

1. **Convene a Community of Practice**
   - A community of practice that uses data and tools to sustain long-term alignment in planning activities within the Department.
   - A community with specific roles in developing various programs and plans, meeting regularly to ensure continuous improvement and alignment of data and tools.

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Recommendations to Advance Alignment of Data and Tools

2. Establish a communication structure

- A communication structure that encourages the discussion and sharing of data and tools among the Department's plans and programs.
- The communication structure will clarify information flows
  - from programs responsible for the production (e.g., groundwater level measurements) or ingestion of data (e.g., GSP annual reports)
  - to programs that need that data in their work (e.g., groundwater model calibration).

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Recommendations to Advance Alignment of Data and Tools

3. **Develop and maintain a Catalogue of Information (body of knowledge)**
   - A catalog of data and tools, including information on custodians of the data and tools available, on the Assembly Bill 1755 Open Water Data Platform.
   - Build on existing efforts like the Delta Stewardship Council (DSC)'s Integrated Modeling Steering Committee (IMSC) online modeling inventory.

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Recommendations to Advance Alignment of Data and Tools

4. Establish consistent standards and methods for using data and tools

- Consistent planning horizon.
- Consistent population, land use, crops, precipitation, streamflow, water supply, water use.
- Baseline hydrologic data set that accounts for climate change that has already occurred.
- Consistent data, tools, and performance indicators for climate change analyses.
- Consistent reporting of similar sets of outcomes and findings by plans and programs.
- Synthesis of information and outcomes generated by other plans in Water Plan.

Recommendations to Advance Alignment of Data and Tools

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4. Establish consistent standards and methods for using data and tools
5. **Bridge the timestep gap between water supply and flood modeling**
6. Pilot an Integrated Analyses Environment

Recommendations to Advance Alignment of Data and Tools

5. Bridge the timestep gap between water supply and flood modeling

- This is critical because:
  - Integrating flood, water supply, and groundwater modeling and analyses is essential to effectively manage flood risks, water supply, and groundwater resources.
  - Many of the key adaptation strategies to meet future water resource challenges including the implementation of the SGMA focuses using floodwaters to increase recharge to augment water supply as a climate change and drought adaptation strategy.
  - Meeting ecosystem needs effectively also requires bridging water supply and flood modeling.

Recommendations to Advance Alignment of Data and Tools

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2. Establish a communication structure
3. Develop and maintain a Catalogue of Information (body of knowledge)
4. Establish consistent standards and methods for using data and tools
5. Bridge the timestep gap between water supply and flood modeling
6. **Pilot an Integrated Analyses Environment**

Recommendations to Advance Alignment of Data and Tools

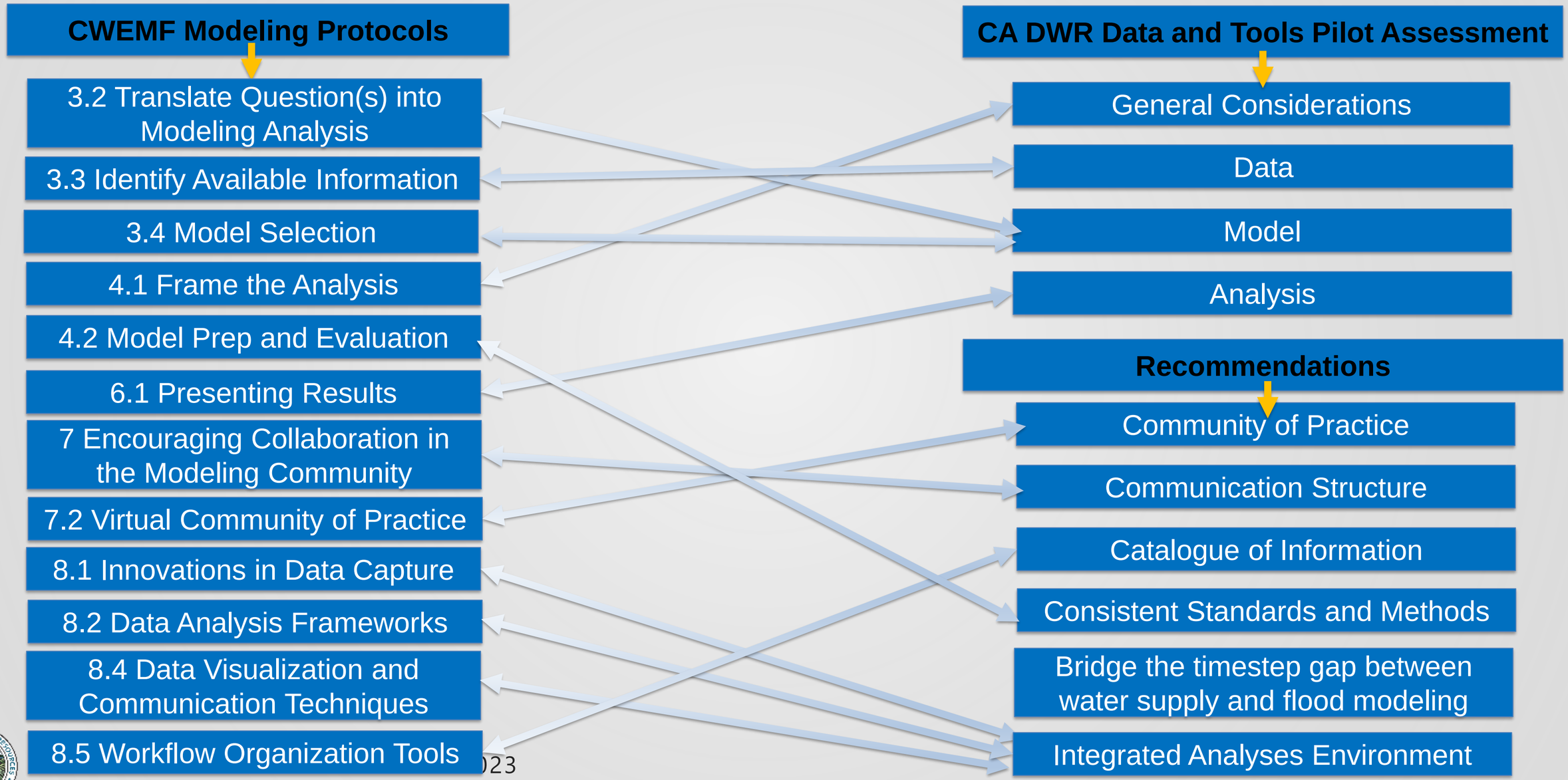
6. Pilot an Integrated Analyses Environment

- A collaboratively developed pilot integrated analyses environment for data and tools, consisting of
  - a data management system,
  - a model management system, and
  - a GIS-based map management system.

Near-term Progress

- A community of practice (Data and Tools Alignment Subcommittee) under the Open Data Information Working Group using the Department's existing organizational structure of the Environmental Coordination Committee.
- Water Resources Engineering Memorandum (WREM) for consistent climate change analysis in the Department's planning studies.
- Baseline climate adjusted hydrologic data via detrending of historical data to account for the climate change that has already occurred.
- Consistent water accounting through a systems approach, common vocabulary, and standardized templates for organizing water budget data and information (Water Budget Handbook).

Potential Touch Points



Thank You!