

Managing for Water Supply and Ecological Flows

Maine Water Conference

Augusta, Maine

March 21, 2007



SAVING THE LAST GREAT PLACES ON EARTH



Project Team:

Mark P. Smith and Colin Apse,
The Nature Conservancy

Brian Joyce and Jack Sieber,
Stockholm Environment Institute

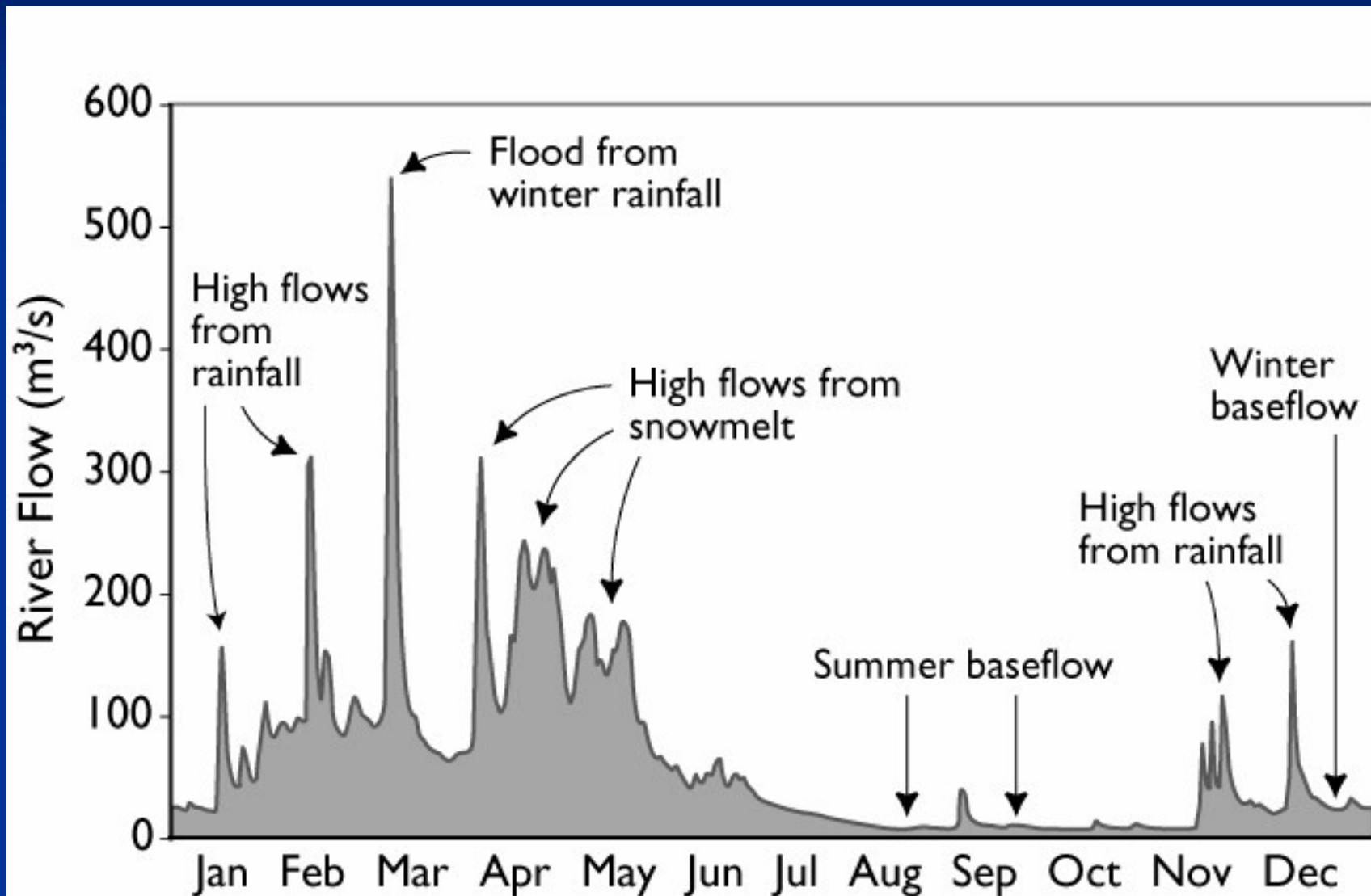
Richard Vogel, Stacey Archfield and
Yongxuan Gao, Tufts University



SAVING THE LAST GREAT PLACES ON EARTH



Natural Variability



Project Context

Natural variations in precipitation can result in problems for water supplies



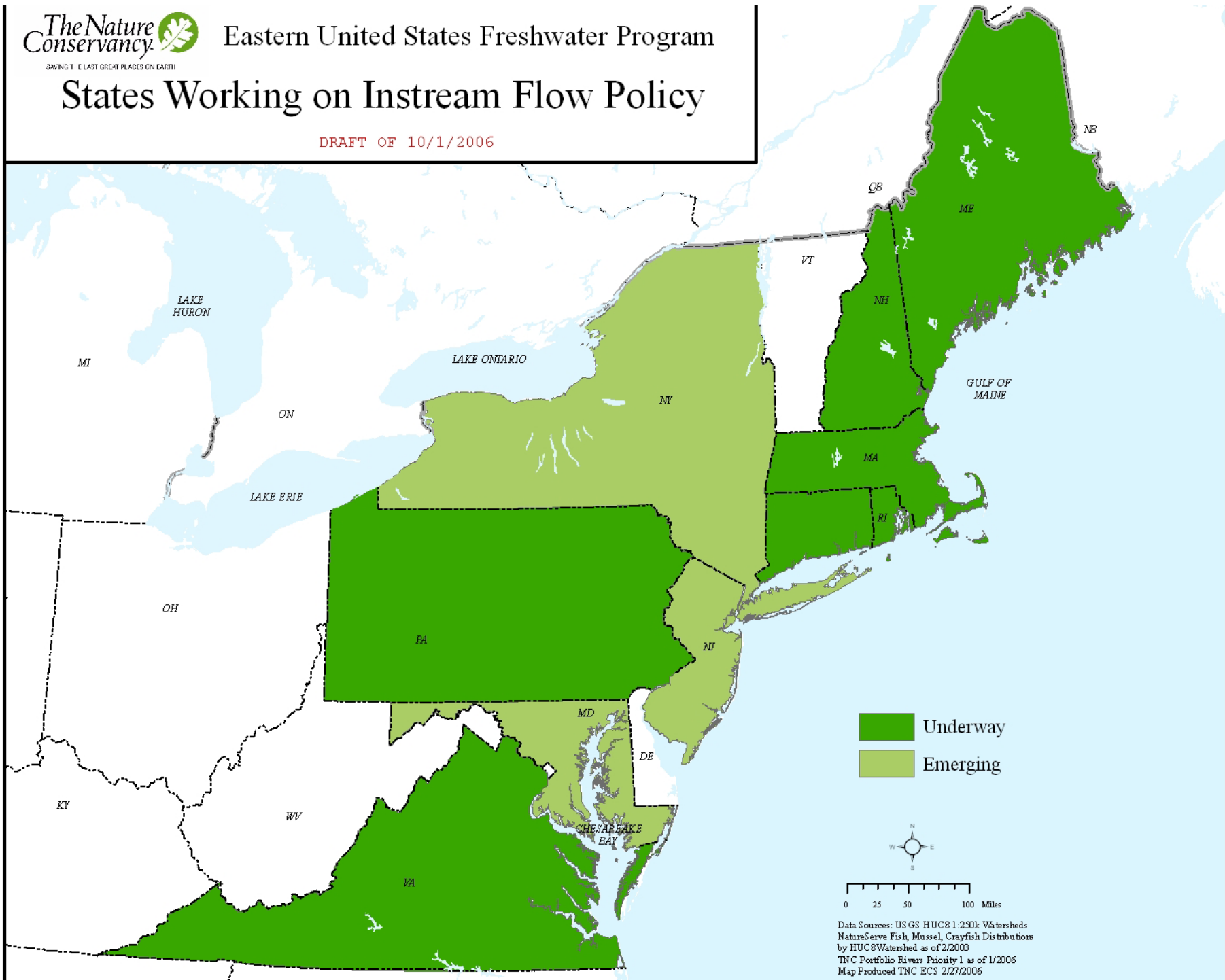
Middleton Pond,
Massachusetts



Wenham Lake
Massachusetts

States Working on Instream Flow Policy

DRAFT OF 10/1/2006



Data Sources: USGS HUC81250k Watersheds
NatureServe Fish, Mussel, Crayfish Distributions
by HUC8Watershed as of 2/2003
TNC Portfolio Rivers Priority 1 as of 1/2006
Map Produced TNC ECS 2/27/2006



Water Evaluation And Planning System

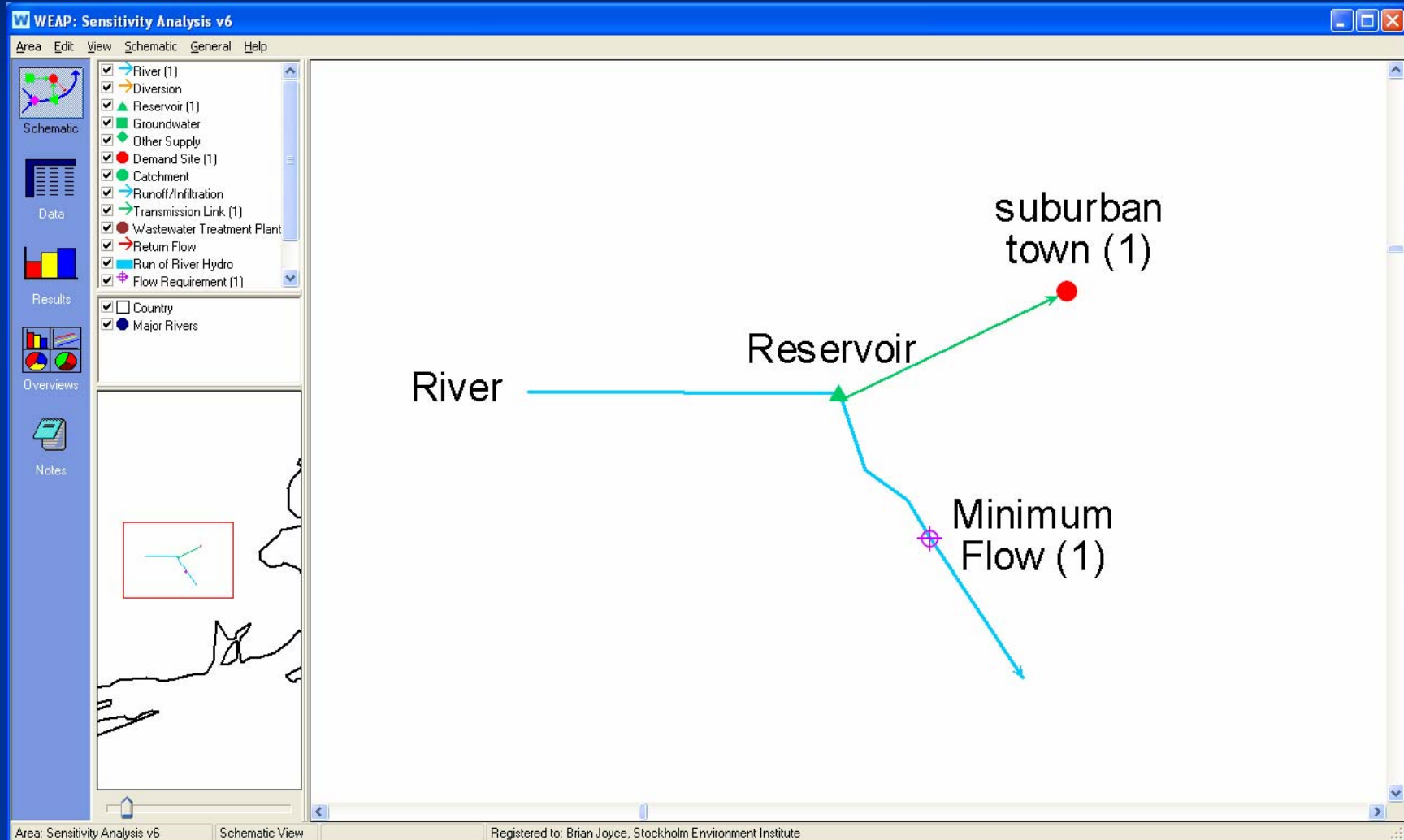


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WEAP in Planning

- Provides a common framework and a transparent set of data that can be explored by all stakeholders and decision-makers
- Scenarios can be easily developed to explore options for the future
- Implications of various policies can be evaluated

Balancing Supply and Demands



Incorporating Environmental Flow Requirements into Water Supply Management

- Flow Policies:
- Drought Management Policies:

Incorporating Environmental Flow Requirements into Water Supply Management

■ Flow Policies:

1. **Fixed minimum**

- 0.10 cfs/m
- 0.25 cfs/m
- 0.50 cfs/m
- 0.75 cfs/m

Incorporating Environmental Flow Requirements into Water Supply Management

■ Flow Policies:

1. Fixed minimum
2. **Fraction of inflow**

- 20 percent of inflow
- 40 percent of inflow
- 60 percent of inflow
- 80 percent of inflow

Incorporating Environmental Flow Requirements into Water Supply Management

■ Flow Policies:

1. Fixed minimum
2. Fraction of inflow
3. **Adaptive based on reservoir levels**

Scenario	0 – 30% Storage	30 – 60% Storage	60 – 100% Storage
Fixed Minimum	0.10 cfsm	0.25 cfsm	0.50 cfsm
Fraction of Inflow	10 %	30 %	50 %

Incorporating Environmental Flow Requirements into Water Supply Management

■ Flow Policies:

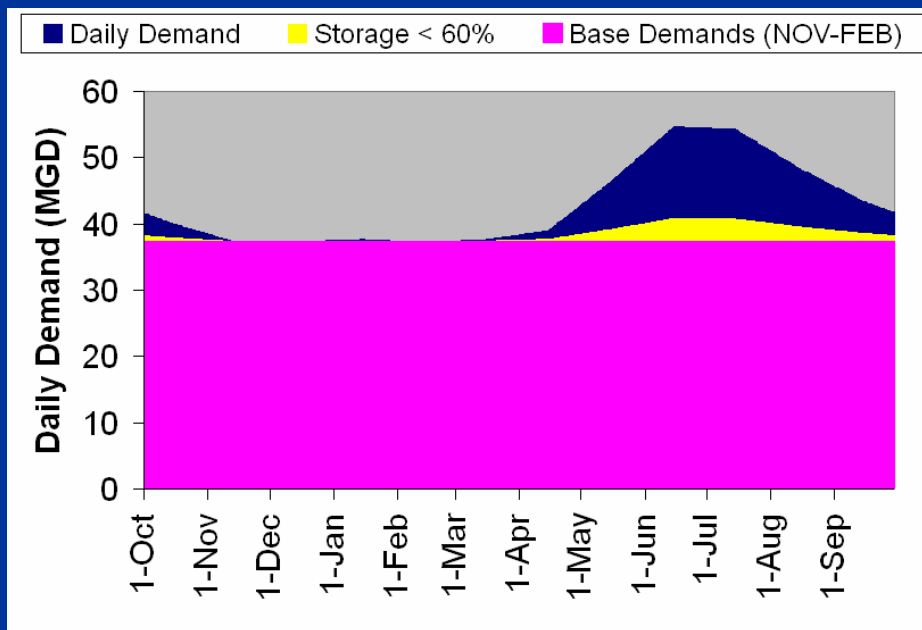
1. Fixed minimum
2. Fraction of inflow
3. Adaptive based on reservoir levels
4. **Flow components**
 - **add back some high flows**

	High Pulse	Minimum Flow (cfsm)
Scenario 1	Seasonal Q10	0.10
Scenario 2	Seasonal Q10	0.25
Scenario 3	Seasonal Q10	0.50
Scenario 4	Seasonal Q10	1.00 Spring 0.25 Summer 0.50 Fall/Winter

Incorporating Environmental Flow Requirements into Water Supply Management

- Drought Management Policies:

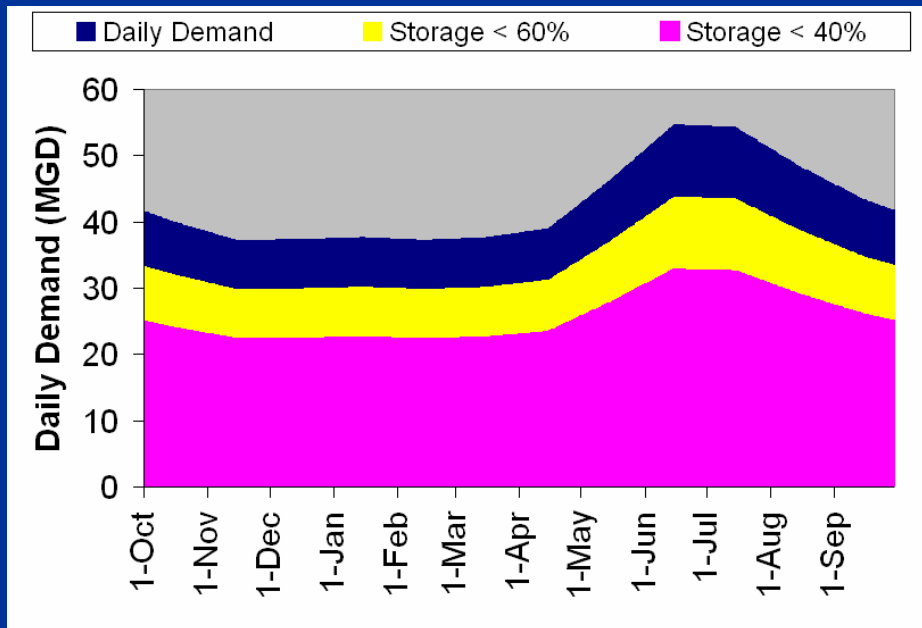
1. **Reduce peak demands**



Incorporating Environmental Flow Requirements into Water Supply Management

■ Drought Management Policies:

1. Reduce peak demands
2. **Reduce total demands**



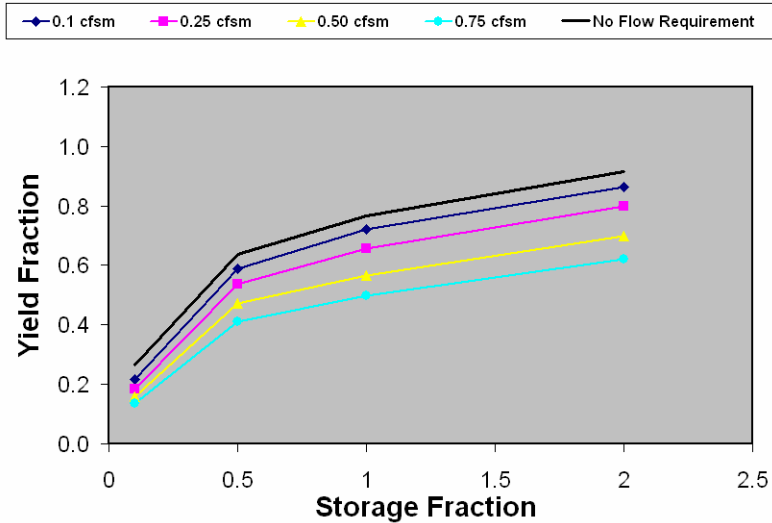
Quantifying Trade-offs and Key Variables

1. The relationship between water supply yield, reservoir size and flow requirements;
2. Drought management increases overall yield
3. Same yield can result in different flows;
4. Measuring trade-offs between policy objectives

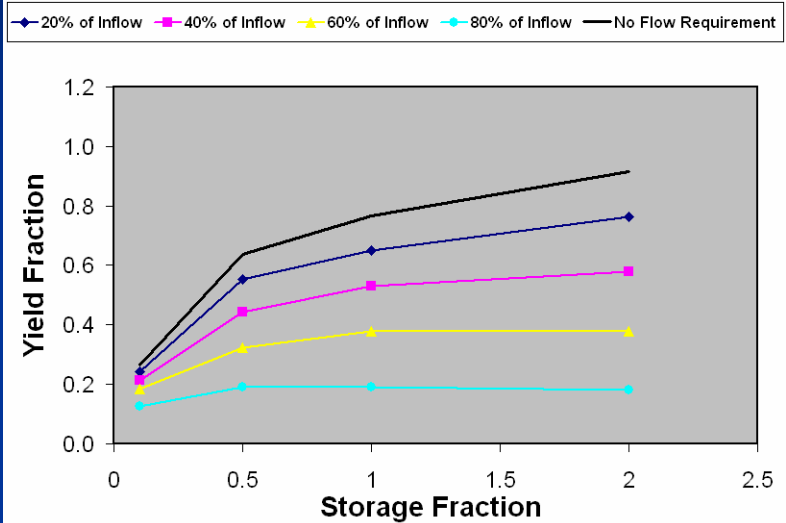
Safe Yield

without Drought Management

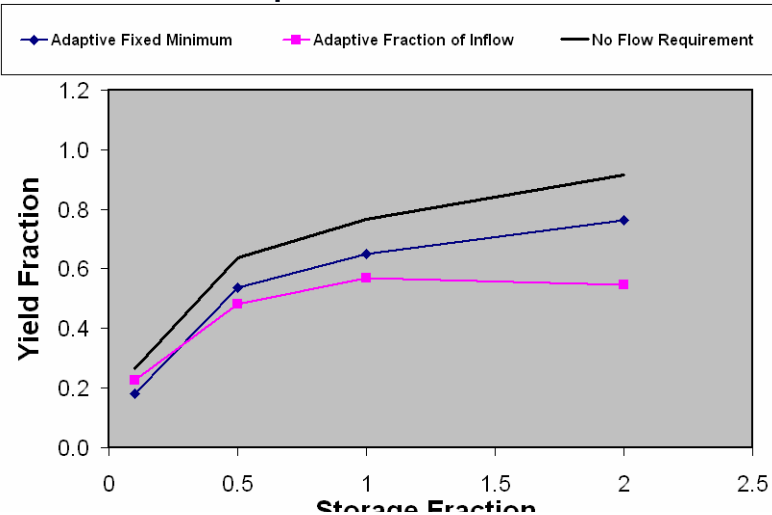
Fixed Minimum



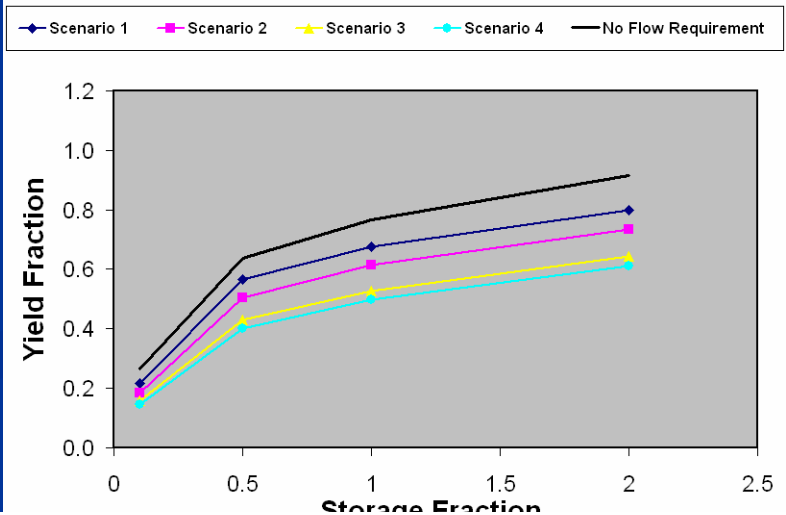
Fraction of Inflow



Adaptive Releases



Flow Components

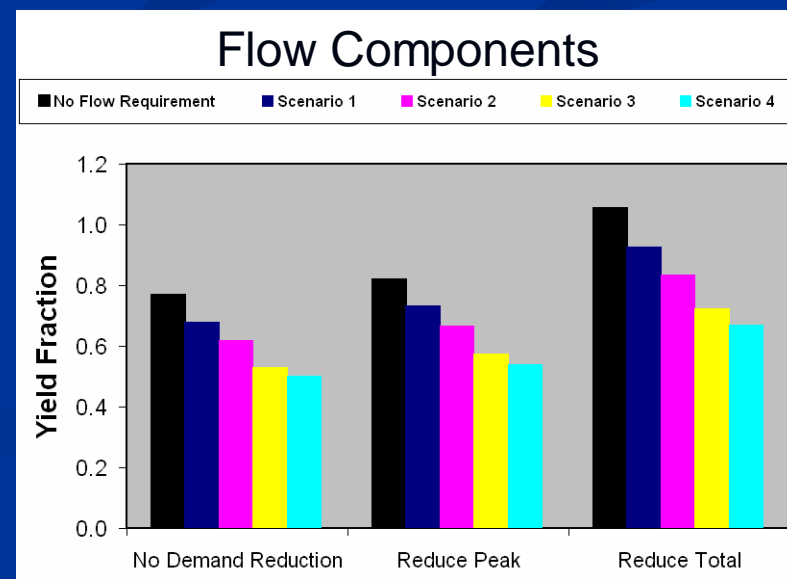
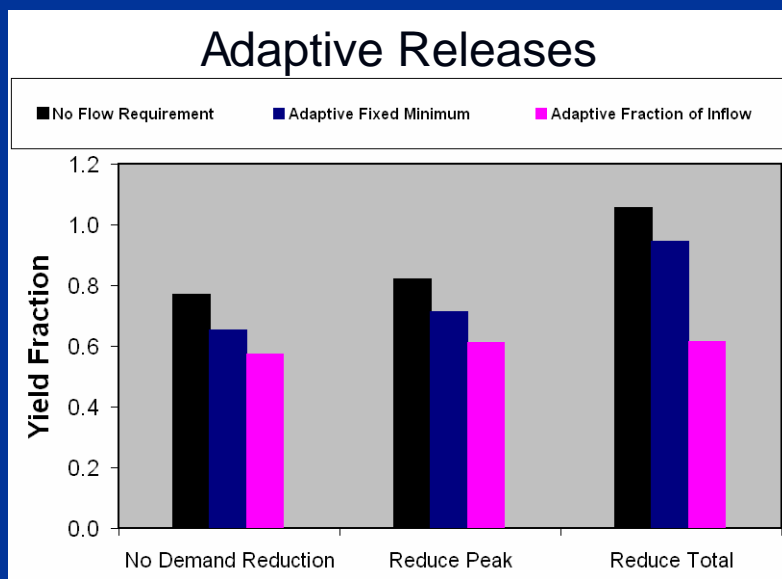
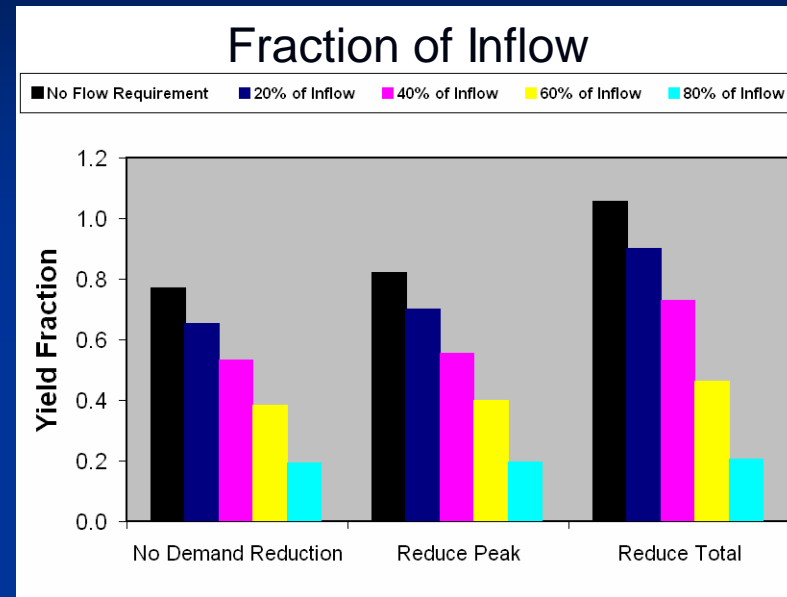
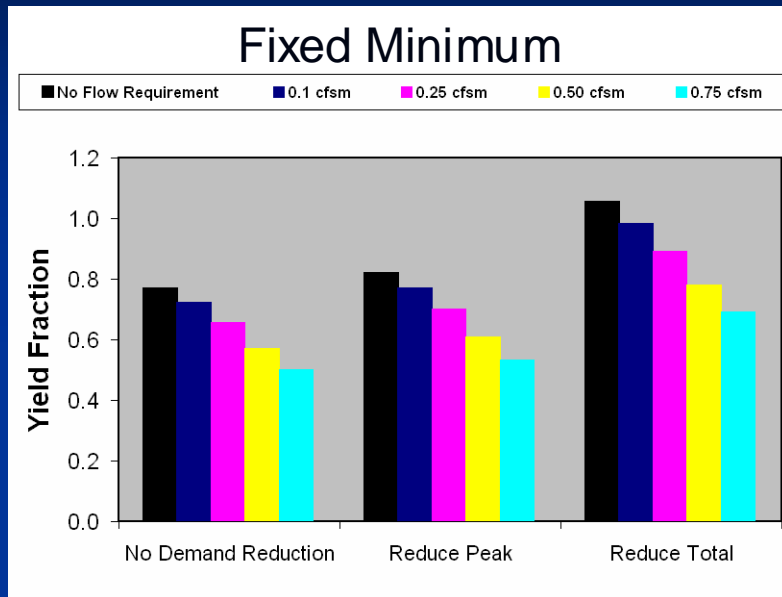


Quantifying Trade-offs and Key Variables

1. The relationship between water supply yield, reservoir size and flow requirements;
2. **Drought management increases overall yield**
3. Same yield can result in different flows;
4. Measuring trade-offs between policy objectives

Change with Drought Management

Storage Fraction = 1.0



Quantifying Trade-offs and Key Variables

1. The relationship between water supply yield, reservoir size and flow requirements;
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4. Measuring trade-offs between policy objectives

Safe Yields

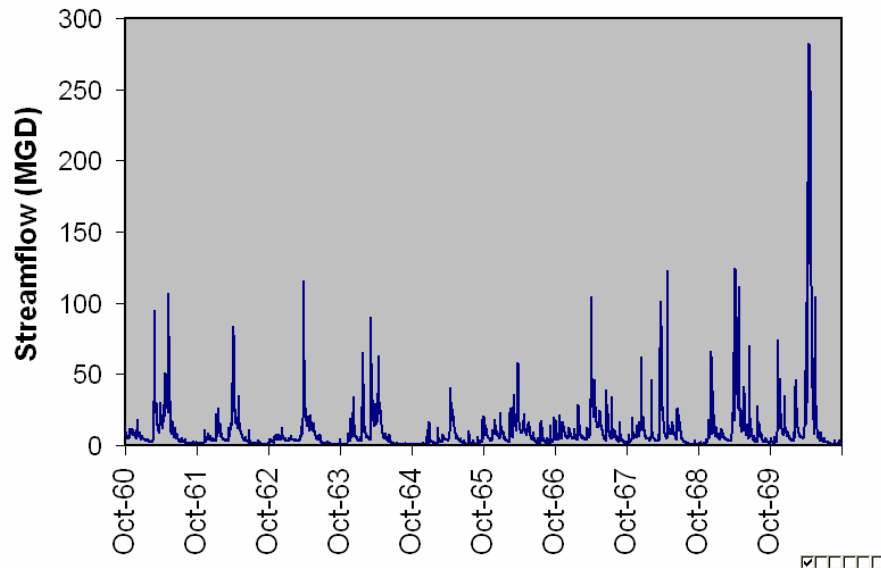
Storage Fraction 1.0

Scenario	No Drought Management	Reduce Peak	Reduce Total
No Flow Requirement	0.77	0.82	1.06
Fixed Minimum : 0.10 cfs	0.72	0.77	0.98
Fixed Minimum : 0.25 cfs	0.66	0.70	0.89
Fixed Minimum : 0.50 cfs	0.57	0.61	0.78
Fixed Minimum : 0.75 cfs	0.50	0.53	0.69
Fraction of Inflow : 20%	0.65	0.70	0.90
Fraction of Inflow : 40%	0.53	0.55	0.73
Fraction of Inflow : 60%	0.38	0.40	0.46
Fraction of Inflow : 80%	0.19	0.20	0.20
Flow Components : scenario 1	0.68	0.73	0.92
Flow Component : scenario2	0.62	0.66	0.83
Flow Components : scenario 3	0.53	0.57	0.72
Flow Components : scenario 4	0.50	0.54	0.67
Adaptive Fraction of Inflow	0.57	0.61	0.61
Adaptive Fixed Minimum	0.65	0.71	0.94

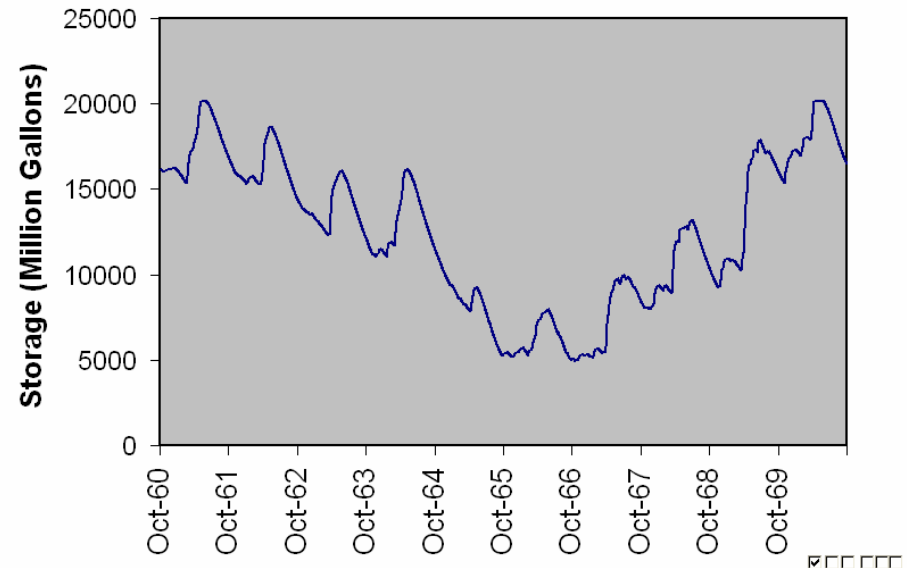
Impact of Policies on Flow and Storage

Storage Fraction = 1 & Yield Fraction = 0.61

Streamflow



Reservoir Storage



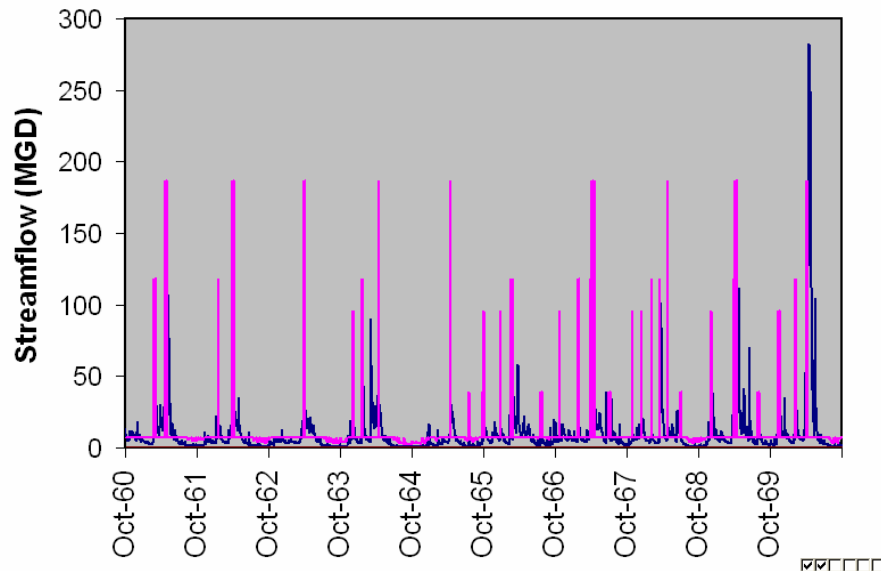
— FRACTION 0.2 - NO DROUGHT MNGT
— ADAPTIVE FIXED MINIMUM - NO DROUGHT MNGT
— ADAPTIVE FRACTION OF INFLOW - REDUCE PEAK

— FLOW COMPONENTS SCENARIO 2 - NO DROUGHT MN
— FIXED MINIMUM 0.50 - REDUCE PEAK
— ADAPTIVE FRACTION OF INFLOW - REDUCE TOTAL

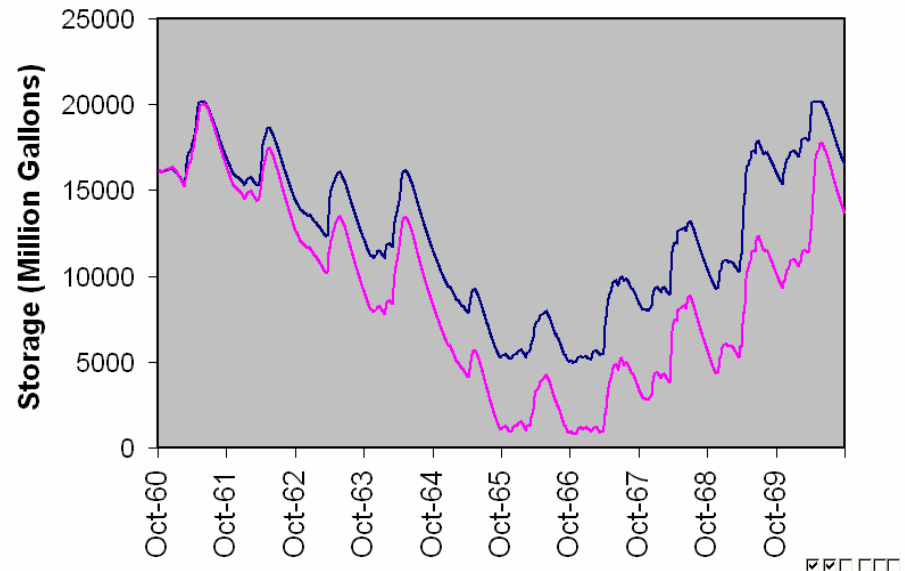
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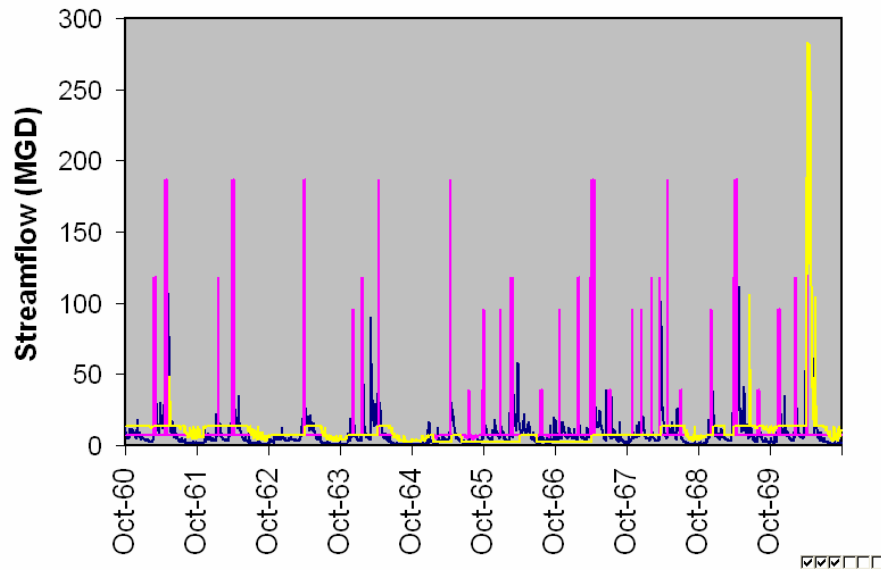
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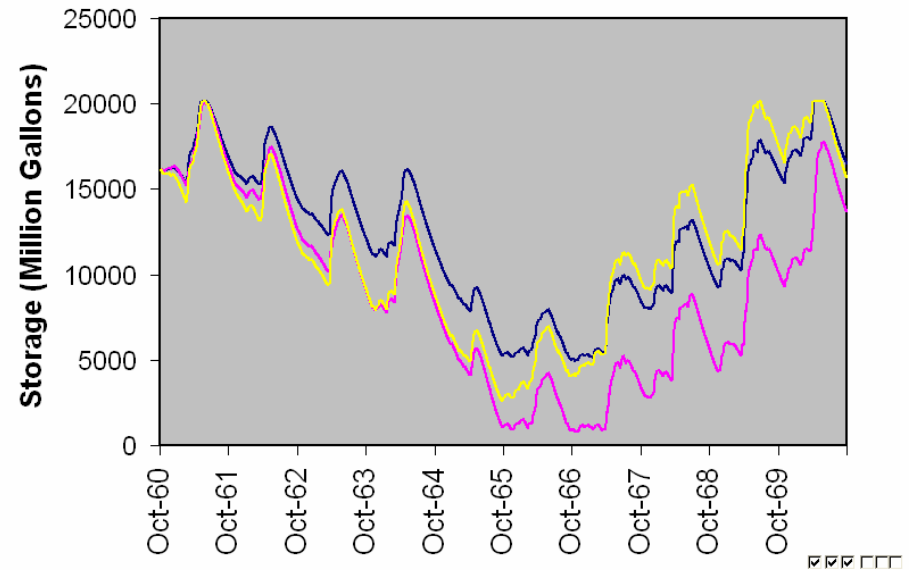
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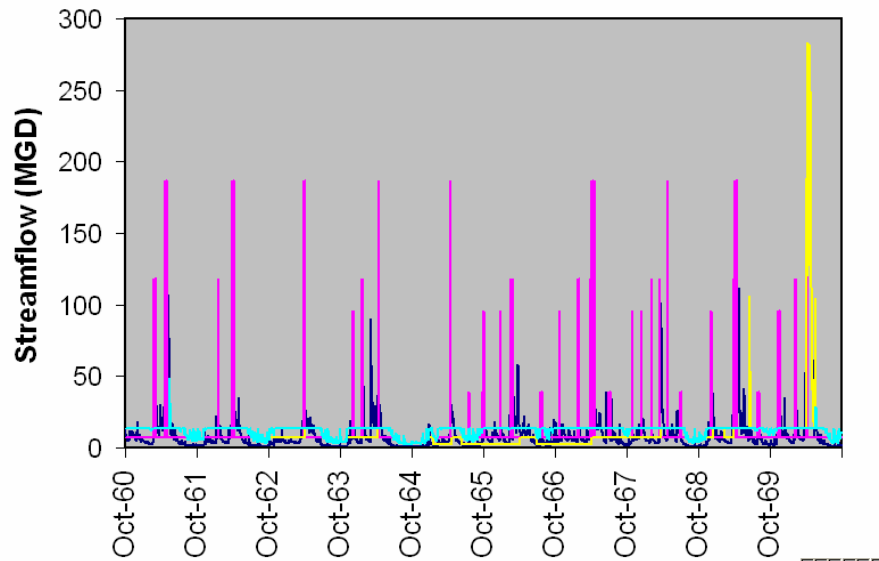
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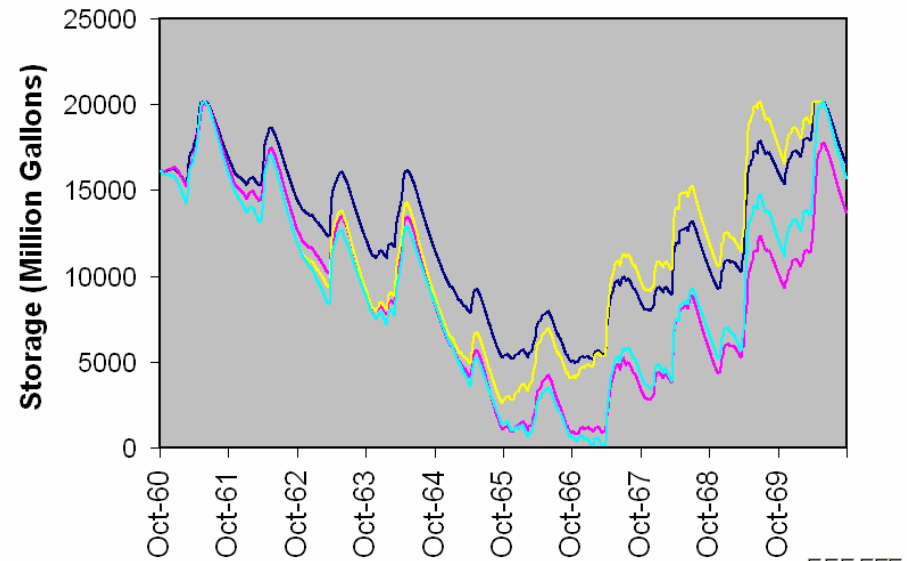
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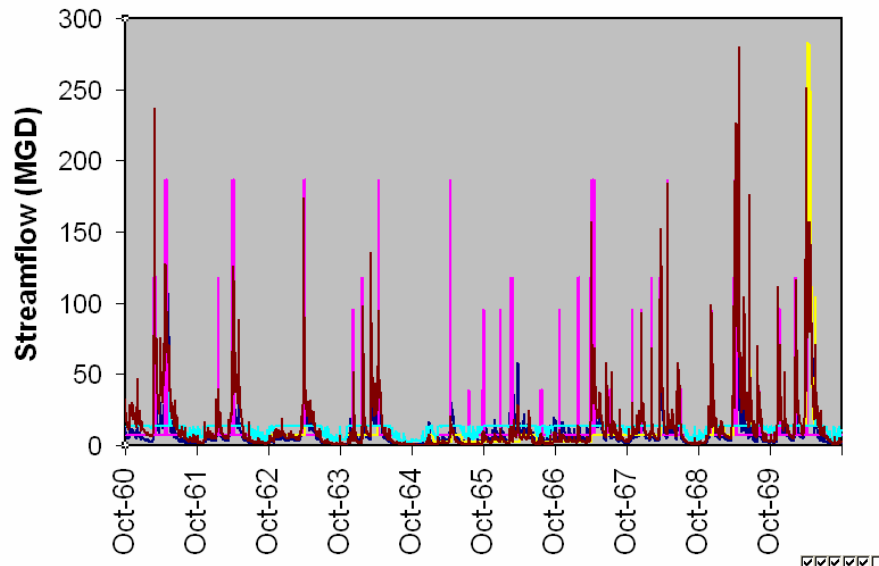
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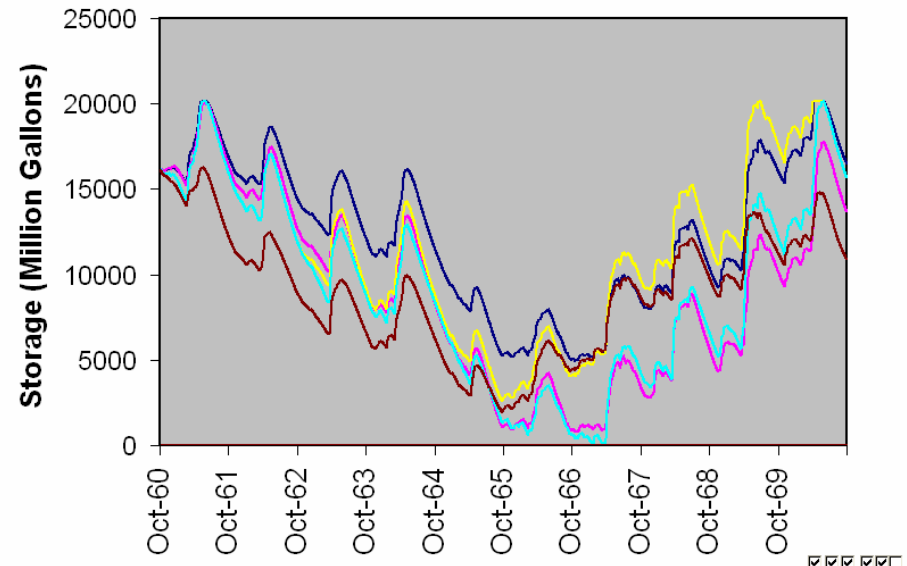
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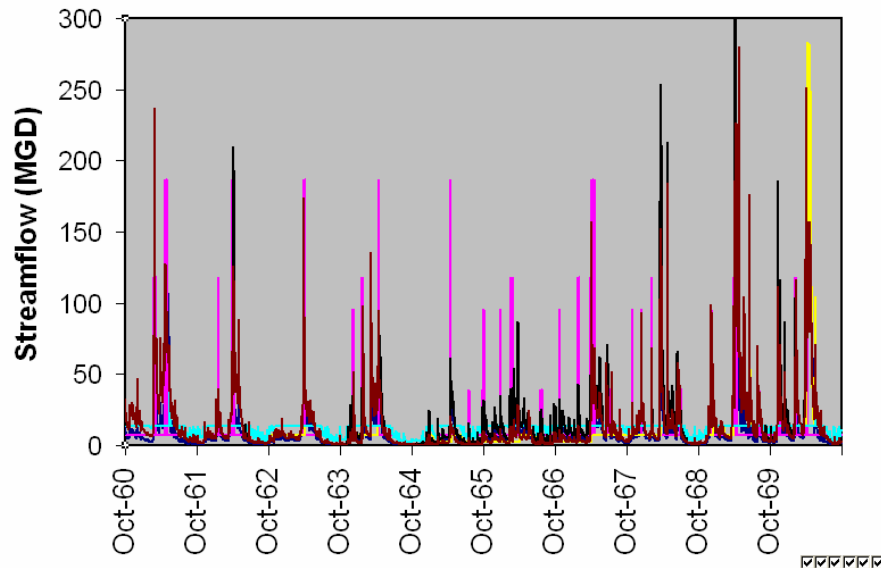
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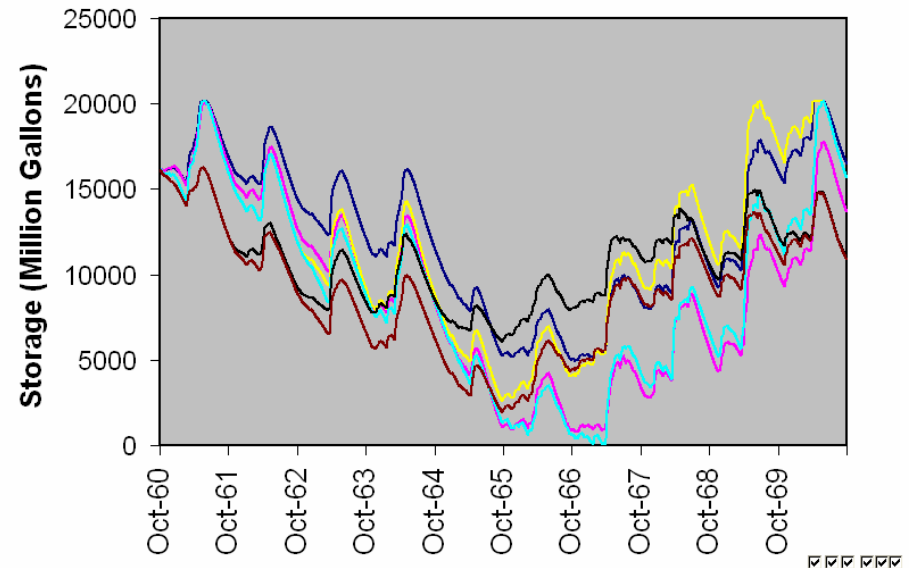
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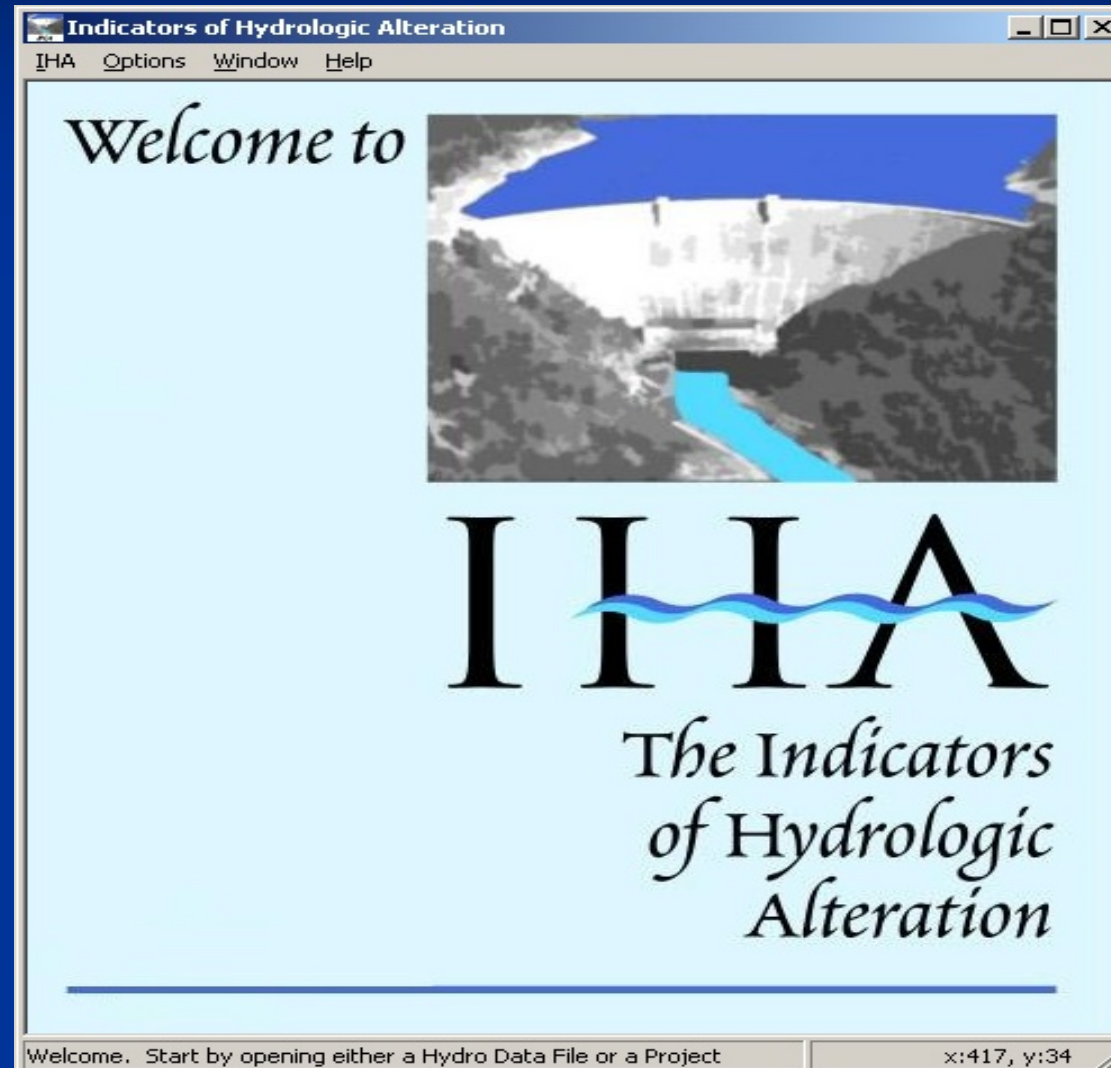
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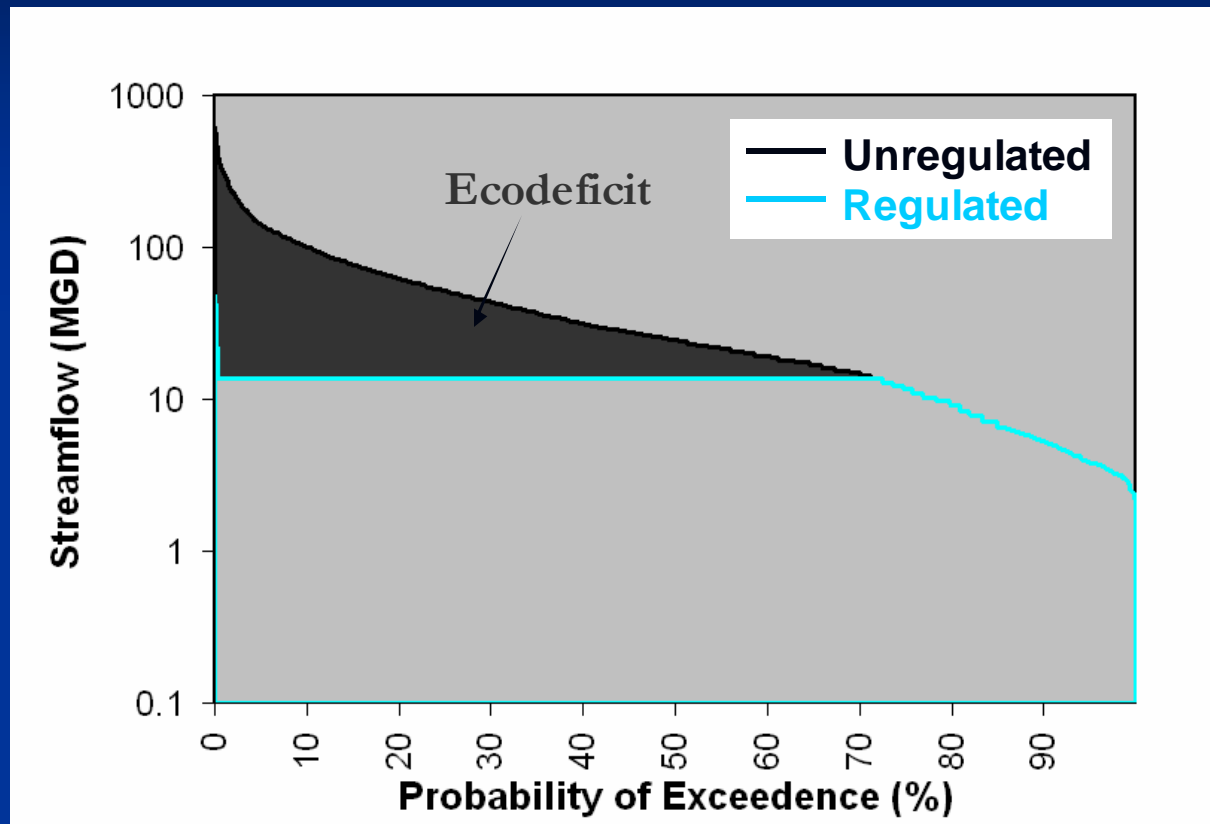
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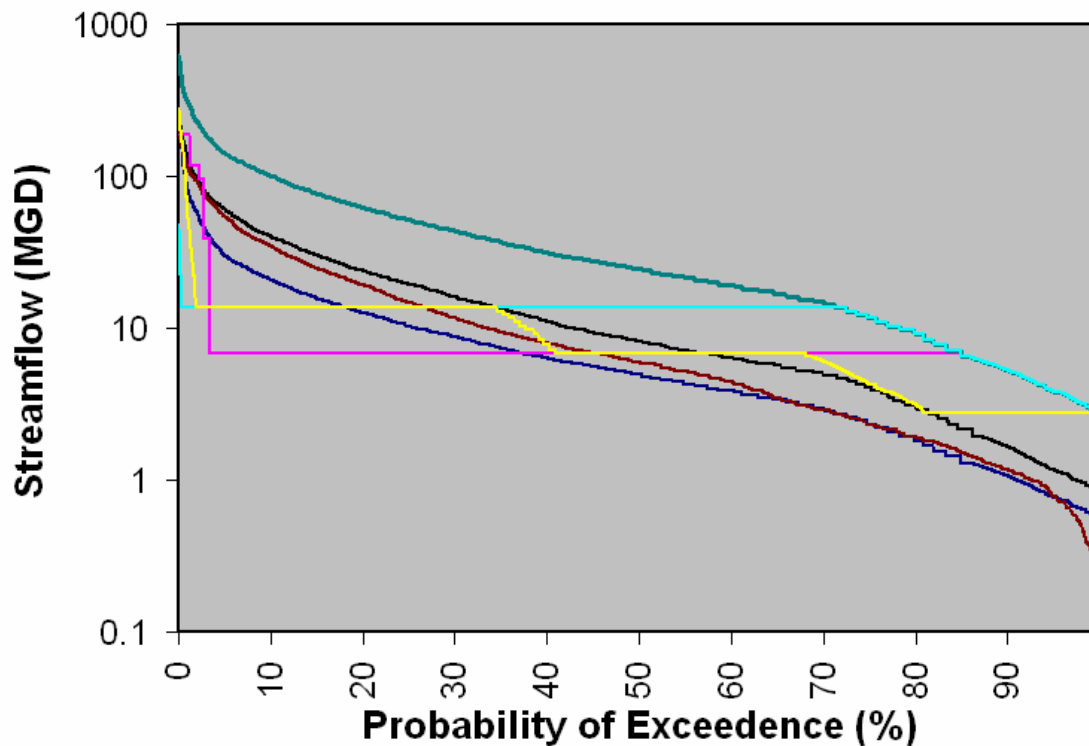
Indicators of Hydrologic Alteration



The 'Ecodeficit'



The 'Ecodeficit'



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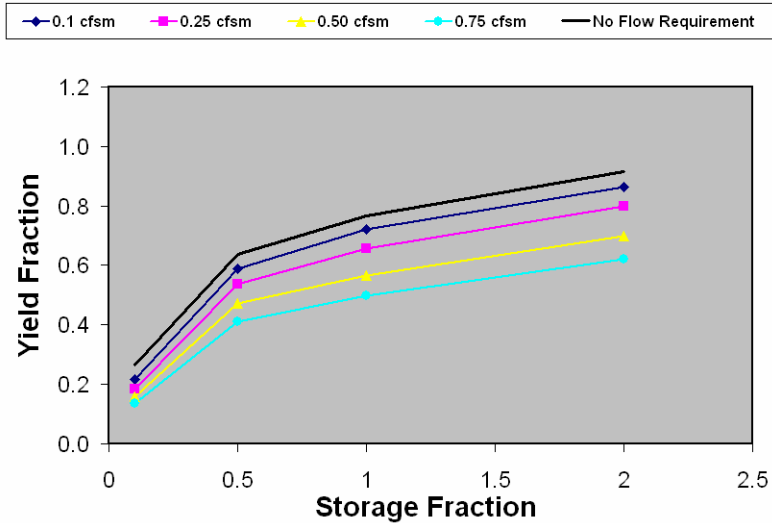
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Thank You

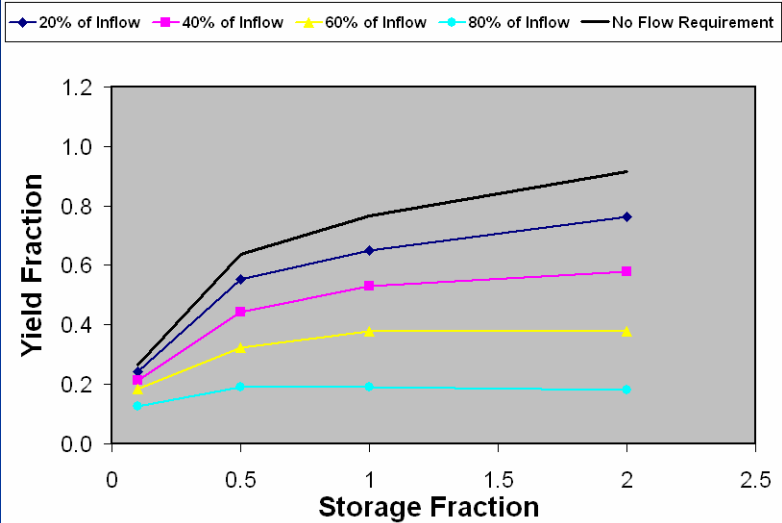
Safe Yield

No Drought Management

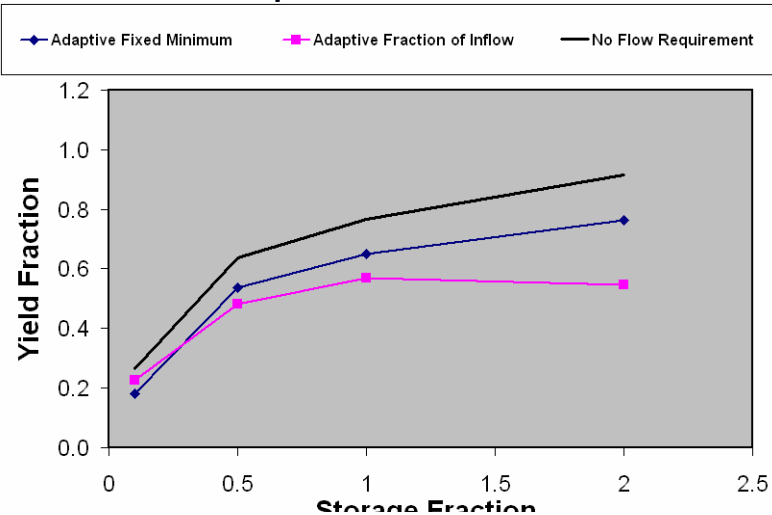
Fixed Minimum



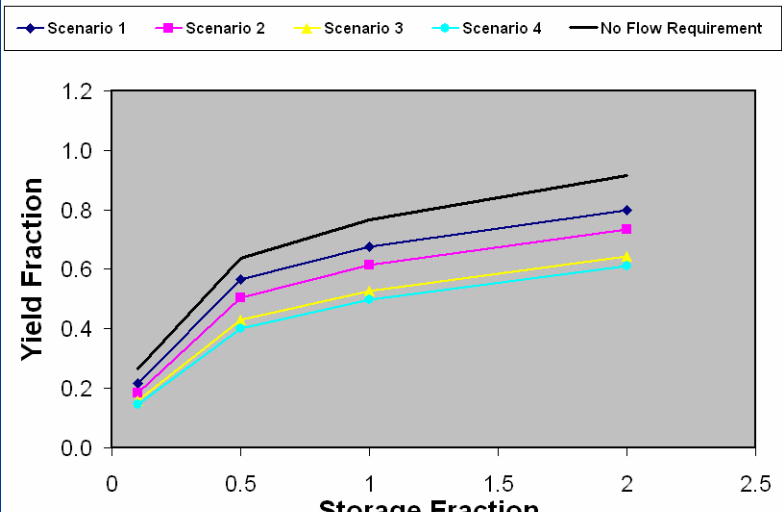
Fraction of Inflow



Adaptive Releases



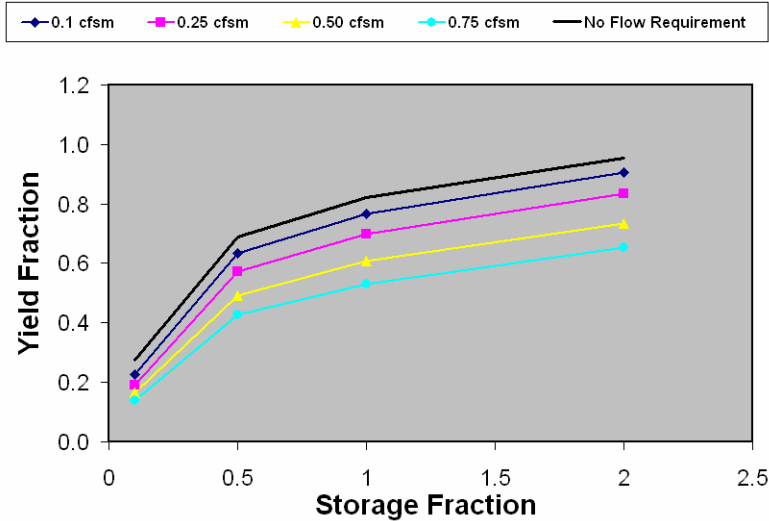
Flow Components



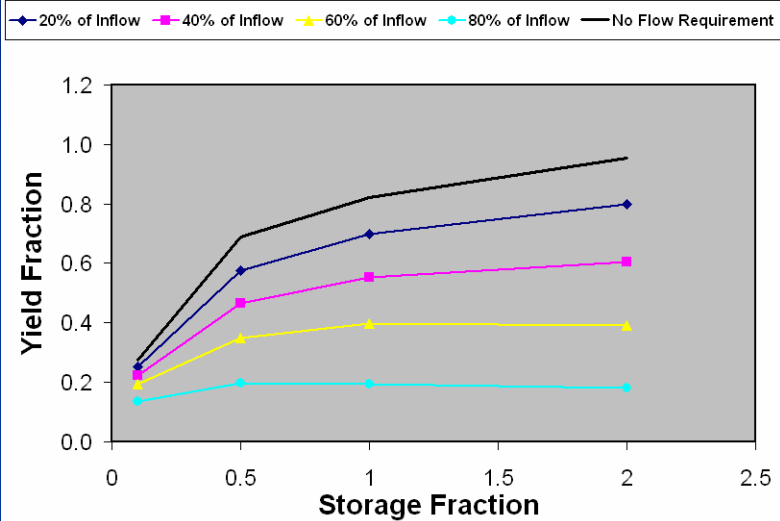
Safe Yield

Reduce Peak Demands

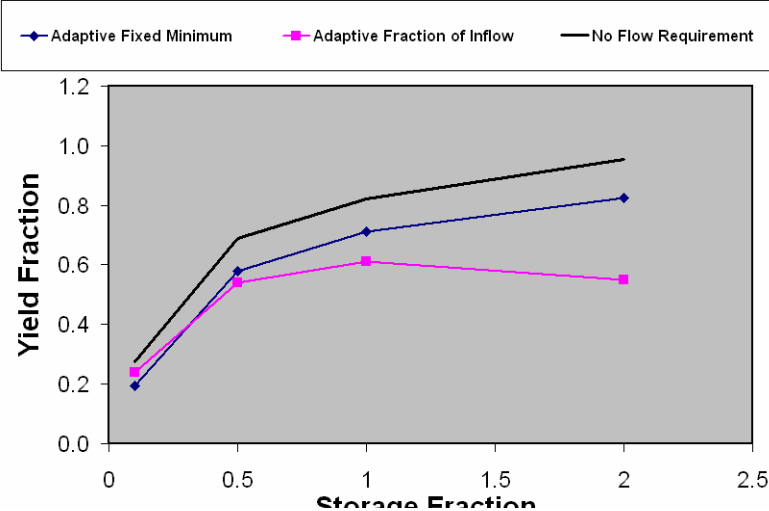
Fixed Minimum



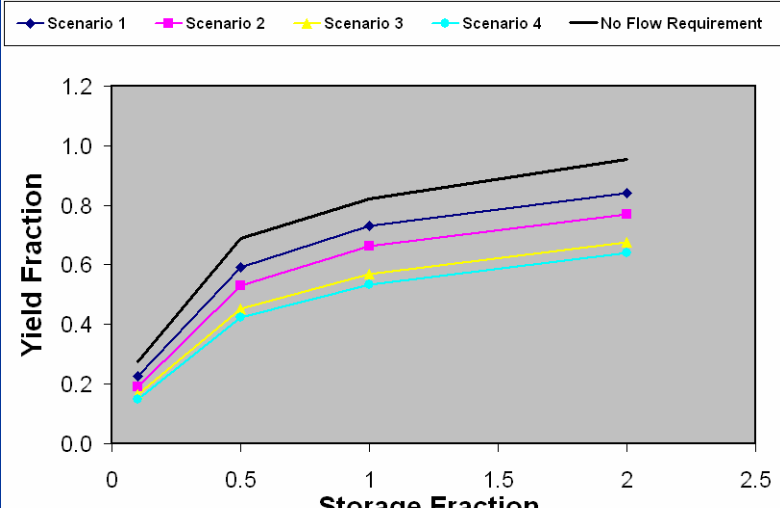
Fraction of Inflow



Adaptive Releases



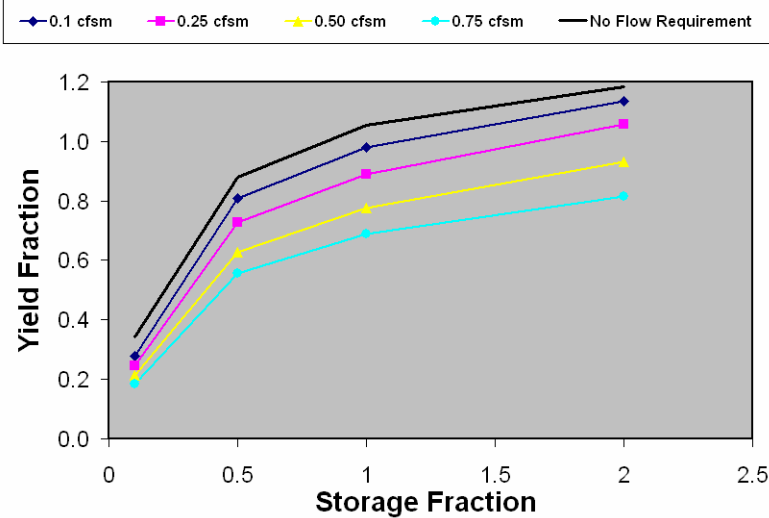
Flow Components



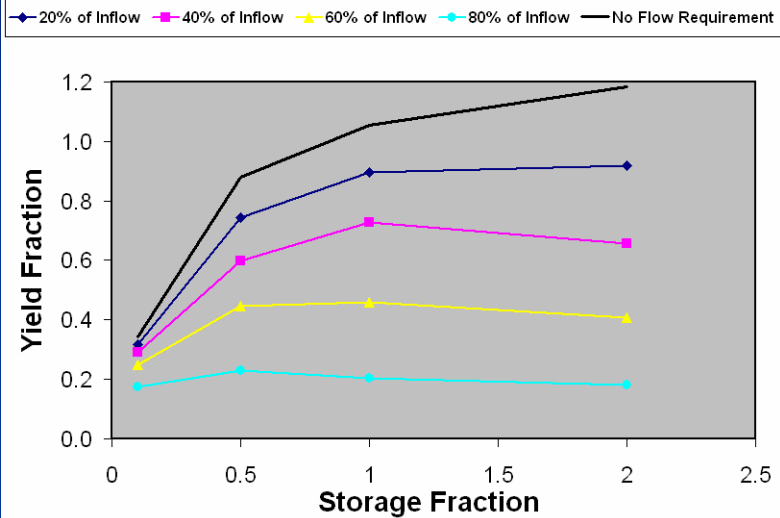
Safe Yield

Reduce Total Demands

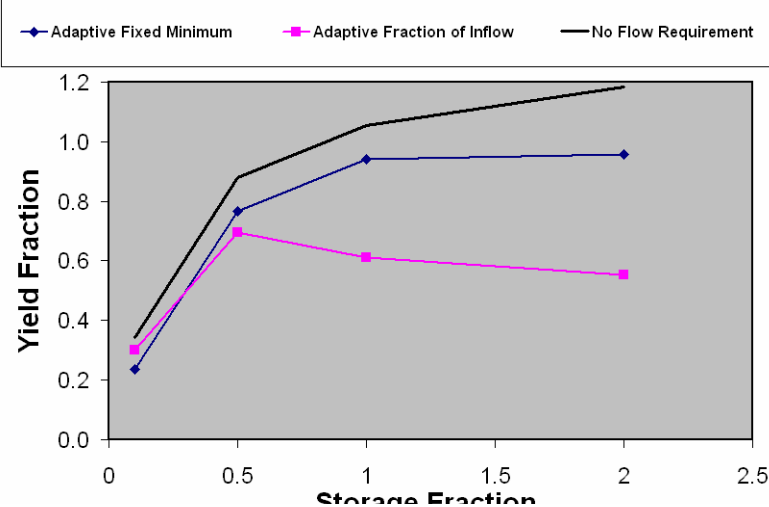
Fixed Minimum



Fraction of Inflow



Adaptive Releases



Flow Components

