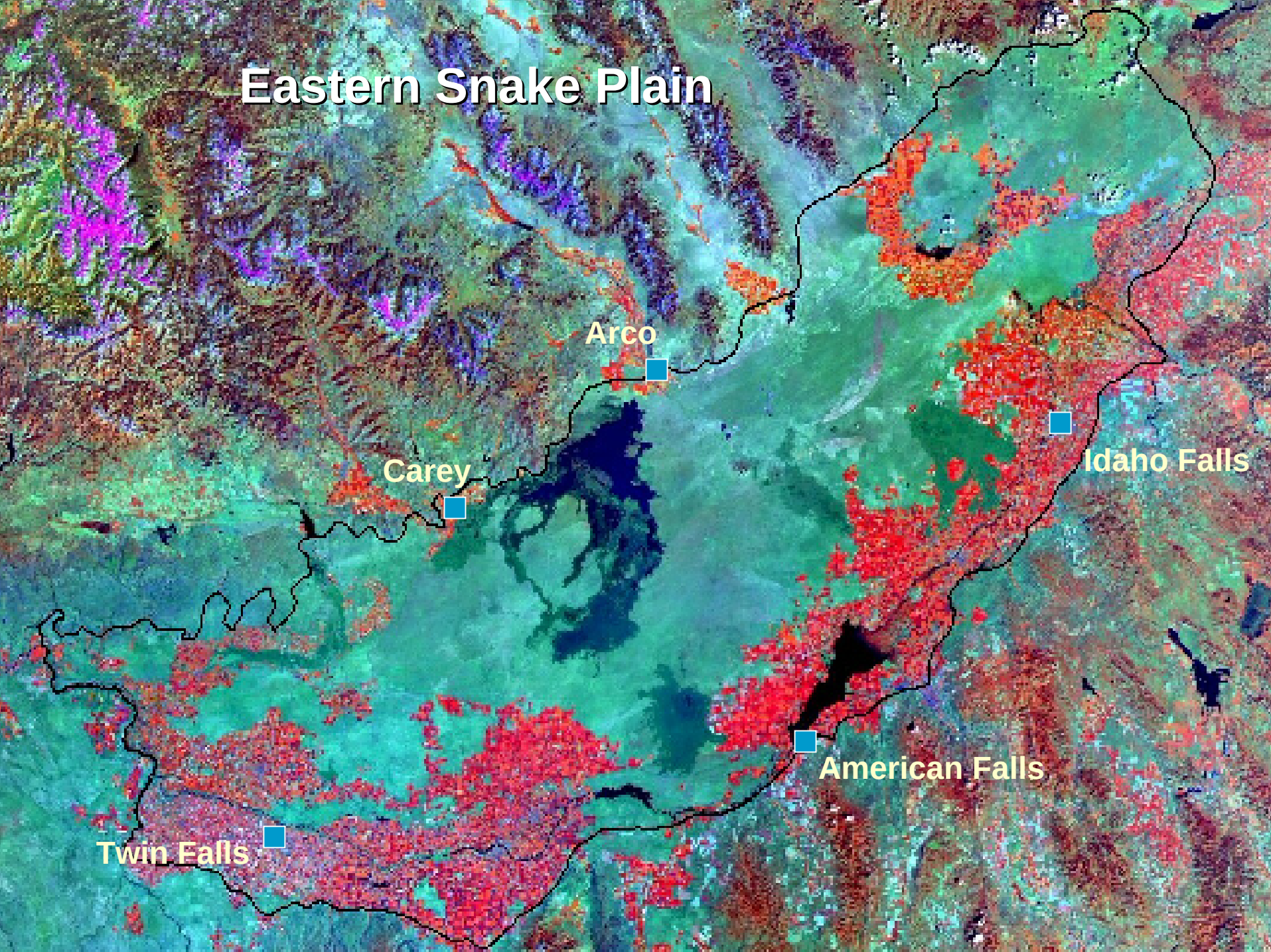
The Eastern Snake River Plain Aquifer

Eastern Snake Plain Aquifer Working Group
Expanded Natural Resources Interim Committee

Charles E. Brockway
Brockway Engineering


Eastern Snake Plain
Arco
Carey
Idaho Falls
American Falls
Twin Falls

Topics

- Hydrology 101-Basics of the Eastern Snake River Plain Aquifer
- Hydrologic Status of the Aquifer
- Long Term Trends in Aquifer Indicators
- Aquifer Response to Changes in Recharge or Pumping

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ESRPA Aquifer General Characteristics

- 10,000+ square miles Ashton to King Hill
- Layered basalt (lava) system, 5000 ft deep in places
- 8,000,000 acre feet per year throughput
- 50% of recharge is (has been) the result of surface irrigation
- 800,000 acres irrigated from groundwater
- 10,000+ wells drilled in aquifer

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Hydrology and Aquifer Basics

- Water table gradient
- Aquifer hydraulic conductivity
- Storage: how much water does it hold?
- Homogeneity and anisotropy

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Hydrology and Aquifer Basics II

- Water Balance - What Goes in Comes Out (almost)
  - Outflow – springs, pumping, river exchange, ET
  - Inflow – precipitation, irrigation, tributary underflow, river exchange
  - Change in Storage
  - A Negative Water Balance is an Indicator of an Overappropriated Aquifer

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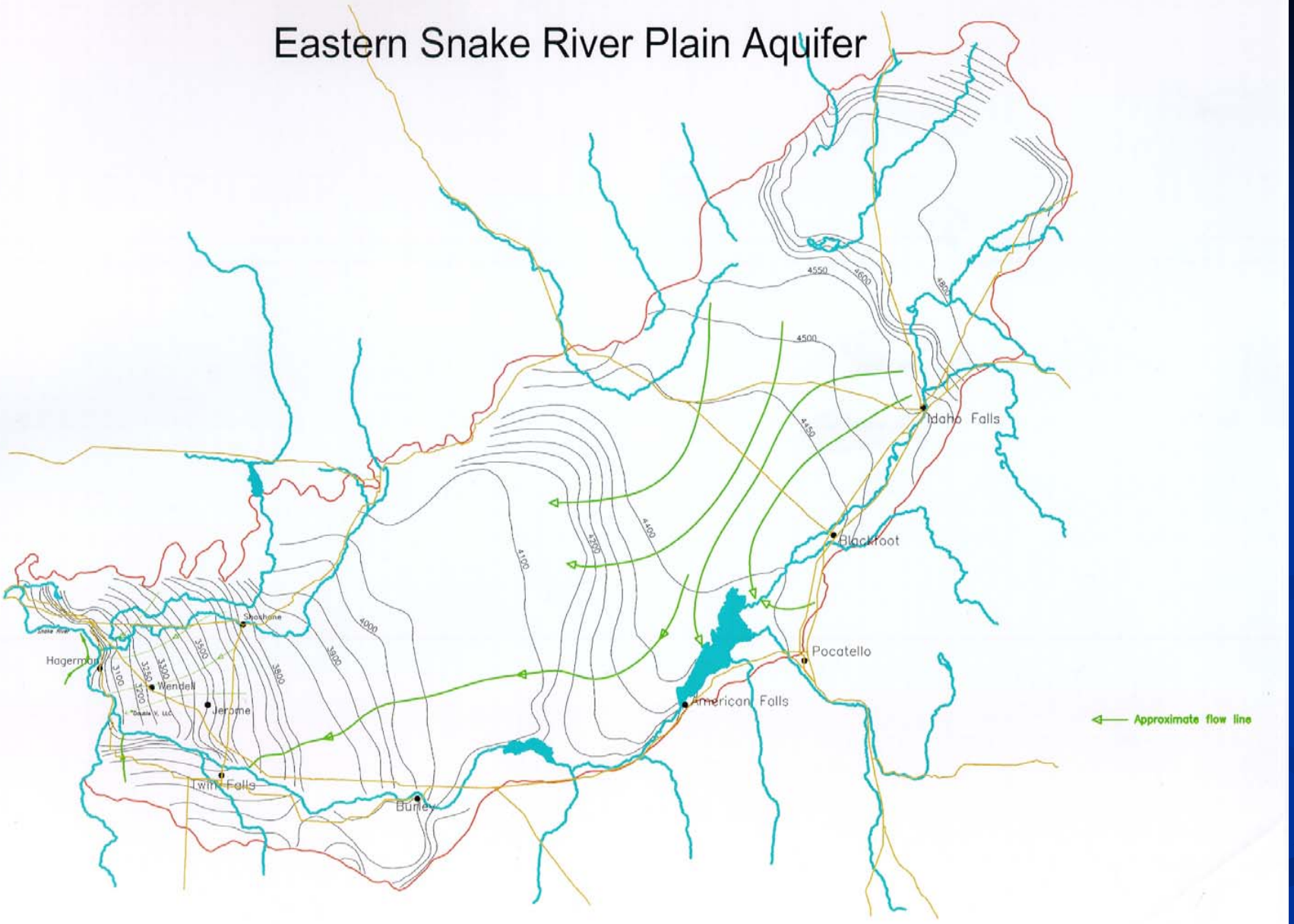
Eastern Snake River Plain Aquifer



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ESRPA Aquifer II

- Major spring areas (reaches)
  - American Falls: 2,000,000 af/year
  - Thousand Springs: 4,000,000 af/year
- Storage: 5,000,000 acre feet
- Huge aquifer unaffected by climate? NO!
- Huge aquifer unaffected by man? NO!

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Aquifer Water Level Changes

- Variations in aquifer stress caused by changes in:
  - Irrigation Application from Surface Sources
  - Natural Recharge: Precipitation, Underflow
  - Consumptive Depletions by Pumping
  - Managed recharge (future?)
- Water levels, storage, and spring flows declining

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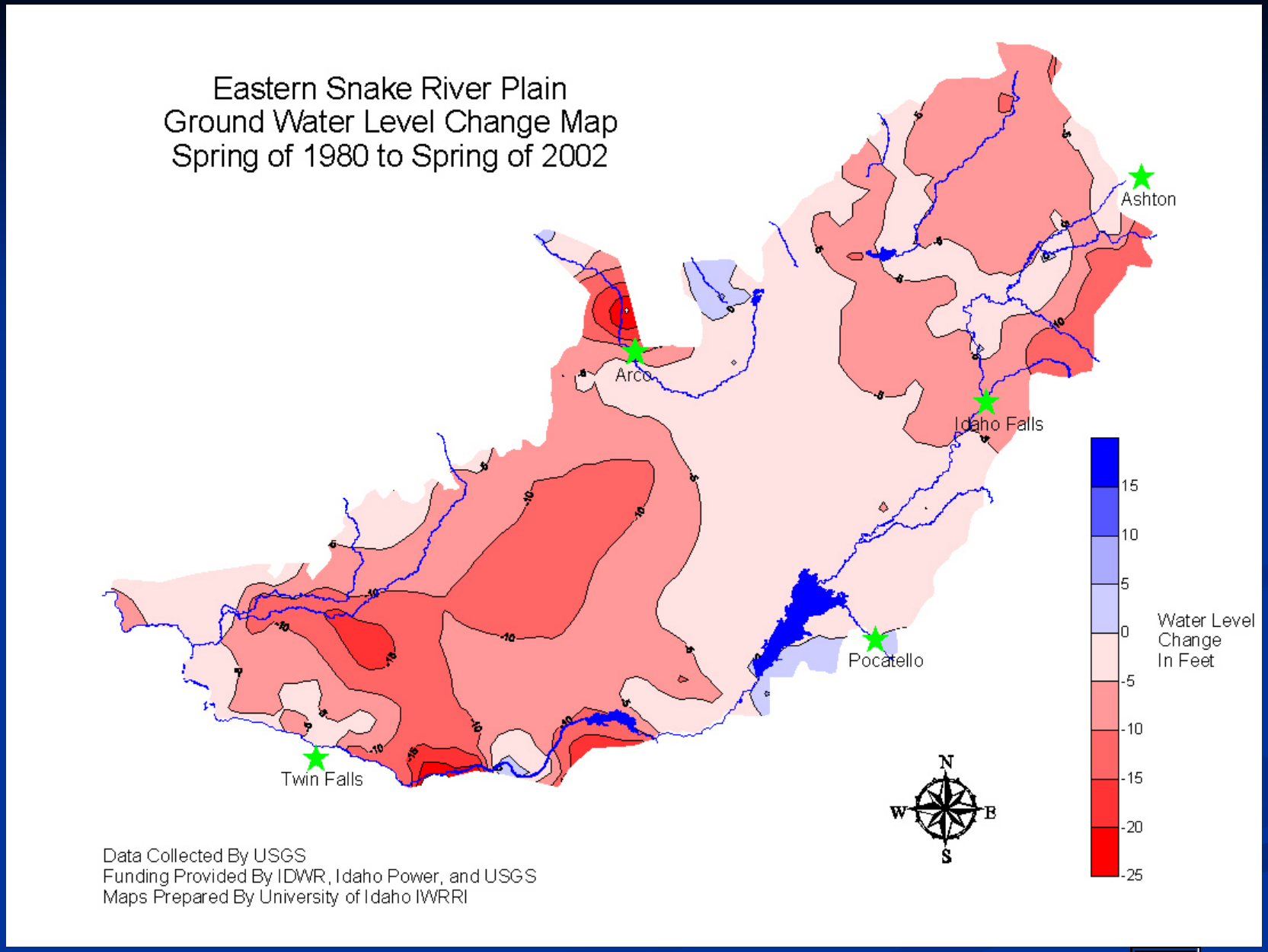

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GROUND WATER HYDROGRAPHS

LEGEND

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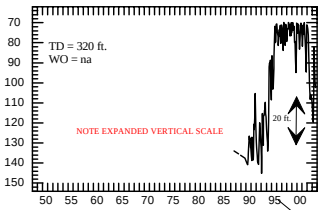
WELL 06S13E-08BDA2



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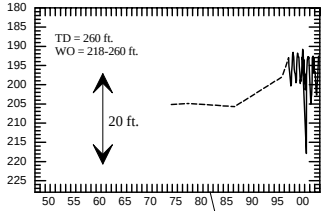

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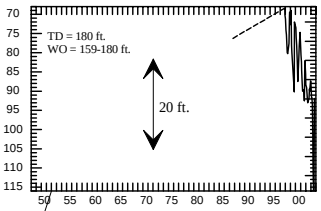

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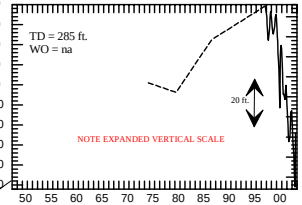

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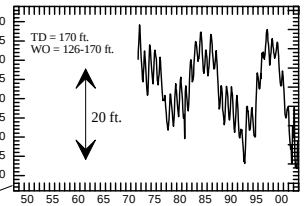

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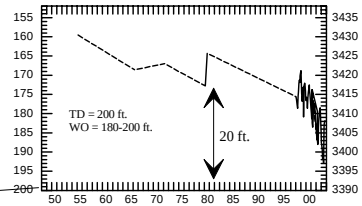

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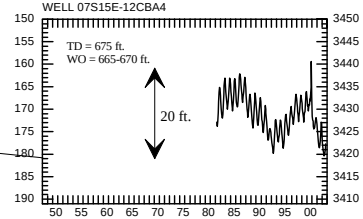

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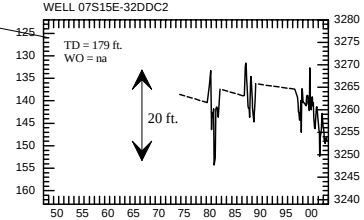

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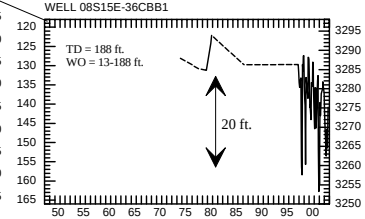

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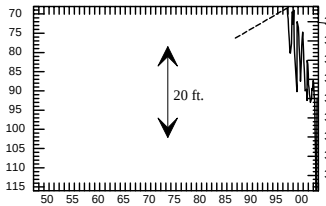

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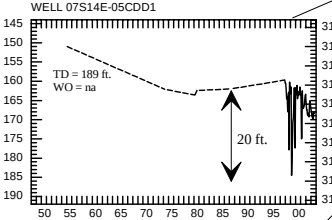

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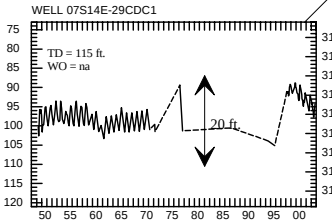

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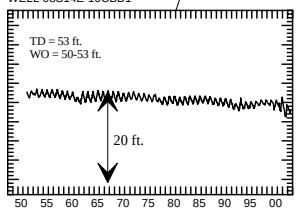

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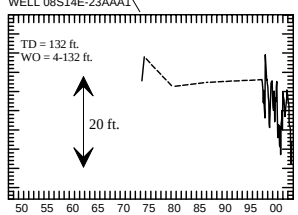

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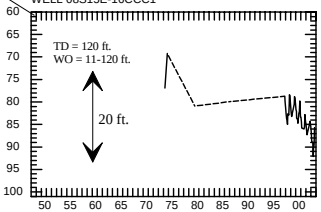

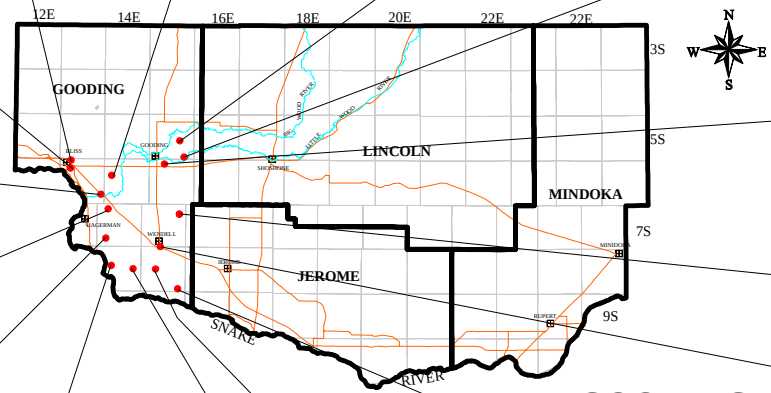

GOODING COUNTY

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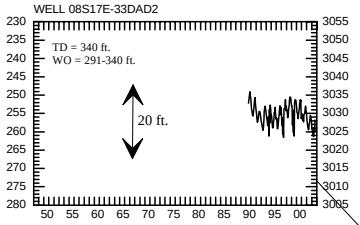
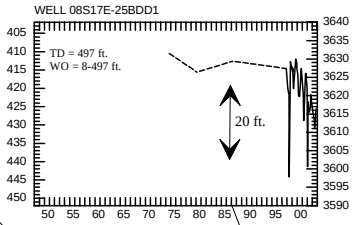
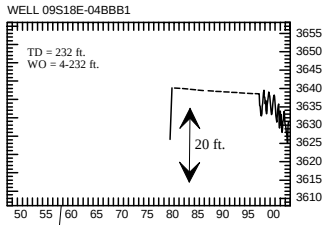
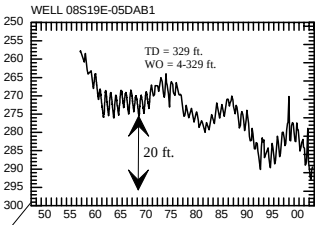
JEROME COUNTY

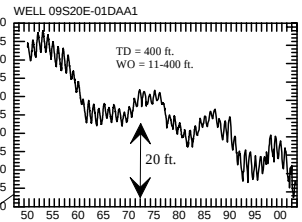
GROUND WATER HYDROGRAPHS

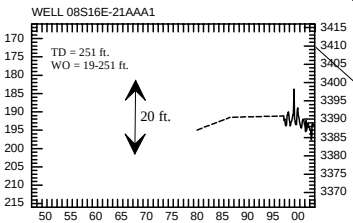


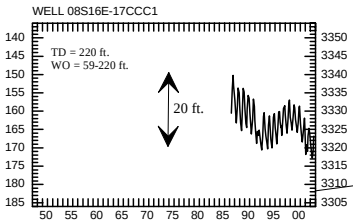


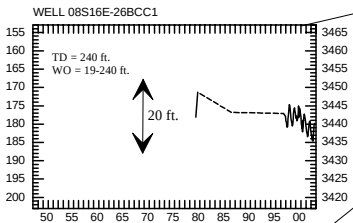


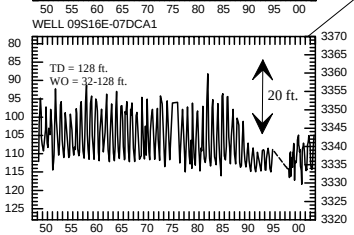


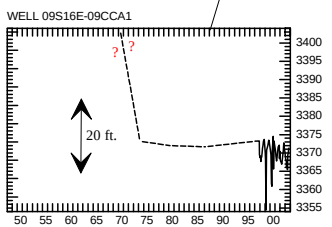


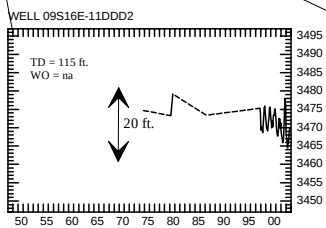


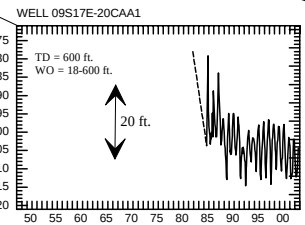


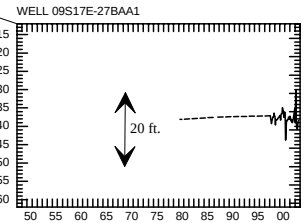


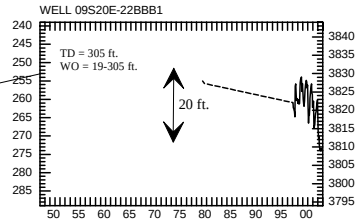


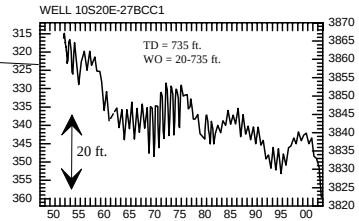


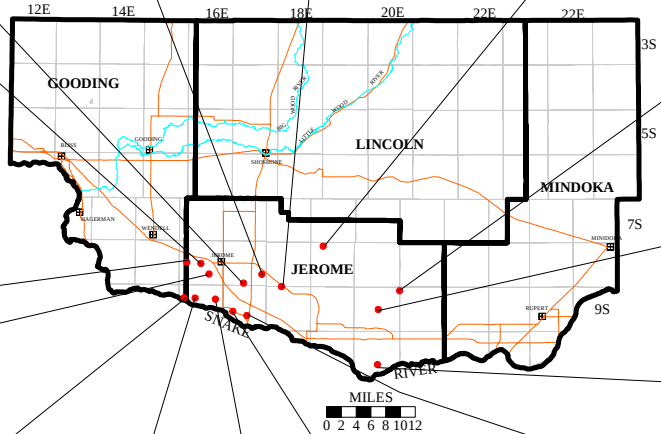












N
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LEGEND

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LEFT SIDE: DEPTH TO WATER
RIGHT SIDE: WATER ELEVATION
BASE: YEAR
ALL MEASUREMENTS IN FEET
● WELL LOCATION
CURRENT TO FALL 2003

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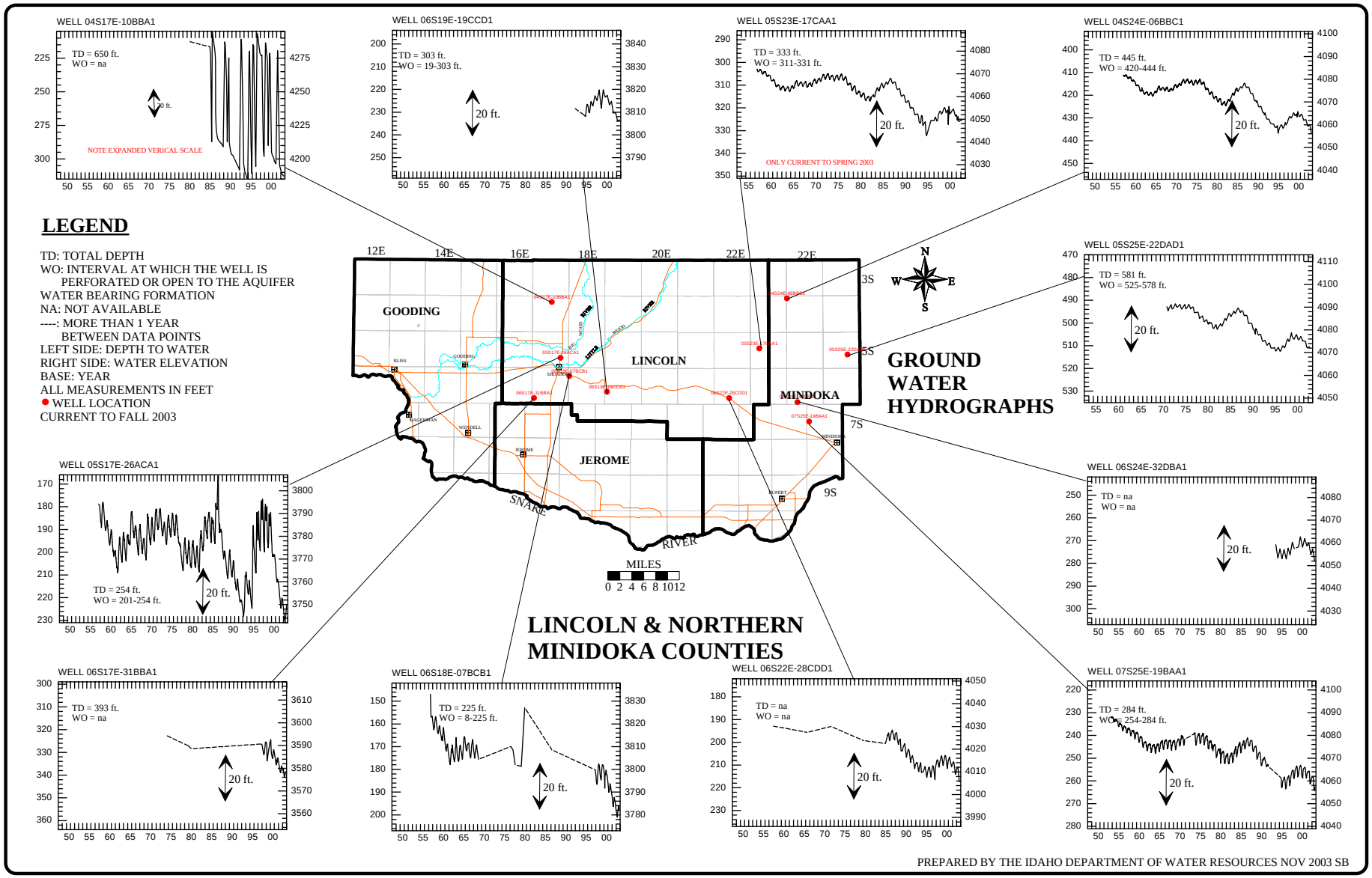
GROUND WATER HYDROGRAPHS

LINCOLN & NORTHERN MINIDOKA COUNTIES



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GROUND WATER HYDROGRAPHS

SOUTHERN MINIDOKA COUNTY

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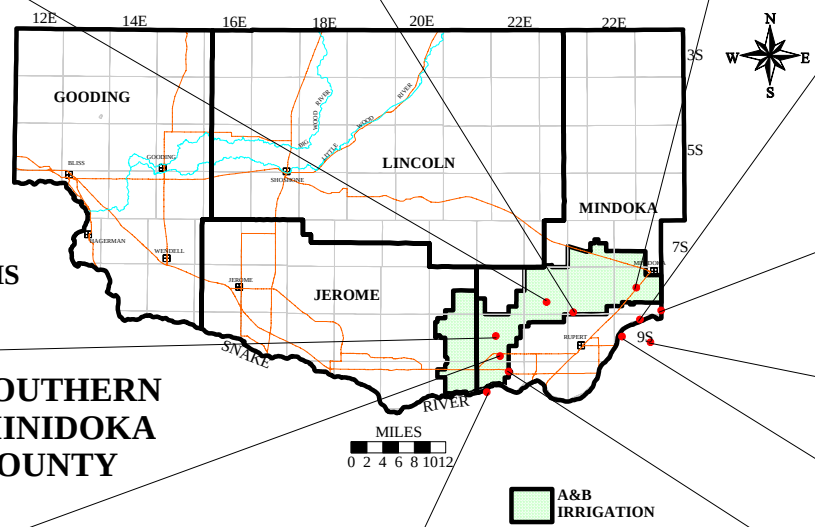

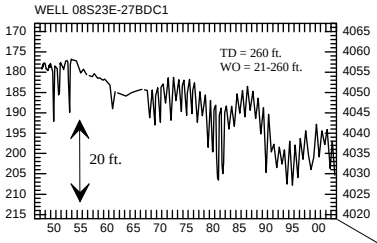

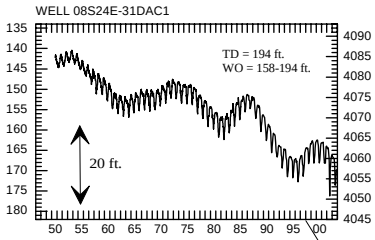

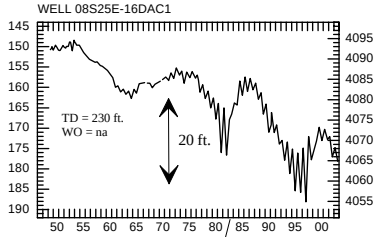

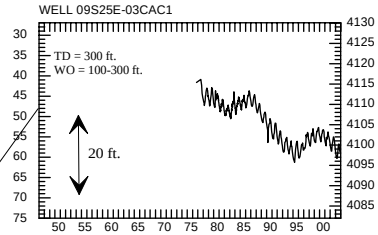

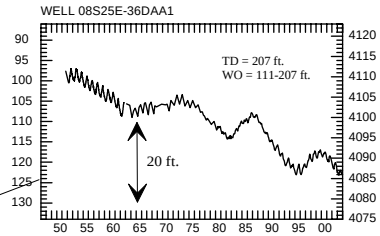

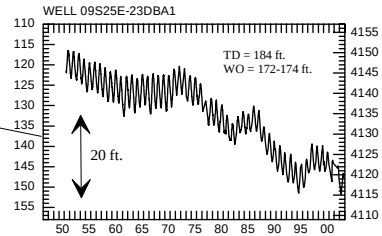

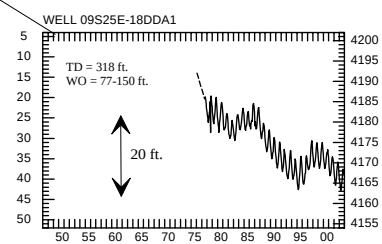

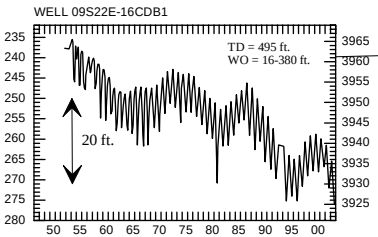

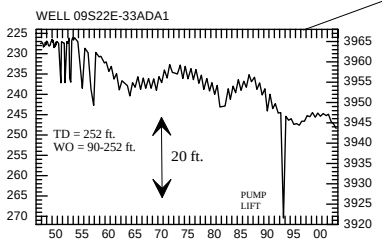

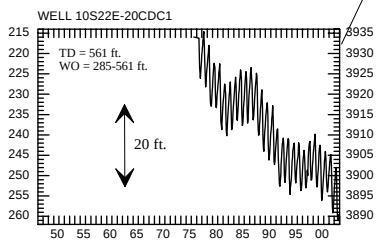

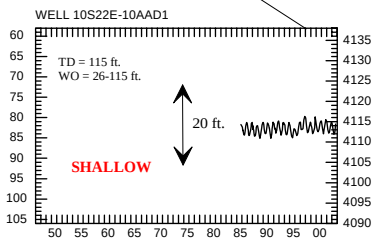

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GROUND WATER HYDROGRAPHS

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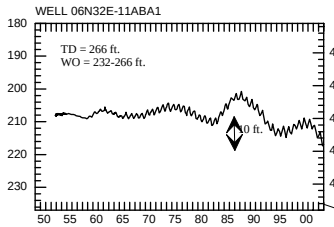

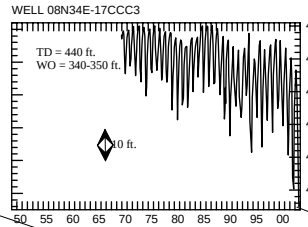

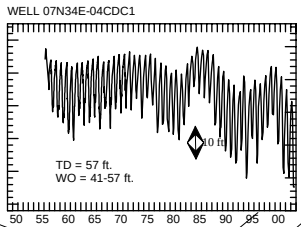

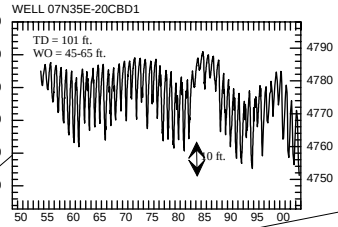

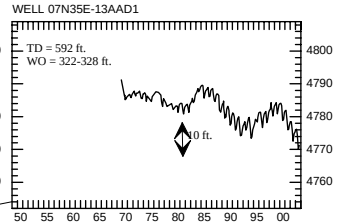

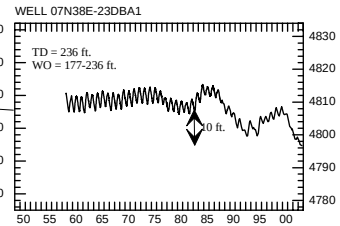

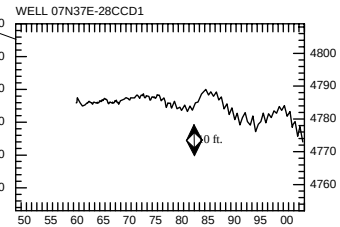

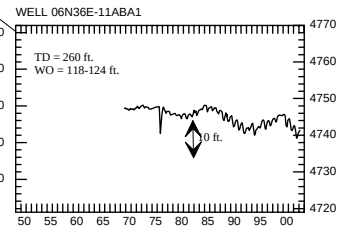

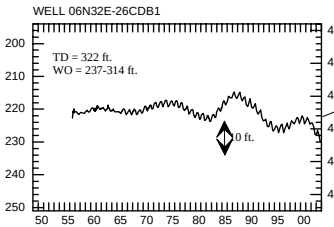

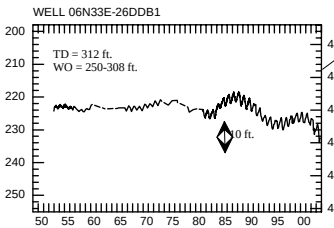

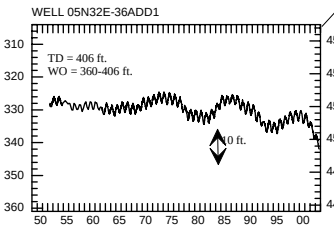

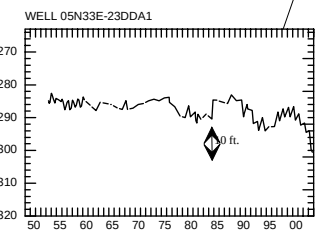

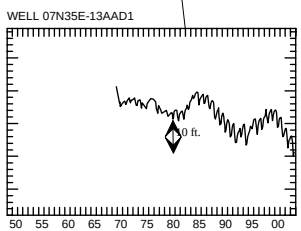

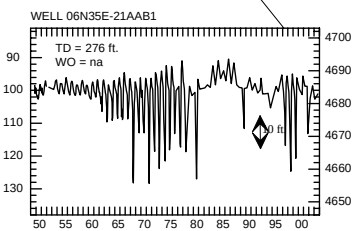

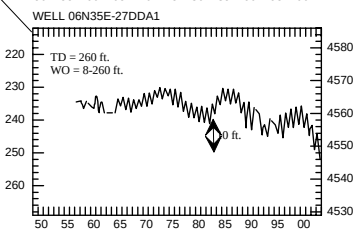

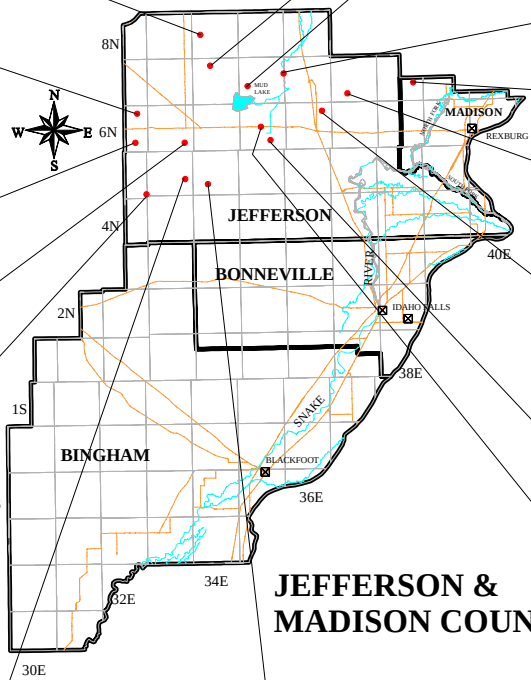

JEFFERSON & MADISON COUNTIES

PREPARED BY THE IDAHO DEPARTMENT OF WATER RESOURCES NOV 2003 SB

GROUND WATER HYDROGRAPHS

LEGEND

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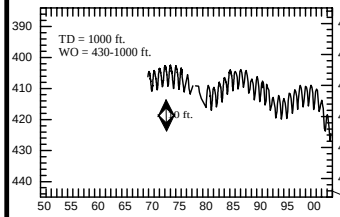
BASE: YEAR
ALL MEASUREMENTS IN FEET
● WELL LOCATION
CURRENT TO FALL 2003

WELL 04N35E-14AAA1



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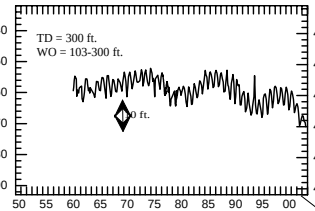

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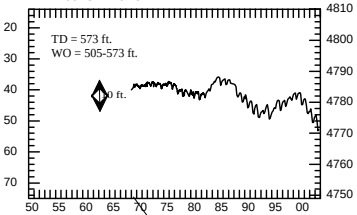

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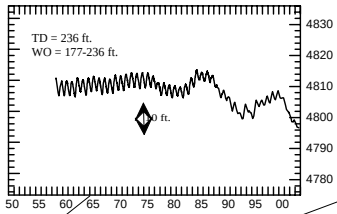

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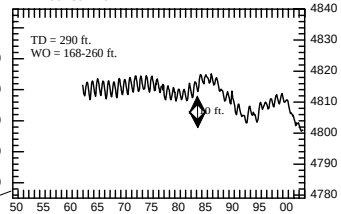

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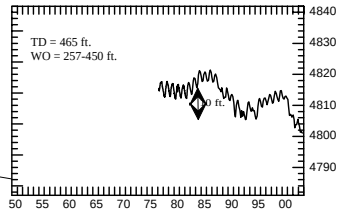

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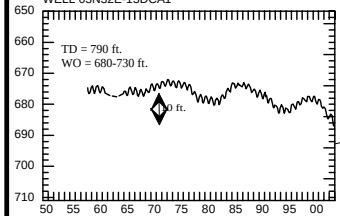

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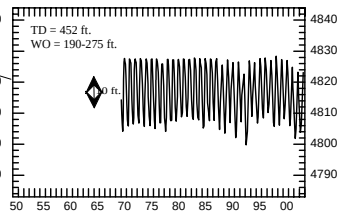

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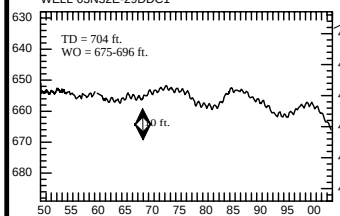

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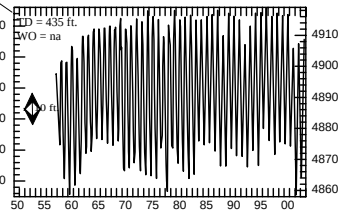
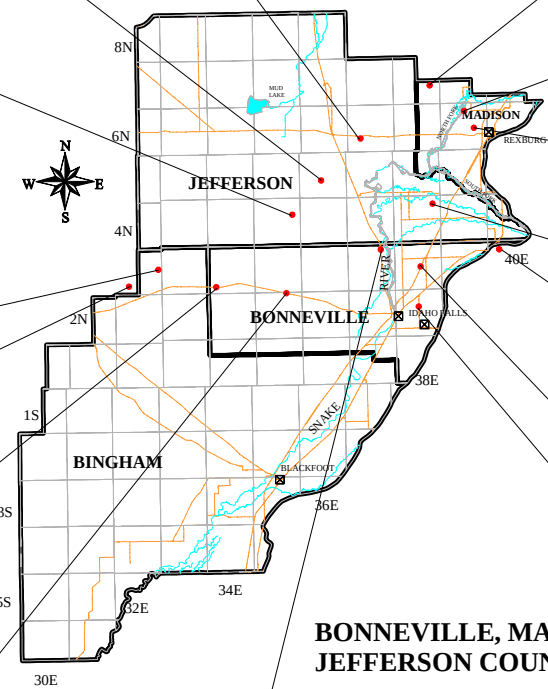
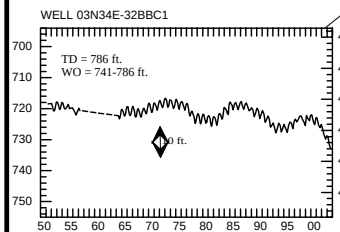




BONNEVILLE, MADISON& JEFFERSON COUNTIES

WELL 03N34E-32BBC1



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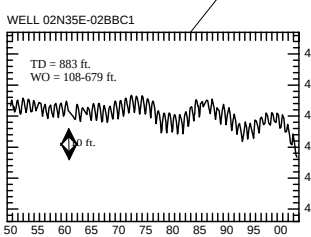

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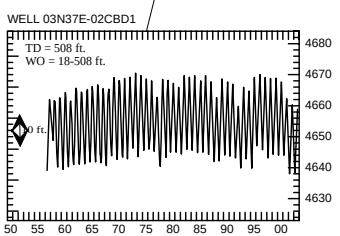

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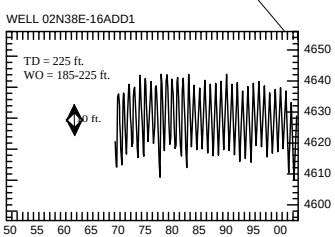

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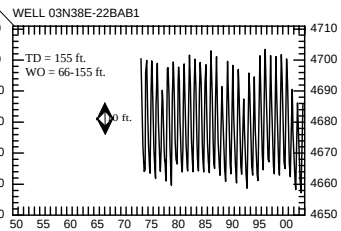

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GROUND WATER HYDROGRAPHS

BINGHAM COUNTY

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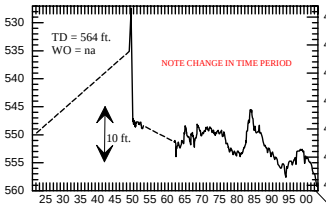
● WELL LOCATION
CURRENT TO FALL 2003

WELL 01N30E-10BBA1



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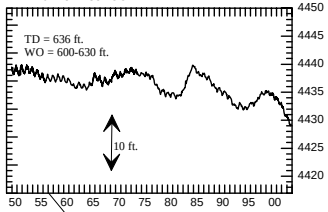

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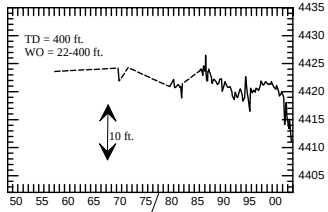

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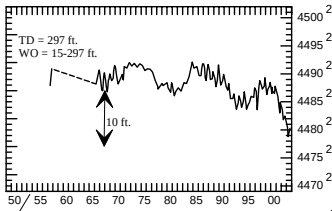

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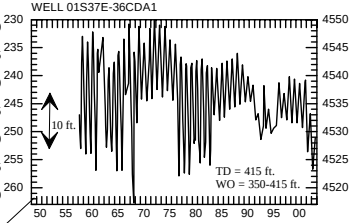

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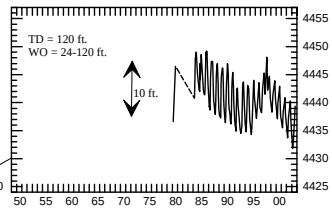

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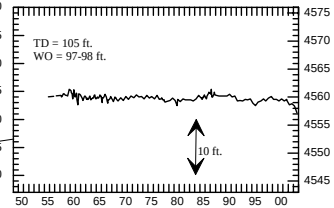

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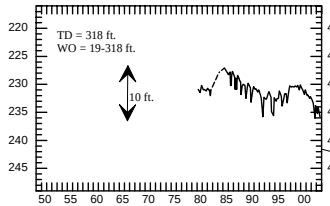

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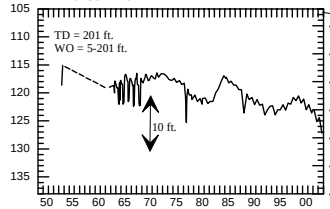

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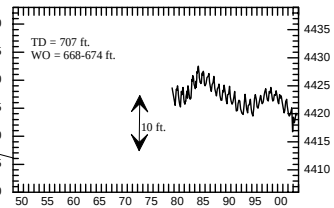

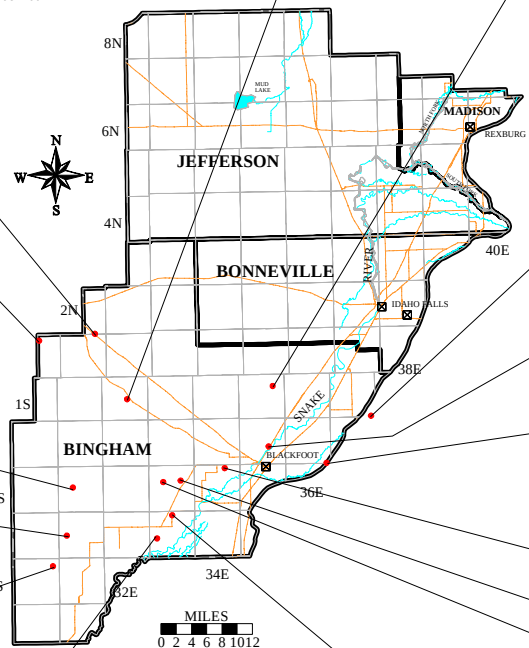

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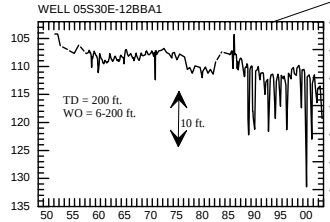

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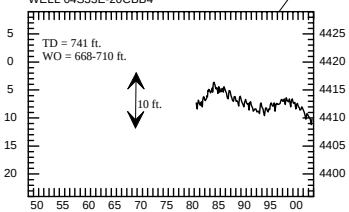

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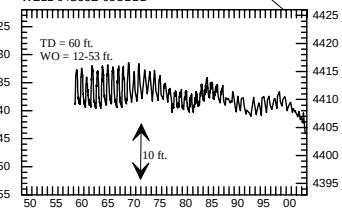

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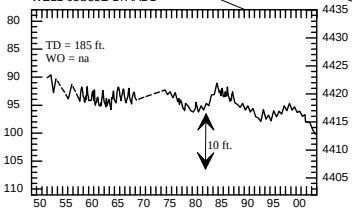

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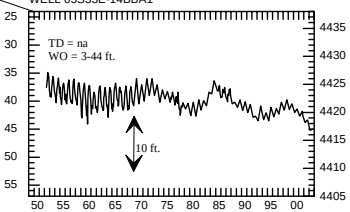

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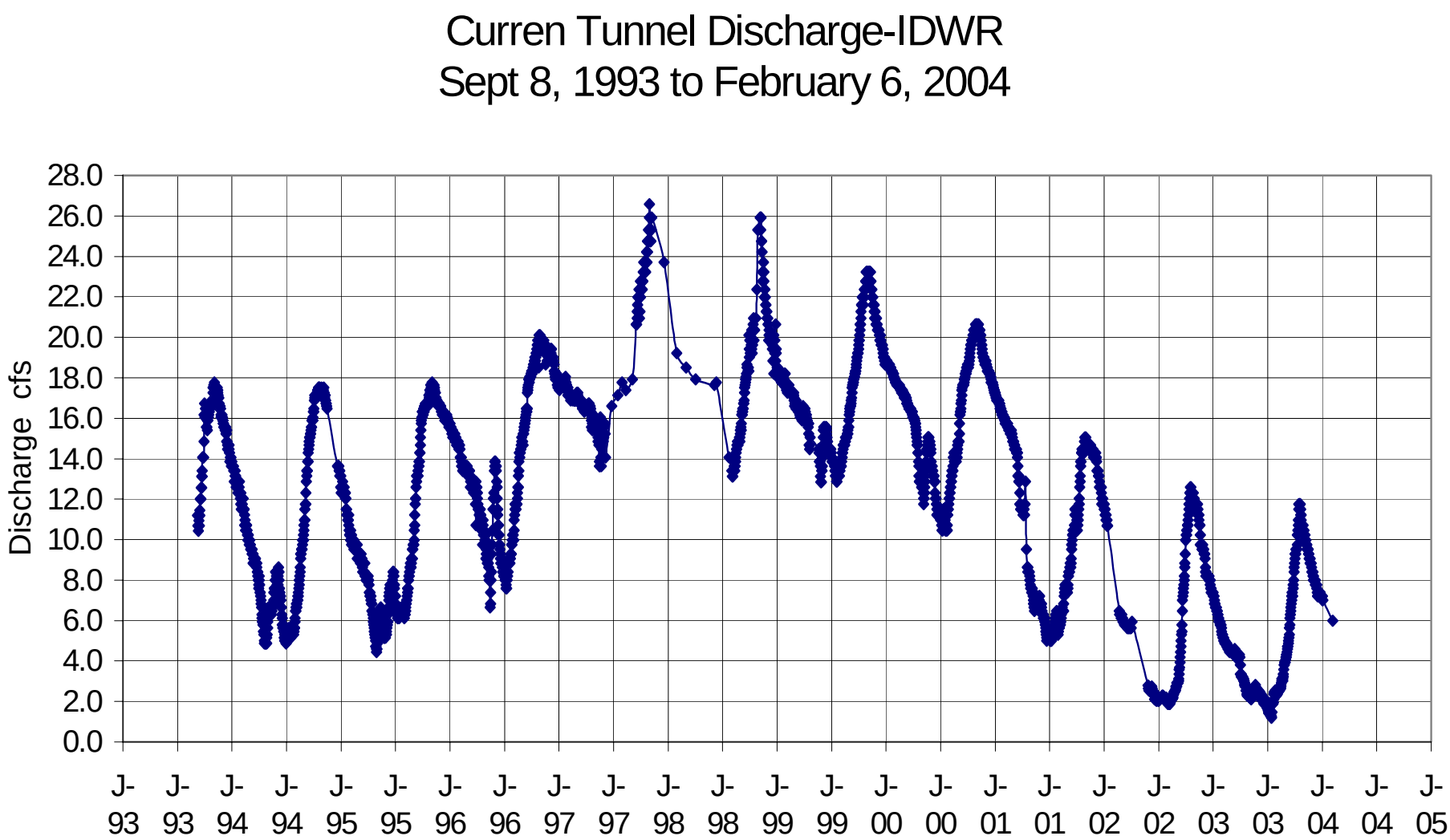
Curren Tunnel Discharge-IDWR
Sept 8, 1993 to February 6, 2004
Discharge cfs
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
J-93
J-93
J-94
J-94
J-95
J-95
J-96
J-96
J-97
J-97
J-98
J-98
J-99
J-99
J-00
J-00
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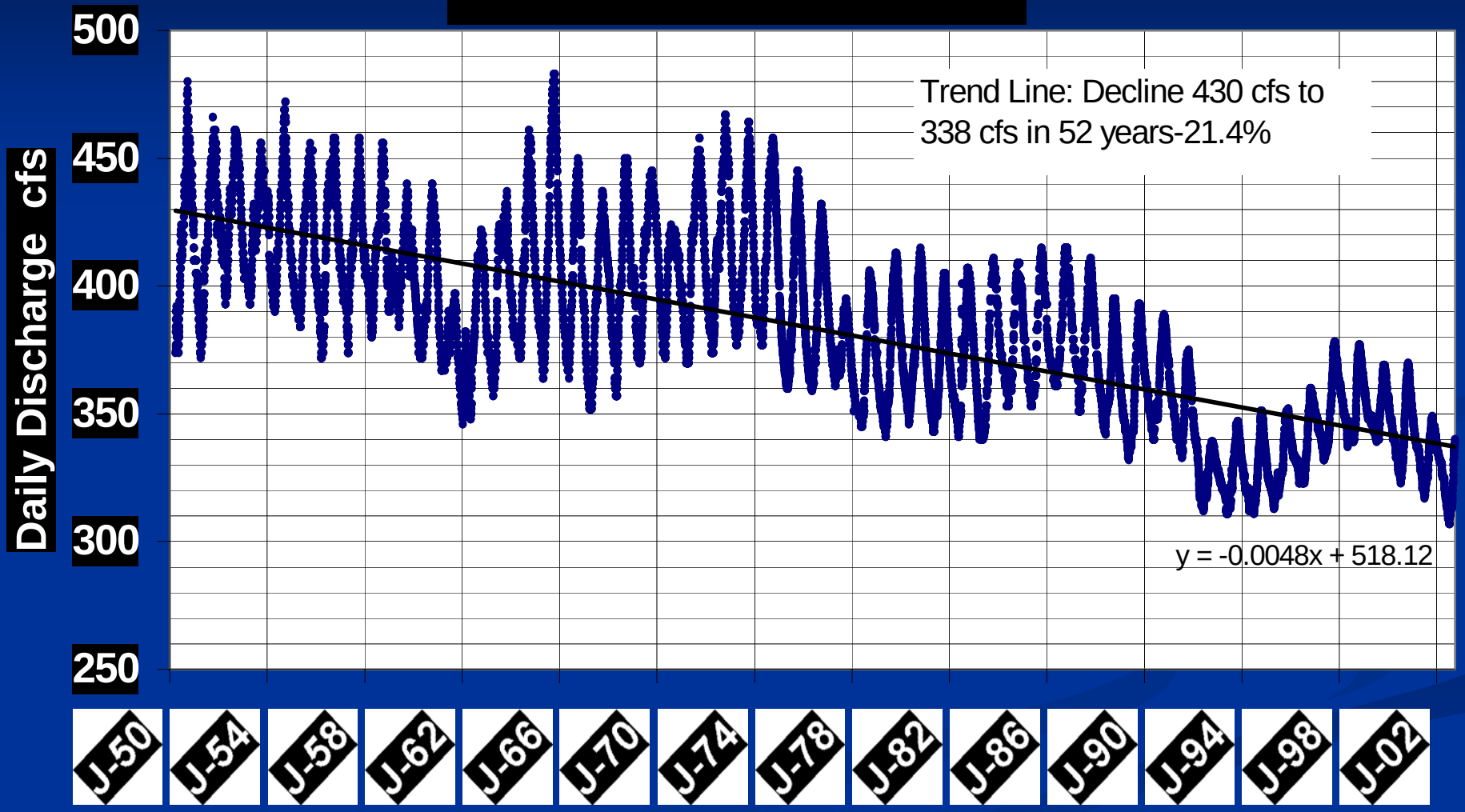
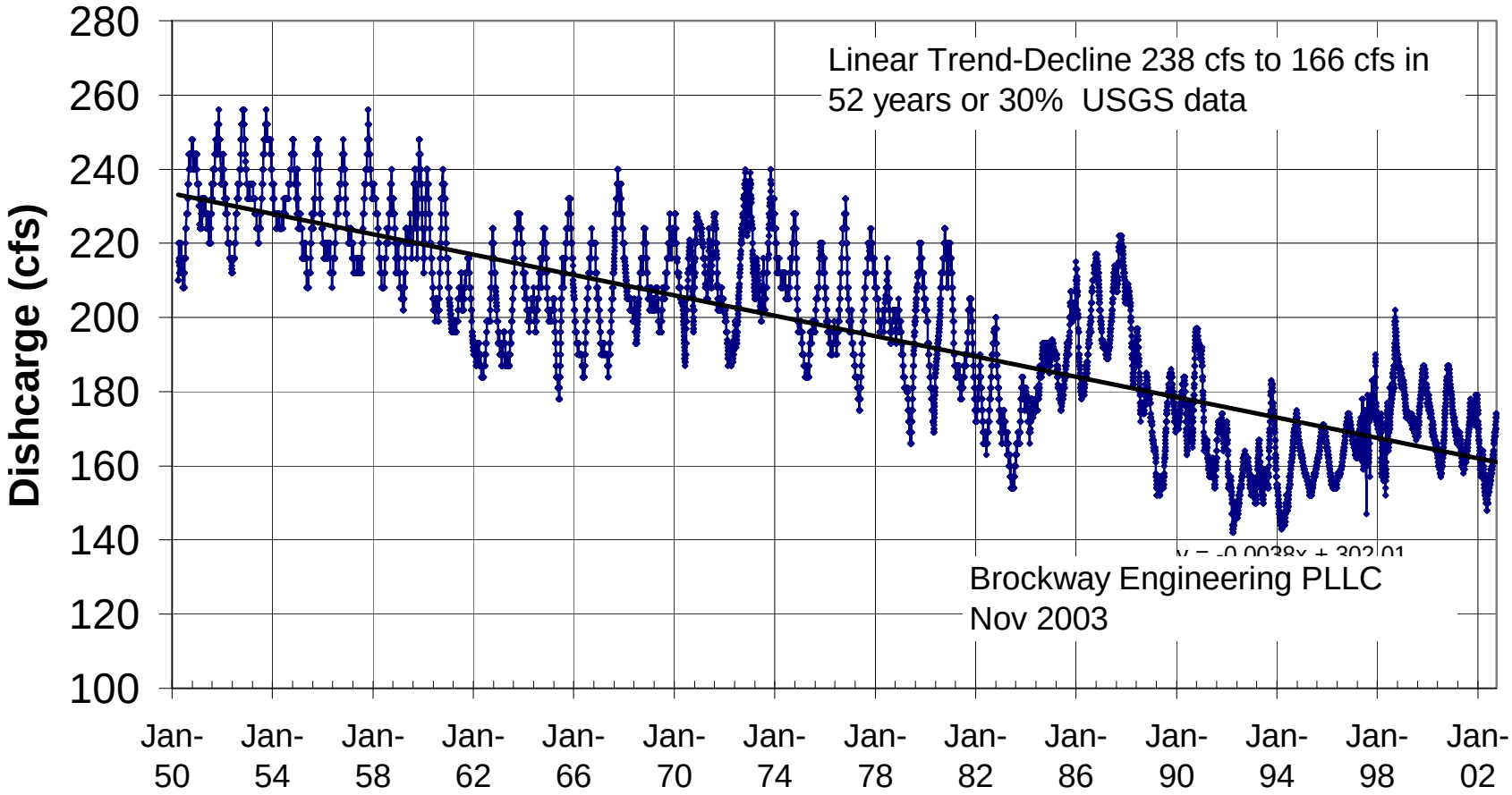
J-04
J-05

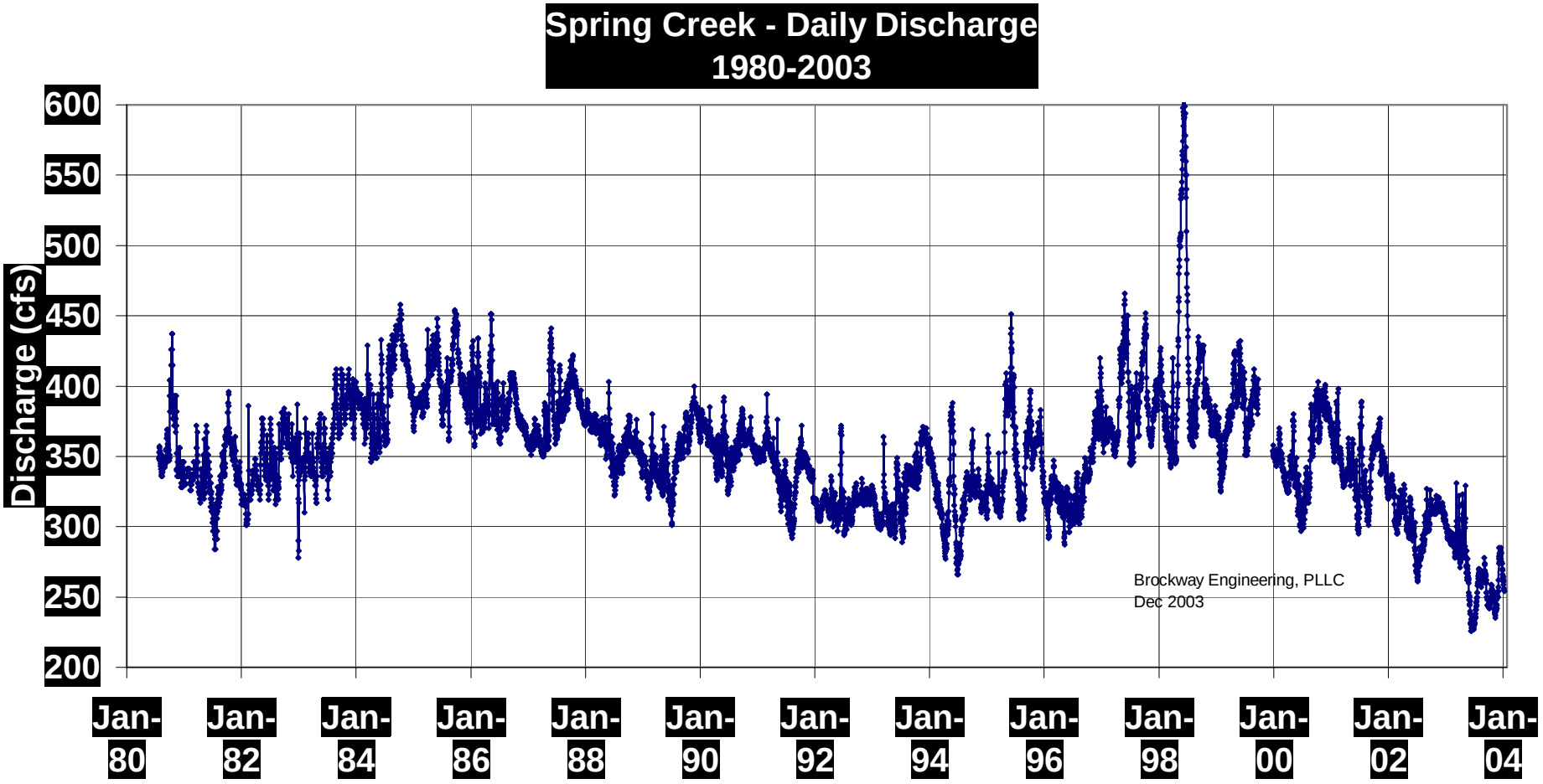
Box Canyon Spring nr Wendell
USGS 1950-2002



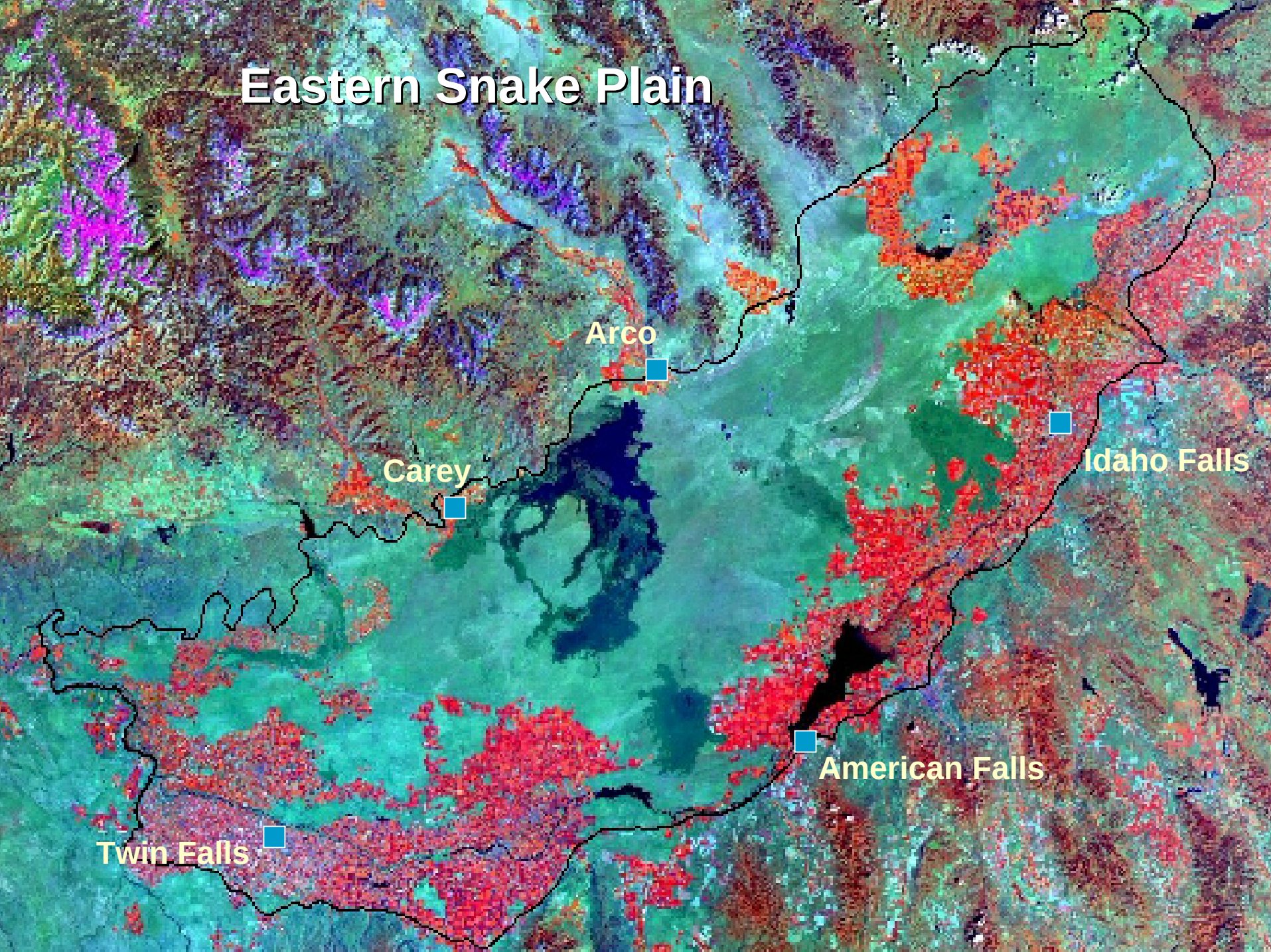
BROCKWAY ENGINEERING

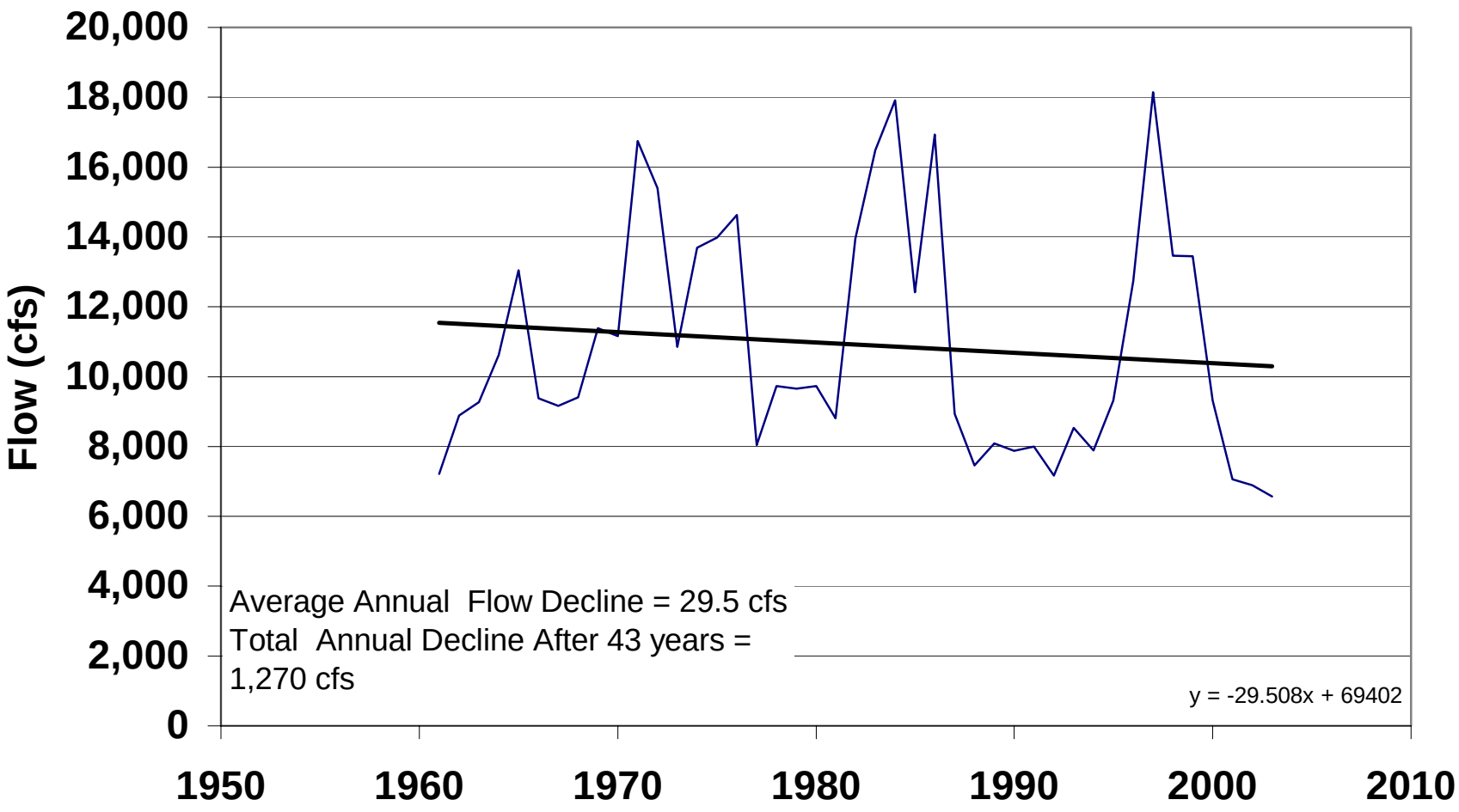
Blue Lakes Spring - Daily Discharge
1950-2002





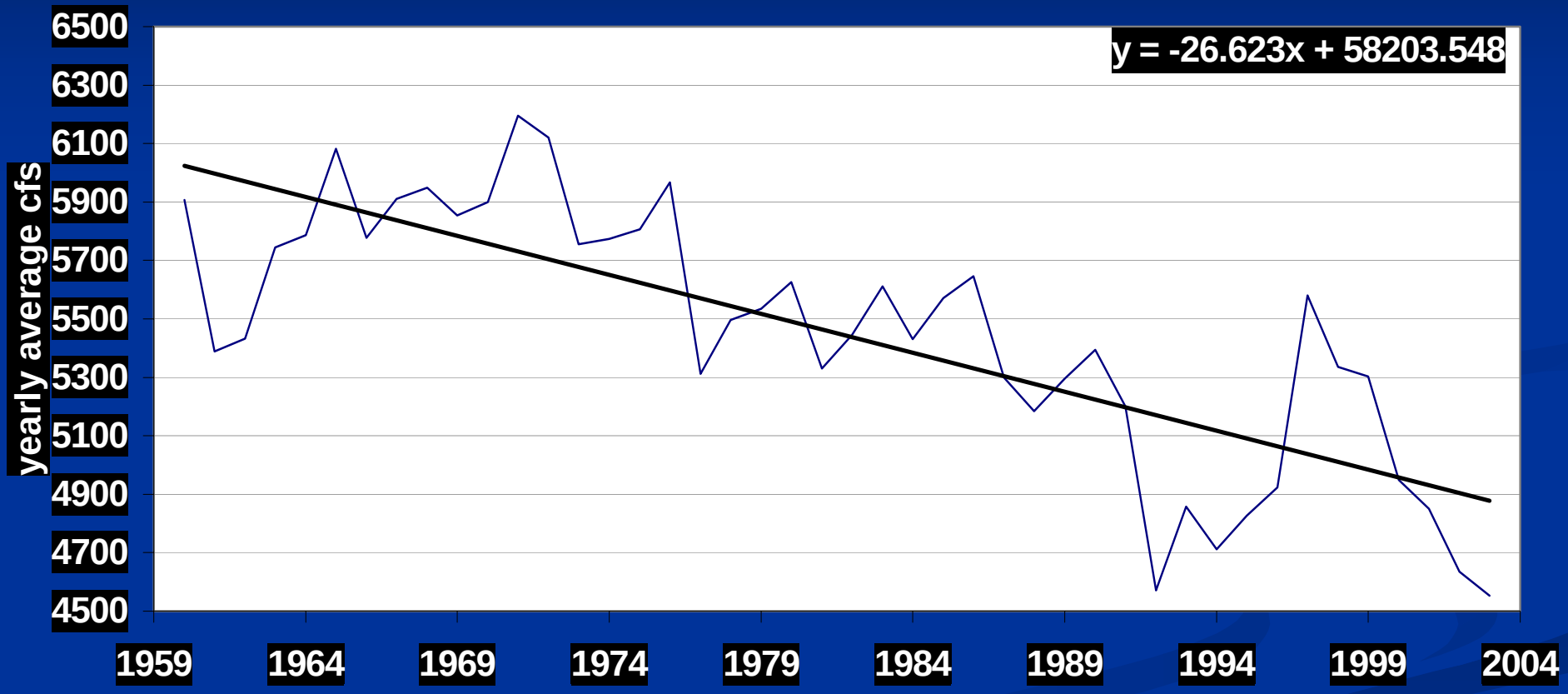
BROCKWAY ENGINEERING


Eastern Snake Plain
Arco
Carey
Idaho Falls
American Falls
Twin Falls

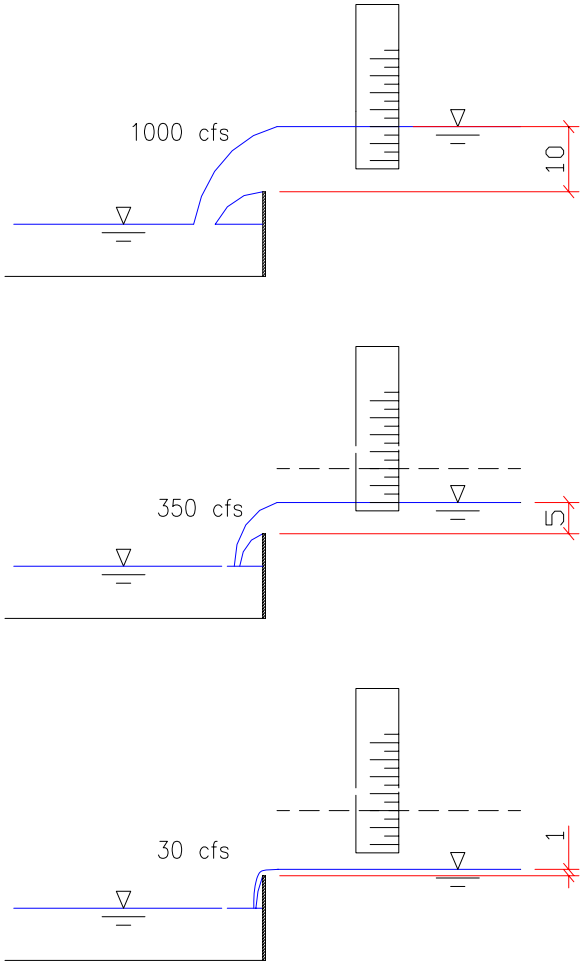


BROCKWAY ENGINEERING

Lower Salmon less Twin Falls (Kimberly) - 1960-2003
Actual Data



BROCKWAY ENGINEERING



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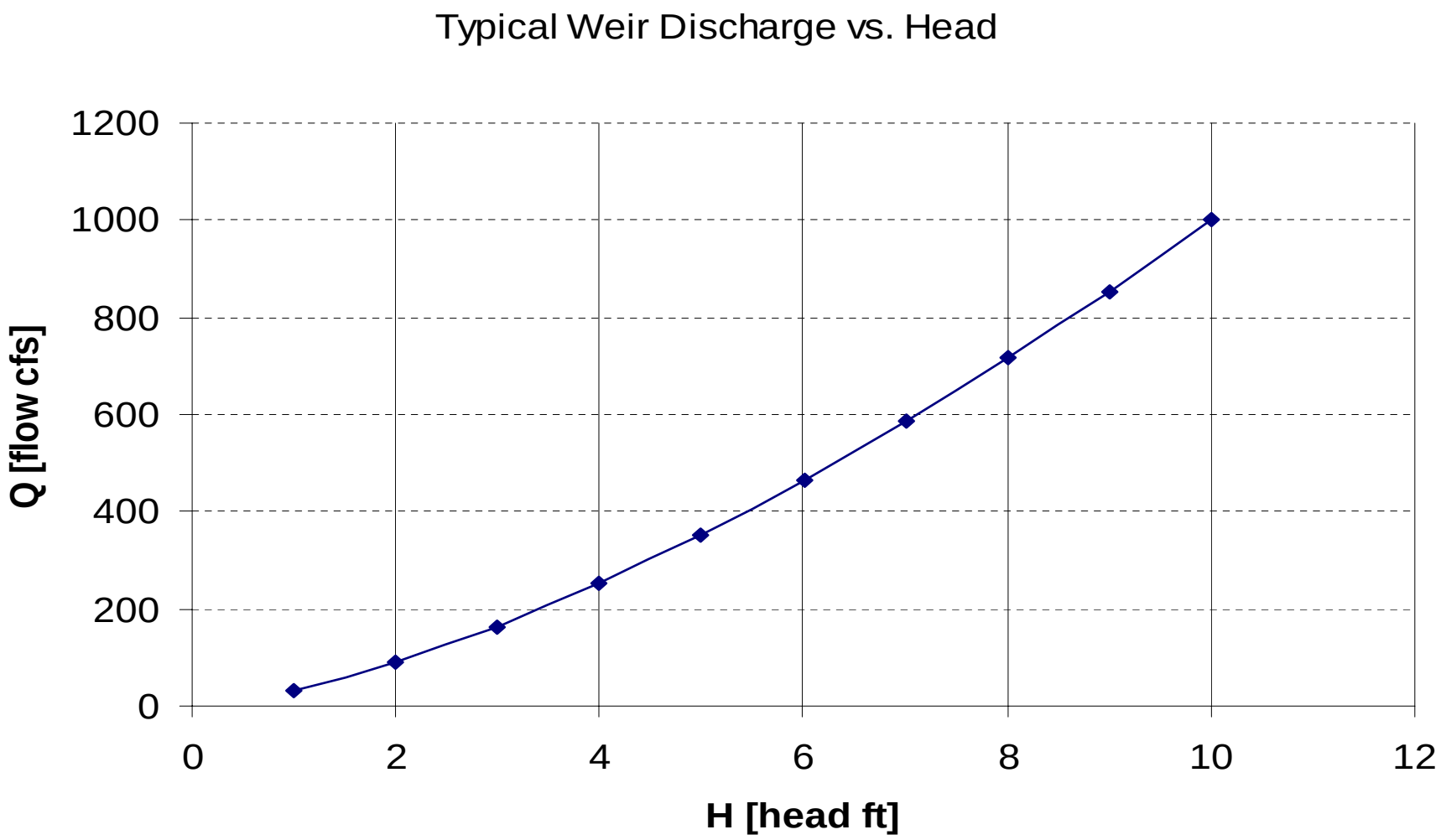

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Questions Needing Answers

- Regional impacts on aquifer water levels and spring flows (planning functions)
- Specific long term reach gain impacts (spring flows) due to pumping
- Differences in water levels or specific reach gains due to transferring ground water pumping
- What mitigation for impacts is appropriate?

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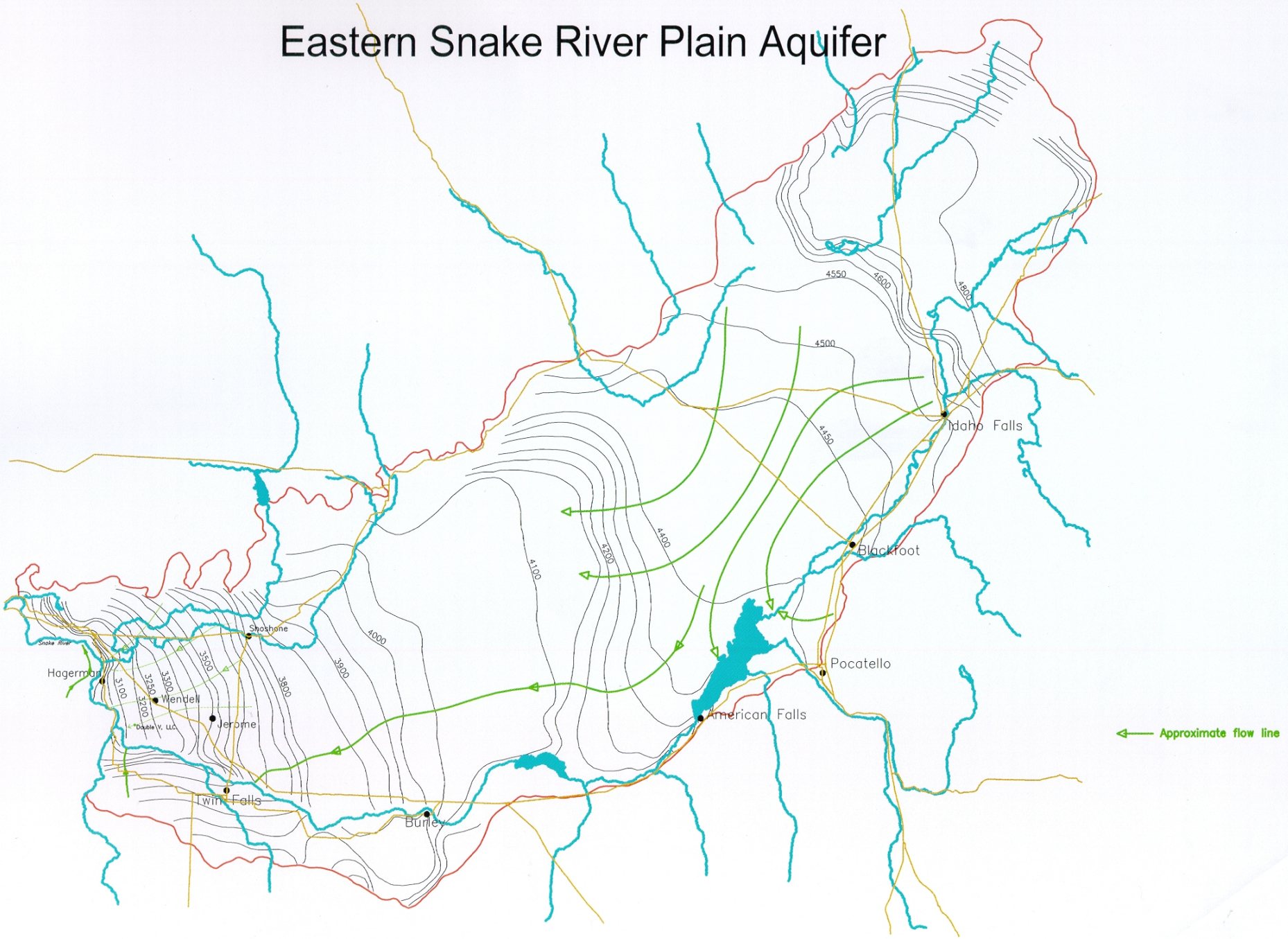
Eastern Snake River Plain Aquifer



The Tool

Ground Water Model

- The aquifer is too complicated to predict responses with simplified methods
- What does it do?
- How good should it be? Perfect
- How good is it? Not perfect
- Original model: University of Idaho 1977
- Model update: U of I / IWRRI (nearly done)

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Aquifer Response

- The entire aquifer is hydraulically connected
- Springs throughout the aquifer respond to changes in recharge or pumping with different magnitude and different timing
- Long term response from distant wells
- Short term response from nearby wells

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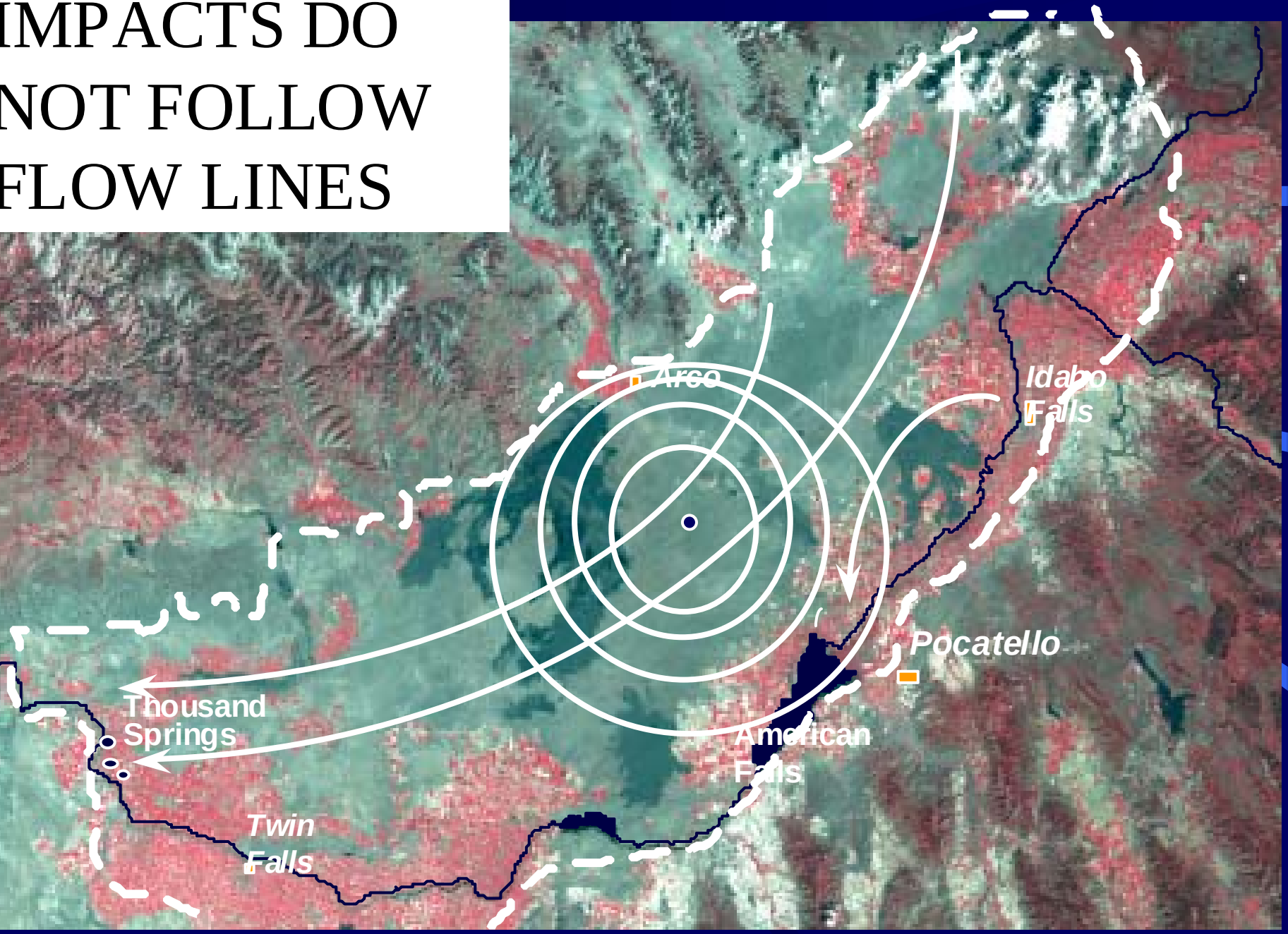
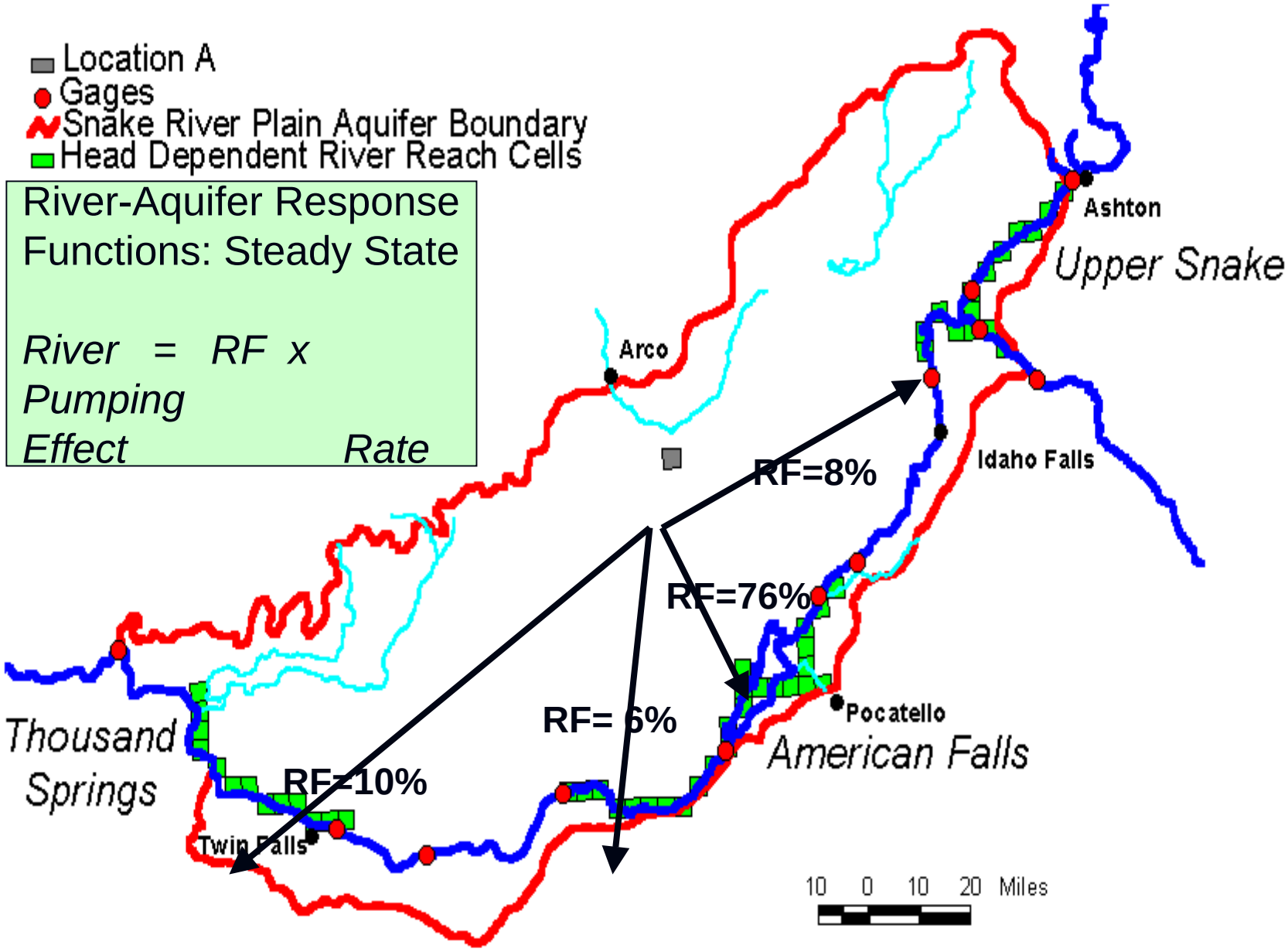
IMPACTS DO NOT FOLLOW FLOW LINES





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Thousand Springs Area Spring Flow Changes Associated with ESPA Ground Water Pumping

Generated Utilizing the ESPA Hydrologic Model

Developed by BROCKWAY ENGINEERING

The Idaho Water Resources Research Institute

(University of Idaho)

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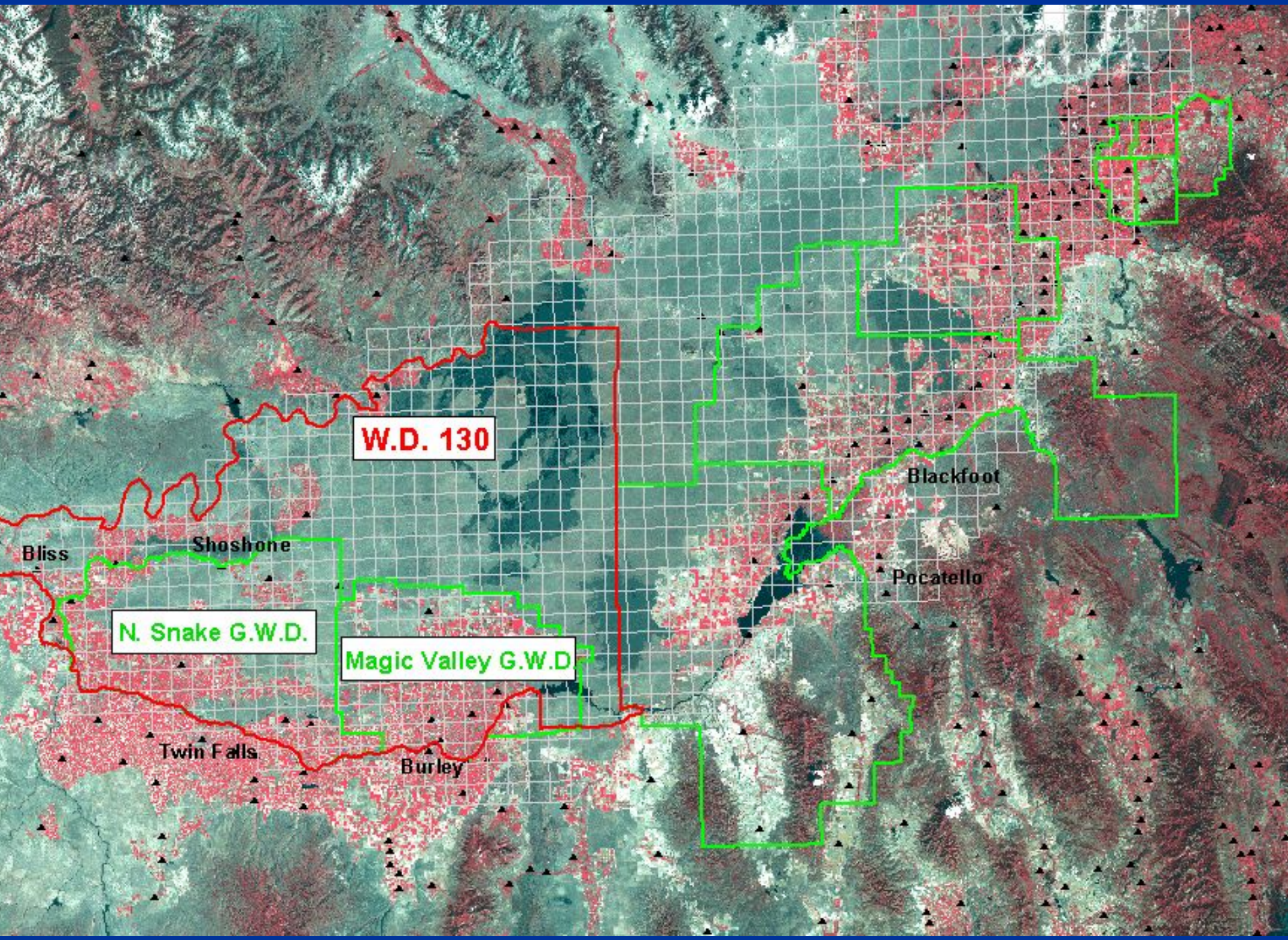

W.D. 130
Blackfoot
Bliss
Shoshone
Pocatello
N. Snake G.W.D.
Magic Valley G.W.D
Twin Falls
Burley

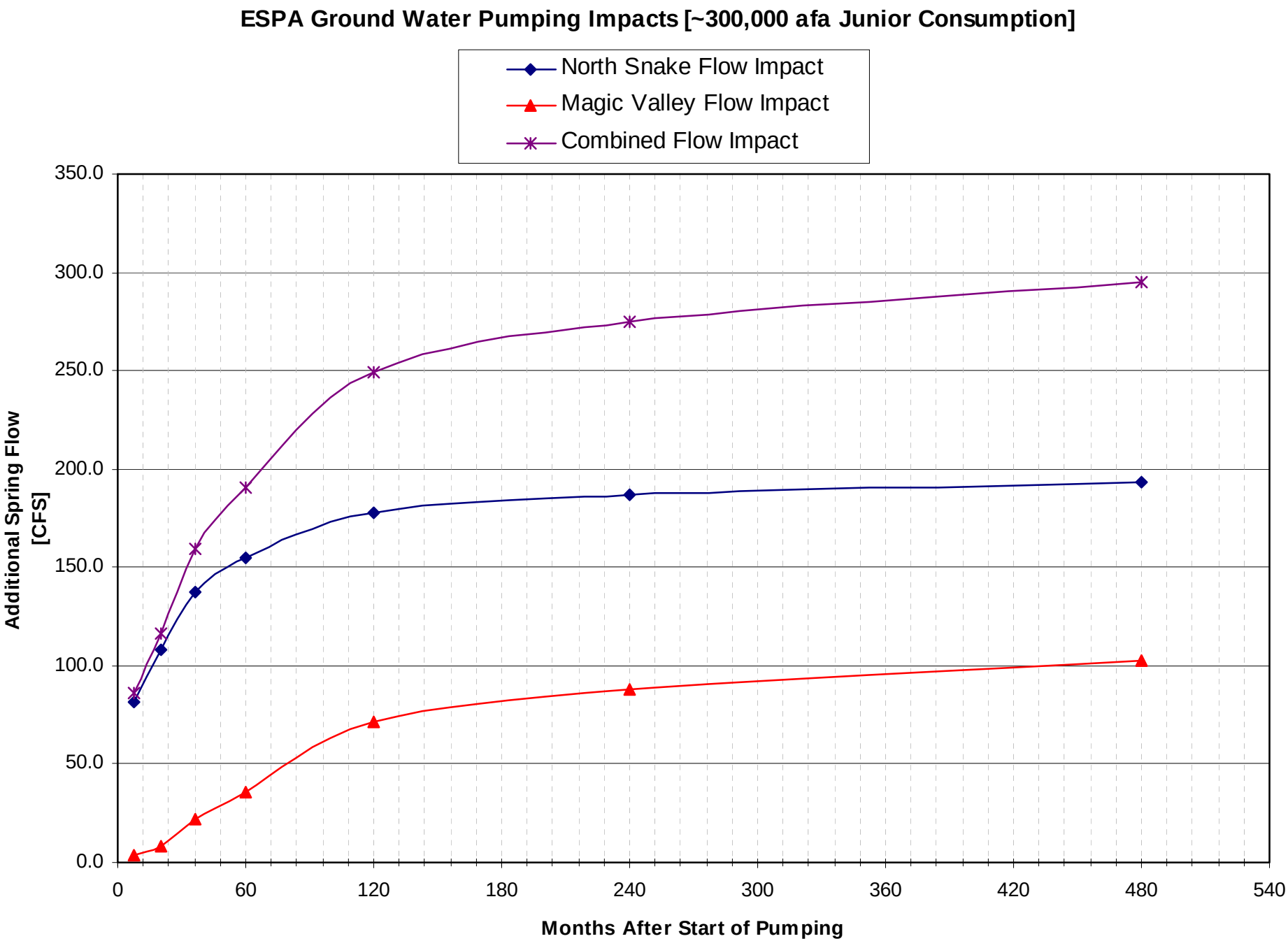
Based on analysis of irrigated area within Water District 130

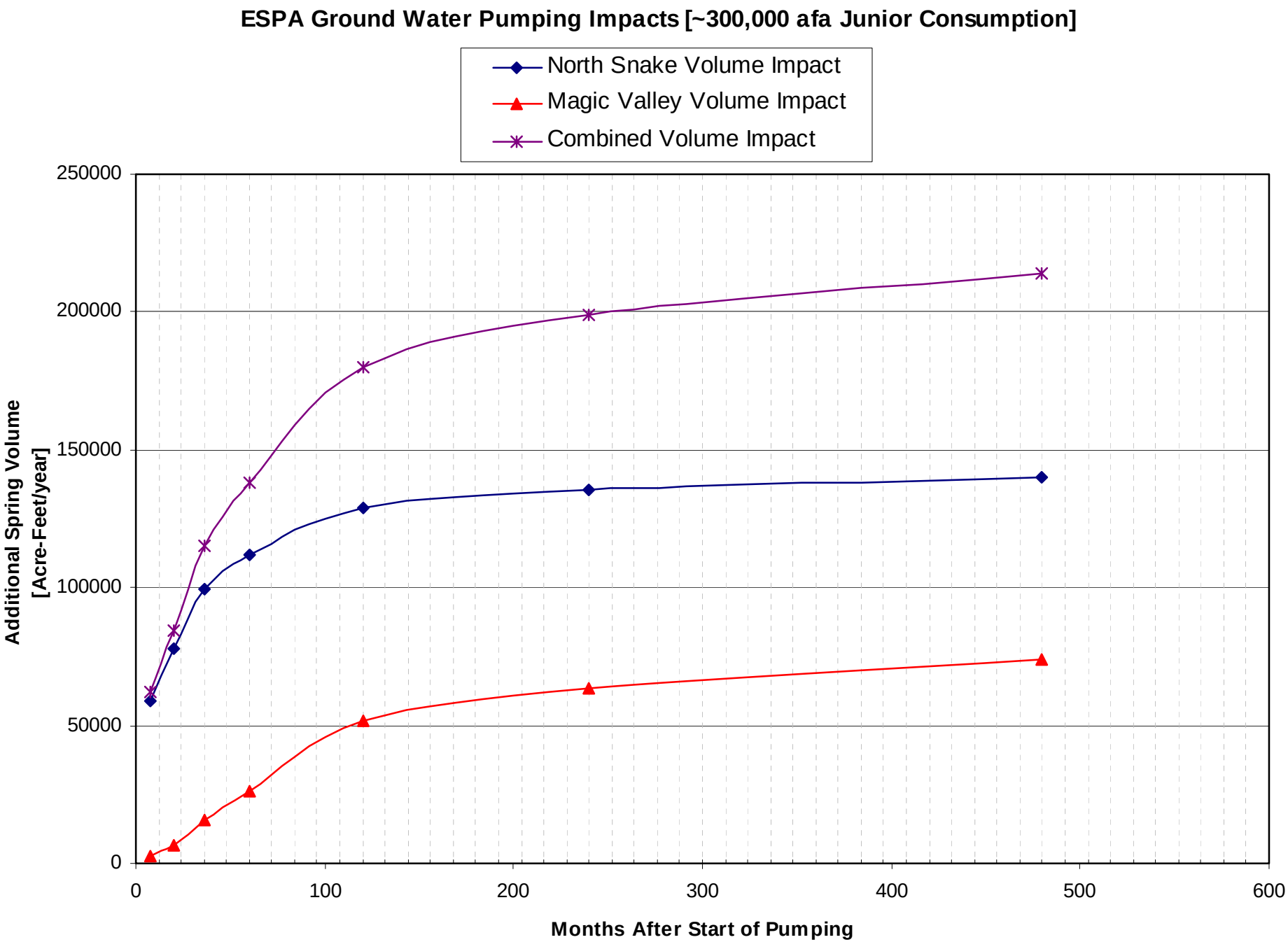
From IDWR (Bryce Contor of UI-IWRRI)

	640,177	Total Irrigated acres within Water District 130	
	335,076	acres (52.3%)	of which are irrigated with Surface Water
	264,713	acres (41.4%)	of which are irrigated with Ground Water
	40,388	acres (6.3%)	of which are irrigated with Ground Water & Surface Water
Therefore:	**284,907**	acres are Irrigated Strictly with Ground Water	
		(Assuming 50% of mixed source irrigation is supplied from Ground Water)	

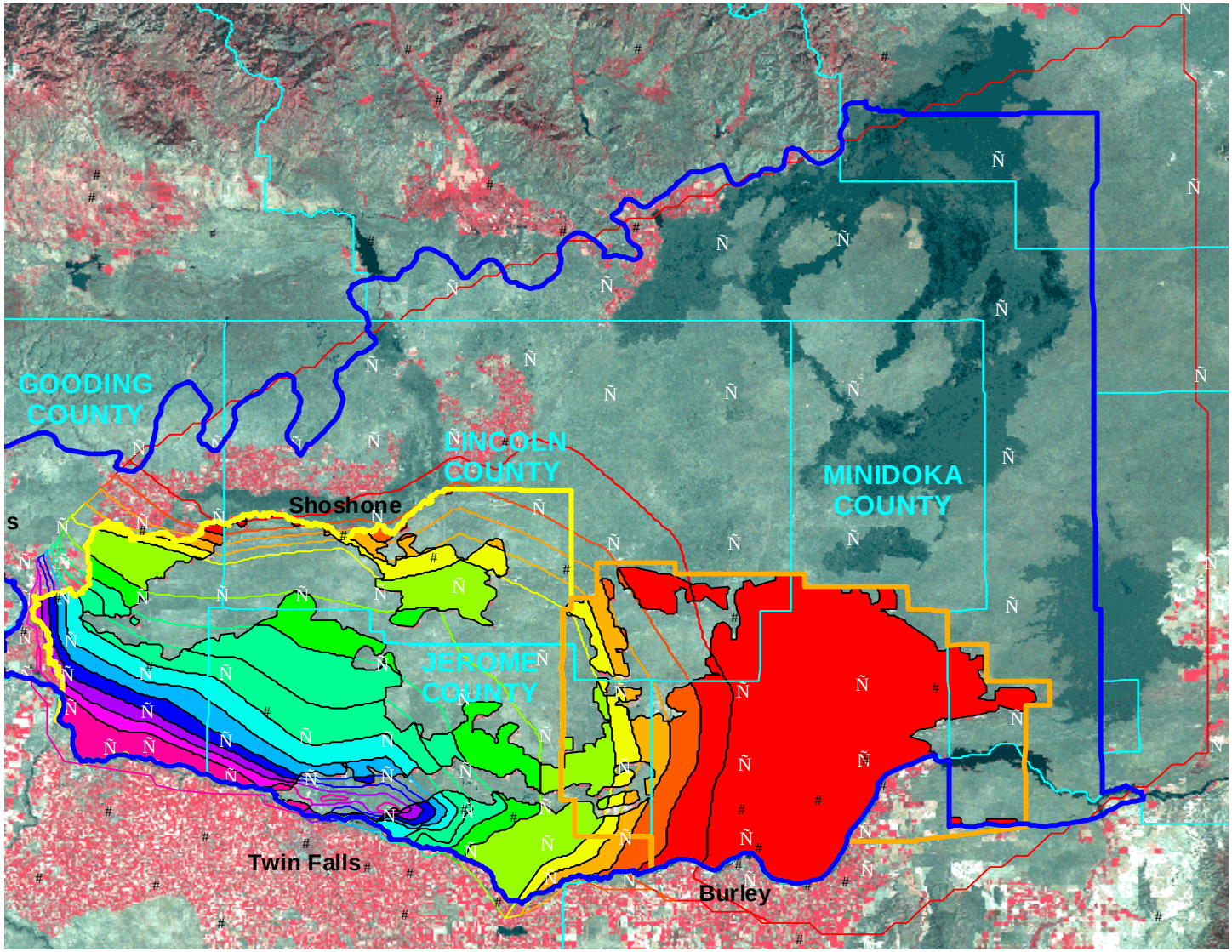
Brockway Engineering PLLC analysis of District 130 Irrigation

	890,054	Total gross area within irrigated area shapefile including roads & buildings		
		This works out to	**71.9%**	of the total area is actual irrigation
	640,177	of which	**44.5%**	are irrigated solely from Ground Water
		North Snake Ground Water District Irrigation		
	363,963	Total gross area determined within North Snake Ground Water District		
x 71.9% =	**261,783**	acres of actual irrigation of which 44.5% is Ground Water		
x 44.5% =	**116,505**	acres of Ground Water irrigation within North Snake Ground Water District		
x 50% =	**58,252**	acres of Ground Water irrigation within North Snake Ground Water District		
		JUNIOR to Spring user priorities (1964)		
		Magic Valley Ground Water District Irrigation		
	339,912	Total gross area determined within Magic Valley Ground Water District		
x 71.9% =	**244,484**	acres of actual irrigation of which 44.5% is Ground Water		
x 44.5% =	**108,806**	acres of Ground Water irrigation within Magic Valley Ground Water District		
x 50% =	**54,403**	acres of Ground Water irrigation within Magic Valley Ground Water District		
		JUNIOR to Spring user priorities (1964)		
	112,655	TOTAL JUNIOR GROUND WATER IRRIGATED ACRES WITHIN N. Snake & Magic Valley G.W.D.		
x 2.66afa=	**299,664**	acre-feet per annum of junior consumption		


ESPA Ground Water Pumping Impacts [~300,000 afa Junior Consumption]
North Snake Flow Impact
Magic Valley Flow Impact
Combined Flow Impact
Additional Spring Flow [CFS]
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0
60
120
180
240
300
360
420
480
540
Months After Start of Pumping


ESPA Ground Water Pumping Impacts [~300,000 afa Junior Consumption]
North Snake Volume Impact
Magic Valley Volume Impact
Combined Volume Impact
Additional Spring Volume [Acre-Feet/year]
250000
200000
150000
100000
50000
0
0
100
200
300
400
500
600
Months After Start of Pumping

Ground Water Pumping Impact to Springs (Appearing after 8 Months)



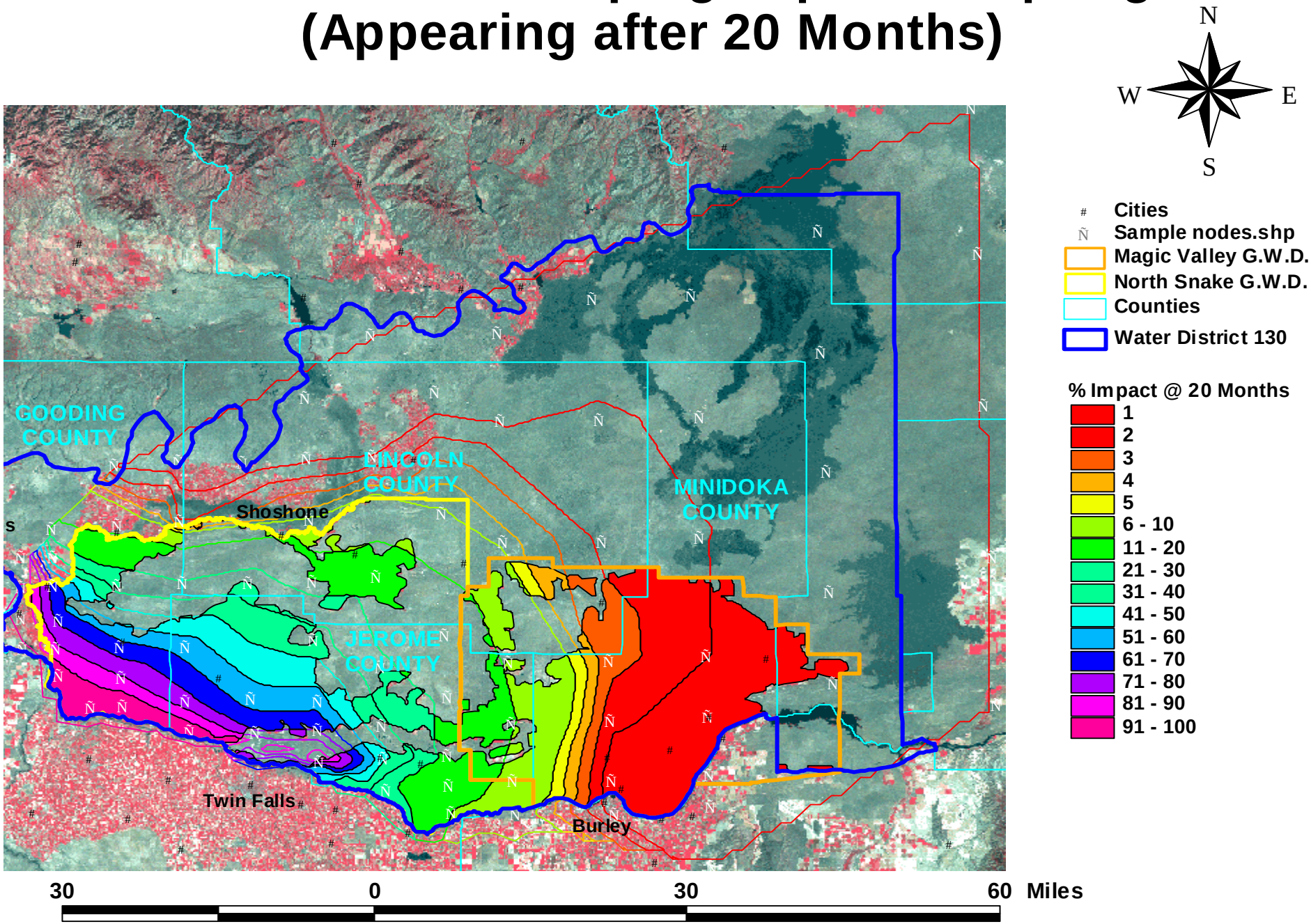
N
W
S

Cities
Sample nodes
Magic Valley G.W
North Snake G.W
Counties
Water District 13

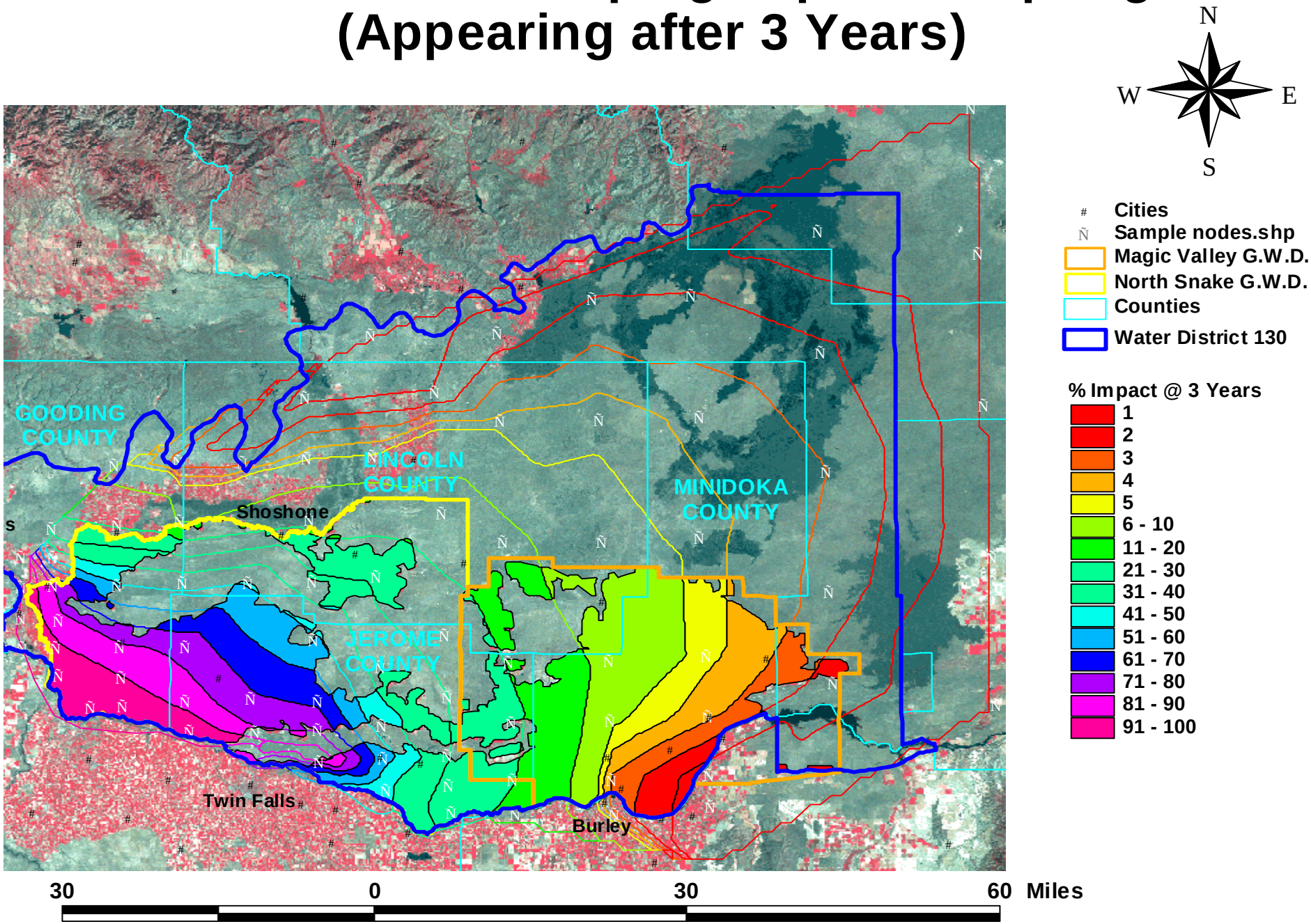
% Impact @ 8 Months
1
2
3
4
5
6 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100

30 0 30 60 Miles

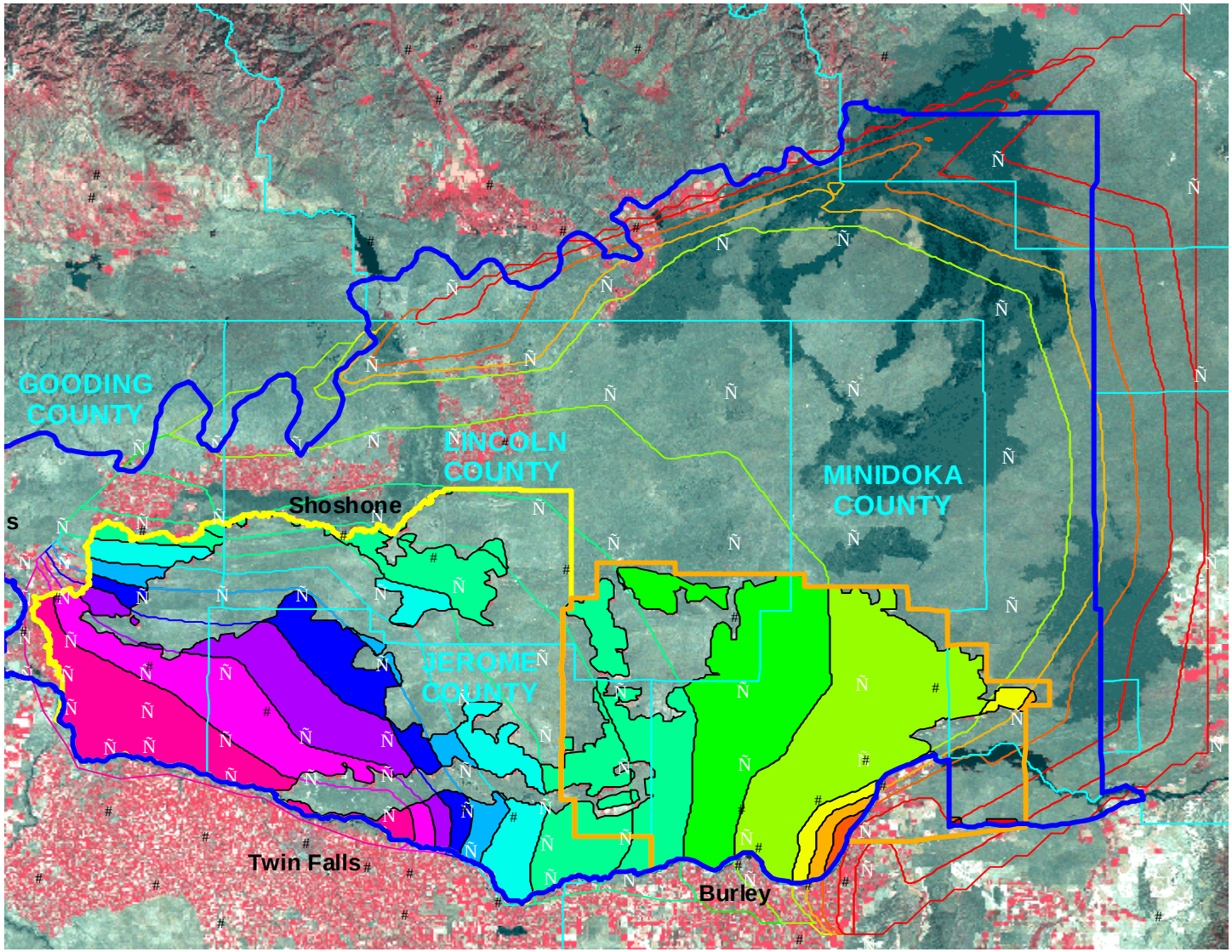
Ground Water Pumping Impact to Springs (Appearing after 20 Months)



Ground Water Pumping Impact to Springs (Appearing after 3 Years)



Ground Water Pumping Impact to Springs (Appearing after 5 Years)



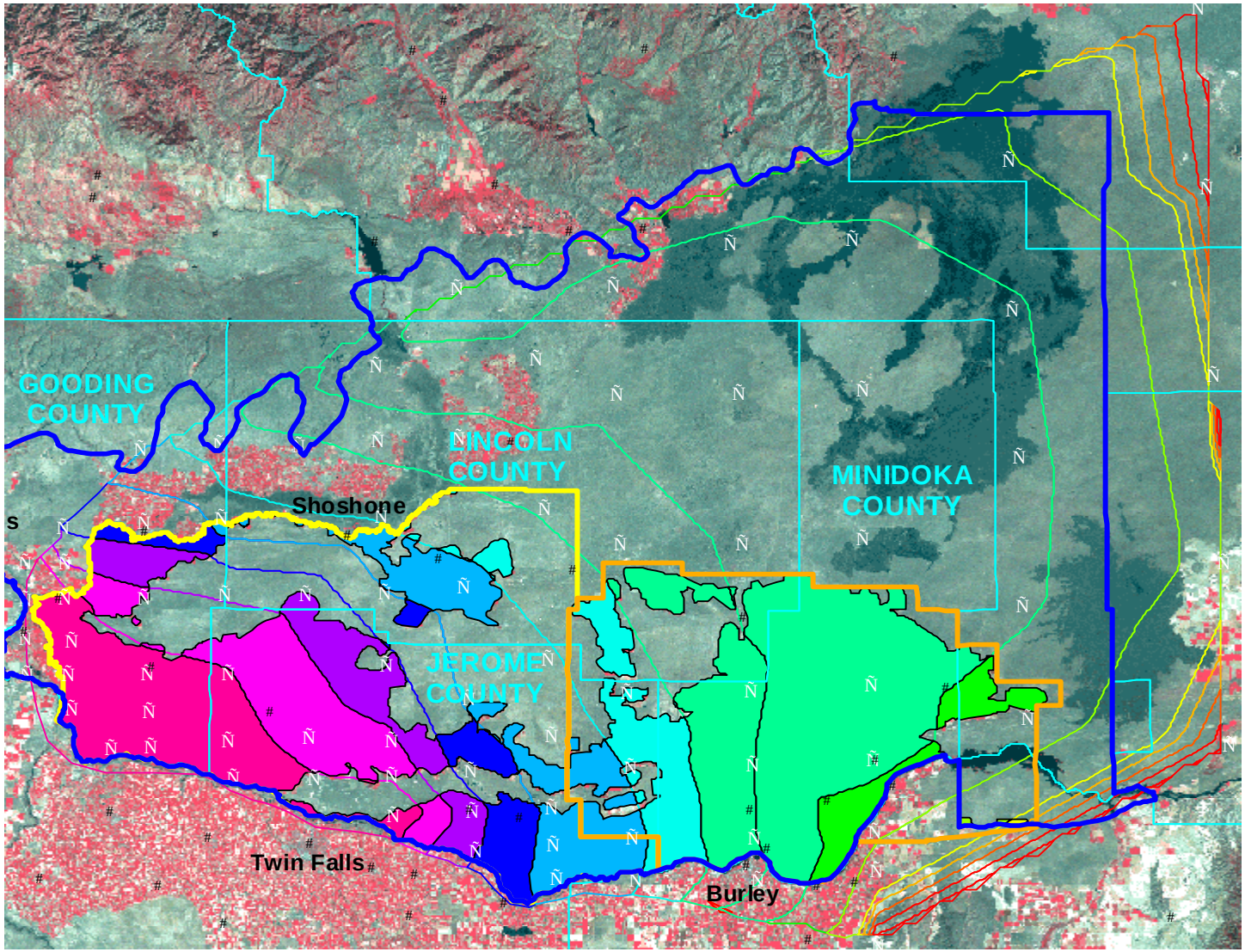
N
W E
S

Cities
Ñ Sample nodes.shp
Magic Valley G.W.D.
North Snake G.W.D.
Counties
Water District 130

% Impact @ 5 Years
- 1
- 2
- 3
- 4
- 5
- 6 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 - 80
- 81 - 90
- 91 - 100

30 0 30 60 Miles

Ground Water Pumping Impact to Springs (Appearing after 10 Years)



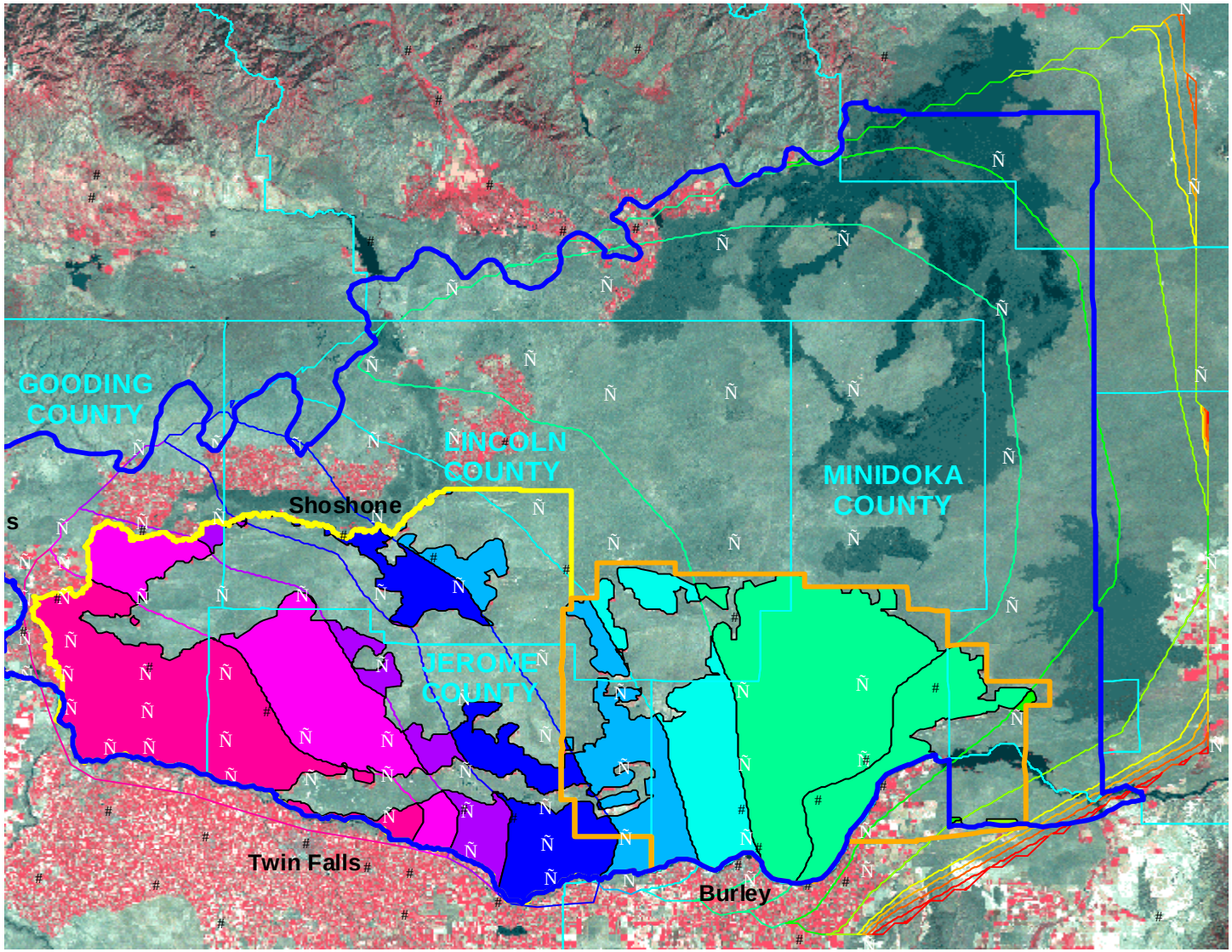
N
W E
S

Cities
Sample nodes.shp
Magic Valley G.W.D.
North Snake G.W.D.
Counties
Water District 130

% Impact @ 10 Years
1
2
3
4
5
6 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100

30 0 30 60 Miles

Ground Water Pumping Impact to Springs (Appearing after 20 Years)



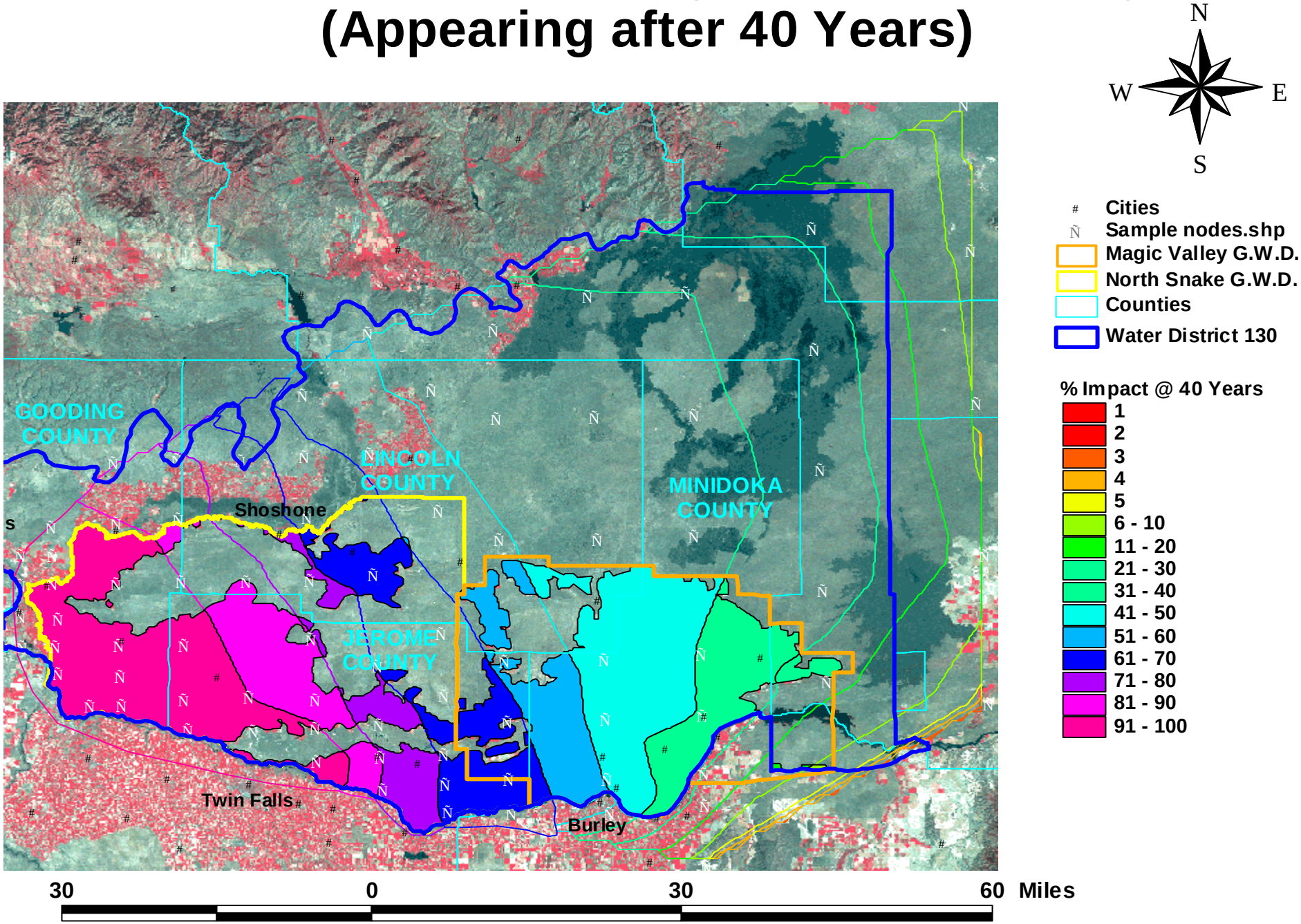
N
W E
S

Cities
Sample nodes.shp
Magic Valley G.W.D.
North Snake G.W.D.
Counties
Water District 130

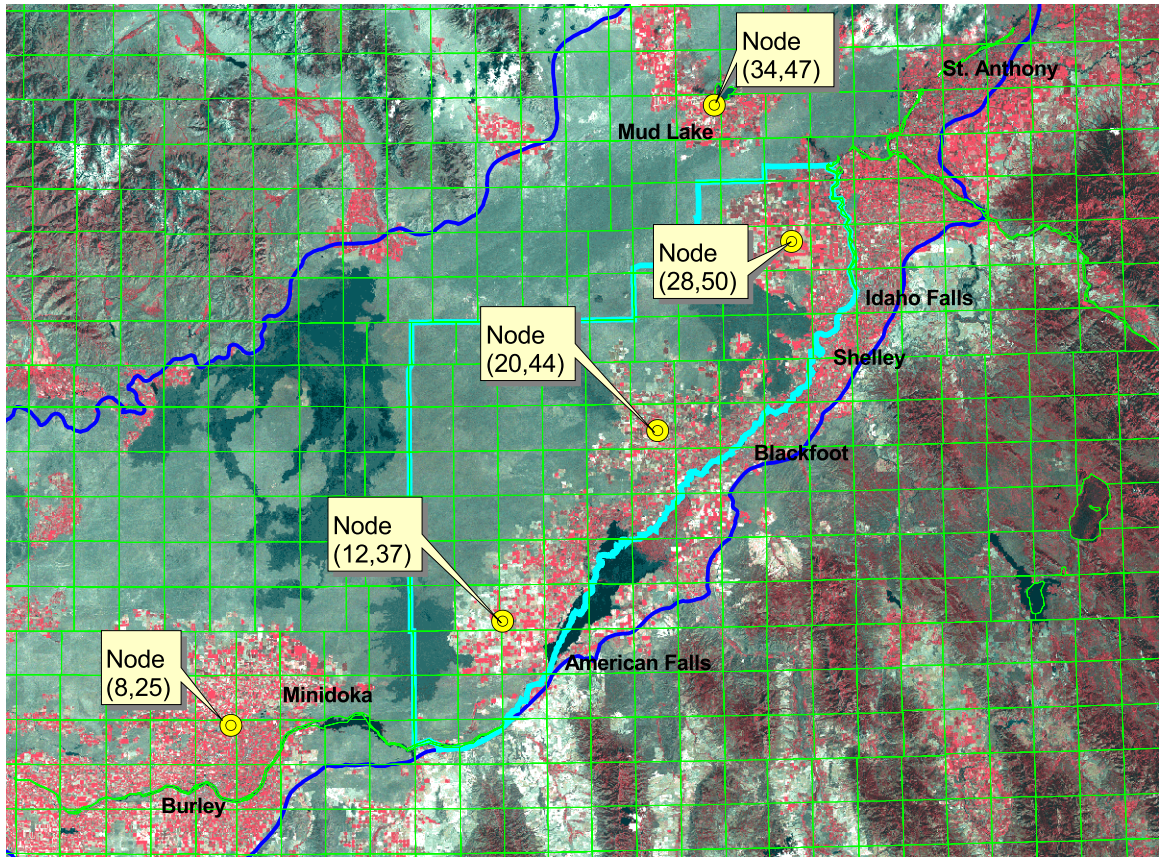
% Impact @ 20 Years
1
2
3
4
5
6 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100

30 0 30 60 Miles

Ground Water Pumping Impact to Springs (Appearing after 40 Years)



Eastern Snake River Plain Aquifer
Ground Water Impact Sample Nodes



1987 Infrared Aerial Photo Mosaic

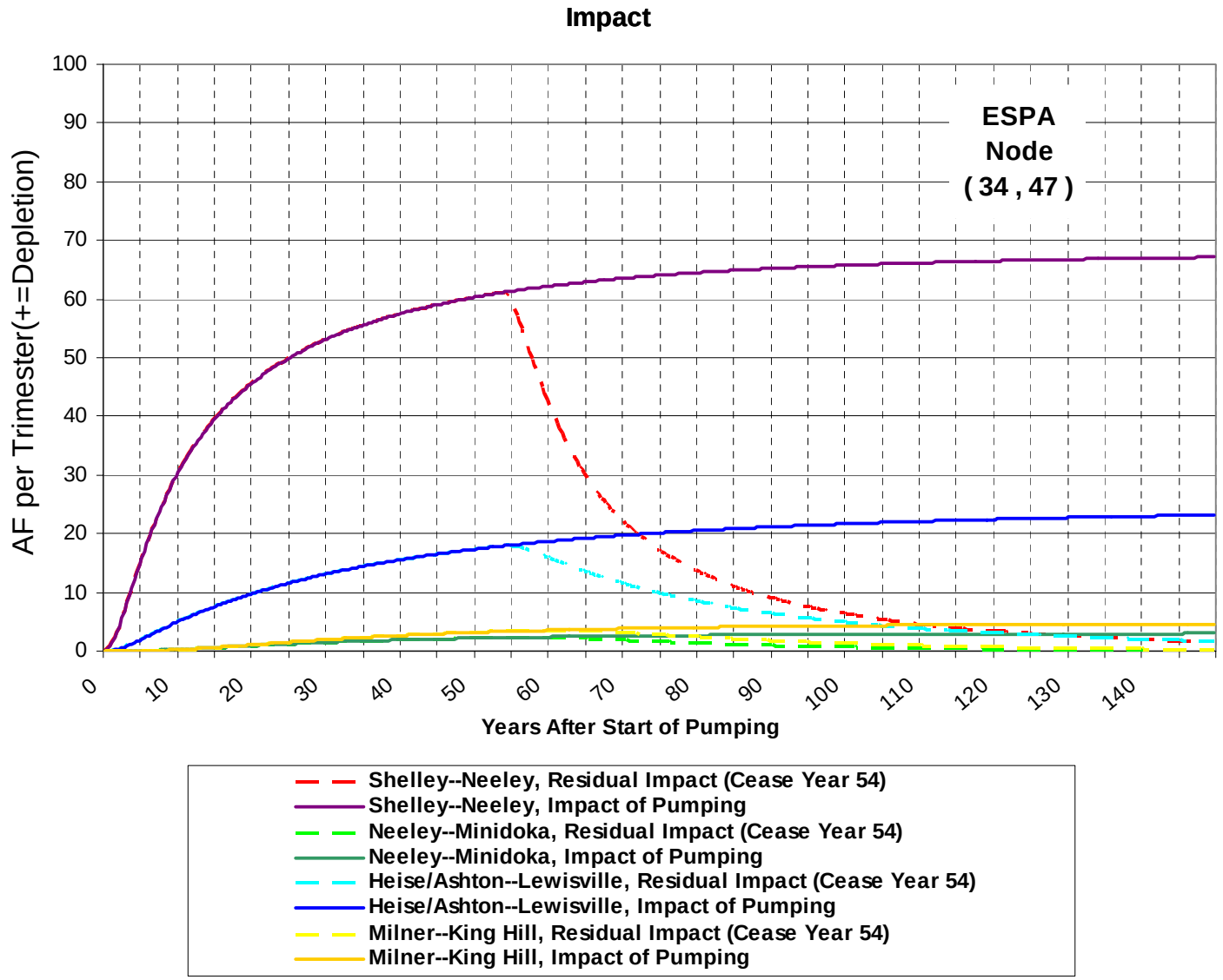
20 0 20 40 60 80 100 Miles

Townships
Water district 120
Snake River Plain Aquifer Model Boundary

N
W E
S

JCH - March 24, 2004
Brockway Engineering, PLLC

ESPA Ground Water Model Hydrologic Response



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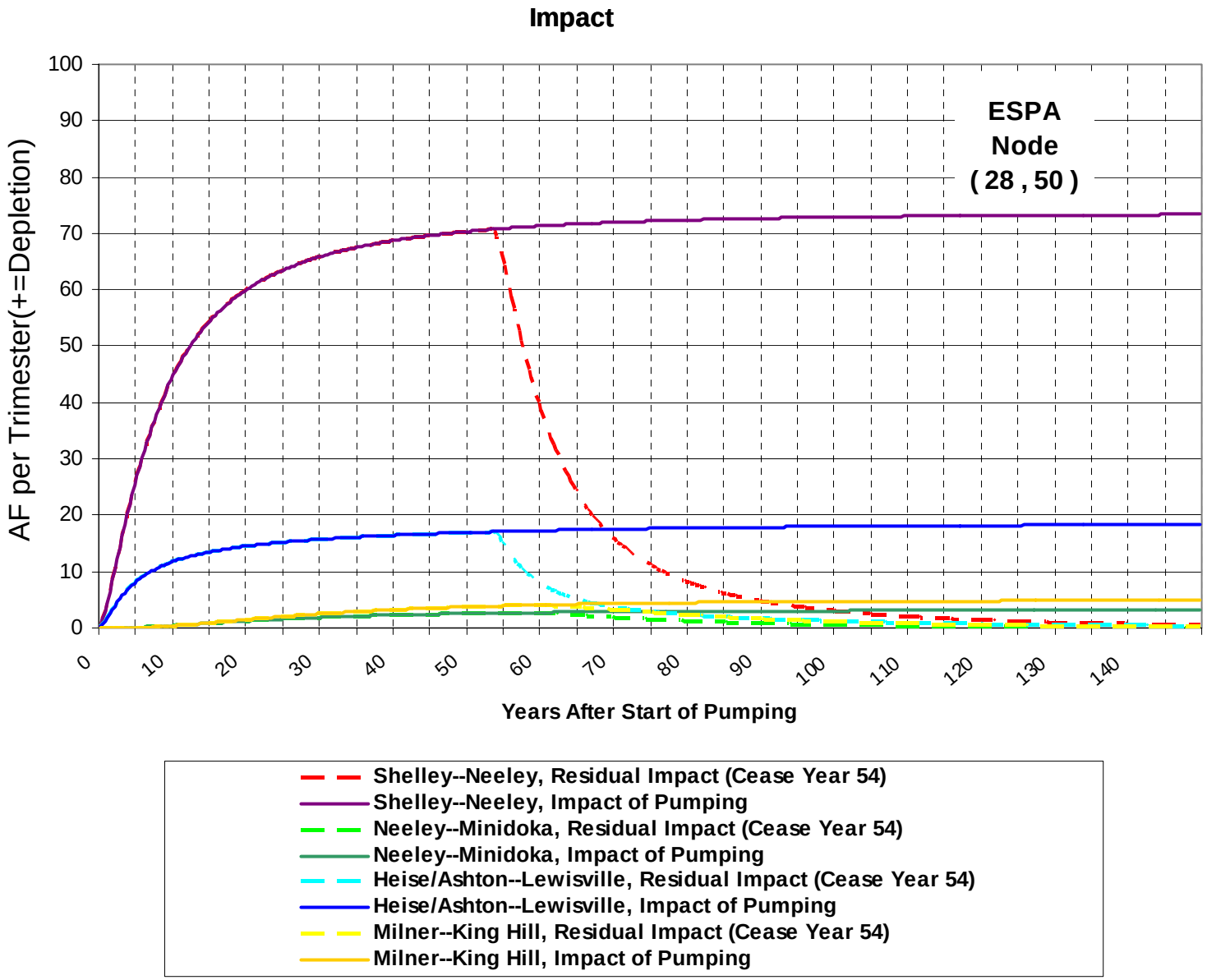
ESPA Ground Water Model Hydrologic Response



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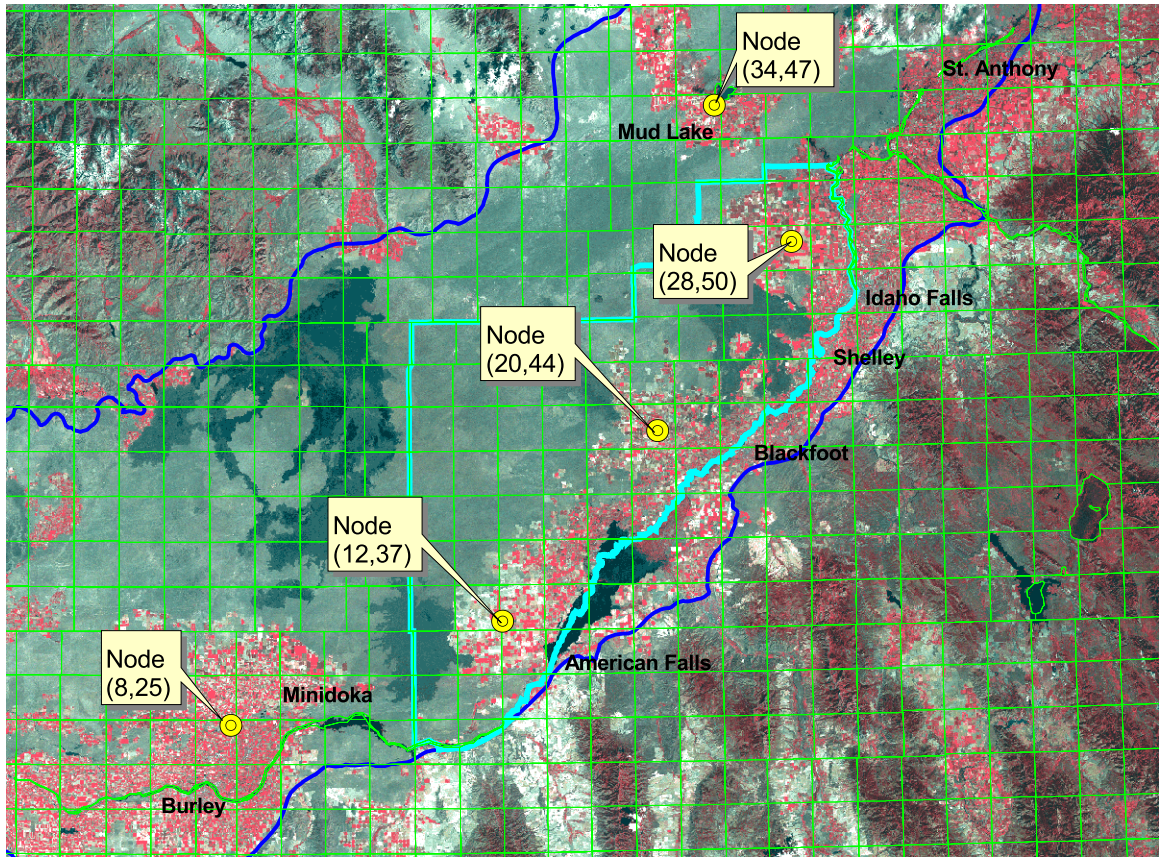
Eastern Snake River Plain Aquifer
Ground Water Impact Sample Nodes



1987 Infrared Aerial Photo Mosaic

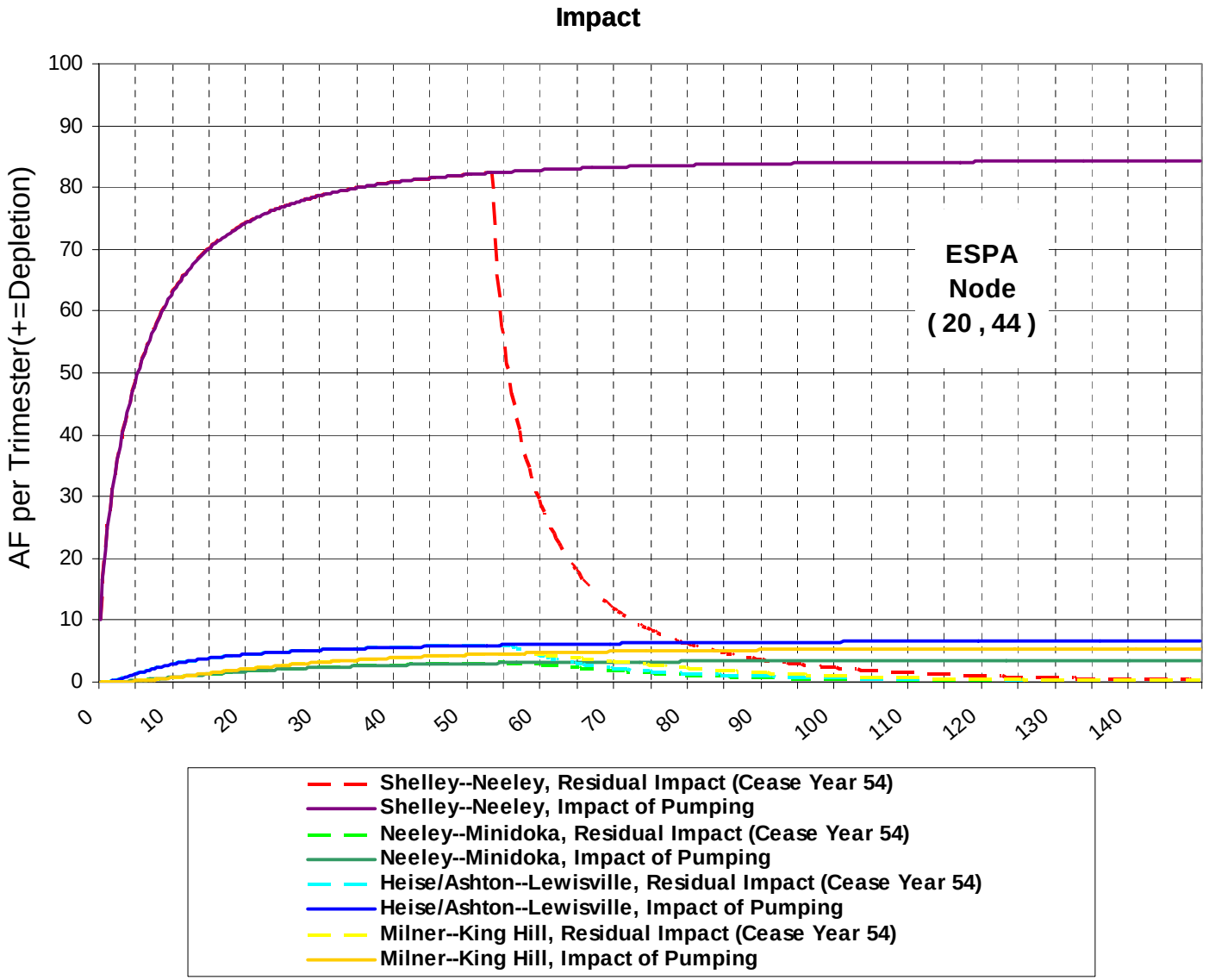
20 0 20 40 60 80 100 Miles

Townships
Water district 120
Snake River Plain Aquifer Model Boundary

N
W E
S

JCH - March 24, 2004
Brockway Engineering, PLLC

ESPA Ground Water Model Hydrologic Response



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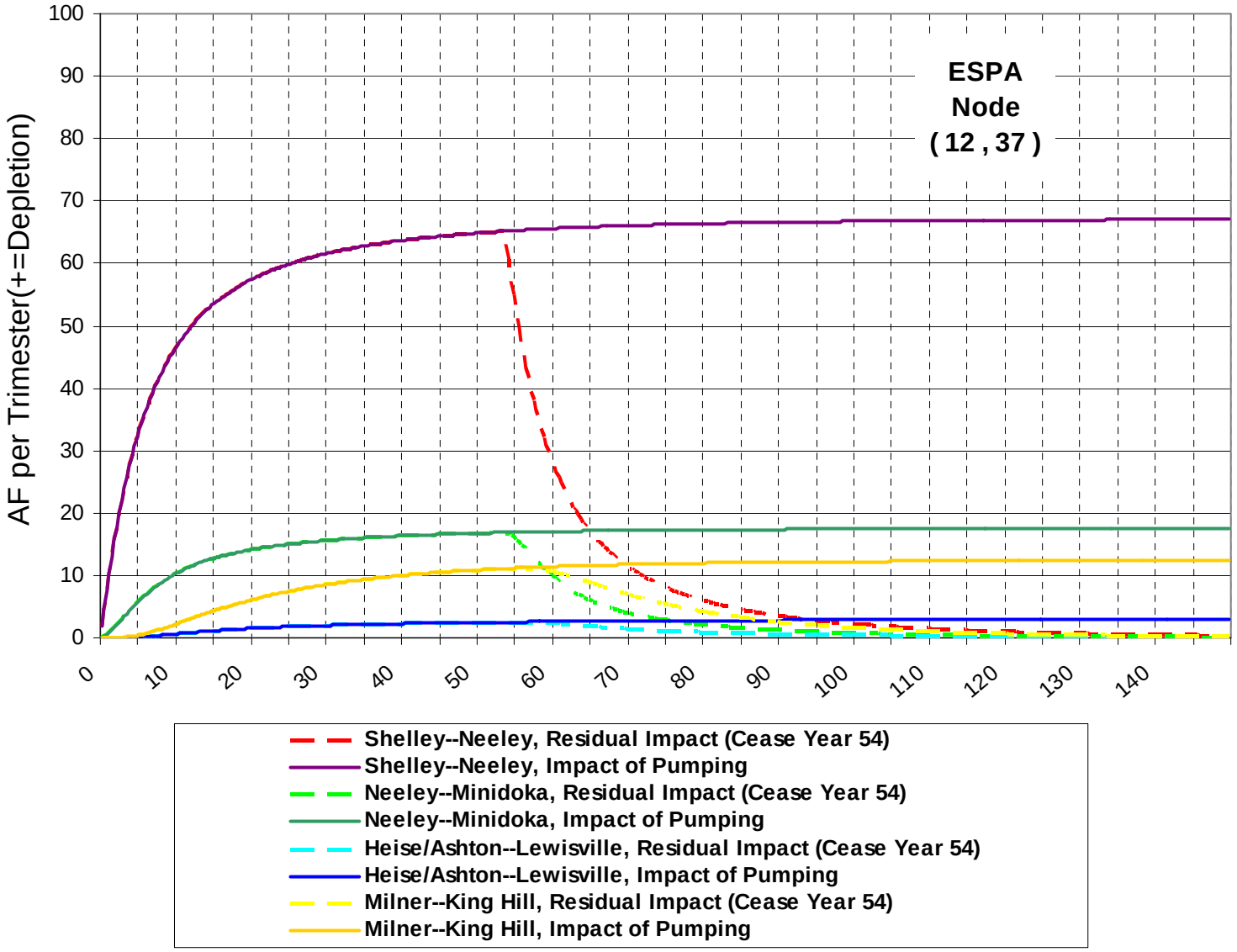
ESPA Ground Water Model Hydrologic Response

Impact



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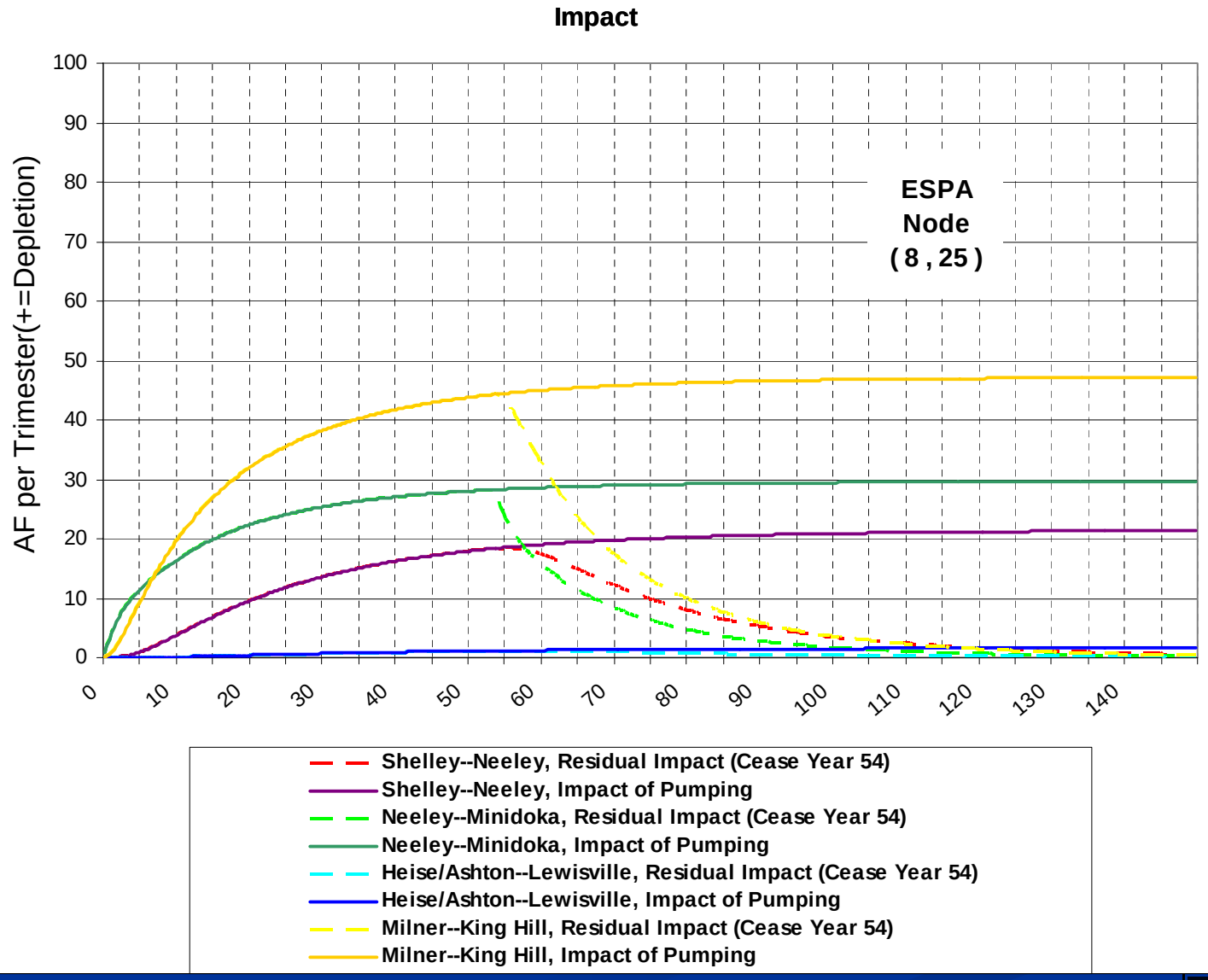
ESPA Ground Water Model Hydrologic Response



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CLASS IS OVER

YOU ALL GET A's

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Opinion

- It is <u>not</u> possible to develop management and regulatory procedures which will provide defensible, efficient, equitable distribution of the total water resource , meet all of the provisions of the appropriation doctrine and optimize the total water resource.
- Why not?
  - Not smart enough
  - Physical system won't let us
  - Legal system won't let us
- Compromise

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