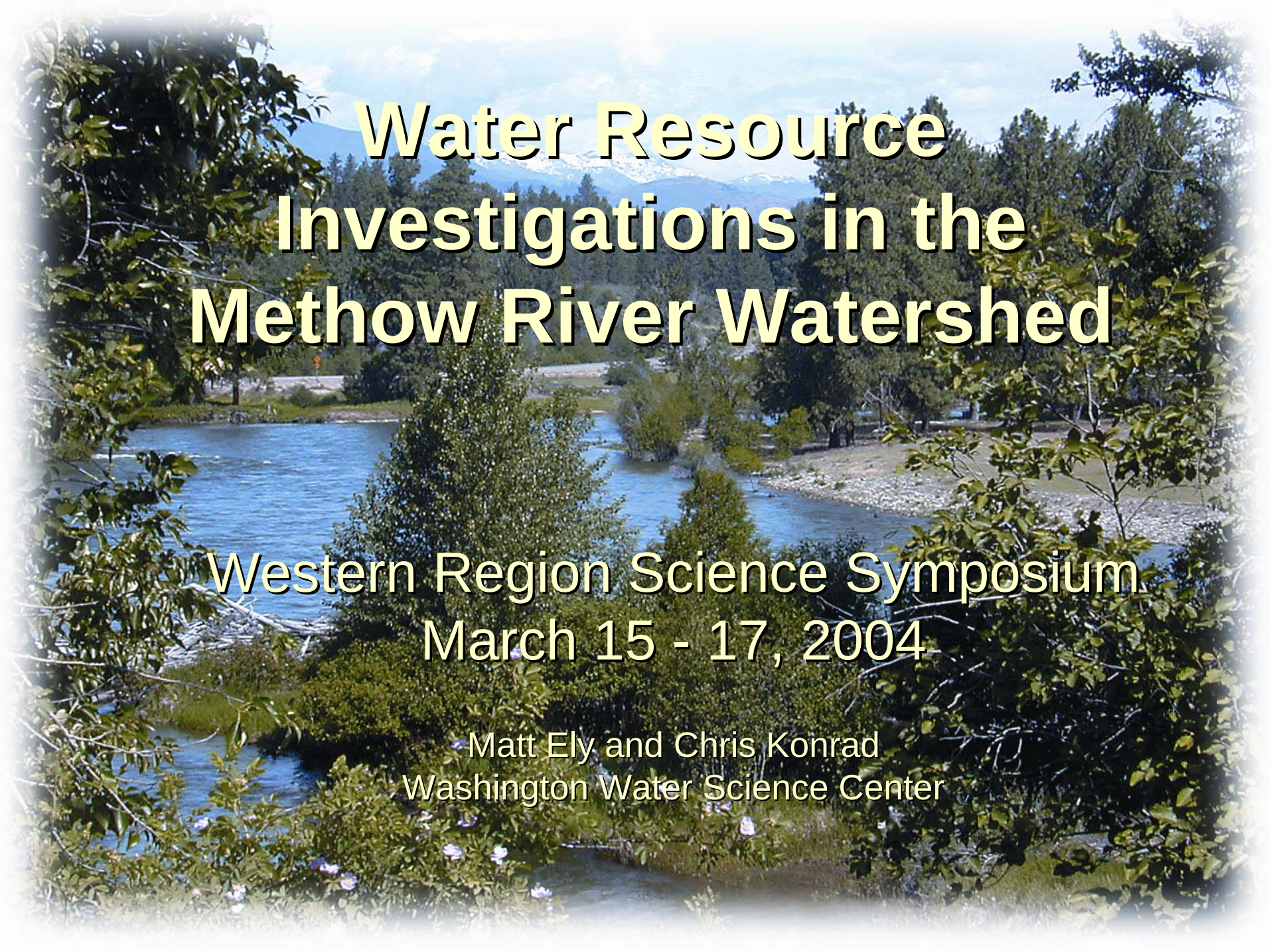
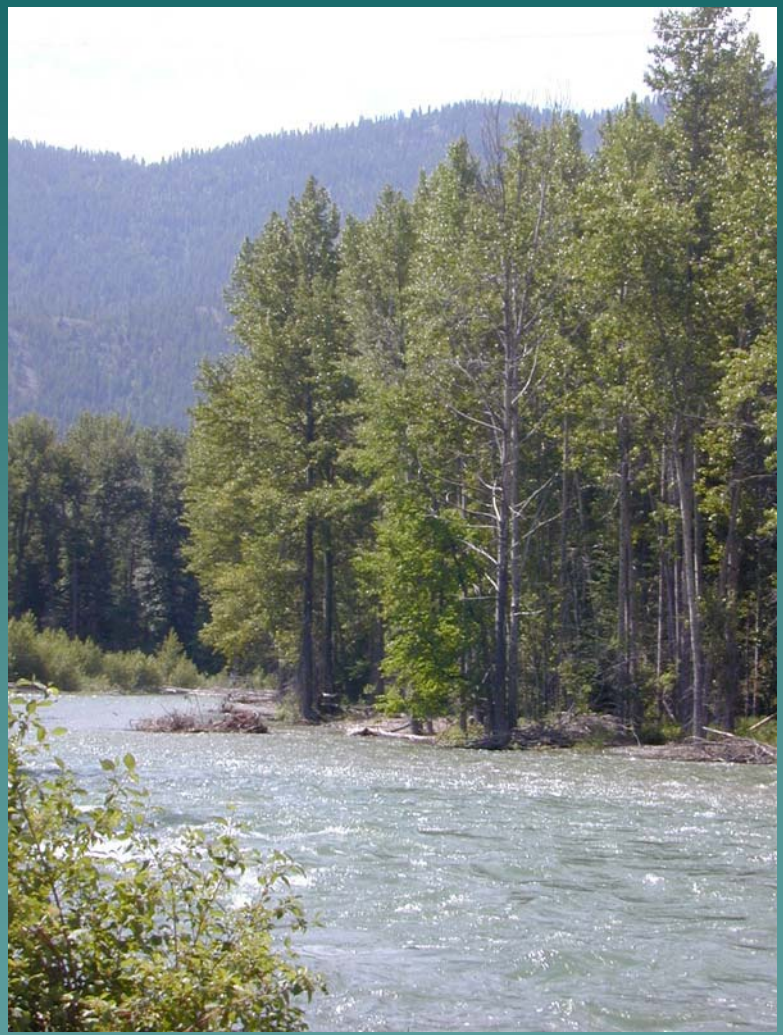
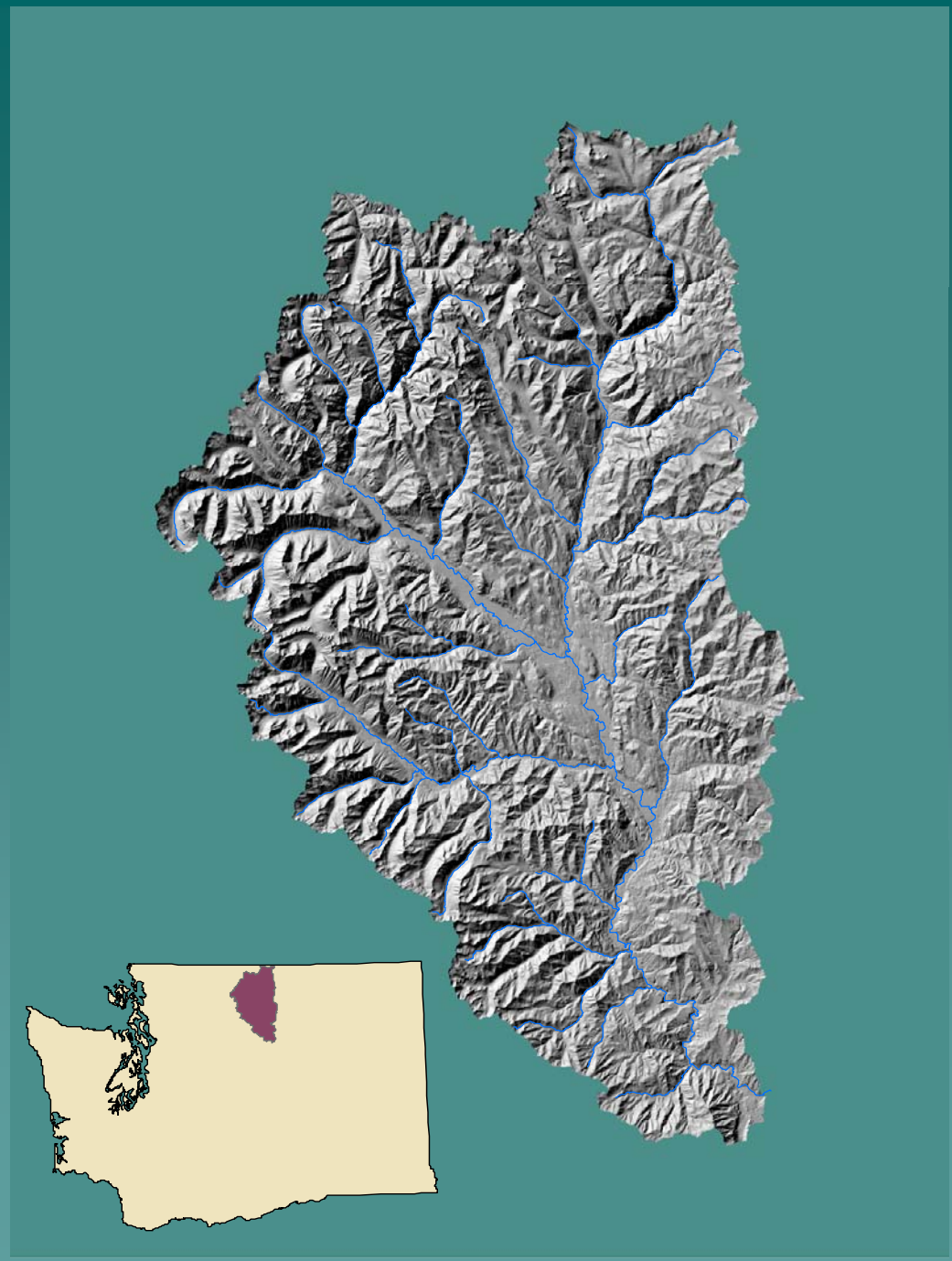


Water Resource Investigations in the Methow River Watershed

Western Region Science Symposium
March 15 - 17, 2004

Matt Ely and Chris Konrad
Washington Water Science Center





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Don’t worry.
I’m with the Government.

- Washington State Watershed Planning Act
- Listing of three species of fish under the Endangered Species Act
- Contentious situation between farmers, environmentalists, and government agencies
- Significant funding from Washington’s senator

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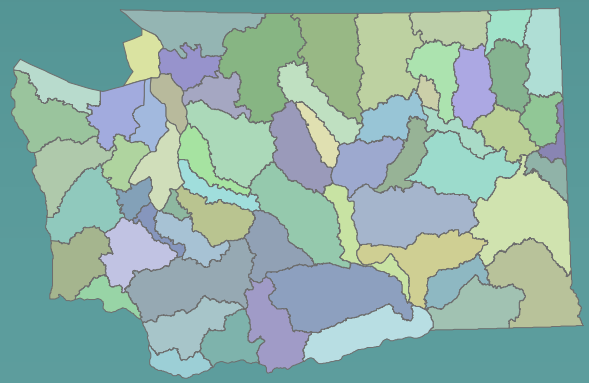
Washington State Watershed Planning Act is unstructured

- Designed to provide “a framework for developing local solutions to water issues on a watershed basis”
- Voluntary, comprehensive planning process designed to allow local citizens, governments, and tribes to develop management plans



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Okanogan National Forest

Department of Ecology

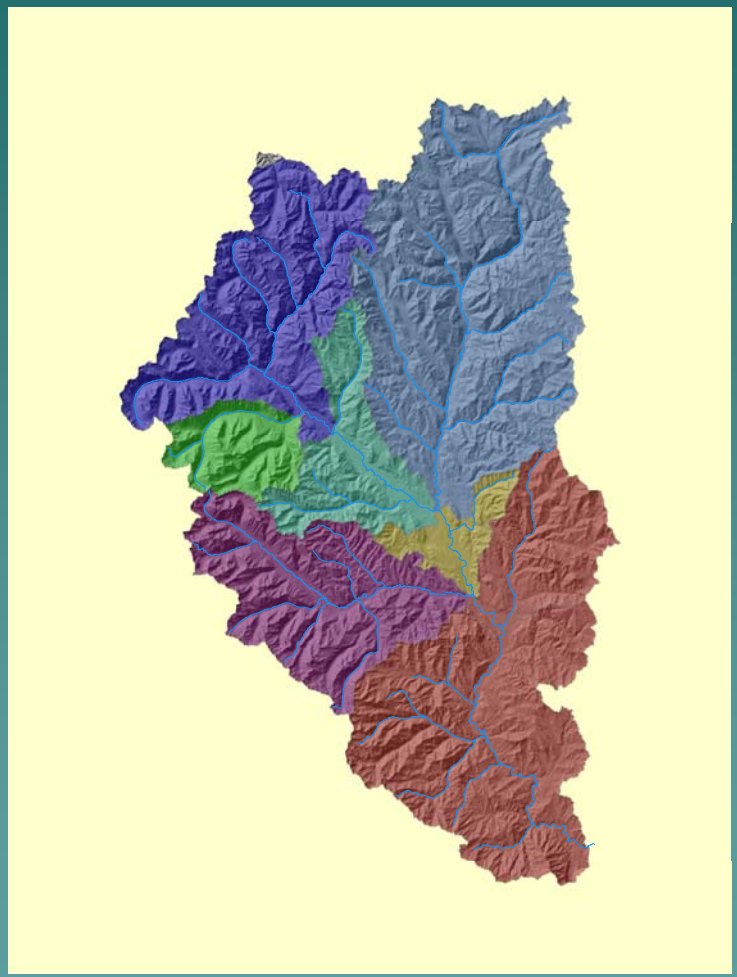
Golder Associates

OKANOGAN COUNTY

Methow Basin Planning Unit

Bureau of Reclamation
Managing Water in the American West

“The enemy of my enemy is my friend…unless he’s from Beaver Creek”



- The Planning Unit approach creates odd bedfellows and shifting alliances
- Difficult to predict reactions of proposed studies and the results

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Methow Watershed Studies

- Watershed Modeling
  - Phase One – Watershed model to simulate natural streamflow conditions
  - Phase Two – Refined watershed model to simulate streamflow with irrigation canals
- Hydrogeologic Framework
- Ground-water/surface-water interaction

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Cooperator questions directed the scope of the study

- Methow River Planning Unit
  - Leaking irrigation canals
  - Fluctuating lake levels
  - Lining of irrigation canals
- WA State Dept of Ecology
  - Transportation losses
  - Streamflow for instream flow determination
- Bureau of Reclamation
  - Lining existing irrigation canals
  - Increasing irrigation canals
  - Changing from irrigation canals to wells
  - Effects of forest management

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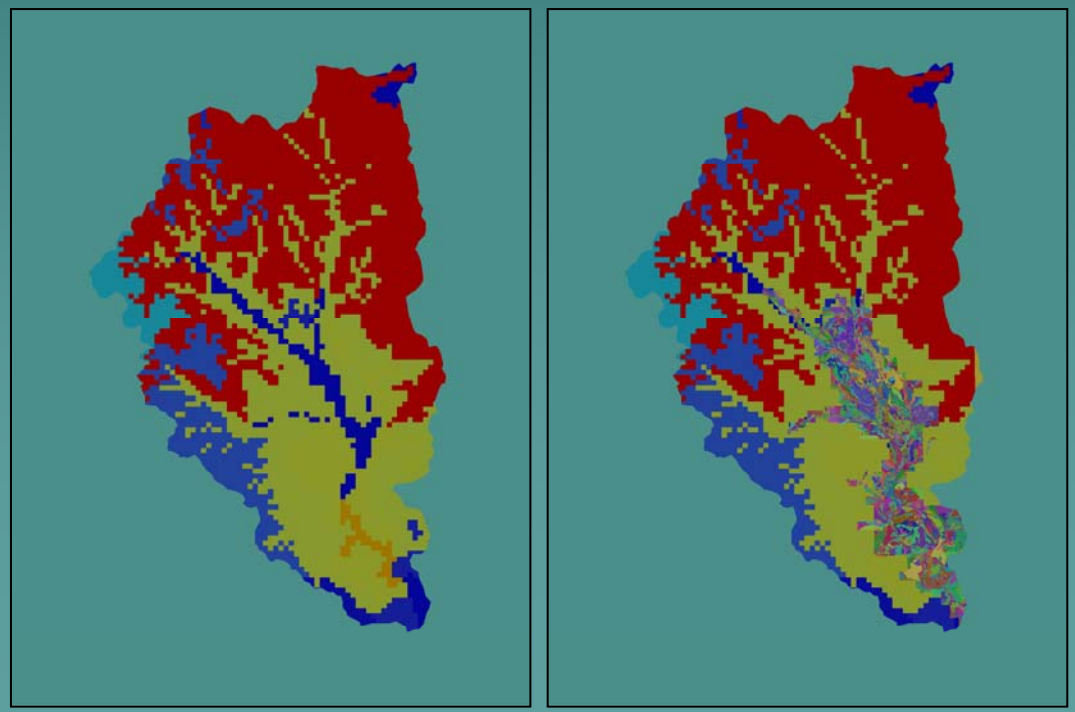
Watershed Modeling Needs

- More data
  - Installed additional streamflow gages
  - Conducted seepage measurements
  - Created refined parameter information
- New computer algorithms (modules)



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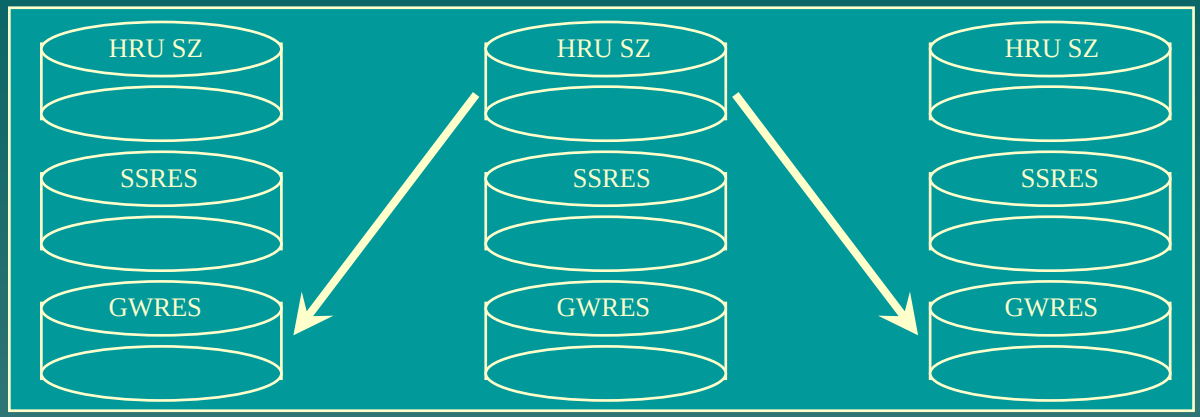
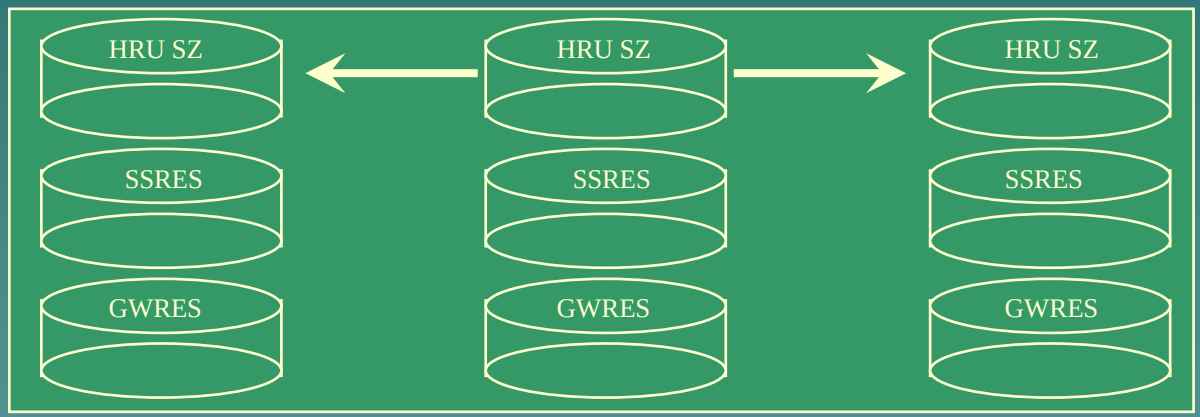
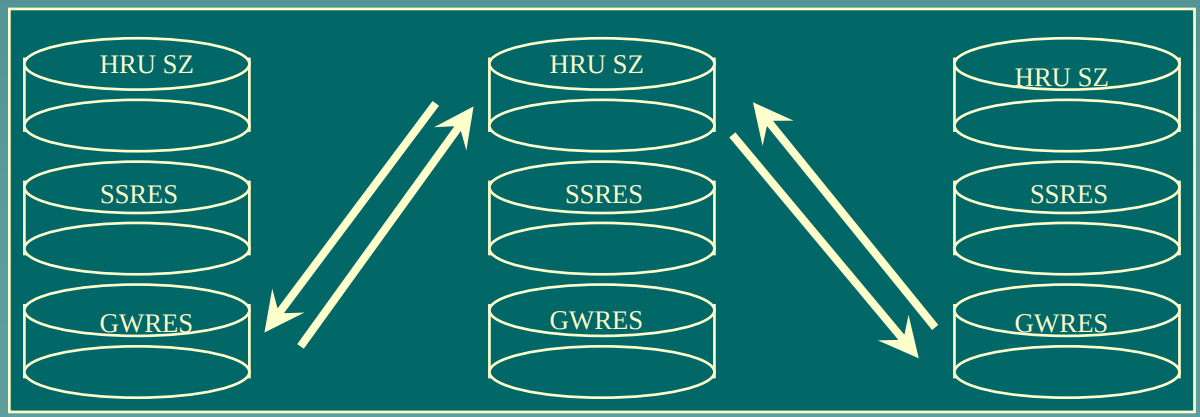


Irrigation Diversions

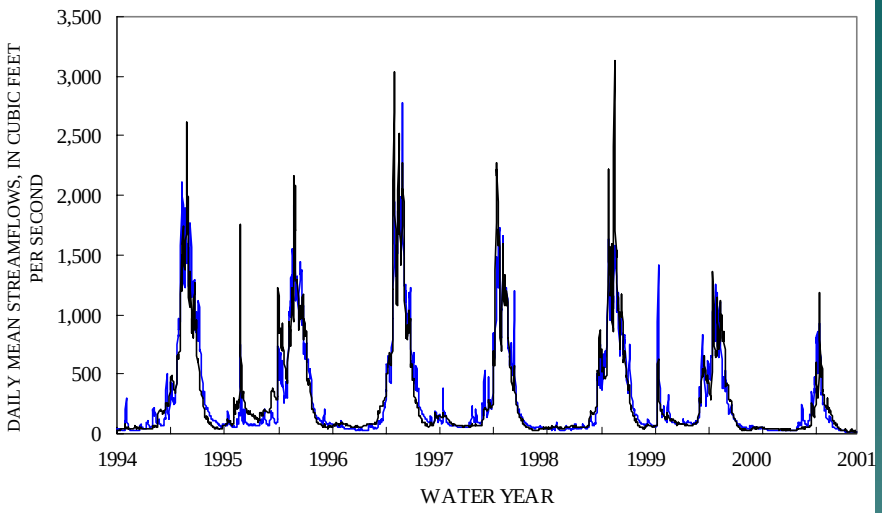


Irrigation Application



Stream Channel Routing

C Twisp River near Twisp (12448998)



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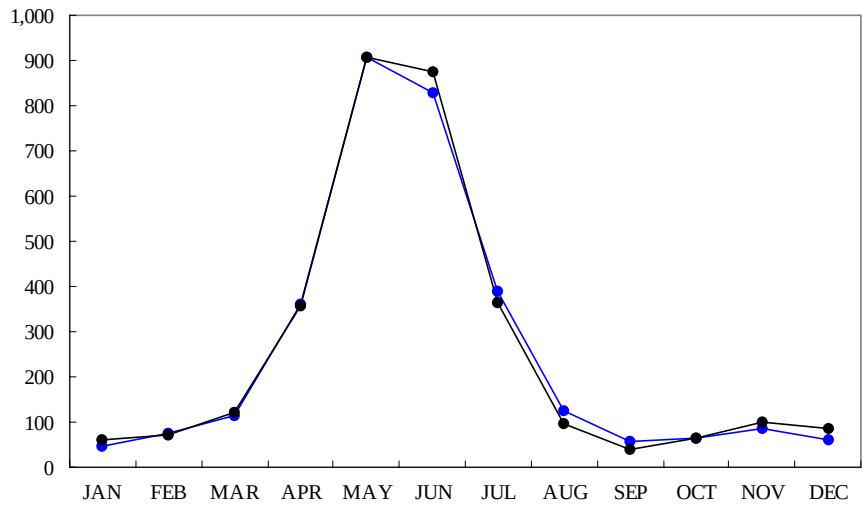
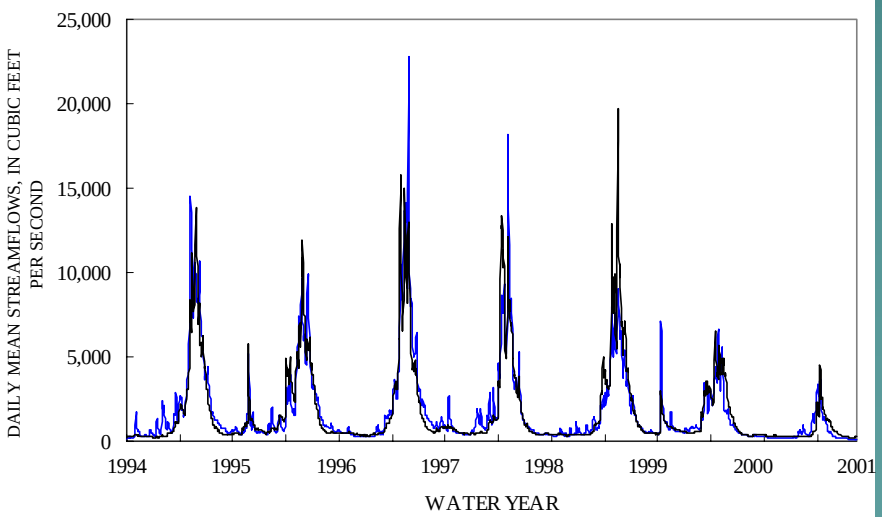


D Methow River near Pateros (12449950)



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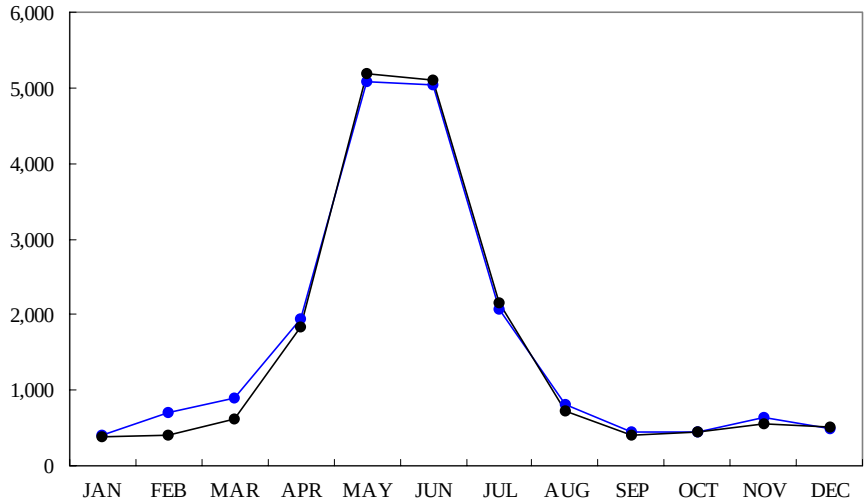

Simulated Streamflow Water Years 1960 - 2001

	Twisp	Beaver	Met abv Goat	Early Winters	Met nr Pat	Goat	Wolf	Chewuch
Jan	63.7	23.8	89.0	9.7	495.8	5.8	7.0	75.1
Feb	79.4	29.0	80.3	8.1	462.0	5.4	6.5	75.6
Mar	103.7	48.1	95.9	8.3	655.8	6.1	8.8	112.2
Apr	379.3	123.7	569.4	127.3	2131.7	64.8	67.1	448.6
May	1059.1	104.9	2324.4	631.6	6054.0	191.8	177.4	1810.1
Jun	895.9	40.1	2312.3	579.7	5188.2	107.9	120.8	1355.7
Jul	315.9	22.2	1123.2	313.8	2115.0	28.9	29.5	412.2
Aug	115.9	15.2	438.7	157.7	870.4	15.0	15.0	173.7
Sep	66.0	11.6	223.9	75.1	503.9	10.5	13.0	115.8
Oct	77.7	11.4	198.0	37.2	509.3	13.1	23.0	102.2
Nov	117.8	13.6	189.8	19.9	604.8	14.4	13.6	106.7
Dec	62.6	15.7	106.2	13.1	442.2	7.4	7.5	77.1

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Simulated vs. Measured Streamflow

Water Year 1992-2001 Low-flow periods

Station Name	Month	Mean simulated streamflow (cfs)	Mean measured streamflow (cfs)	Bias, in percent
Methow abv Goat	Sep	201.0	37.7	
	Oct	175.6	30.7	
	Nov	277.1	107.1	
	Dec	130.4	79.1	
	Total	784.1	254.6	112.9
Andrews Creek	Sep	6.6	7.6	
	Oct	4.6	6.4	
	Nov	4.0	7.2	
	Dec	3.3	5.7	
	Total	18.5	26.9	-12.7
Chewuch	Sep	88.5	75.6	
	Oct	106.1	96.3	
	Nov	119.3	101.6	
	Dec	102.5	84.6	
	Total	416.5	358.0	6.6
Methow at Winthrop	Sep	306.9	268.0	
	Oct	316.6	288.2	
	Nov	465.4	388.0	
	Dec	283.1	337.7	
	Total	1372.0	1281.9	2.8
Twisp	Sep	55.5	39.7	
	Oct	64.8	62.9	
	Nov	87.0	99.7	
	Dec	59.6	86.3	
	Total	266.9	288.6	-0.1
Methow at Twisp	Sep	355.1	300.1	
	Oct	397.0	362.7	
	Nov	583.4	482.7	
	Dec	375.7	414.1	
	Total	1711.2	1559.7	3.9
Methow at Pateros	Sep	439.2	400.4	
	Oct	449.0	438.1	
	Nov	644.6	558.1	
	Dec	483.3	502.7	
	Total	2016.0	1899.2	2.4

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GW/SW Interaction Questions

- To what extent do irrigation diversions reduce low-flow discharge in the rivers?
- What fraction of ground-water recharge is due to irrigation canal seepage?
- How would increased ground-water pumping (rather than surface water diversions) influence low-flow discharge in rivers?

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Detailed investigation of GW/SW interactions

Objective: quantify irrigation-induced recharge and its effect on ground-water discharge to the river in a limited study area.

Approach:

- construct a water budget;
- perform seepage runs in canals and river;
- monitor ground-water elevations changes;
- analyze relationships among recharge, ground-water elevations, and discharge to the river; and
- Use results of the detailed study to help refine the ground-water flow component of the watershed model.

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Local interest in detailed study

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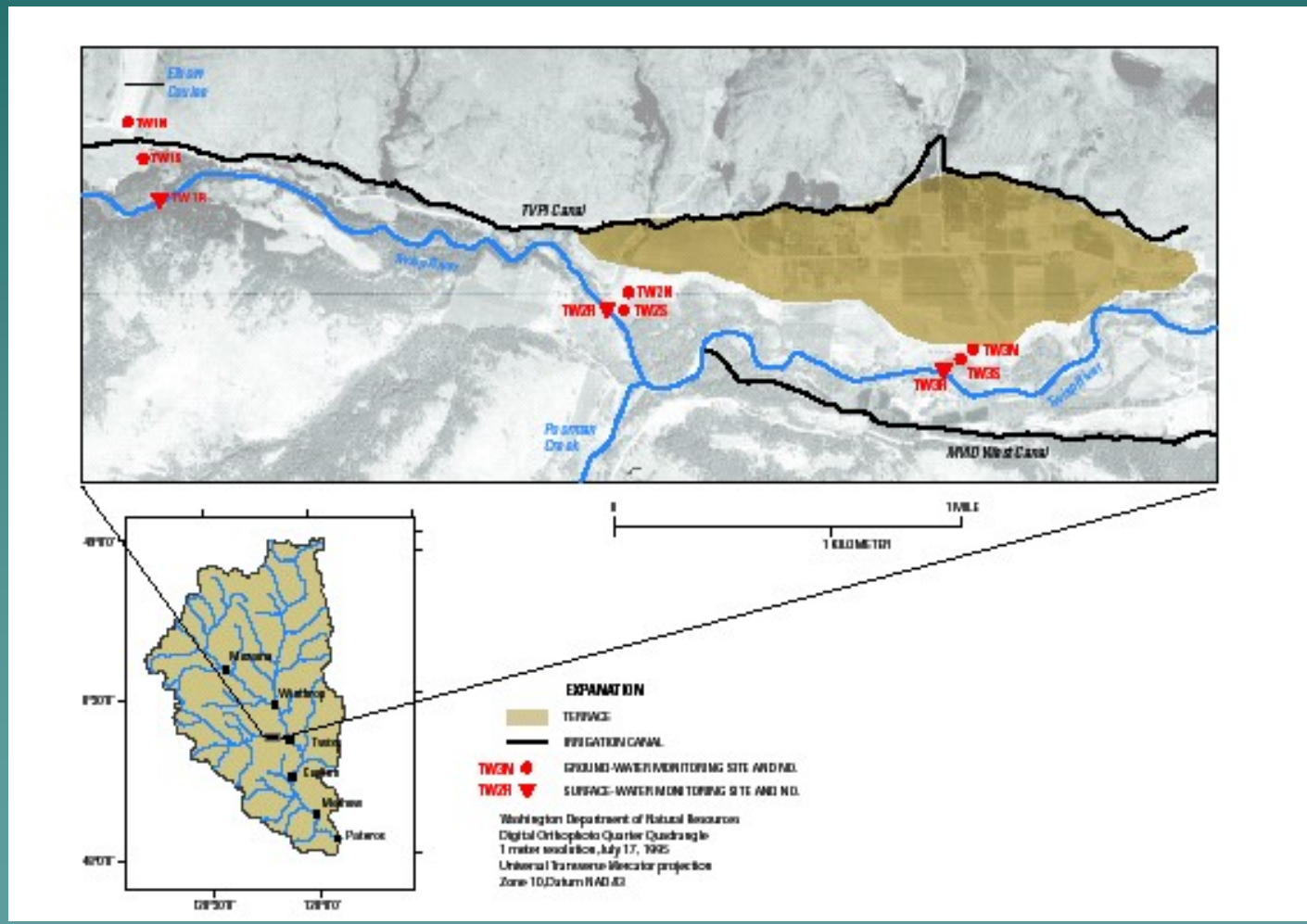
Detailed Investigation Area, Twisp River, Washington



GW Study Results

- Seasonal recharge from irrigation canals was evident as well as the timing of the decline in water levels after diversions stopped for the season.
- Increased streamflow gains due to irrigation-canal seepage were evident in some reaches, but decayed once diversions stopped.

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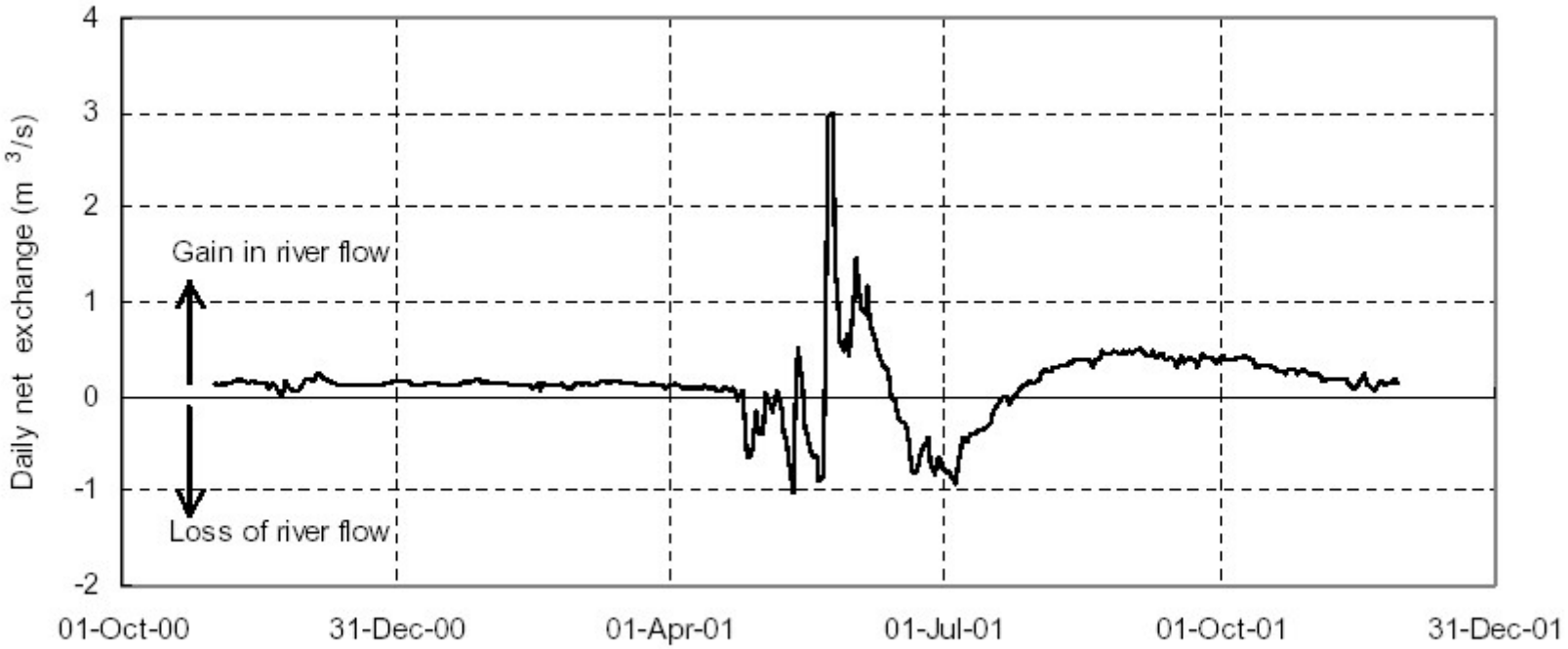
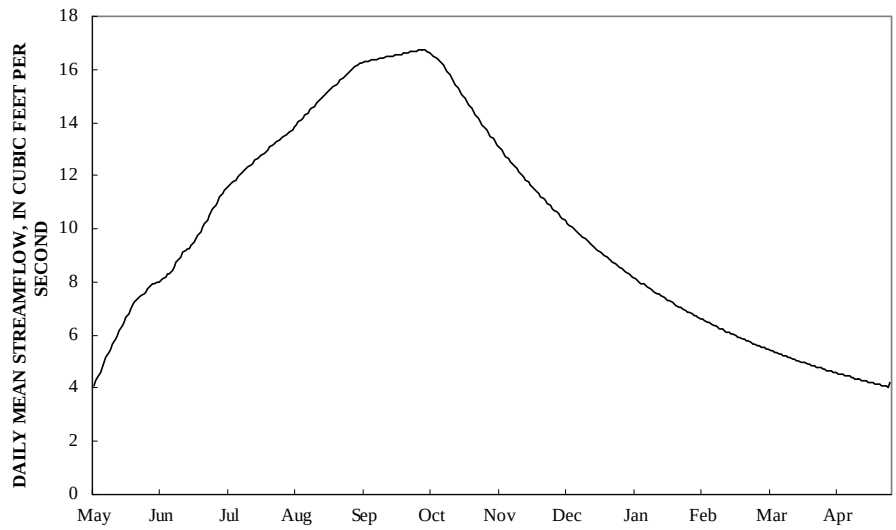


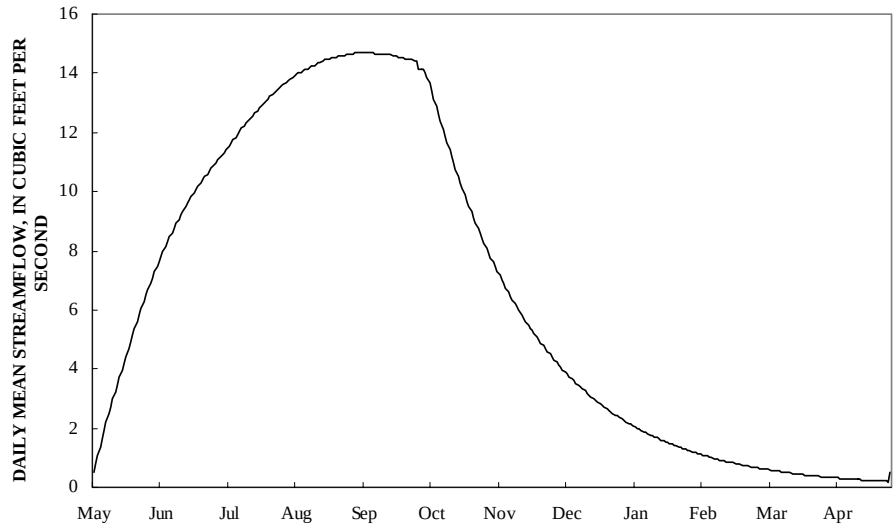
Figure 1. Daily net exchange between the Twisp River and aquifers in the lower Twisp River valley.

Irrigation seepage contribution to streamflow

A Chewuch River near Winthrop (12448000)



B. Twisp River near Twisp (12448998)



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The Methow River above Goat Creek is naturally dry from late summer to early spring in most years.

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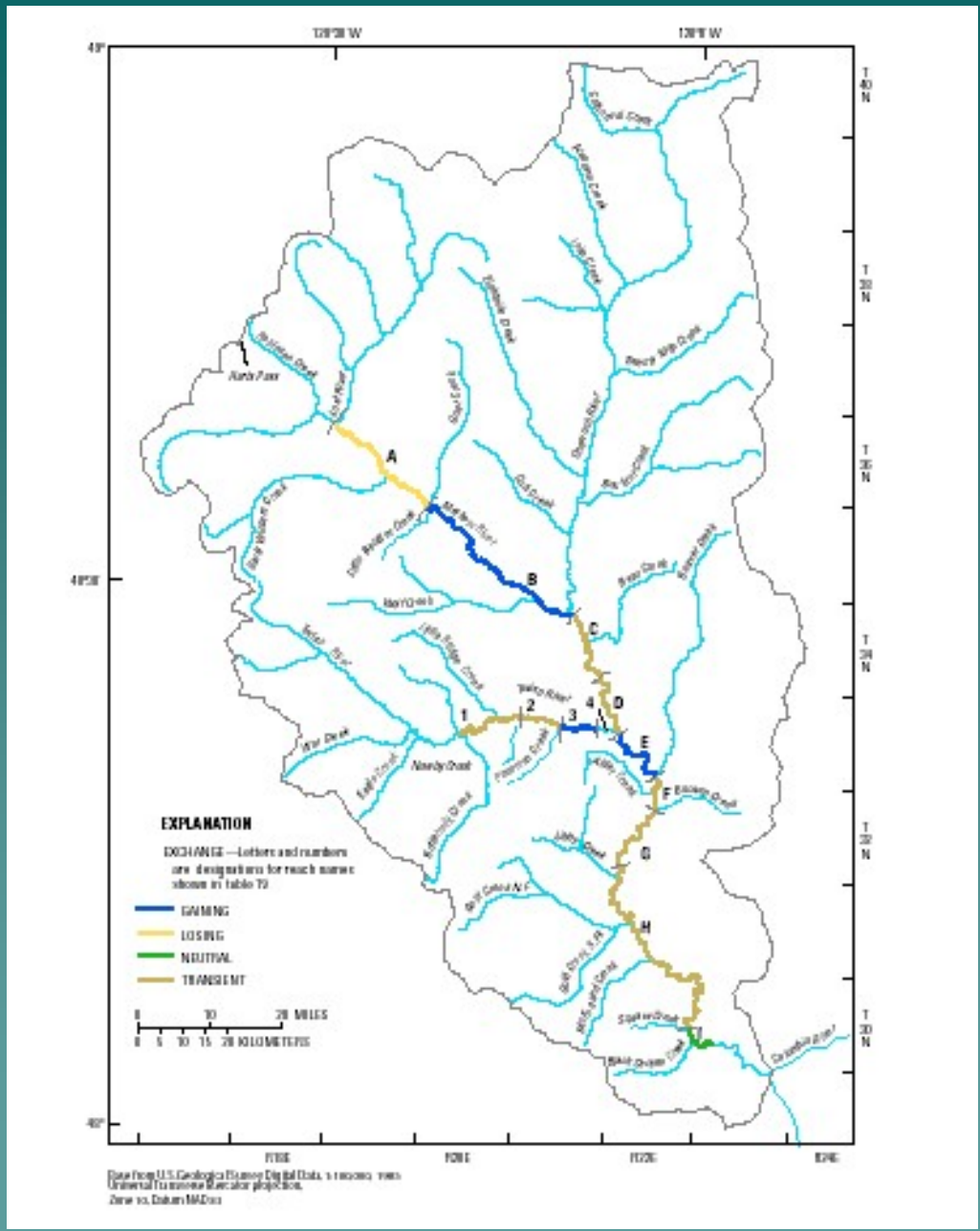
Basin-wide consideration of streamflow gains and losses provided a broader context for the influence of irrigation canal seepage



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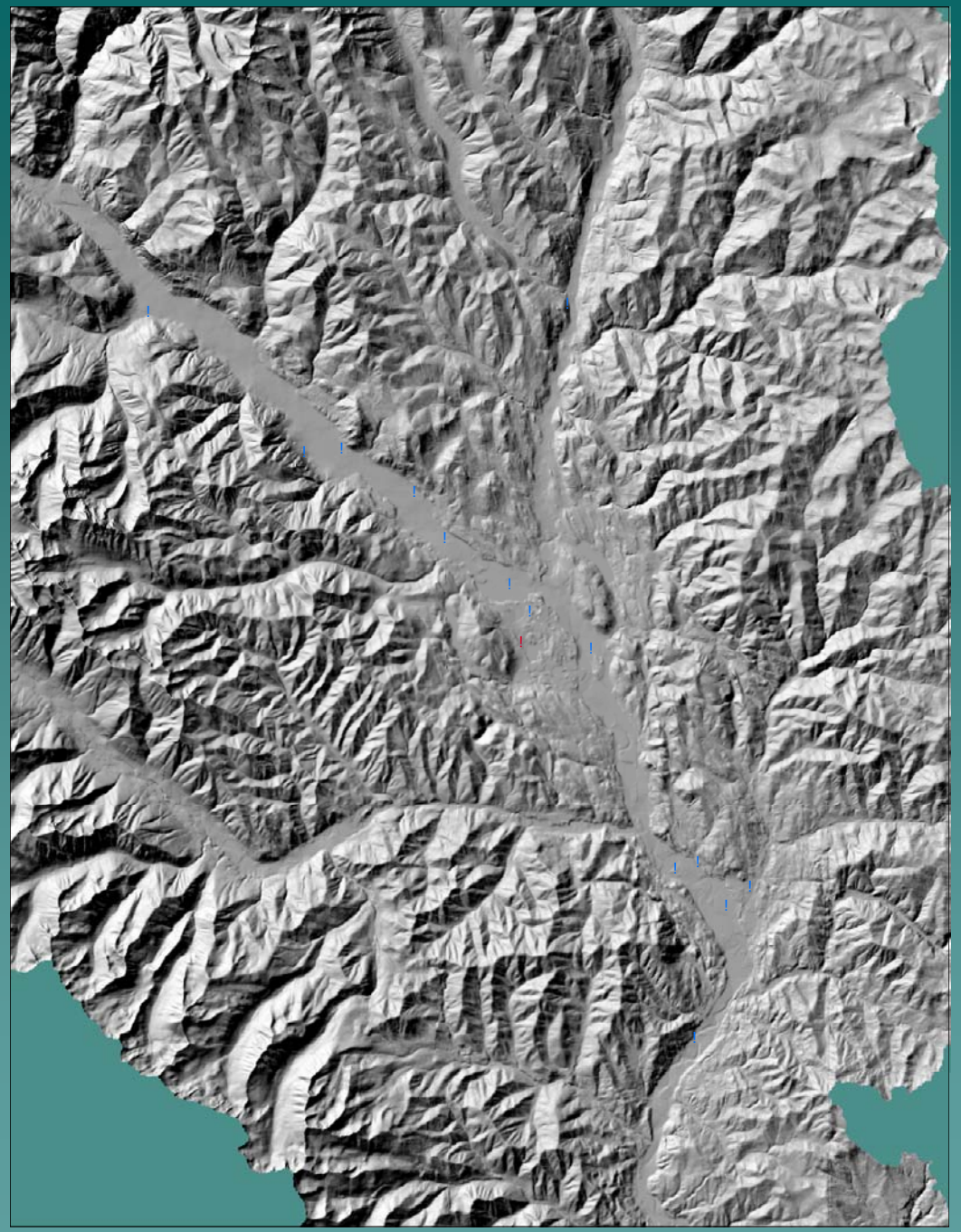
Location of Installed Ground-Water Level Recorders



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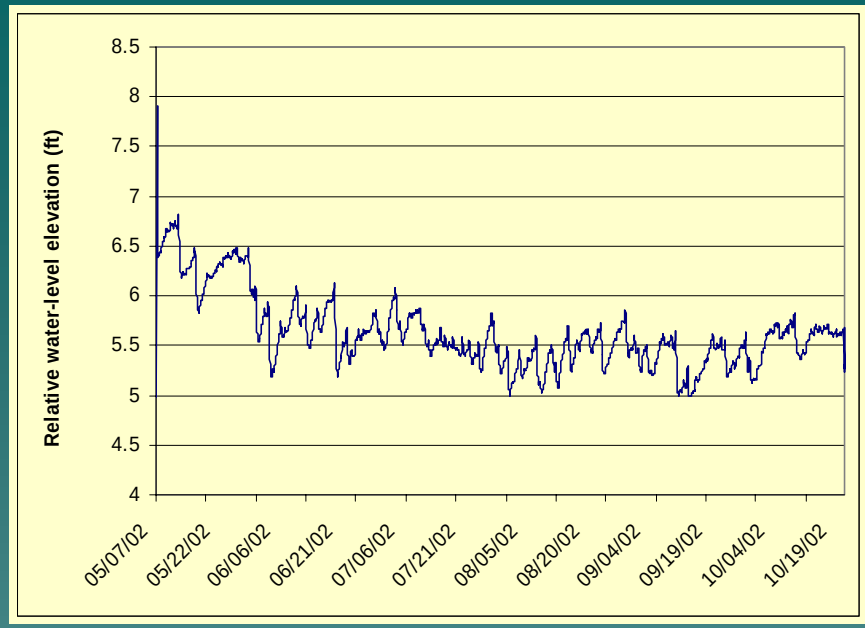
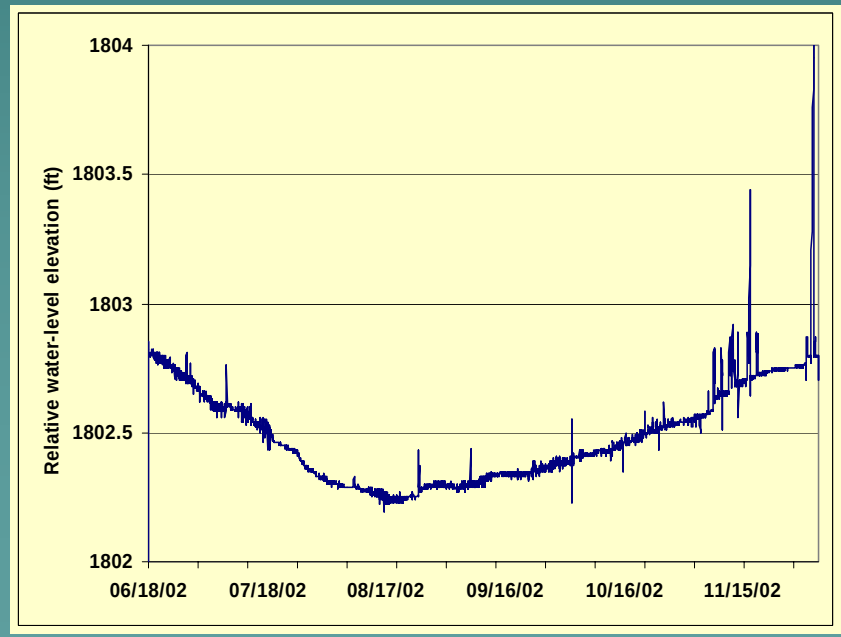
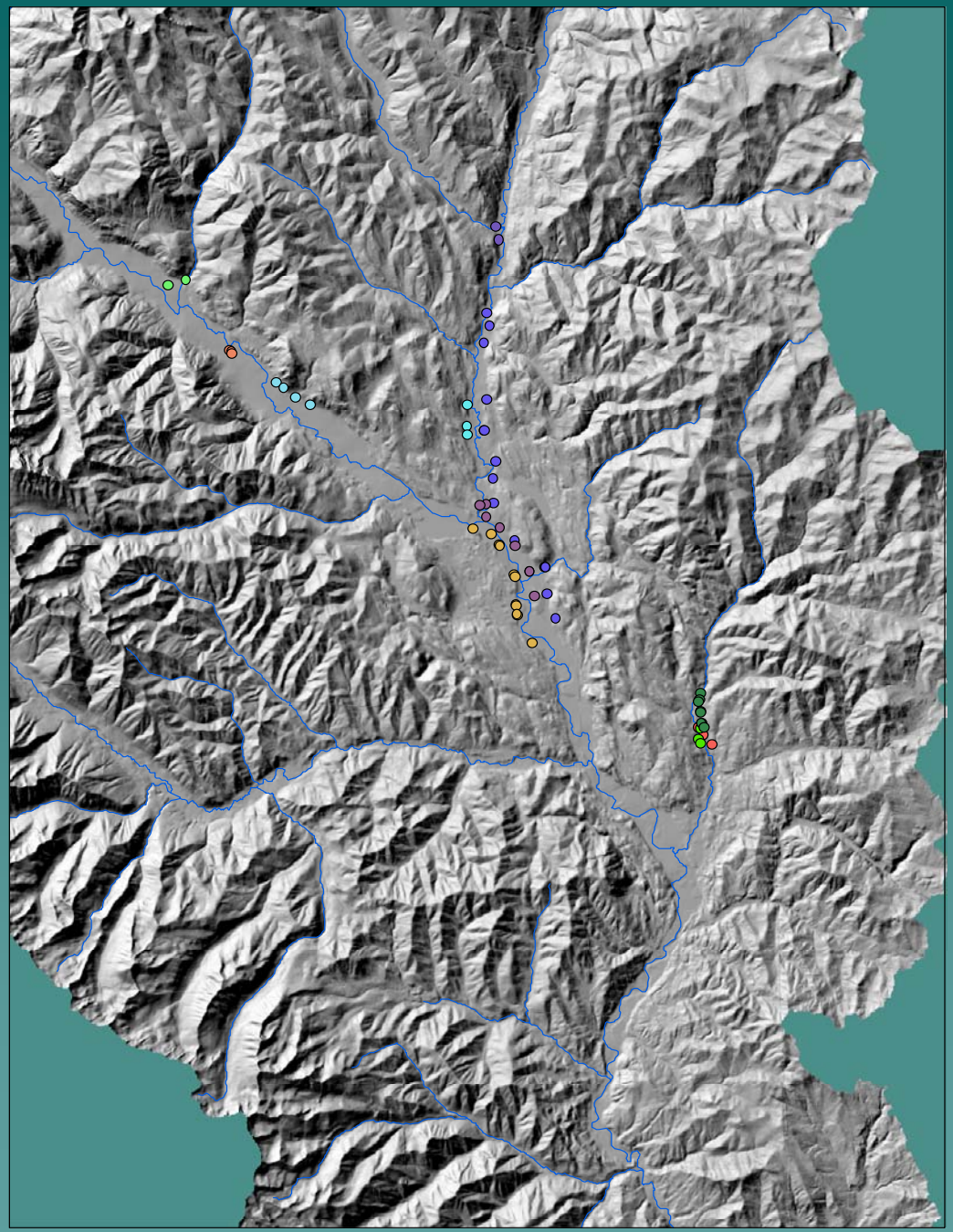

Relative water-level elevation (ft)
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
05/07/02
05/22/02
06/06/02
06/21/02
07/06/02
07/21/02
08/05/02
08/20/02
09/04/02
09/19/02
10/04/02
10/19/02


Relative water-level elevation (ft)
1804
1803.5
1803
1802.5
1802
06/18/02
07/18/02
08/17/02
09/16/02
10/16/02
11/15/02

Location of May 2002 Seepage Measurements



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MMS Scenarios for USBR

(1) baseline of current flow
(2) line irrigation canals to limit seepage losses
(3) increase surface-water diversions through unlined canals for aquifer recharge
(4) convert from surface-water to groundwater resources to supply water for irrigation
(5) reduce tree density in forested headwater catchments, and
(6) natural flow

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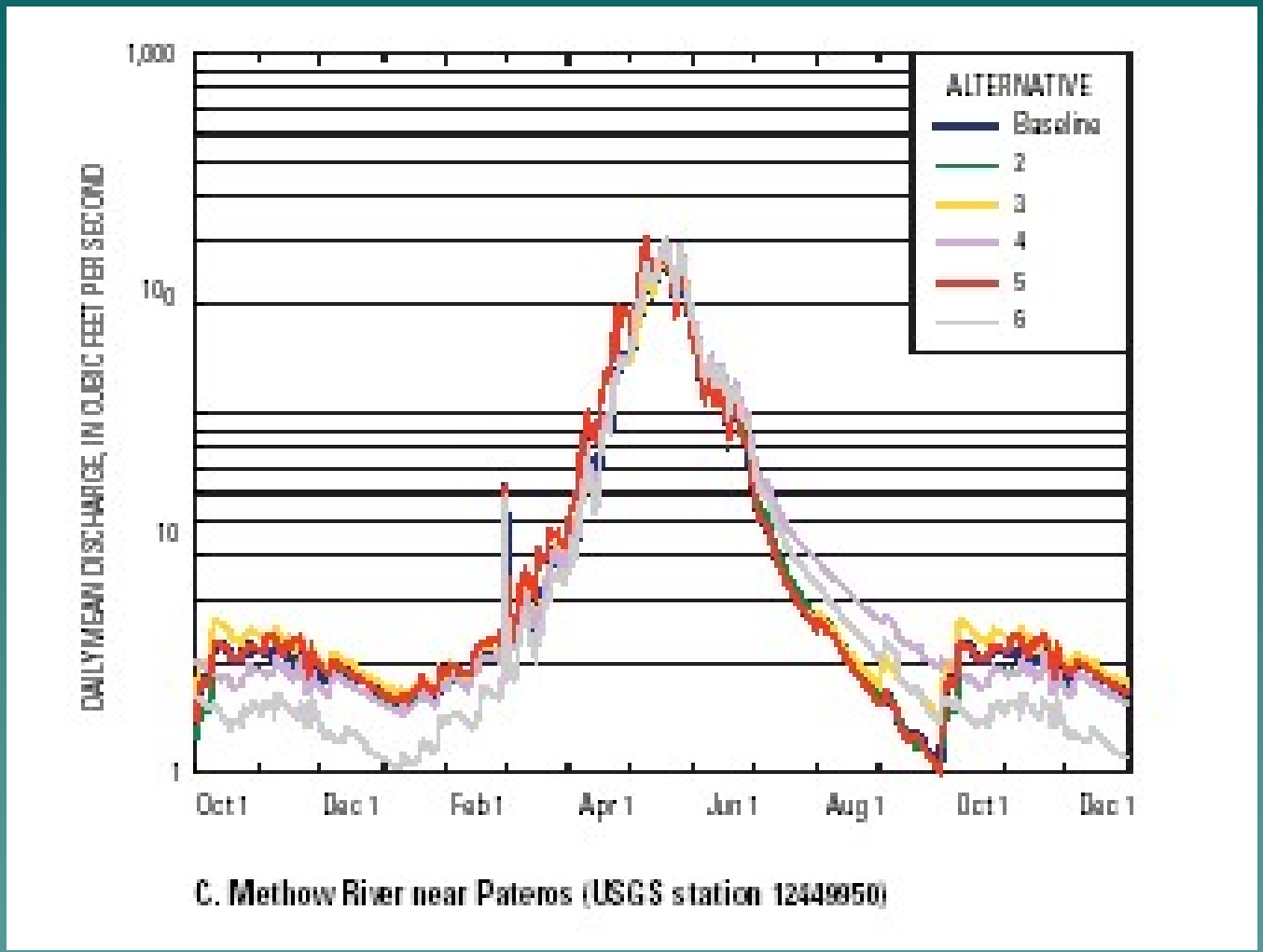
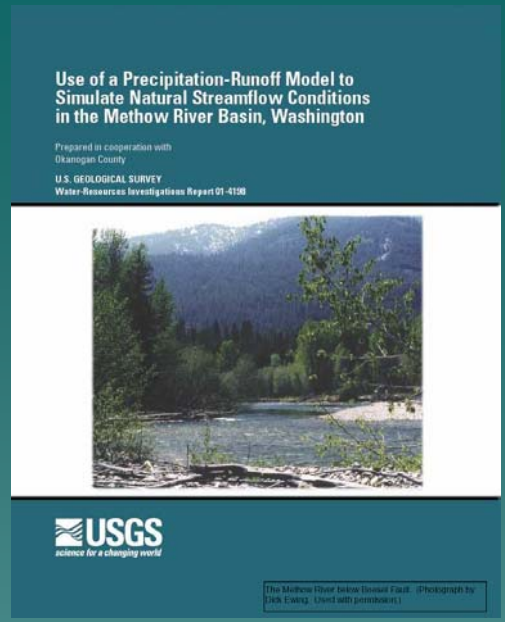
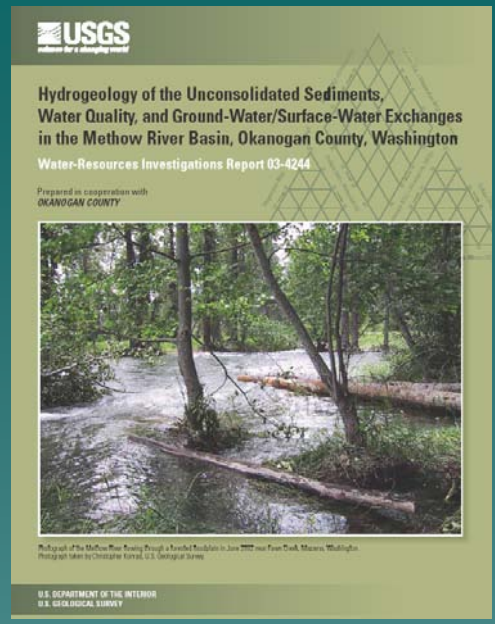
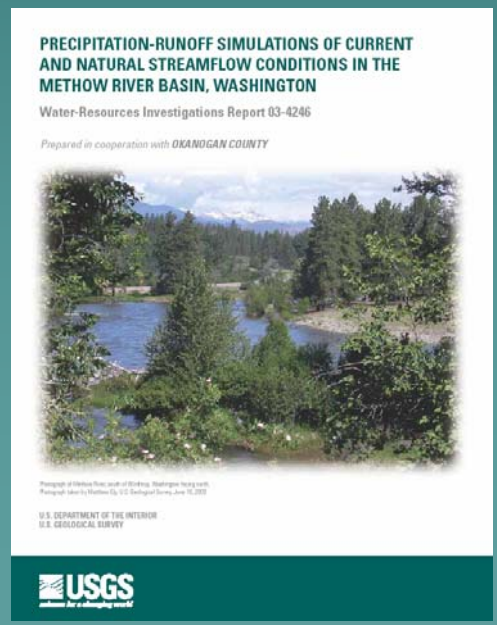


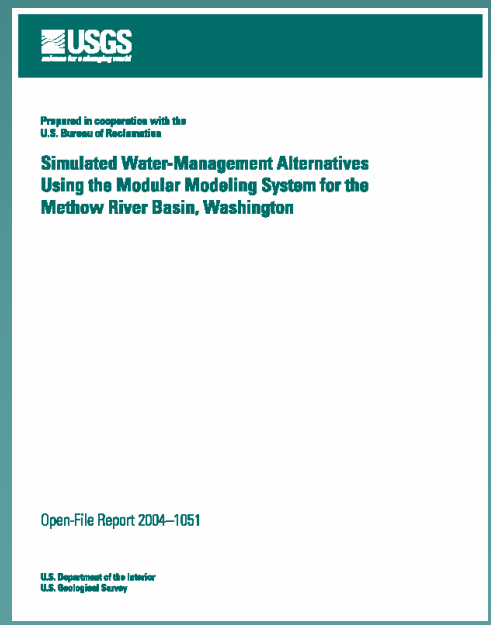
90-percent exceedence values for simulated daily streamflow for water years 1960–2001.

USGS Reports have been well received but timing of release did not always coincide with cooperator needs









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Methow Valley News

No surprises in study that shows links between rivers, aquifer and irrigation canals

For years, irrigators have been trying to convince state and federal agencies that seepage of water from open irrigation canals helped recharge the rivers in the Methow basin. **Now, a study released by the U.S. Geological Survey has helped to clarify the relationship between the rivers, the underground aquifer and the valley's irrigation ditches.**

The Wenatchee World online

Editorial -- The dry facts in the Methow

Somewhere, you suspect, a federal official was laughing when irrigators in the Methow Valley made the claim that their old, porous irrigation ditches might actually help salmon. It is heresy to think that water taken for human purposes could return to the river, perhaps to the benefit of endangered species.

~~~~~~~~~~~~~~~~

Now comes a genuine scientific study from the United States Geological Survey saying that the irrigators were right all along. The leaky irrigation ditches not only recharge the aquifer, but do so substantially. Seepage from canals in late summer boosts the flow of the Methow between Twisp and Winthrop by about 30 cubic feet per second. The canals recharge the groundwater, which is a crucial source of river flows. In late summer, groundwater accounts for more than half the flow of the Methow at its confluence with the Columbia.

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- Importance of strong USGS presence in study area
  - USGS has been streamgaging in the Methow watershed since 1919
  - More importantly, the USGS *streamgager* worked in the Methow since 1990
- Importance of strong liaison in study area
- Importance of strong active interest in study area

- Unstructured framework of the watershed planning process ensured some degree of failure
  - Ecology was ***not*** a member of the Planning Unit
  - Locals had narrow focus on issues
  - USGS could broaden focus but not drive impacts
  - Methow Basin watershed plan is currently not approved by Ecology

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