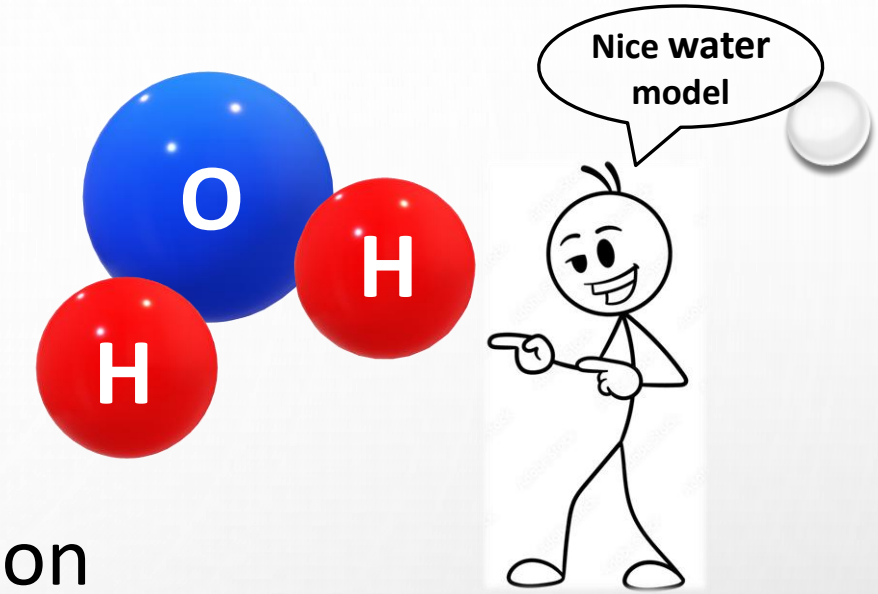
Role of Models in California Water

September 23, 2024

MBK ENGINEERS

Topics



- Role of Models in California Water
  - Historical role of models and evolution
    - Type
    - Application
  - Current role of models
  - Role of models in the future

Role of Models

- The purpose of water resource systems planning and management modeling is to provide useful and timely information to those involved in managing such systems.

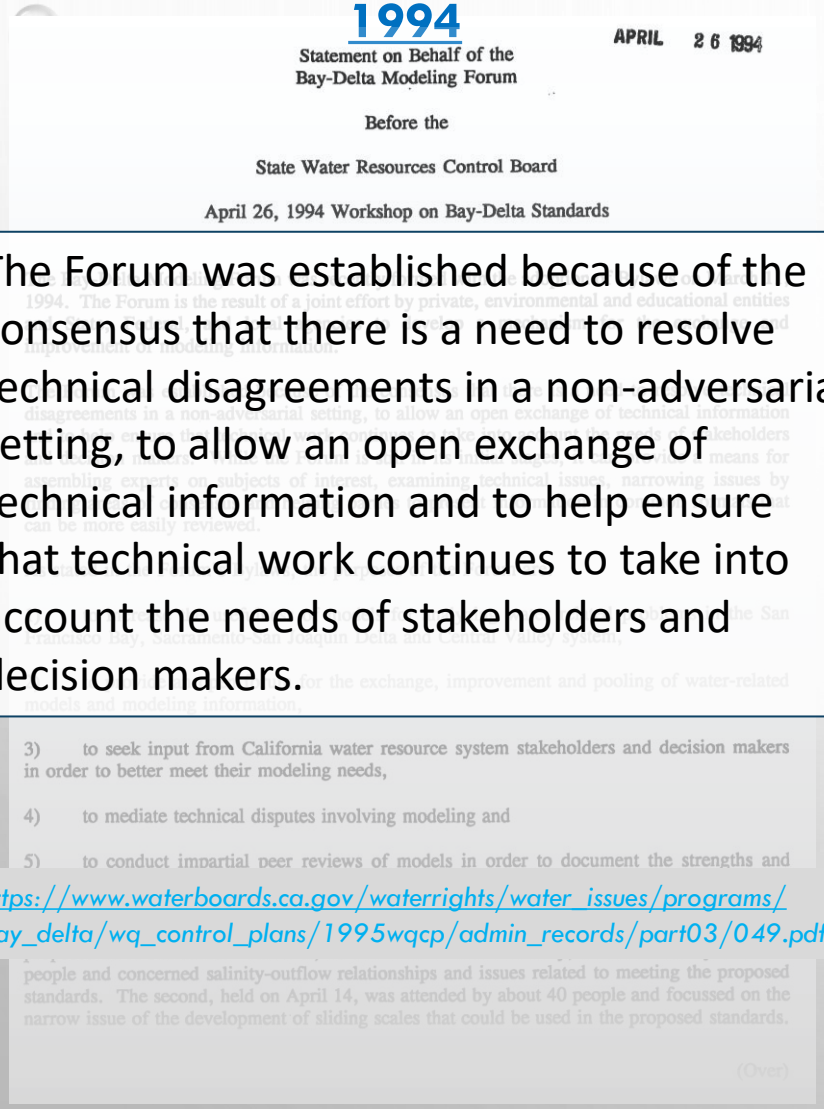
- The aim of analysts is to provide meaningful (understandable), useful, accurate, and timely information. This information is to help better understand the system, its problems, and alternative ways to manage.

Use of Models

- Provide information to decision makers
- Facility planning
- Operations planning
- Salinity management
- Environmental assessment and compliance
- Effects of regulatory changes
- Evaluate vulnerability and adaptation to climate change
- Effects of changes to:
  - Fishery
  - Hydropower
  - Water quality
  - Water supply
  - Economic
  - Recreation
  - Many more
- To play with and develop more sophisticated models
- Many others

CWEMF (Bay-Delta Modeling Forum) When, What, Why, How

1994



Statement on Behalf of the
Bay-Delta Modeling Forum

APRIL 26 1994

Before the

State Water Resources Control Board

April 26, 1994 Workshop on Bay-Delta Standards

The Forum was established because of the consensus that there is a need to resolve technical disagreements in a non-adversarial setting, to allow an open exchange of technical information and to help ensure that technical work continues to take into account the needs of stakeholders and decision makers.

3) to seek input from California water resource system stakeholders and decision makers in order to better meet their modeling needs,

4) to mediate technical disputes involving modeling and

5) to conduct impartial peer reviews of models in order to document the strengths and

people and concerned salinity-outflow relationships and issues related to meeting the proposed standards. The second, held on April 14, was attended by about 40 people and focussed on the narrow issue of the development of sliding scales that could be used in the proposed standards.

(Over)

https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/1995wqcp/admin_records/part03/049.pdf

Current Mission Statement

Mission Statement – cwemf (https://cwemf.org/wp/about-2/mission-governance/mission-statement/)

CWEMF is a non-profit, non-partisan organization whose mission is to increase the usefulness of models for analyzing California's water & environment related problems.

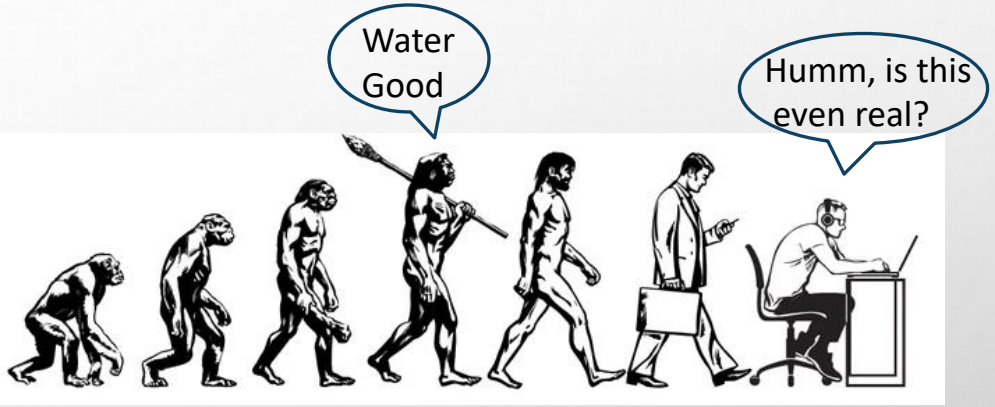
Protocols for Water and Environmental Modeling November 19, 2021

Microsoft Word - Modeling Protocols Report 11-19-2021.docx (cwemf.org)

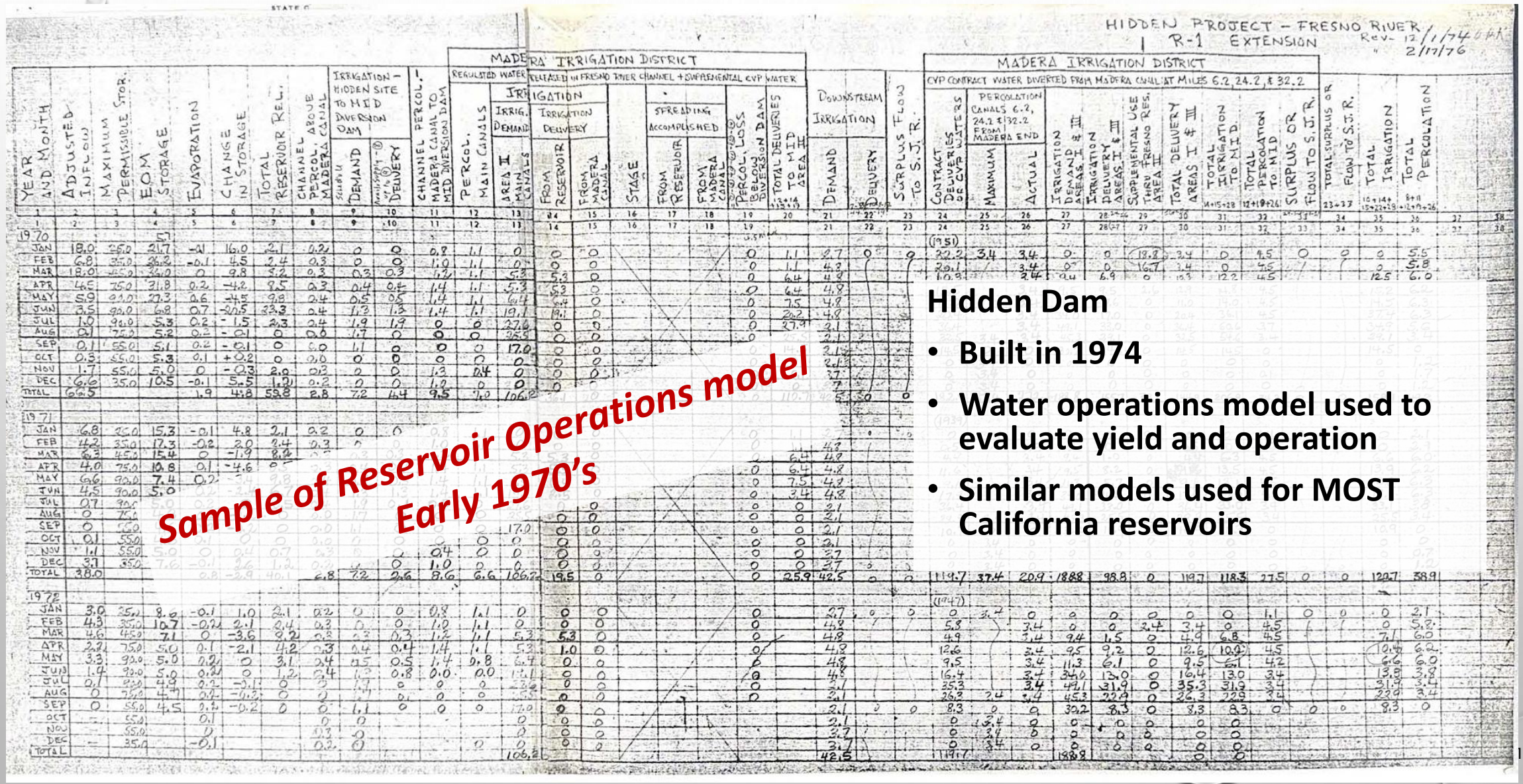
https://cwemf.org/wp/wp-content/uploads/2021/11/Modeling-Protocols-Report-Final-11-19-2021.pdf

Role of Models
Historical Perspective

- Role and use of models in California water has evolved over the past 40 years
- Influenced by:
  - Computing power, technology
  - Software development
  - Internet and availability of data
  - Questions / needed information has evolved
    - Societal values and priorities have evolved
- *Reliance more on models and less on studying system*



Timeline / Model Evolution
Pre-1970s



Hidden Dam

- **Built in 1974**
- **Water operations model used to evaluate yield and operation**
- **Similar models used for MOST California reservoirs**

Timeline / Model Evolution
1970's and 1980's

Computer Punch Card

FORTRAN 4 – Mainframe computer

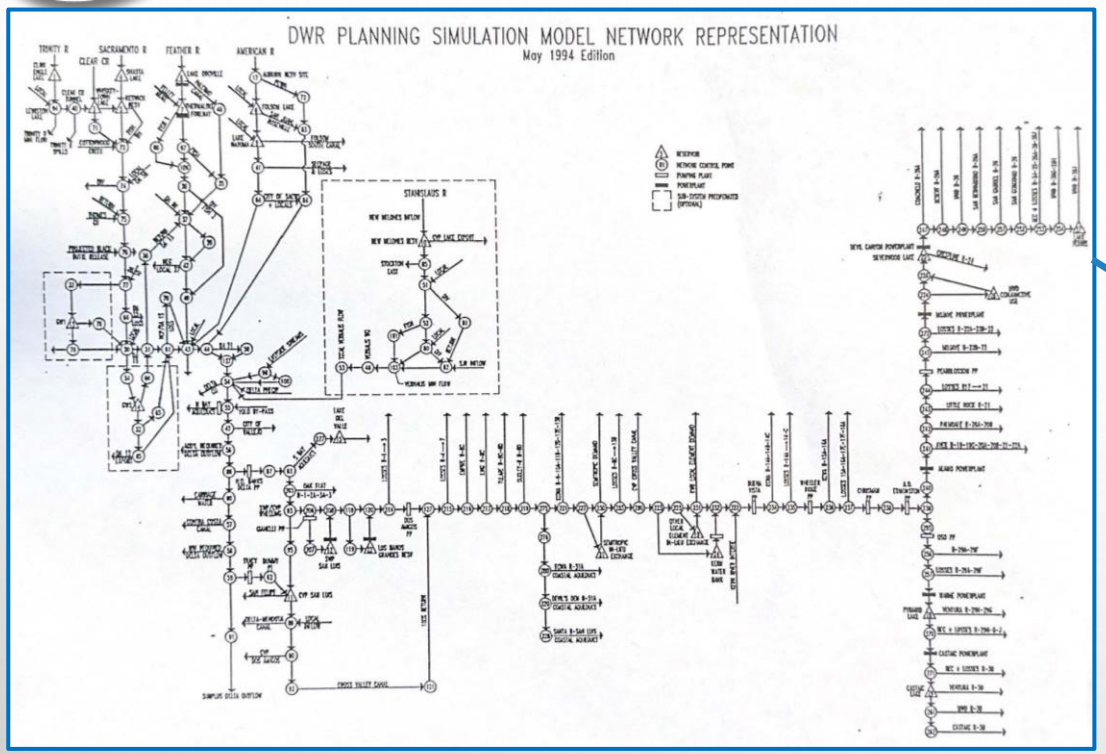
STUDY NO.USCAL-3-82

MONTH	CLAIR ENGLE RESERVOIR (STUDY #2) INFLOW	RELEASE	EVAP	EOM STORAGE	ACCR TO LEWISTN	FLOW BELOW LEWISTN	EXPORT TO CARR PH		WHISKEYTOWN RESERVOIR (STUDY #2) CLEAR CREEK INFLOW	EVAP	CLEAR CREEK RELEASE	EOM STORAGE	EXPORT TO KESWICK	MODIFICATION FOR STUDY #3 MOD TO EXPORT	EXPORT TO KESWICK
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1927-28															
OCT	12	95	1	2065	0	12	83		2	0	7	241	78	0	78
NOV	73	41	-3	2100	4	15	90		13	0	8	214	62	0	62
DEC	41	47	-6	2100	2	12	37		6	0	10	187	60	0	60
JAN	76	78	0	2100	4	9	73		21	0	5	187	89	0	89
FEB	127	127	0	2100	6	9	124		28	0	3	187	149	0	149
MAR	217	0	0	2317	11	9	2		49	0	3	214	21	0	21
APR	187	56	0	2448	9	9	56		20	0	5	241	44	0	44
MAY	194	188	6	2448	10	9	169		12	1	8	241	192	0	192
JUN	48	49	8	2439	2	9	42		3	2	10	241	33	37	70
JUL	17	126	11	2319	1	9	118		2	2	10	241	108	42	150
AUG	7	110	9	2207	1	9	102		0	2	8	241	92	22	114
SEP	6	117	6	2090	1	9	109		1	1	7	241	102	11	113
TOTAL	1007	1034	32		51	120	965		157	8	84		1030	112	1142
1928-29															
OCT	9	97	1	2001	0	12	85		1	1	6	241	79	5	84
NOV	22	22	-3	2004	2	15	9								
DEC	25	42	-6	1993	1	12	31								
JAN	28	52	0	1969	2	9	45								
FEB	45	18	0	1996	2	9	11								
MAR	80	31	0	2045	4	9	26								
APR	75	43	0	2077	4	9	38								
MAY	130	34	6	2176	7	9	32								
JUN	57	45	8	2180	2	9	38								
JUL	14	110	11	2073	1	9	102								
AUG	5	110	9	1959	1	9	102								
SEP	4	125	6	1832	0	9	116								
TOTAL	503	729	32		26	120	635								
1929-30															
OCT	7	109	1	1729	1	12	98								
NOV	7	52	-3	1687	0	15	37								
DEC	146	5	-5	1833	7	12	0								
JAN	39	18	0	1854	2	9	11								
FEB	116	3	0	1967	6	9	0								
MAR	145	9	0	2103	7	9	7								
APR	152	17	0	2238	8	9	16								
MAY	98	26	6	2304	5	9	22								
JUN	41	76	8	2261	3	9	70								
JUL	12	110	11	2652	1	9	102								
AUG	6	111	9	2039	0	9	102								
SEP	6	123	6	1915	0	9	114								
TOTAL	775	659	33		40	120	579								

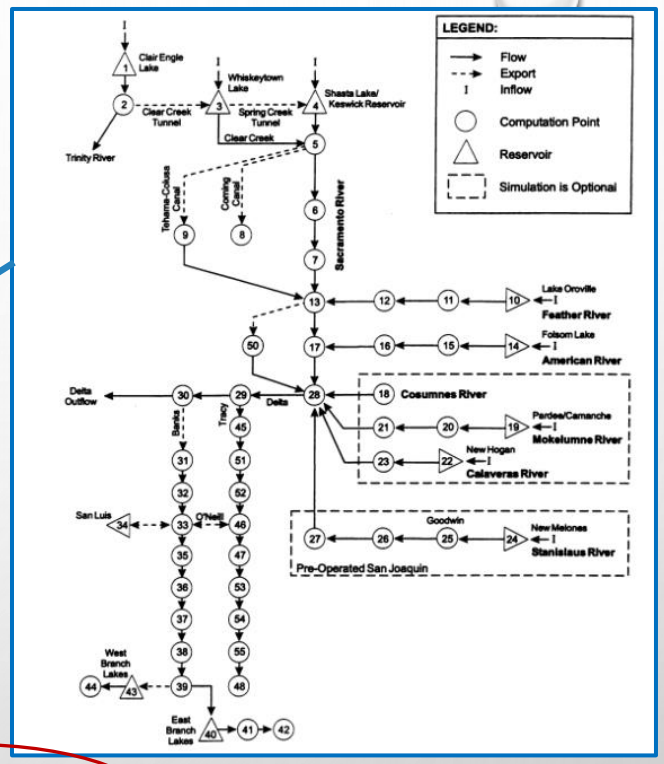
- Used for planning studies
  - Assess Project yield
- Water right settlement (COA)

CVP / SWP Planning Models 1990's

DWR - DWRSIM



Reclamation - PROSIM



CalSim
Joint DWR/Reclamation

- DWRSIM was converted from mainframe to PC and became public in ≈1990
  - Still used card image format (late 1990's)
- Both models used for EIR/EIS support, yield assessment, facility planning, more
- DWR and Reclamation cooperated to develop joint model
  - True spirit of CWEMF

Role of Models

- Past (more than 25 years ago)
  - How much storage do we need to fully meet demands?
  - How much water do we need to meet Delta water quality?
  - Other
- Recent Past (past 25 years)
  - How do we manage our water system?
  - How do we operate to protect fisheries?
  - How do we manage salinity?
  - Evaluation of tradeoffs
  - Effects analysis
  - Other

Tradeoffs

Water Deliveries	Delta Outflow
Delta Flow Requirements	Upstream Environmental Benefit
CVP North of Delta Delivery	CVP South of Delta Delivery
Shasta Storage	Folsom Storage
Oroville Storage	SWP SOD Storage
Urban water supply	Agricultural water supply
North of Delta Storage	South of Delta Storage
Stream Temperature	Stream Habitat
Stream Temperature	Spring Flows
Power	Water Supply
Power	Spring time releases
Species A	Species B
Salmon Habitat	Delta Smelt Flow Criteria
Delta Salinity in Sacramento R.	Delta Salinity in San Joaquin River
American River fishery	Sacramento River fishery
Fall period flows	Spring time flows
Average annual water supply	Dry year water supply reliability

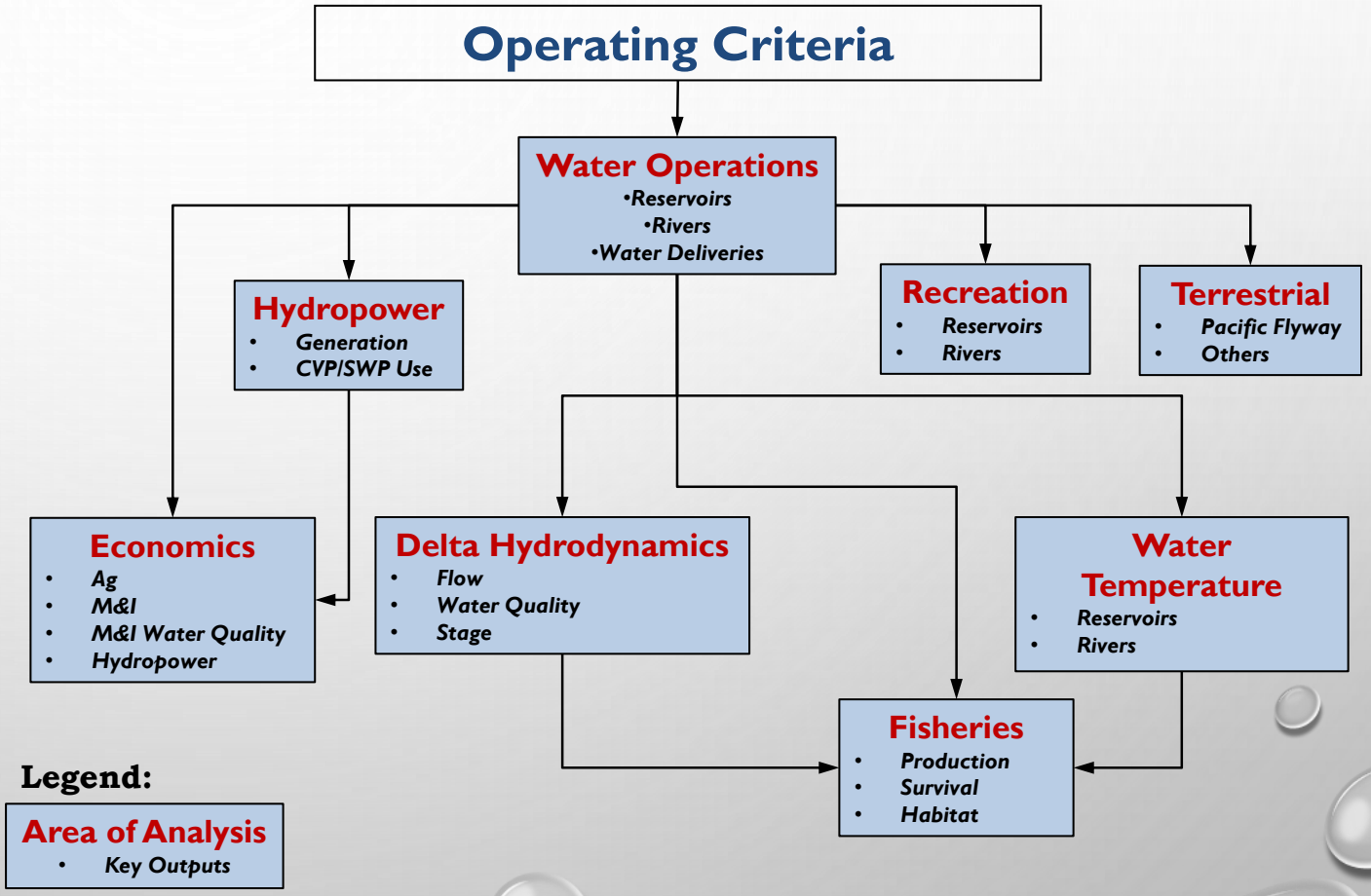
Types and Use of Mathematical Models Used in Bay-Delta Watershed

Model Types

- Operations forecasting
- Precipitation
- Land use process
- Climate models
- GIS
- Flood models
- Groundwater
- Hydrodynamic
- Hydraulic
- Biological
- Economic
- Water temperature
- Water quality
- Demand projection models
- Reservoir operations
- Flood MAR
- **Others (audience input)**

*Not including computational methods

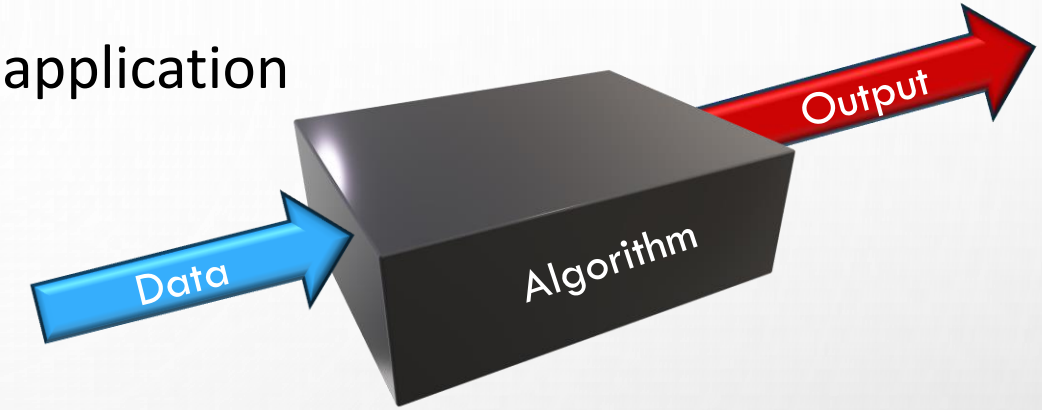
Water operations perspective



Role of Model Components

3 basic components are important to model application

1. Data
2. Algorithms
3. Modeler



Data

- Models should not go beyond the data
  - Data is the foundation of models
  - Reliability of model results is limited to quality of data

Algorithms

- How data are used to represent system being modeled
- Must know how actual system works

Role of Model Components - *Continued*

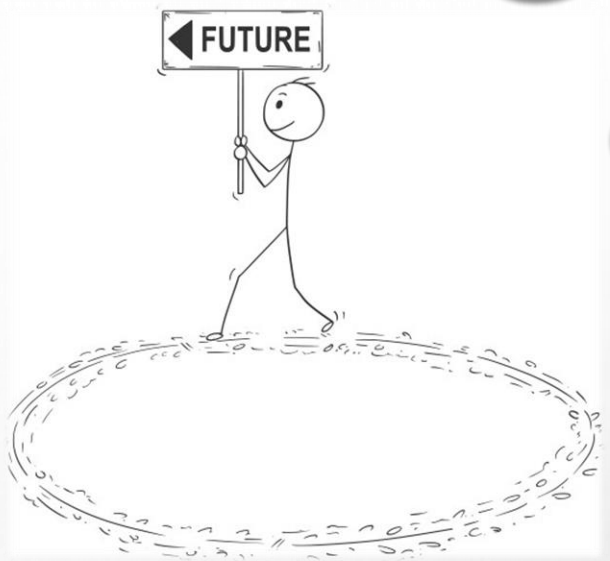
Role of Modeler

- Modelers are responsible for providing information that is:
  - Meaningful (understandable),
  - Useful,
  - Accurate, and
  - Timely.

Modelers are responsible for:

- Understanding the system they are modeling and ensuring models adequately represent system
- Understanding and responding to the questions they are being asked and providing answers
  - I need more money to build a more sophisticated model is NOT an answer, we need to be useful!
- Disclosing model accuracy, what is the appropriate use of model results
- Honesty, modelers need to be objective
- Transparency, not hiding behind the complexity of models when communicating to non-modelers
- Modelers need to provide information when needed

Future Role of Models



- Questions will change
- Greater demand with possibly less water
  - Tradeoffs become more difficult
- More:
  - Model runs
  - Increased level of detail
  - More data
  - Increased sophistication
    - AI?
  - More modelers
  - More decision makers with less time to understand complexity of California water
- Important that modelers can relate models to real system and real decisions

Questions

Thank You