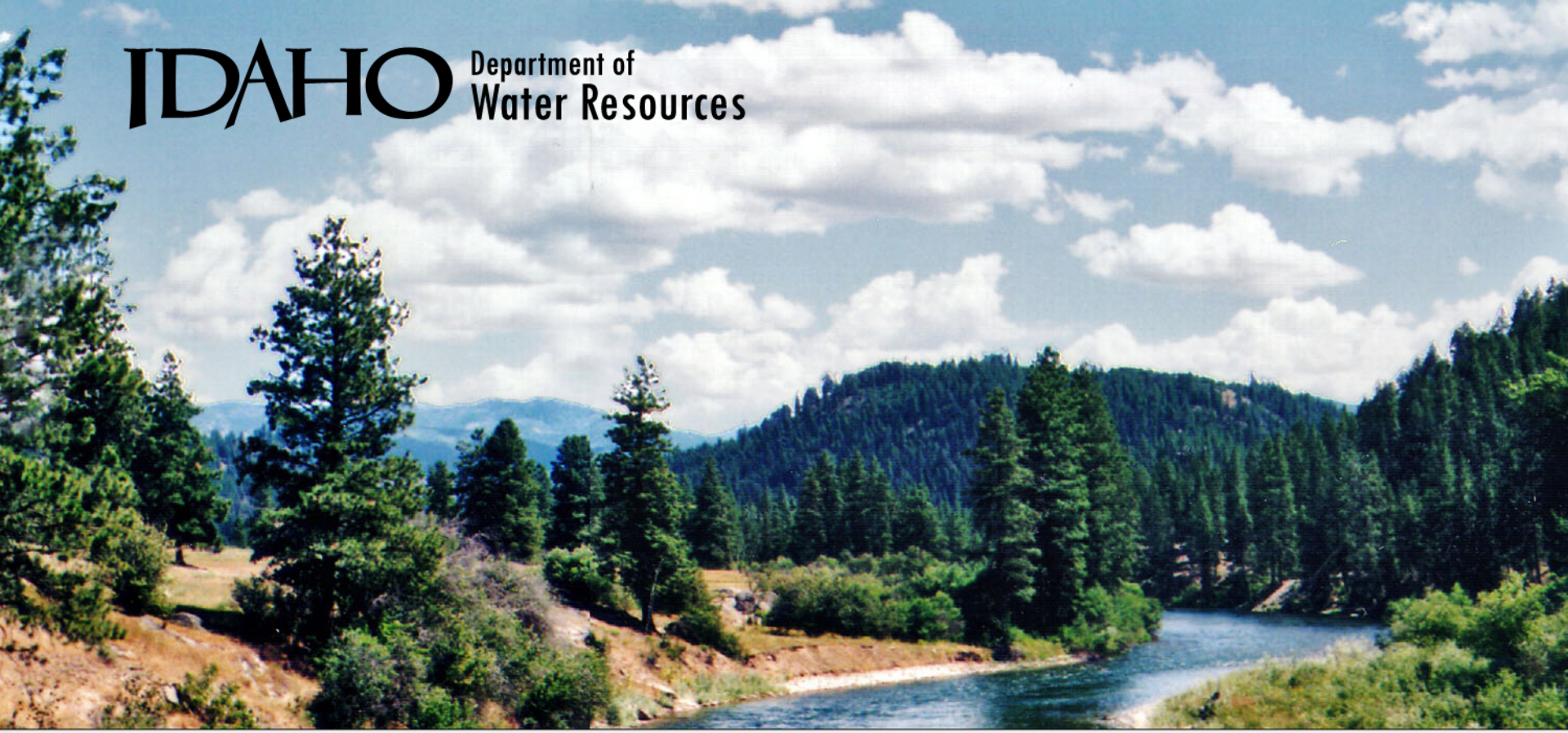


Treasure Valley Aquifer System

OSHER Course
Dennis Owsley, P.G., Technical Hydrogeologist
Idaho Department of Water Resources
September 3, 2014

Overview

- Introduction
- Geologic framework
- Aquifer classification/characteristics
- Data collection
  - BREAK --
- Ground water budget
- Current status of aquifers
- Local investigations
- Overview of other Idaho aquifers

Importance of Ground Water

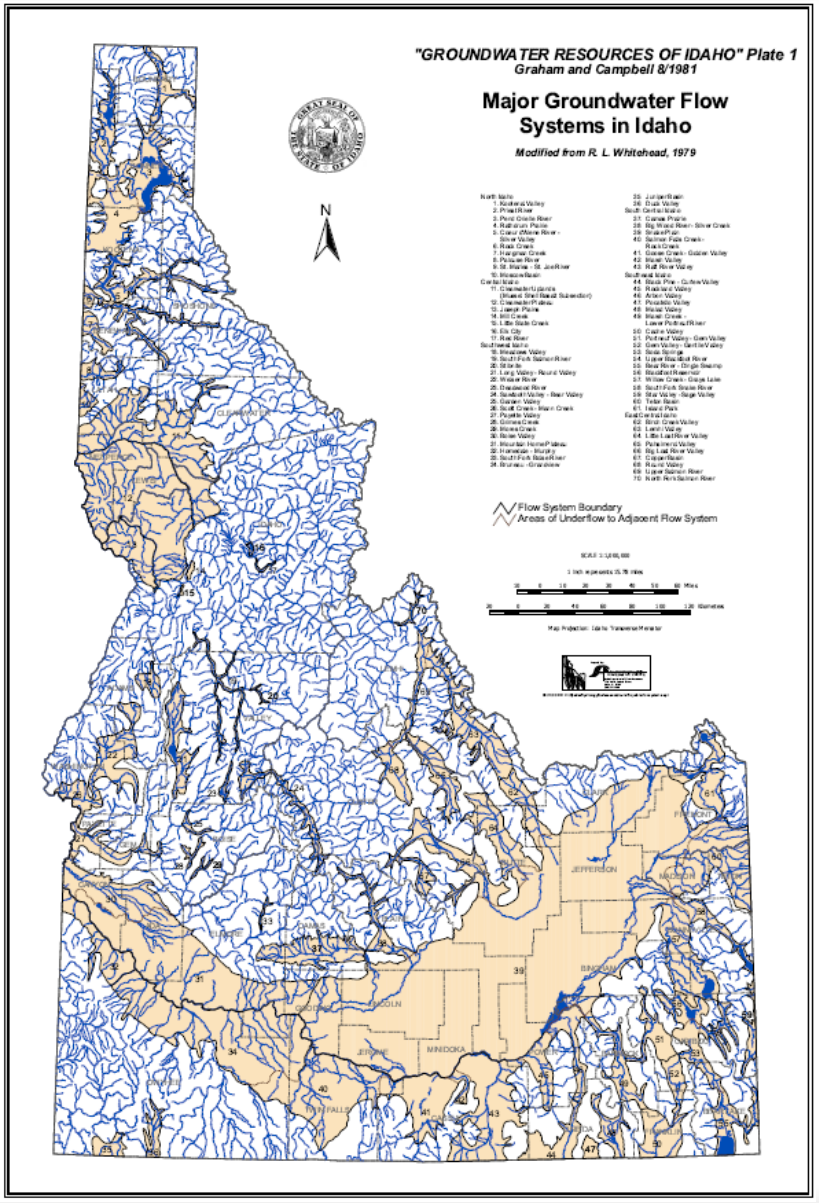
- Over 95% of the drinking water in the valley comes from ground water.
  - (United Water operates two small scale surface water facilities).
- Generally higher water quality
- More reliable supplies

Importance of Ground Water

- Approximately 100,000 AF used for irrigation annually.
- Over 30,000 well records exist throughout the Treasure Valley (primarily domestic wells)
    - Common units to describe water:
        - AF (acre-feet) = amount of water to cover 1 acre of land with 1 foot of water.
        - GPM (gallons per minute)
        - CFS (cubic feet per second)

Occurrence of Ground Water

- Ground water exists throughout the state at various depths below land surface. Areas in which ground water is abundant, aquifers are defined.
- Ground water flow characteristics and trends differ for different aquifers across the state.

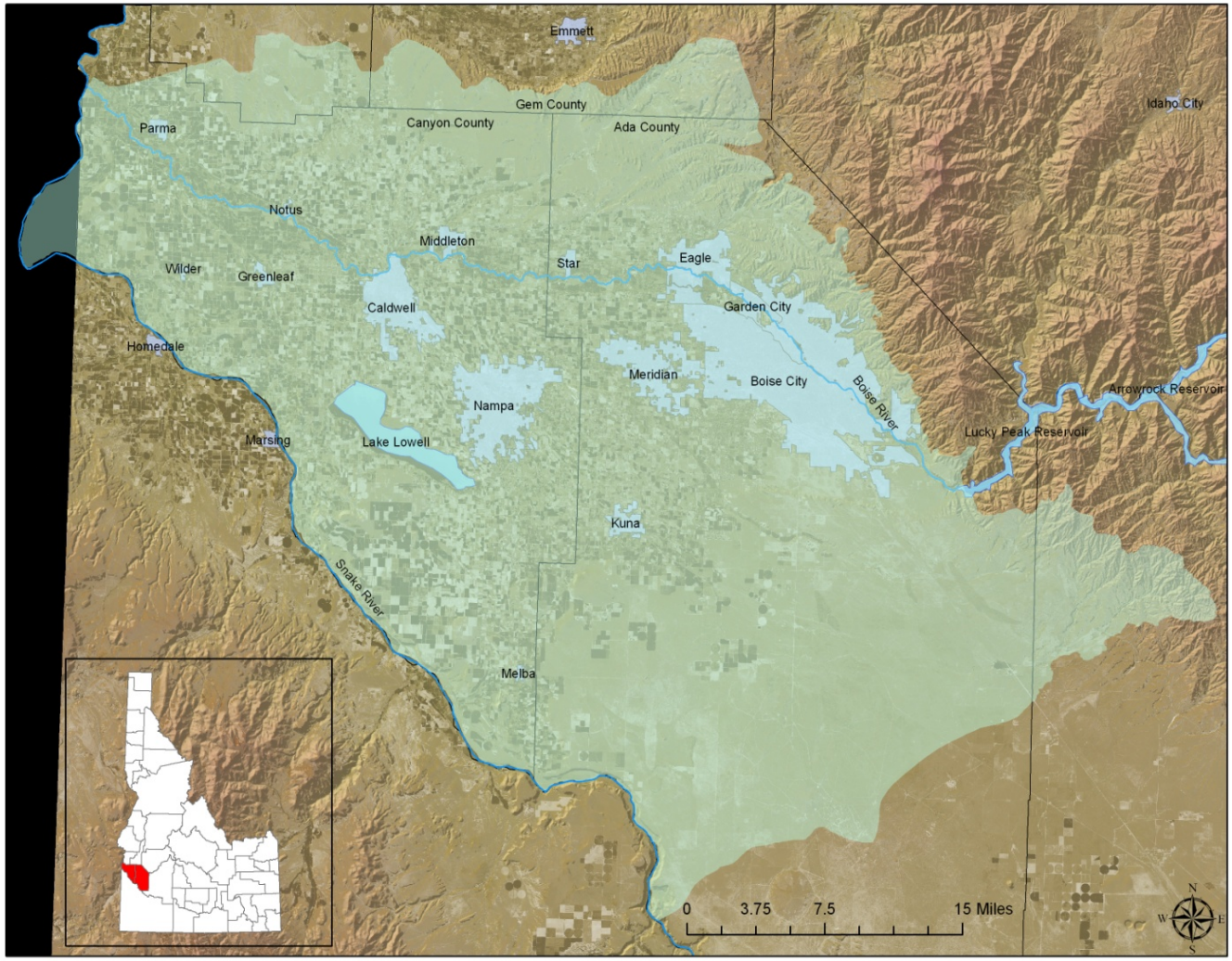


Idaho Aquifers

Definition of an aquifer:

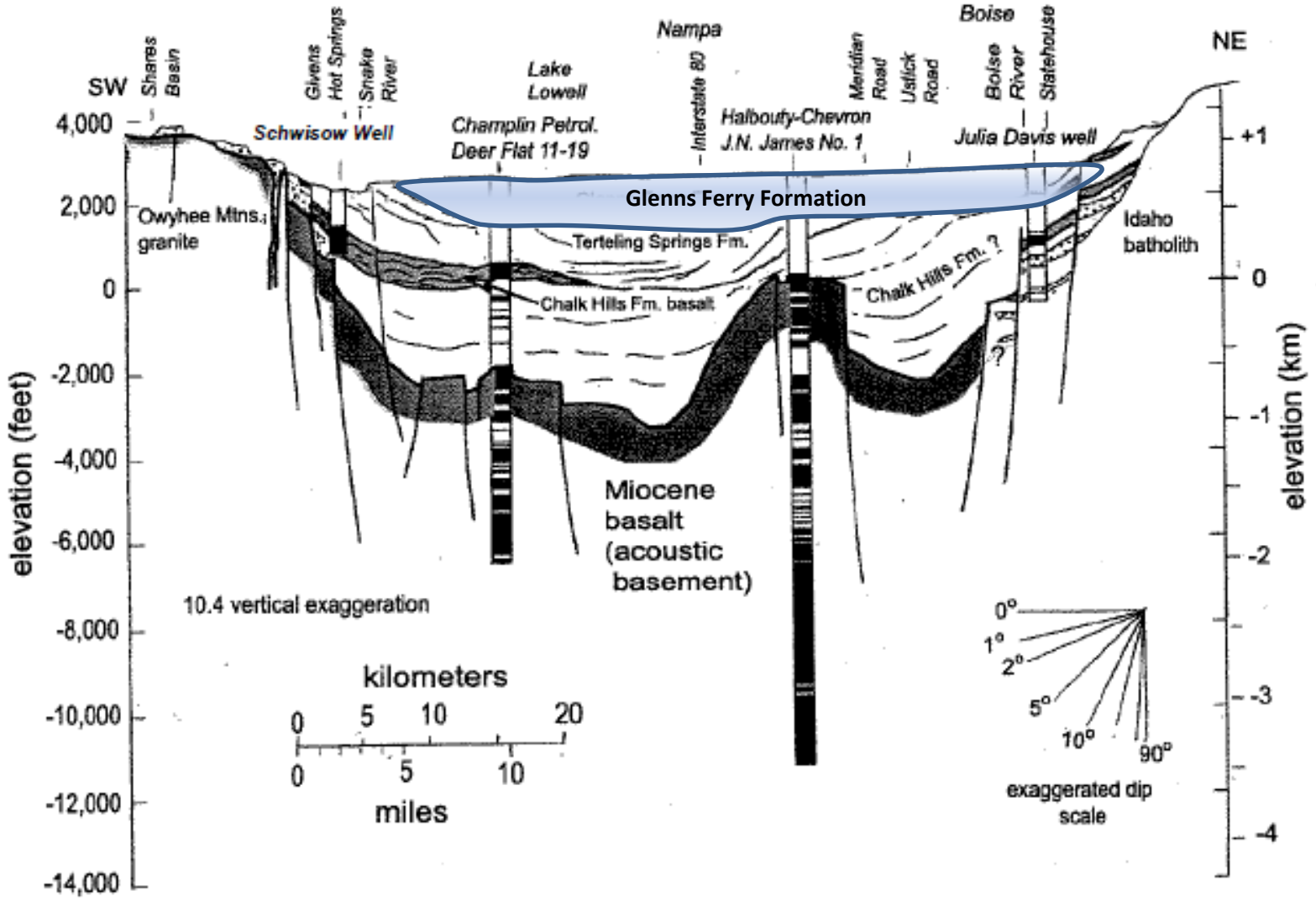
*"Rock or sediment in a formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit **economic** quantities of water to wells and springs."*

Treasure Valley Aquifer Boundary

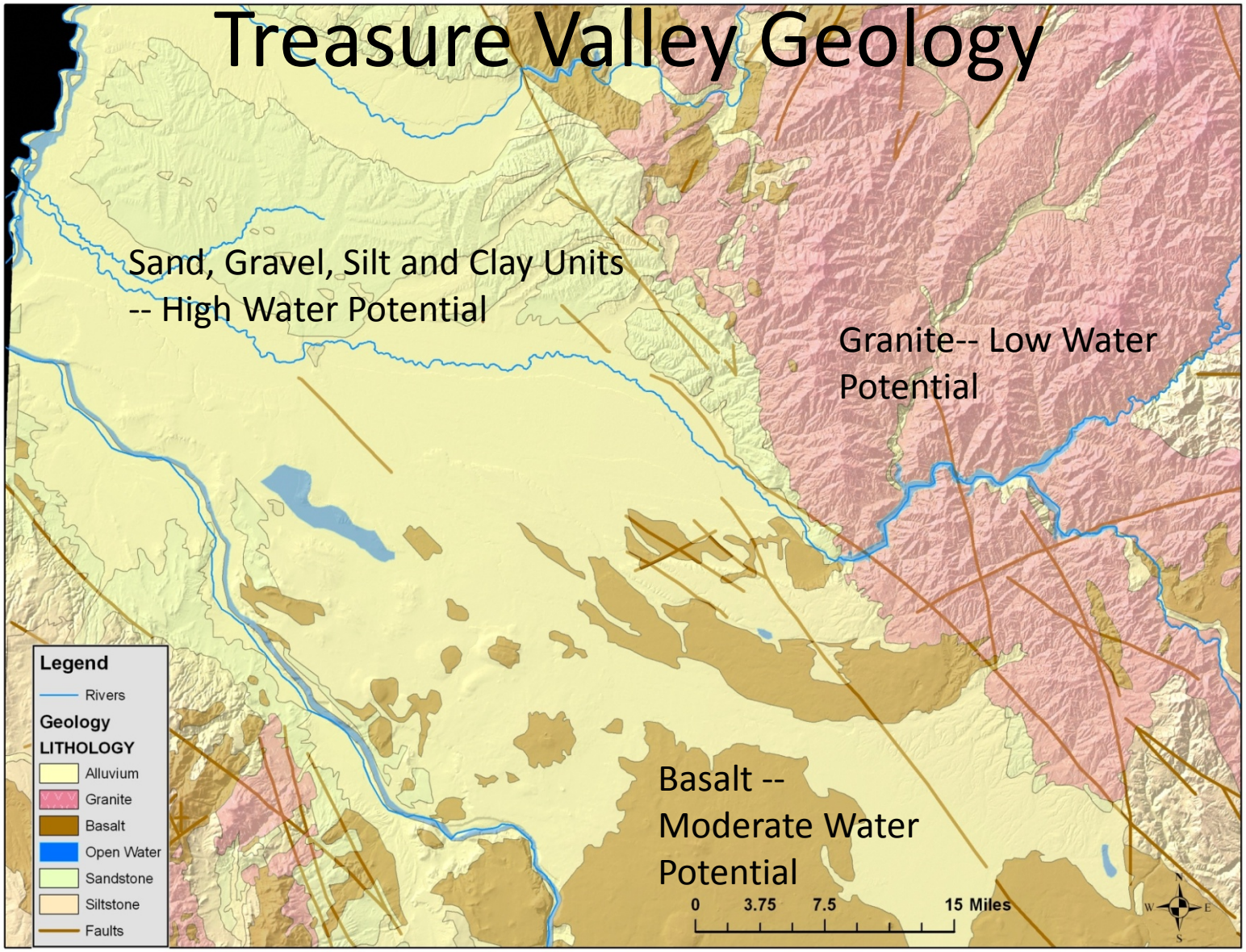


- Boundary extends from Mountain Home Plateau, Oregon Idaho state line, the Snake River, and the Payette River Basin.

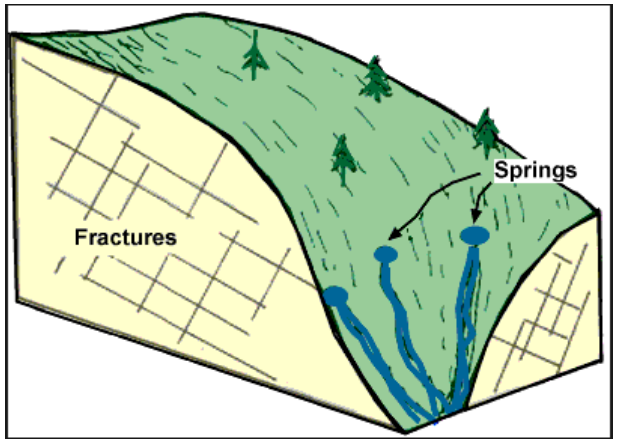
Treasure Valley Geology -- Cross Section



Treasure Valley Geology



Bedrock Units

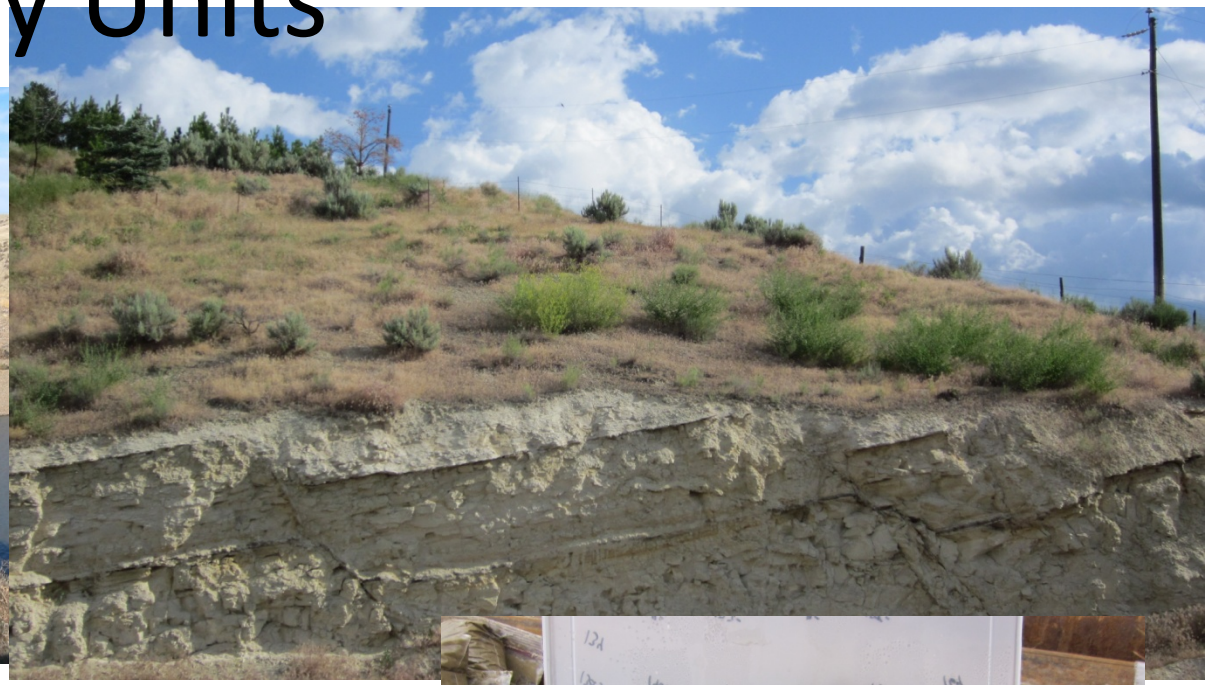


Low water potential. Generally forms a “no-flow” barrier.
Wells constructed in granite have low yields and low sustainability.

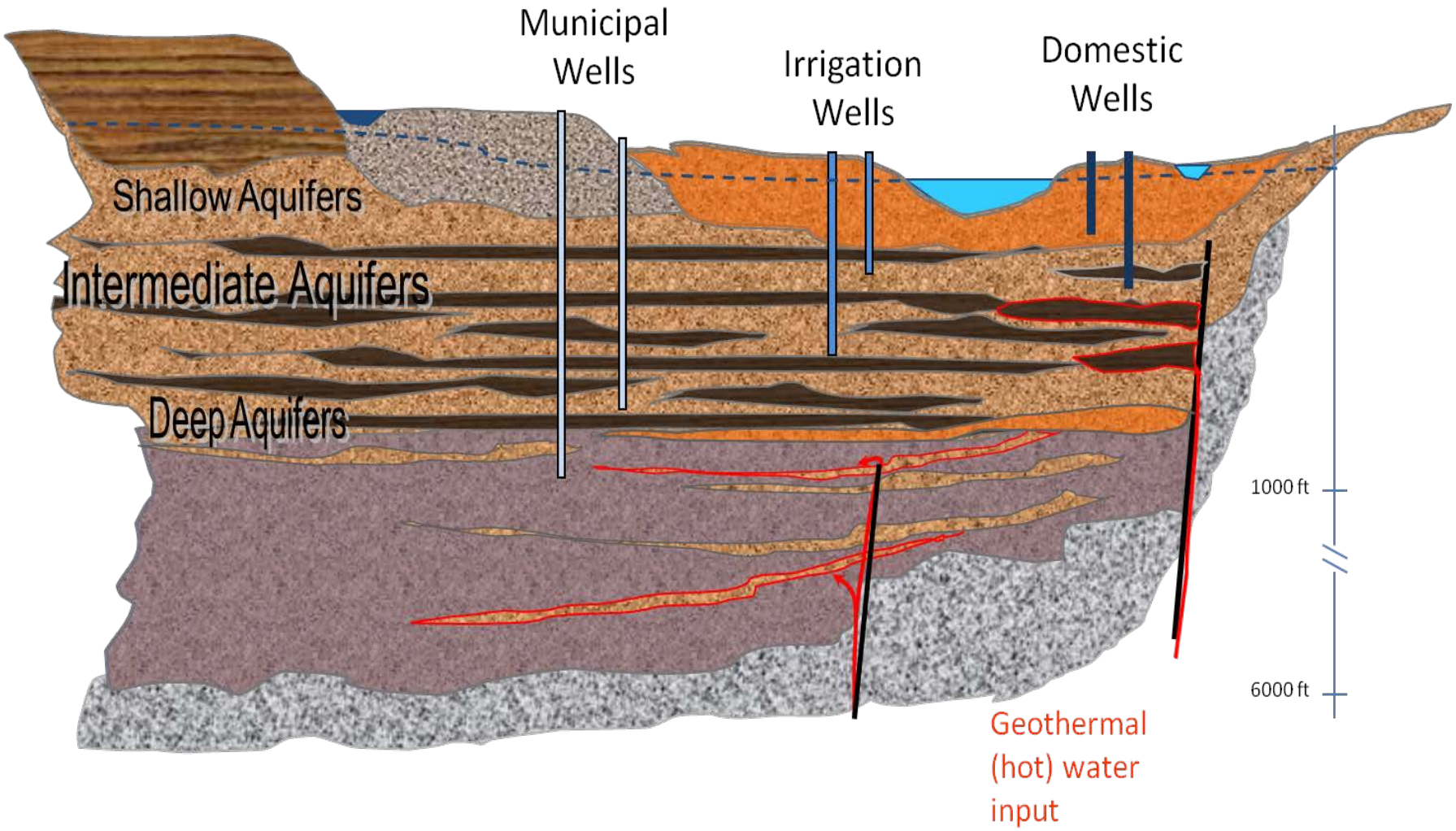
Volcanic Units

Can yield high amounts of water.
Low storage abilities.

Sedimentary Units



Productive aquifer material of the Treasure Valley.
Wells completed into the coarse sands are very productive, and have high storage capabilities.

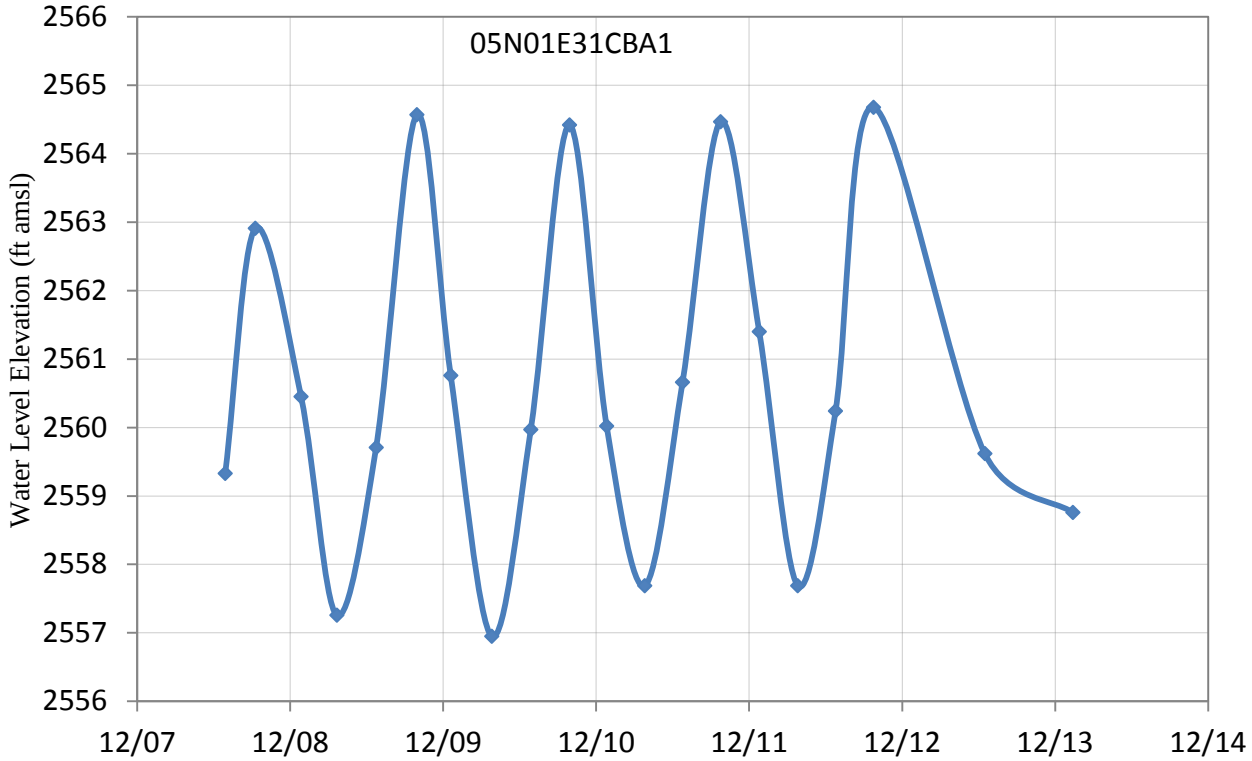

Municipal Wells
Irrigation Wells
Domestic Wells
Shallow Aquifers
Intermediate Aquifers
Deep Aquifers
1000 ft
6000 ft
Geothermal (hot) water input

Aquifer delineation

- Shallow, intermediate, or deep classification is based on well depth and location within the valley.
- Seasonal (and long term) fluctuations are significantly different, based on what portion of the aquifer a well is completed.

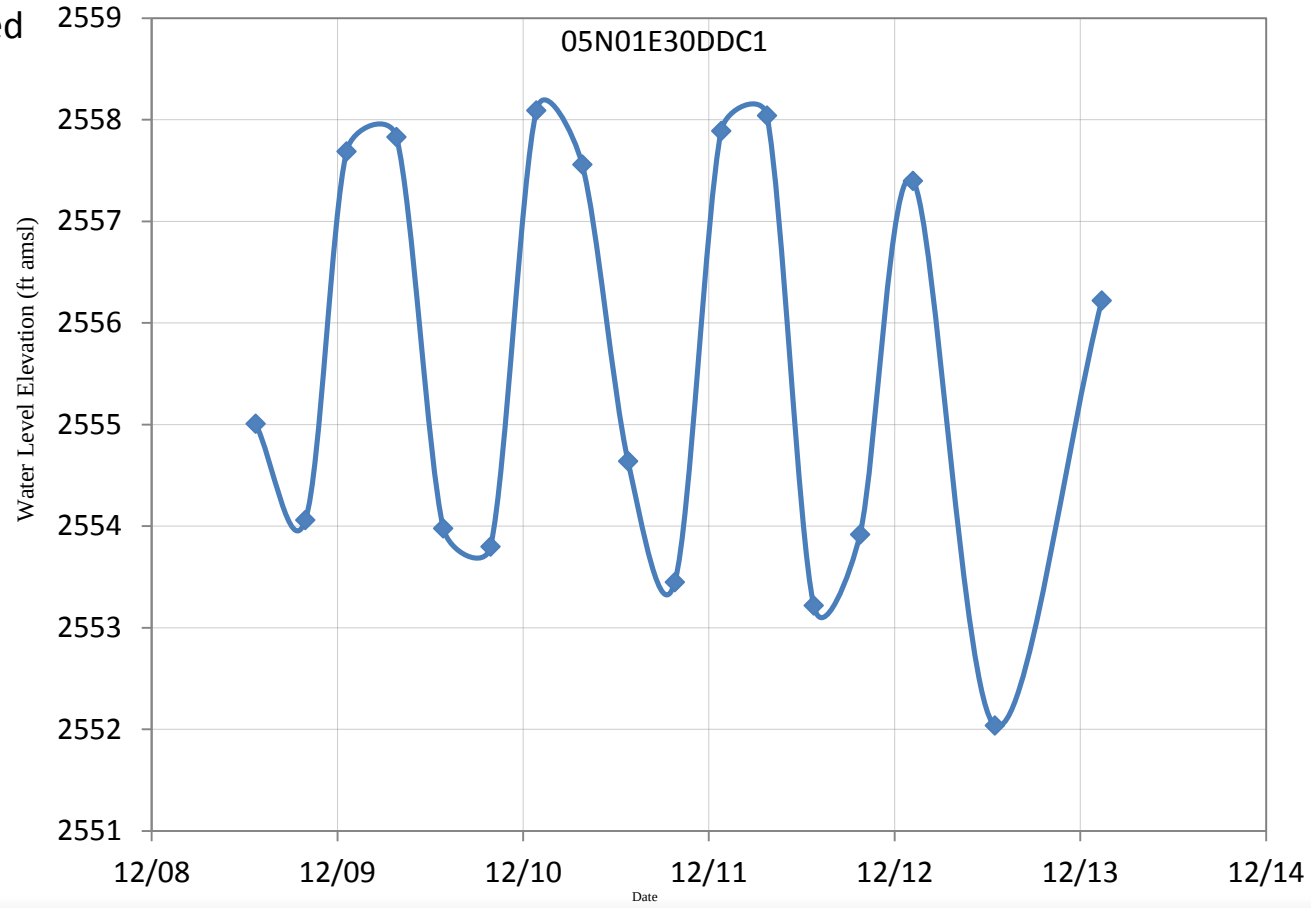
Shallow

- Generally encounter gravel and sand sequences.
- Typically domestic wells
- Good communication with surface water features (recharge).
- Unconfined



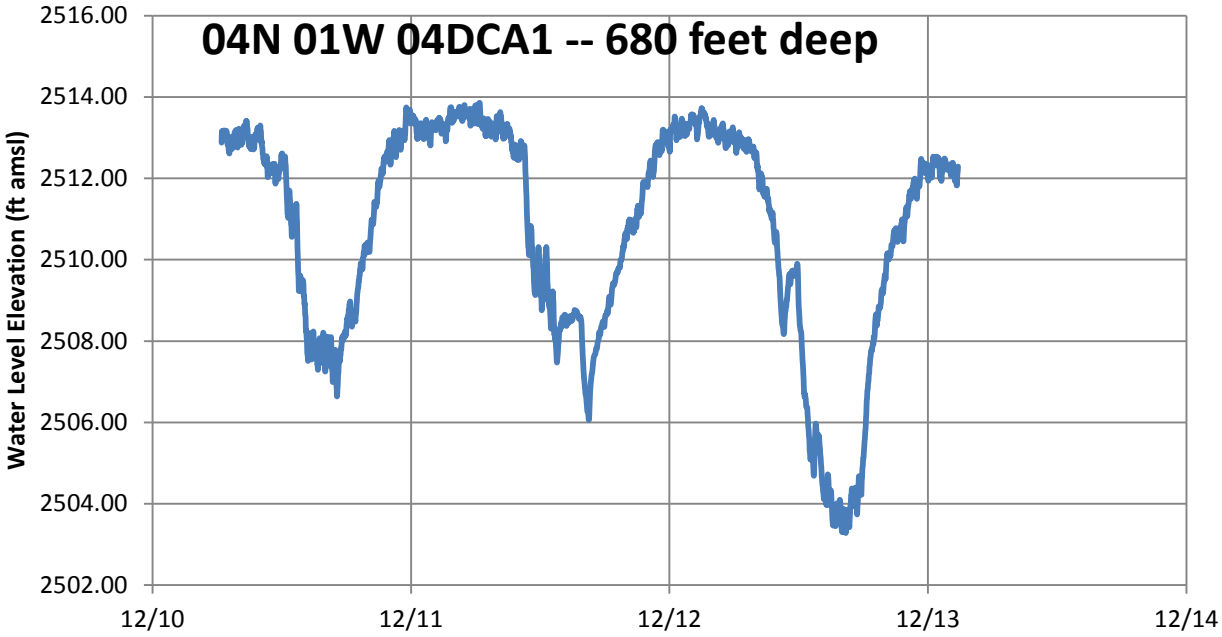
Intermediate Aquifers

- Sands, silts, and clays intermixed. Some gravels present.
- Productive aquifers.
- Domestic, irrigation, municipal wells.
- Minor communication with surface water features (? Recharge)
- Unconfined - semiconfined



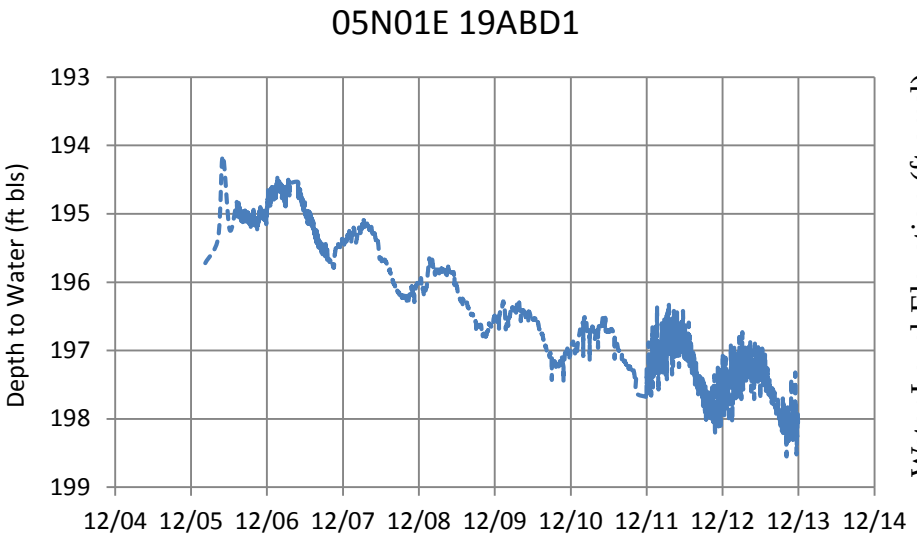
Deep Aquifer

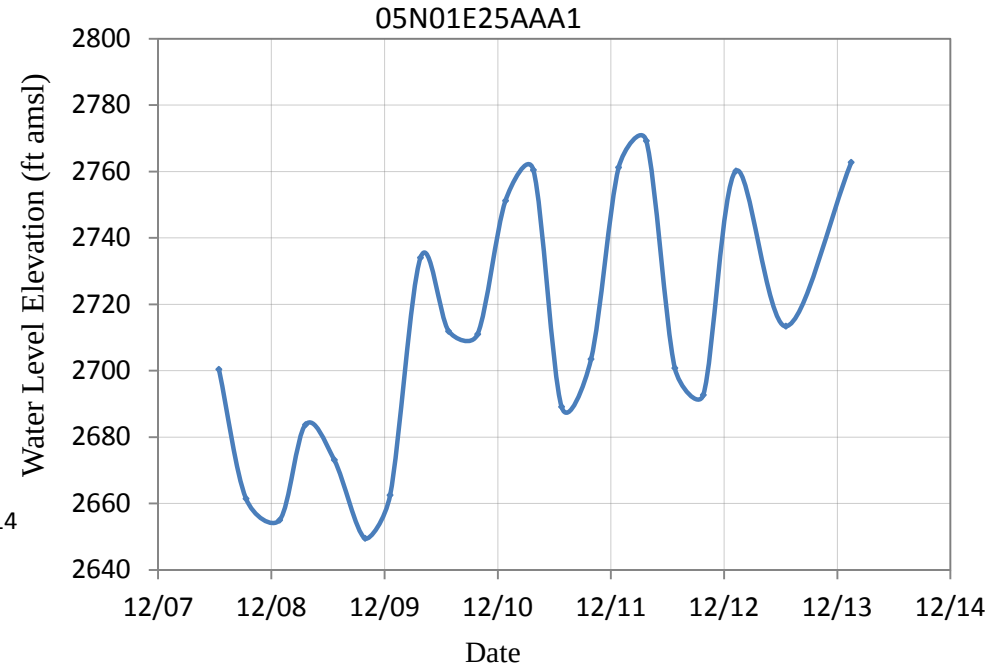
- Sands intermixed within “blue” clay
- Geothermal potential at depth
- Irrigation, municipal, and heat wells
- Little or no communication with surface water features (?? Recharge)
- Confined

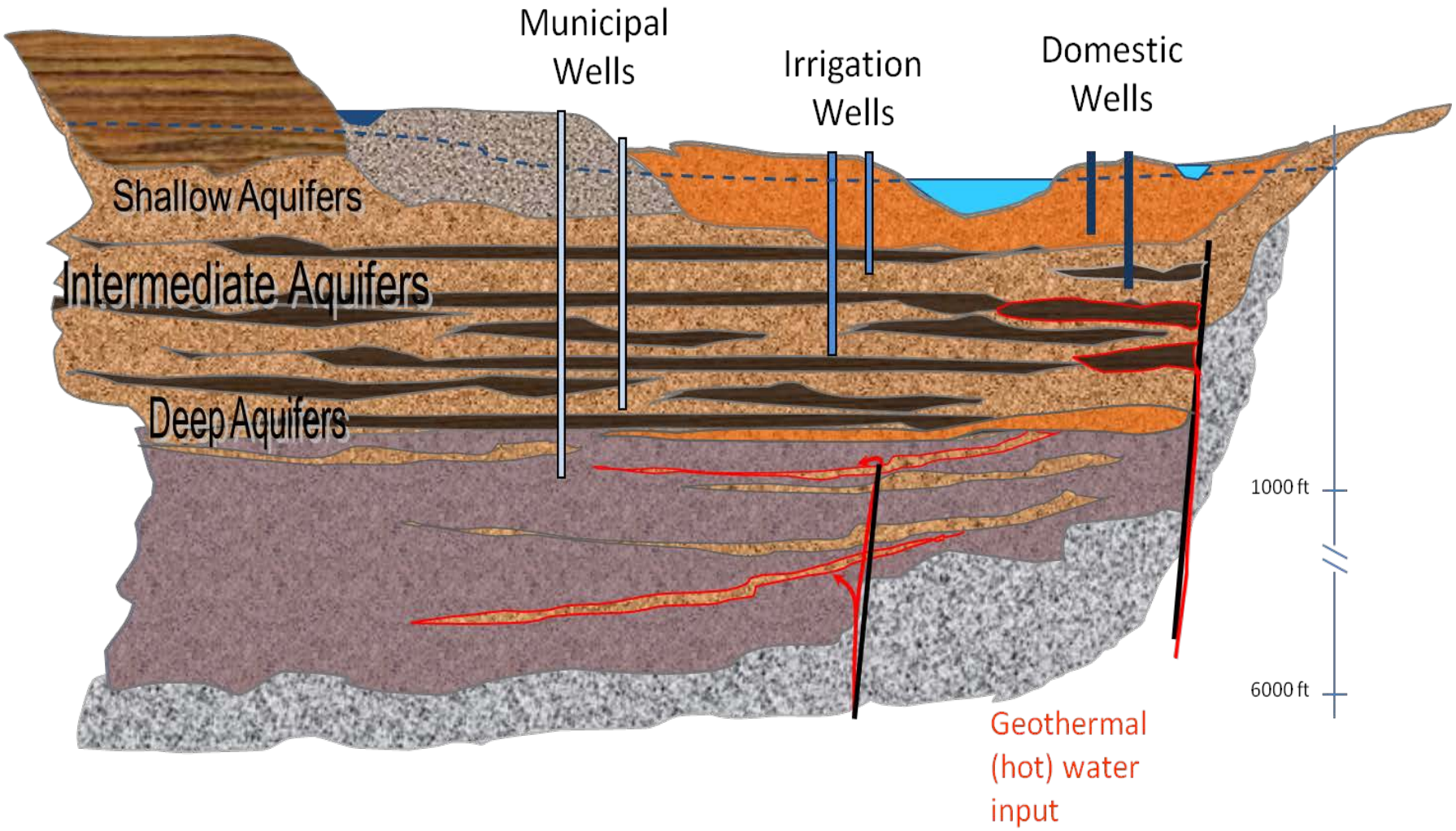


Margin Aquifers

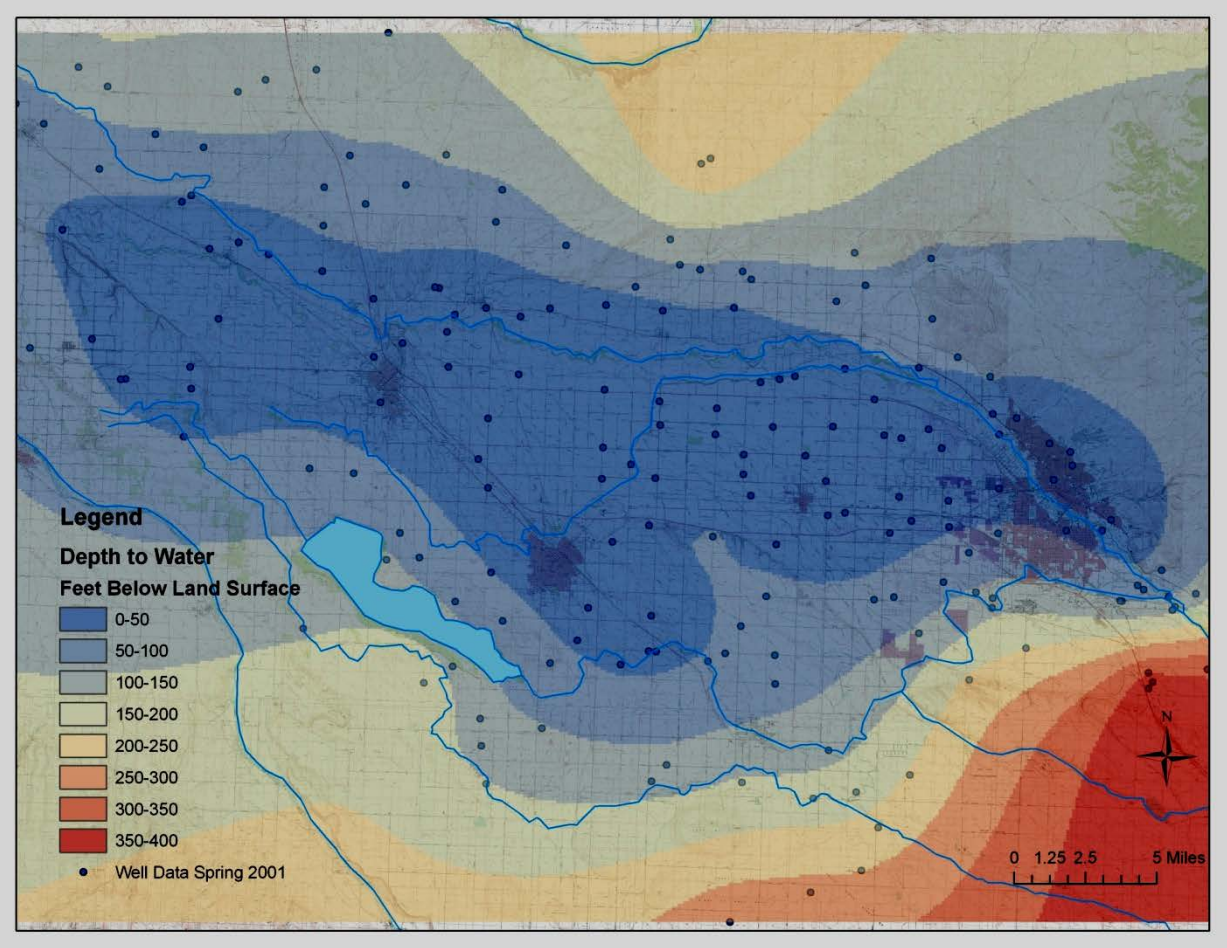
- Foothills areas (sediments)
- Foothills area (bedrock)



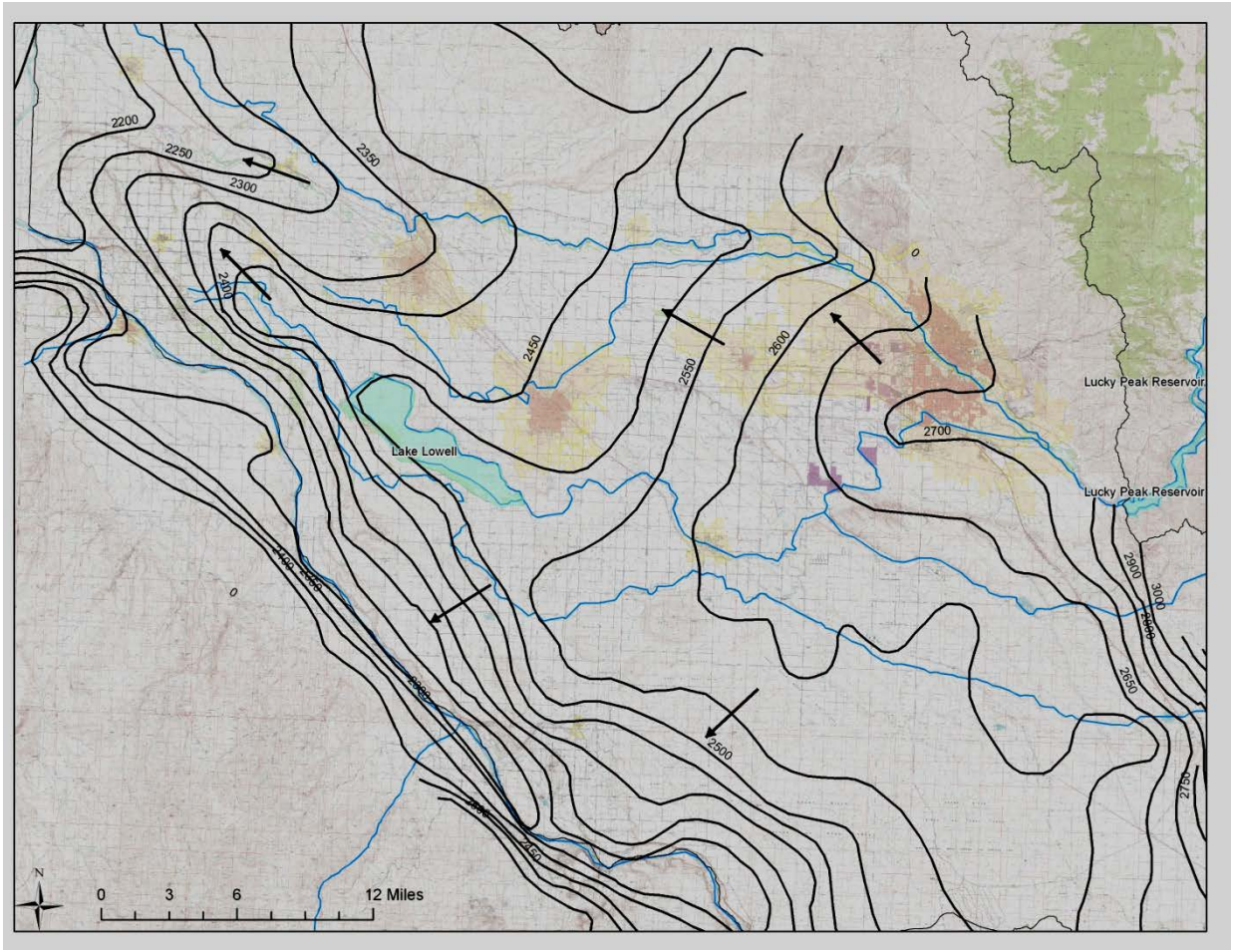



Municipal Wells
Irrigation Wells
Domestic Wells
Shallow Aquifers
Intermediate Aquifers
Deep Aquifers
1000 ft
6000 ft
Geothermal (hot) water input

Depth to Water



Ground Water Flow Direction



Data Collection

- Driller's Reports
- Ground Water Level Monitoring
- Ground Water Modeling
- Drain Discharge Monitoring

IDAHO Department of Water Resources

Driller's Reports

REVISED

Form 238-7
6/07

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

1. WELL TAG NO. D D0060212
Drilling Permit No.
Water right or injection well #

2. OWNER
Name IDWR
Address 322 East Front Street
City Boise State ID Zip 83720

3. WELL LOCATION:
Twp. 1 North ☒ or South ☐ Rge. 4 East ☒ or West ☐
Sec. 23 SW 1/4 (10 acres) SE 1/4 (40 acres) NE 1/4 (160 acres)
Gov't Lot County Elmore
Lat. 43 ° 24.498 (Deg. and Decimal minutes)
Long. 115 ° 56.334 (Deg. and Decimal minutes)
Address of Well Site Farm field approx. 1/4mi NE of Indian Cr. Rd. & Slater Cr. Rd.
City Mayfield
(Give at least name of road + Distance to Road or Landmark)
Lot. Blk. Sub. Name

4. USE:
☐ Domestic ☐ Municipal ☒ Monitor ☐ Irrigation ☐ Thermal ☐ Injection
☐ Other

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Replacement well ☐ Modify existing well
☐ Abandonment ☐ Other

6. DRILL METHOD:
☐ Air Rotary ☒ Mud Rotary ☐ Cable ☐ Other

7. SEALING PROCEDURES

Seal material	From (ft)	To (ft)	Quantity (lbs or ft³)	Placement method/procedure
3/8bentchps	0'	50'	1850 lbs	poured & tagged
DFGrt/Cmnt	30'	415'	120 cu.ft.	tremie

8. CASING/LINER:

Diameter (nominal)	From (ft)	To (ft)	Gauge/ Schedule	Material	Casing	Liner	Threaded	Welded
8"	+1.5'	52	.250	steel	☒	☐	☐	☒
4"	+1'	420	sc80	PVC	☒	☐	☒	☐
4"	440'	450'	sc80	PVC	☒	☐	☒	☐

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 52

9. PERFORATIONS/SCREENS:
Perforations ☐ Y ☐ N Method
Manufactured screen ☒ Y ☐ N Type PVC factory slotted
Method of installation set in

From (ft)	To (ft)	Slot size	Number/ft	Diameter (nominal)	Material	Gauge or Schedule
420'	440'	.020		4"	PVC	Sch80

Length of Headpipe Length of Tailpipe 10'
Packer ☐ Y ☒ N Type

10. FILTER PACK:

Filter Material	From (ft)	To (ft)	Quantity (lbs or ft³)	Placement method
8-12 sand	415'	454'	1250 lbs.	poured & tagged
medbentchip	454'	500'	850 lbs.	poured-backfill

11. FLOWING ARTESIAN:
Flowing Artesian? ☐ Y ☒ N Artesian Pressure (PSIG)
Describe control device

12. STATIC WATER LEVEL and WELL TESTS:
Depth first water encountered (ft) 15 Static water level (ft) 183
Water temp. (°F) Bottom hole temp. (°F)
Describe access port

Well test: / Test method:

Drawdown (feet)	Discharge or yield (gpm)	Test duration (minutes)	Pump	Bailer	Air	Flowing artesian
5	17	480	☒	☐	☐	☐

Water Quality test or comments:

13. LITHOLOGIC LOG and/or repairs or abandonment:

Bore Dia. (in)	From (ft)	To (ft)	Remarks, lithology or description of repairs or abandonment, water temp.	Water Y	Water N
12"	0'	2'	brown top soil		X
12"	2'	12'	brown sandy clay		x
12"	12'	43'	light grey sand	X	
12"	43'	50'	light brown sand		X
8"	50'	52'	tan clay		X
8"	52'	58'	grey sand		X
8"	58'	64'	tan sand & clay strips		X
8"	64'	85'	brown sand	X	
8"	85'	138'	light brown sand & clay strips		X
8"	138'	222'	brown sand & clay strips		X
8"	222'	235'	white/grey sand	X	
8"	235'	246'	brown sand & clay strips		X
8"	246'	285'	light brown clay		X
8"	285'	310'	grey sand	X	
8"	310'	340'	brown sand & clay strips		X
8"	340'	352'	brown clay		X
8"	352'	357'	grey clay		X
8"	357'	375'	grey sand & clay strips		X
8"	375'	420'	grey & brown sand & clay strips		X
8"	420'	440'	grey sand	X	
8"	440'	460'	tan sandy clay		X
8"	460'	470'	grey clay		X
8"	470'	475'	tan & grey sandy clay		X
8"	475'	477'	grey clay		X
8"	477'	483'	grey sandy clay		X
8"	483'	500'	grey clay		X
			Med. chips 0'-30' 500 lbs. btwn 8" & 4"		

RECEIVED SEP 28 2012 WATER RESOURCES WESTERN REGION

Completed Depth (Measurable): 450
Date: Started 11-10-2011 Completed 11-15-2011

14. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.
Company Name Down Right Drilling & Pump,Inc Co. No. 637
*Principal Driller [signature] Date 3-9-12
*Driller Date
*Operator II Date
Operator I Date
* Signature of Principal Driller and rig operator are required.

1 / 1

Form provided by Forms On-A-Disk · (214) 340-9429 · www.FormsOnADisk.com

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USE TYPEWRITER OR BALL POINT PEN

State of Idaho
Department of Water Administration
WELL DRILLER'S REPORT
State law requires that this report be filed with the Director, Department of Water Administration within 30 days after the completion or abandonment of the well.

1. WELL OWNER
Name Otto Bertel
Address Eagle
Owner's Permit No.

2. NATURE OF WORK
☒ New well ☐ Deepened ☐ Replacement
☐ Abandoned (describe method of abandoning)

3. PROPOSED USE
☒ Domestic ☐ Irrigation ☐ Test ☐ Other (specify type)
☐ Municipal ☐ Industrial ☐ Stock ☐ Waste Disposal or Injection

4. METHOD DRILLED
☒ Cable ☐ Rotary ☐ Dug ☐ Other

5. WELL CONSTRUCTION
Diameter of hole 6 inches Total depth 332 feet
Casing schedule: ☒ Steel ☐ Concrete
Thickness .250 inches Diameter 6 inches From + feet To feet
Was a packer or seal used? ☐ Yes ☒ No
Perforated? ☐ Yes ☒ No
How perforated? ☐ Factory ☐ Knife ☐ Torch
Size of perforation inches by inches
Number perforations From feet To feet
Well screen installed? ☒ Yes ☐ No
Manufacturer's name Johnson
Type Model No.
Diameter 5" Slot size 10 Set from 325 feet to 331 feet
Diameter Slot size Set from feet to feet
Gravel packed? ☐ Yes ☒ No Size of gravel
Placed from feet to feet
Surface seal depth 100 Material used in seal ☐ Cement grout ☒ Puddling clay ☐ Well cuttings
Sealing procedure used ☐ Slurry pit ☐ Temporary surface casing ☒ Overbore to seal depth

6. LOCATION OF WELL
Sketch map location must agree with written location.
Subdivision Name Skyline acres
Lot No. 2 Block No.
County ada
SW ¼ SE ¼ Sec. 30, T. 5 N/S, R. 1 E/W

7. WATER LEVEL
Static water level 150 feet below land surface
Flowing? ☐ Yes ☐ No G.P.M. flow
Temperature °F. Quality
Artesian closed-in pressure p.s.i.
Controlled by ☐ Valve ☐ Cap ☐ Plug

8. WELL TEST DATA
☐ Pump ☐ Bailer ☐ Other

Discharge G.P.M.	Draw Down	Hours Pumped

042963

9. LITHOLOGIC LOG

Hole Diam.	Depth From	Depth To	Material	Water Yes	Water No
6"	0	5	Clay		✓
	5	100	Sandy clay		✓
	100	332	Sand and Clay	✓	

10. Work started 12-1-73 finished 1-10-74

11. DRILLERS CERTIFICATION
Firm Name H.C. Nicholson Firm No. 34
Address 921 6th ave So Payette
Signed by (Firm Official) H.C. Nicholson
and (Operator) Don
MICROFILMED

USE ADDITIONAL SHEETS IF NECESSARY FORWARD THE WHITE COPY TO THE DEPARTMENT

Example of Hydrogeologic Data

February 2011

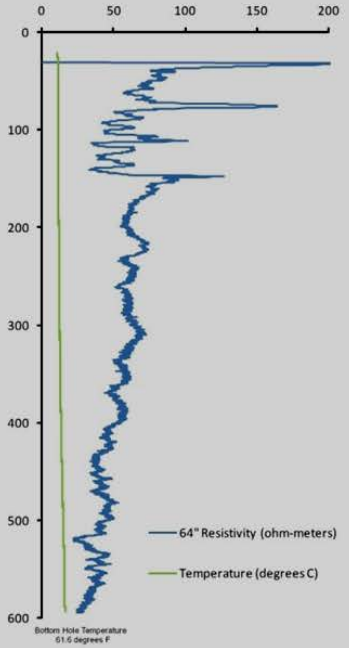
North Ada County Monitoring Well #5
T. 5 N., R. 1 E., Section 29

Water Chemistry

Analyte (mg/L unless otherwise noted)	Shallow	Deep
Alkalinity as CaCO3	202	194
Ammonia	<0.010	<0.010
Arsenic	0.014	0.0061
Calcium as CaCO3	48	57
Chloride	8.45	6.48
Conductivity (uS/cm)	435	454
Fluoride	0.303	0.512
Hardness	160	190
Iron	0.052	0.14
Iron (dissolved/filtered)	<0.010	<0.010
Magnesium	10	12
Manganese (dissolved)	<0.002	0.0062
Nitrate as N	2.85	1.8
Nitrite as N	<0.18	<0.18
Orthophosphate as P	0.188	0.102
pH (SU)	6.88	6.83
Potassium	2.4	2.4
Silica	46	36
Sodium	39	29
Sulfate	26.8	46.1
Sulfide	<0.10	<0.10
Total Dissolved Solids	300	320
Total Kjeldahl Nitrogen	0.14	0.11
Total Organic Carbon	1.35	0.69
Field Temperature (C)	14.1	16.4
Field Conductivity (uS/cm)	461	467
Field pH (SU)	7.62	7.16

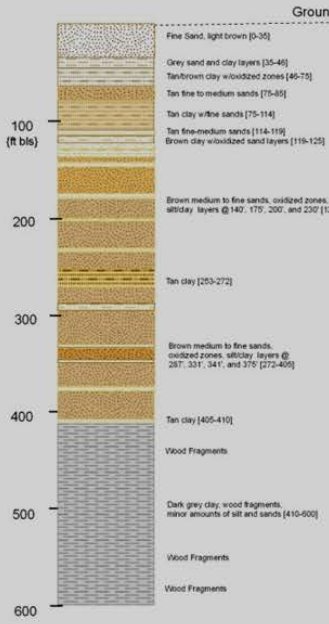
Analysis by Idaho Bureau of Laboratories, Boise, Idaho and Analytical Laboratories, Boise, Idaho.
Samples collected by IDWR on 3/1/2011

Borehole Geophysics



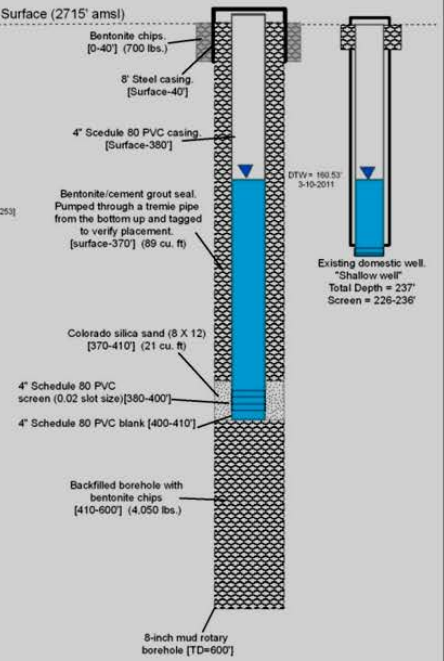
Borehole Geophysics conducted by J.U.B.

Lithologic Description



Lithology based on drill cutting analysis conducted by IDWR

As-Built Well Construction



Well drilling and constuction by Down Right Drilling and Pump Company, Caldwell, Idaho

Example of Hydrogeologic Data

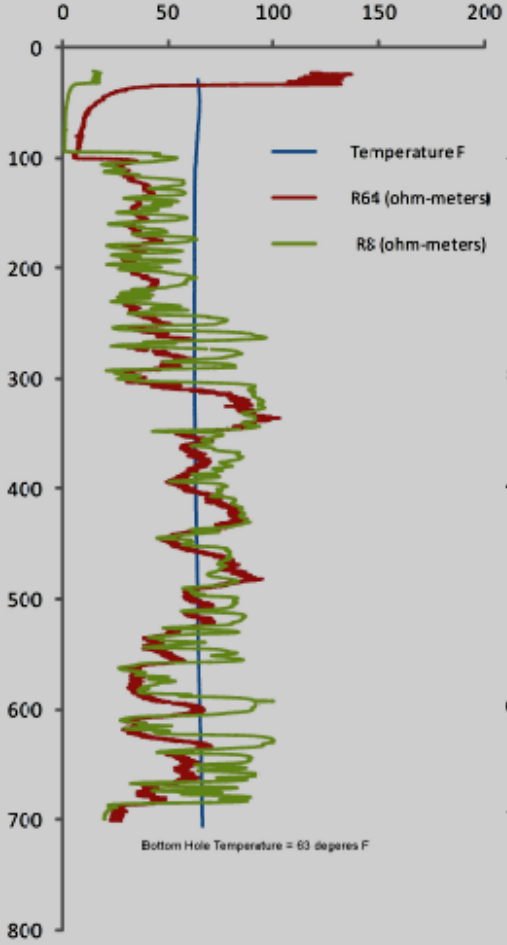
North Ada County Monitoring Well #3
T. 1 N., R. 1W., Section 1

April 2011

Water Chemistry

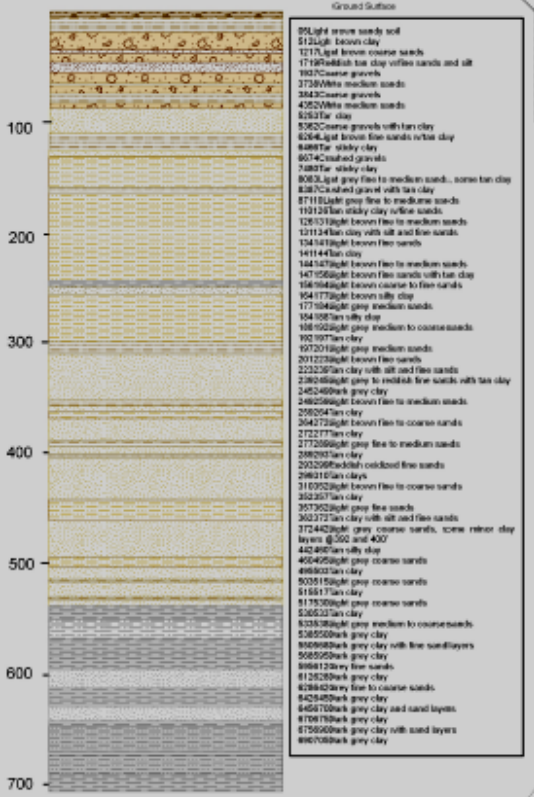
Analyte (mg/L unless otherwise noted)	Shallow	Deep
Alkalinity as CaCO3	260	137
Ammonia	<0.010	<0.010
Arsenic	0.011	0.006
Calcium as CaCO3	61	38
Chloride	4.07	4.85
Conductivity (uS/cm)	418	282
Fluoride	0.487	0.49
Hardness	200	120
Iron	<0.01	0.018
Iron (dissolved/filtered)	<0.010	<0.010
Magnessium	12	6.9
Manganese (dissolved)	<0.002	0.01
Nitrate as N	2.19	0.702
Nitrite as N	<0.18	<0.18
Orthophosphate as P	0.153	0.22
pH (SU)	7.31	7.18
Potassium	2.9	2
Silica	45	35
Sodium	38	20
Sulfate	9.02	22.1
Sulfide	<0.10	<0.10
Total Dissolved Solids	320	200
Total Kjeldahl Nitrogen	0.18	0.2
Total Organic Carbon	0.69	0.19
Field Temperature (C)	14.6	17.1
Field Conductivity (uS/cm)	482	312
Field pH (SU)	7.45	7.27

Borehole Geophysics

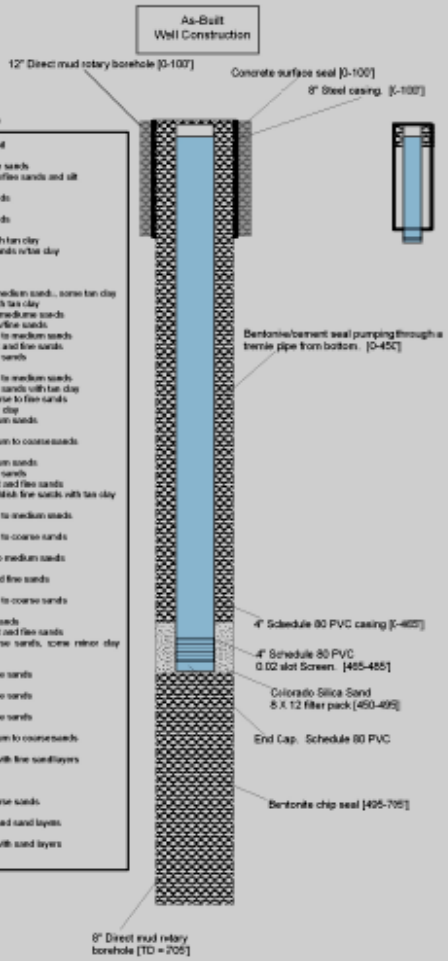


Lithology

Lithology based on drill cutting analysis conducted by IDWR

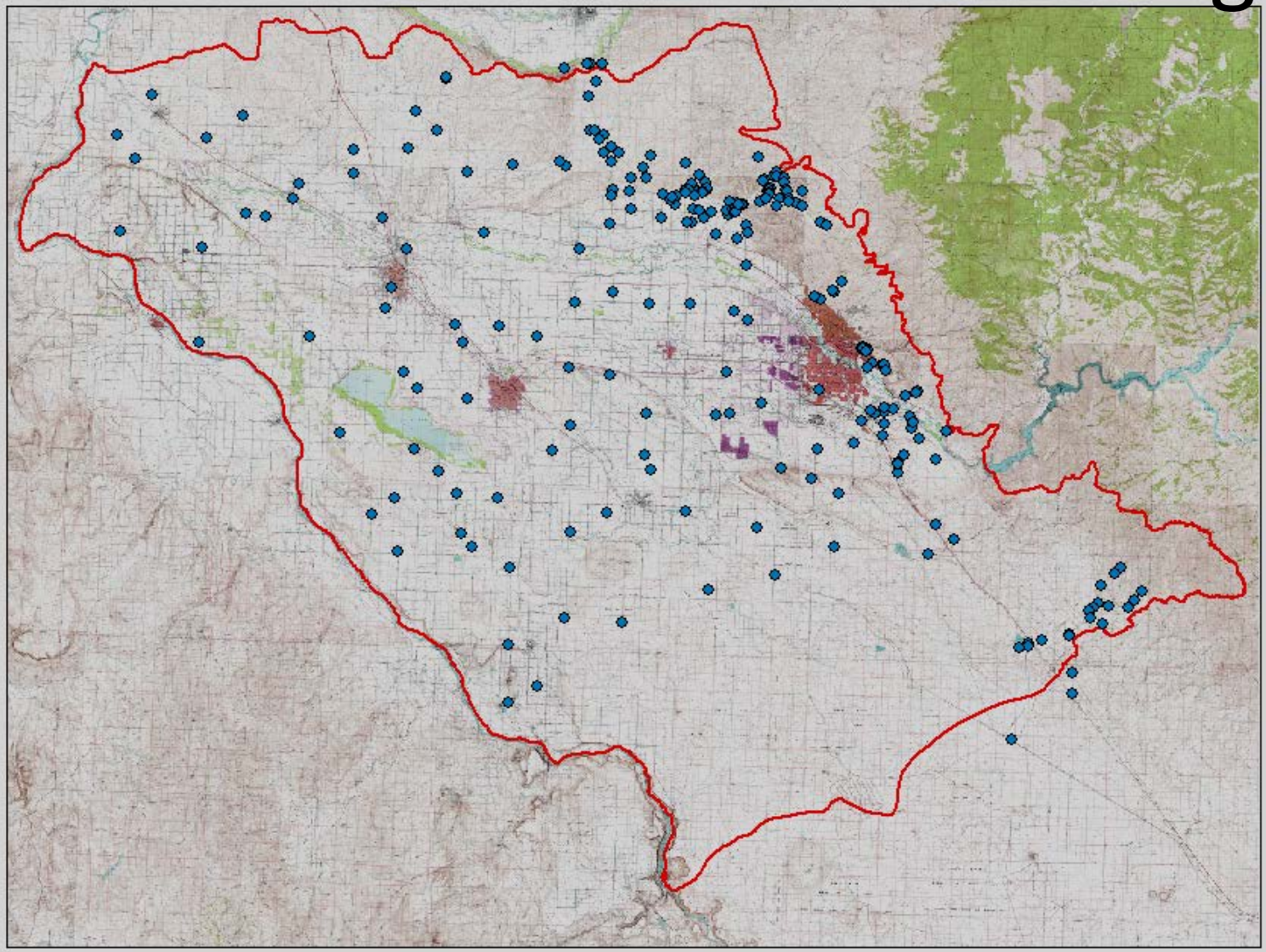


As-Built Well Construction

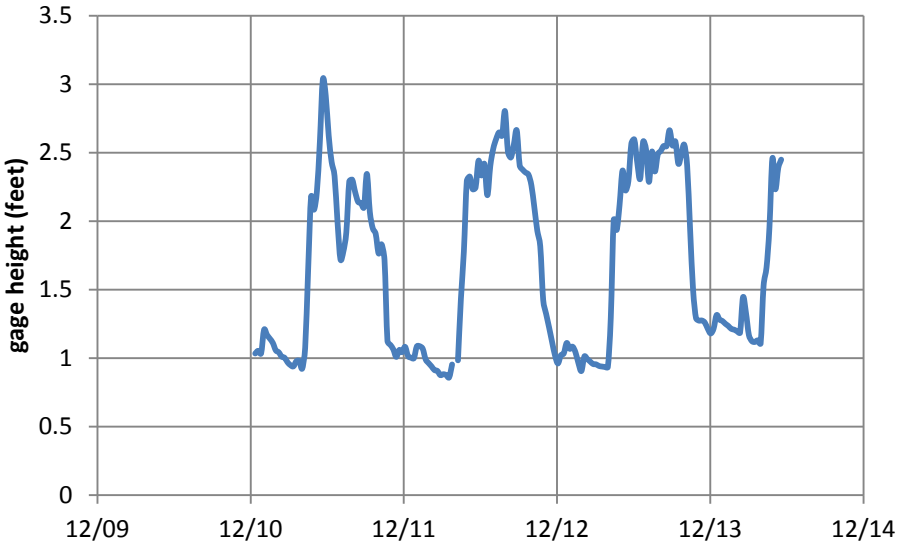


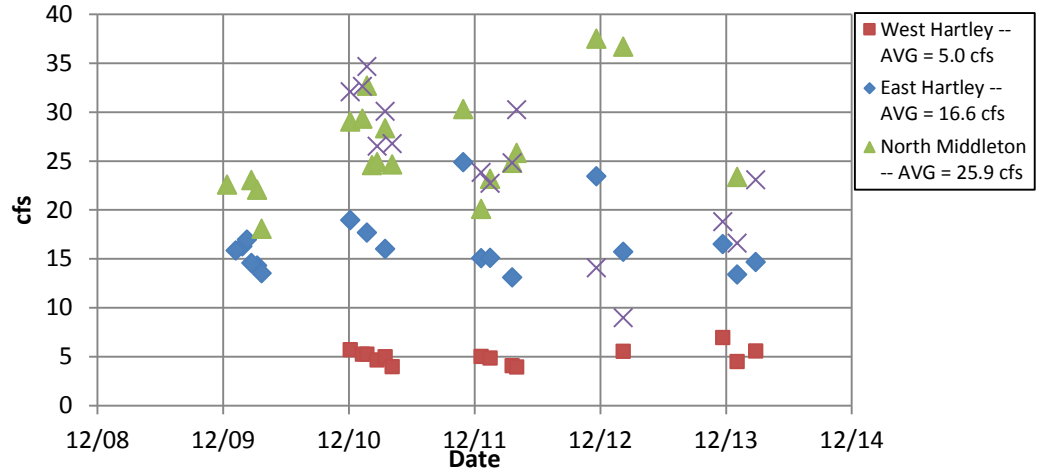
Ground Water Monitoring

Water Level Monitoring



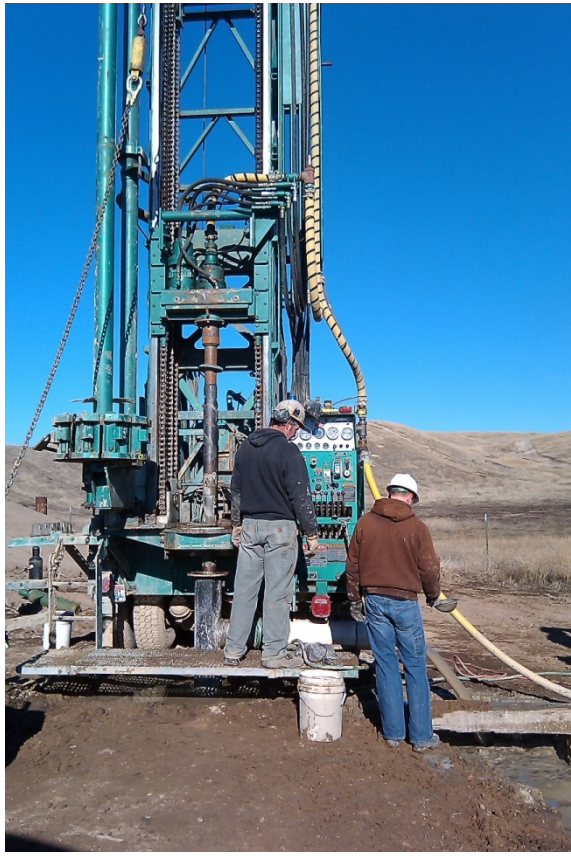
Drain and Stream Gaging





- Questions so far?

- Break for coffee and restrooms……



Ground Water Budget

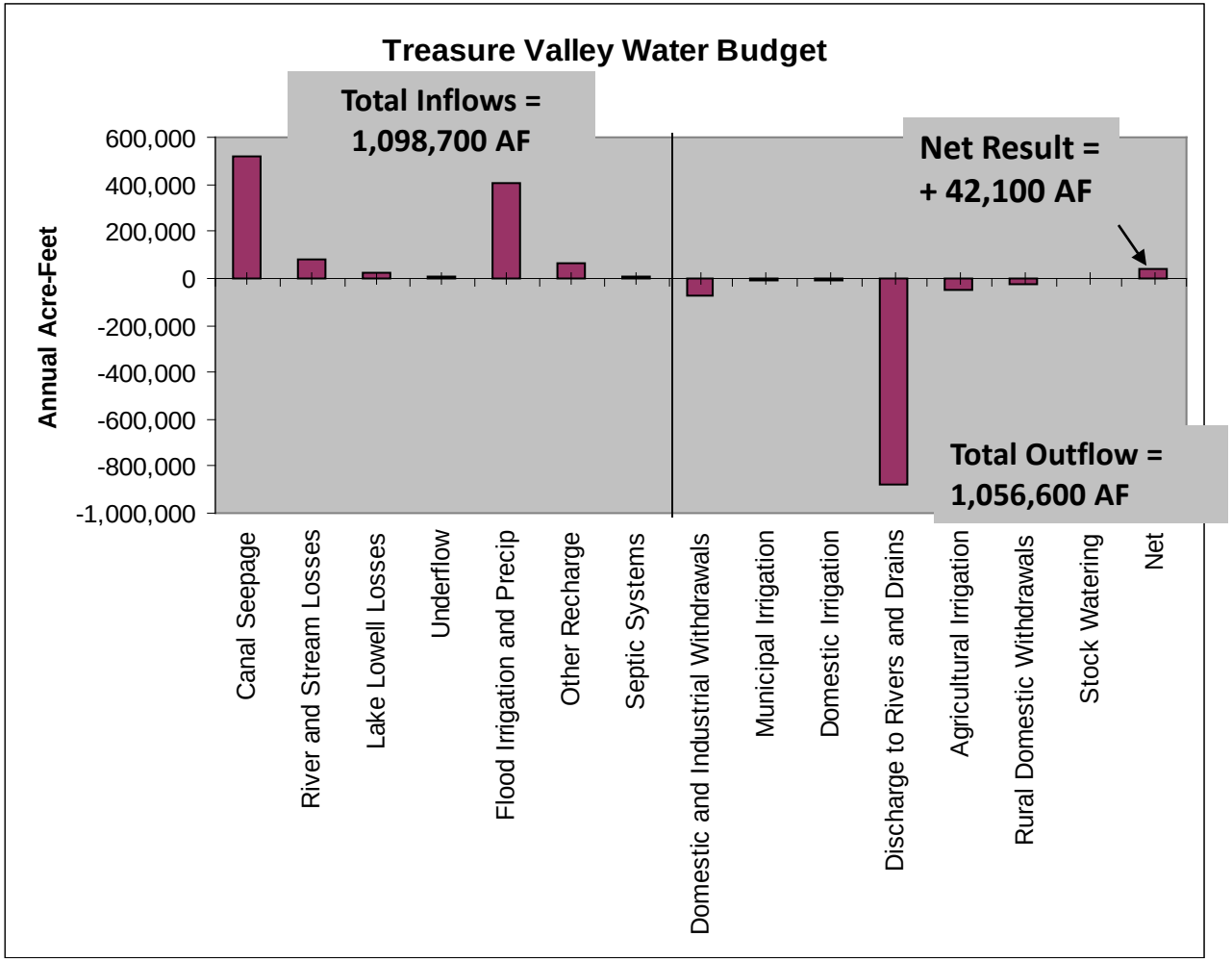
- Simple accounting:

  Inflow – Outflow = Change in storage

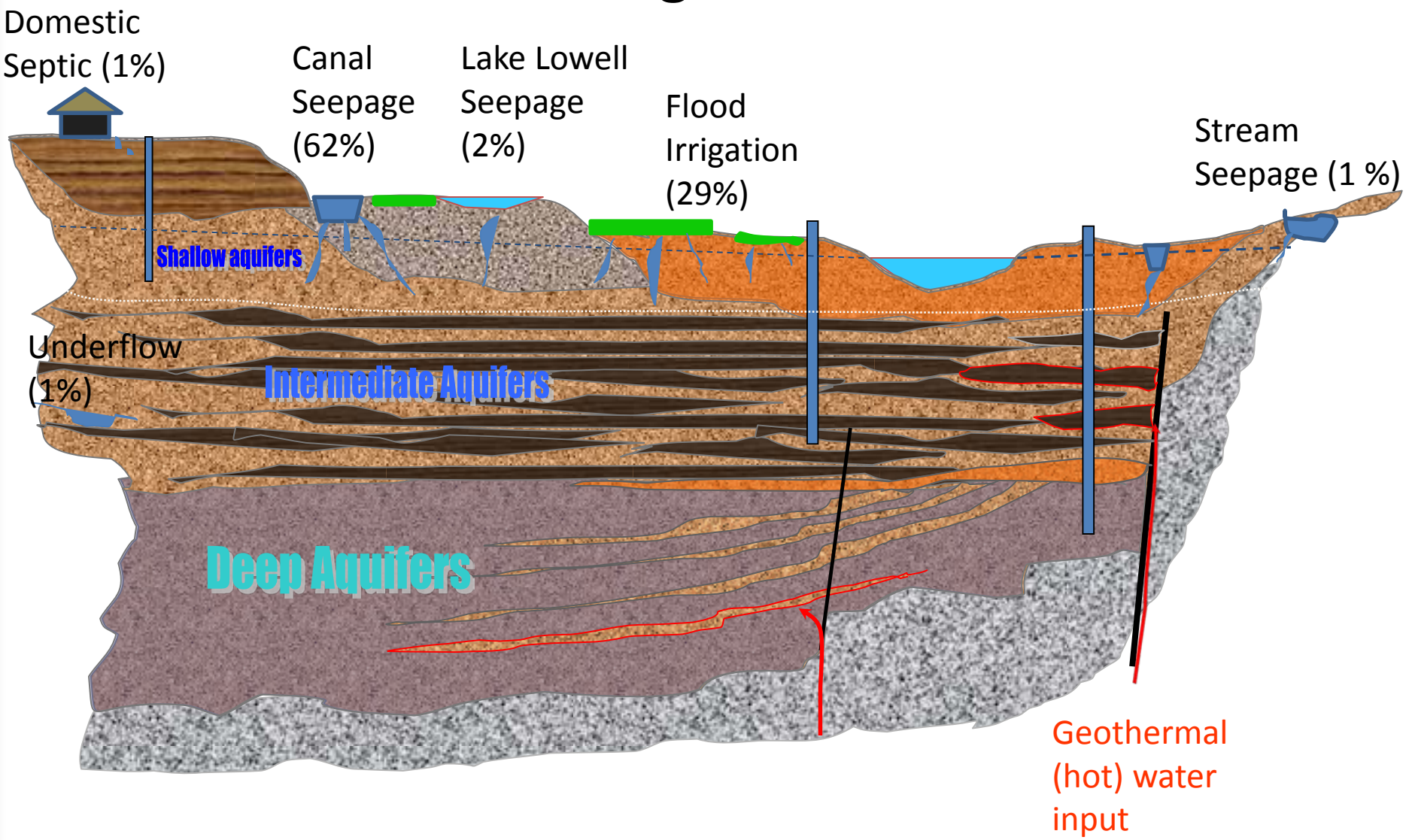
  Inflows: Irrigation seepage, canal seepage, stream loses, precipitation

  Outflows: Discharge to river, wells

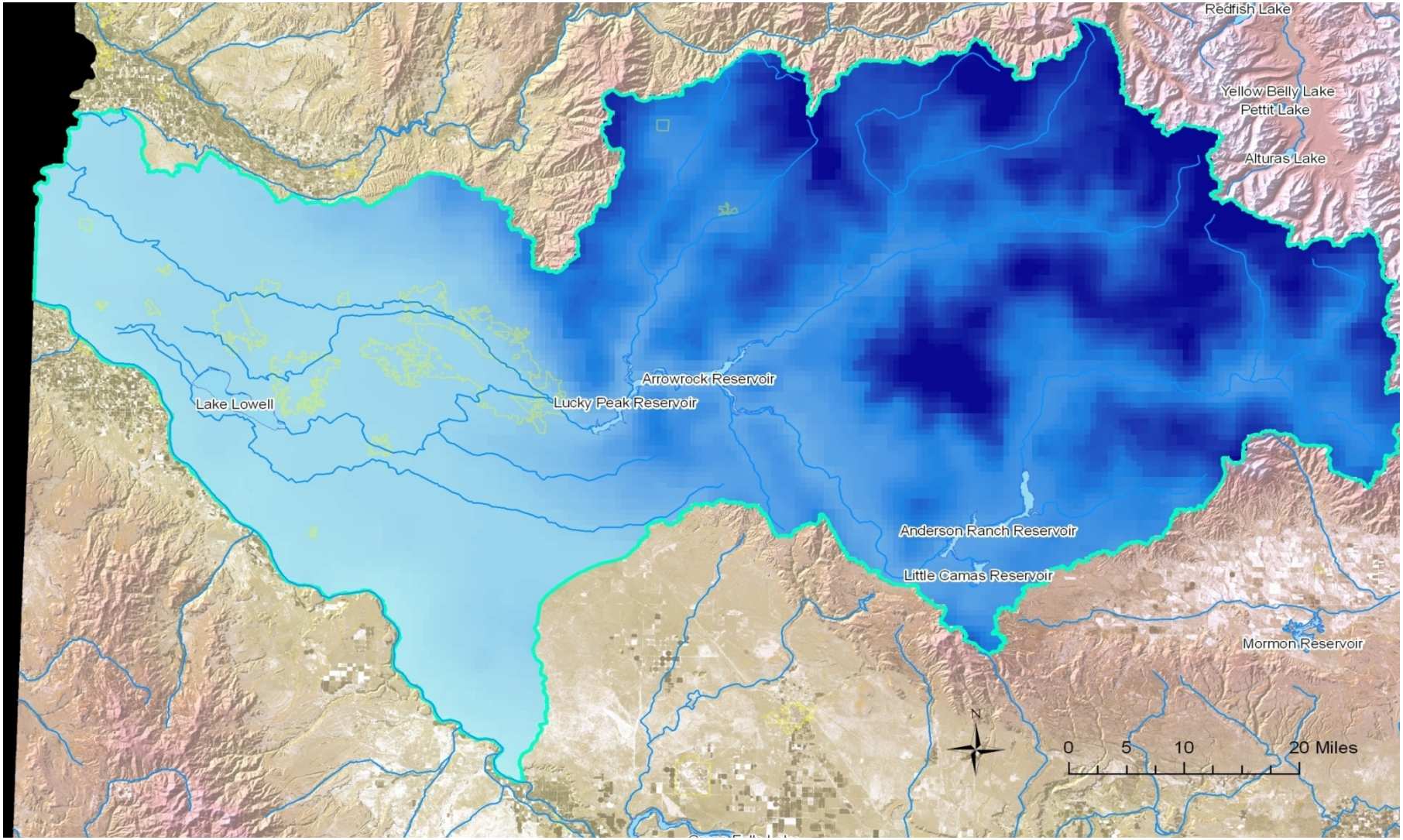
Ground Water Budget



Recharge Sources



Source of Water……



- Approximately 5.7 MAF of precipitation falls in the Boise River watershed.

IDAHO Department of Water Resources

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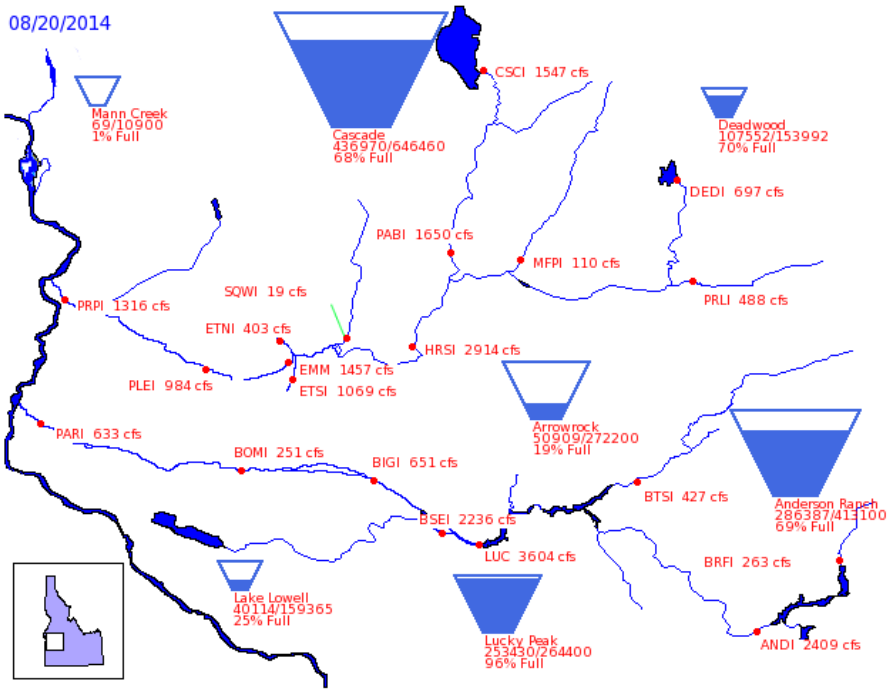
Reservoir System

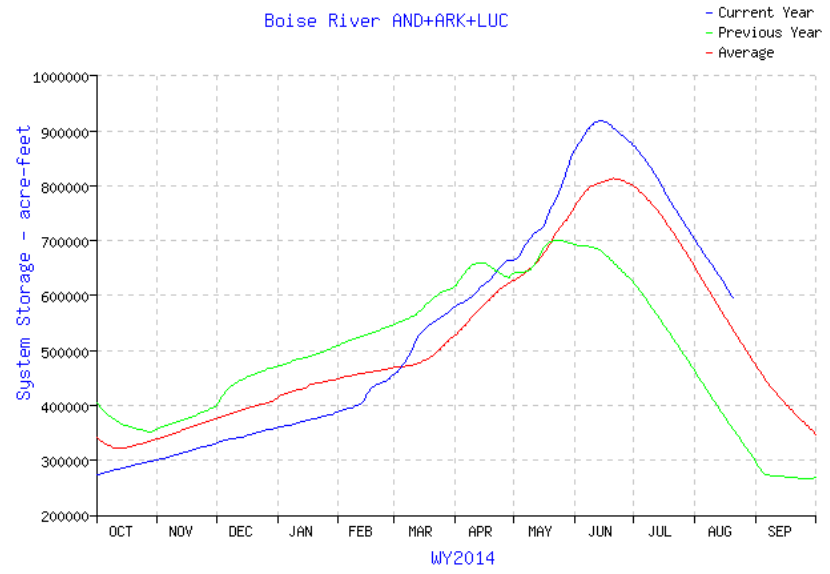
Bureau of Reclamation, Pacific Northwest Region
Major Storage Reservoirs in the Boise & Payette River Basins



PROVISIONAL DATA - SUBJECT TO CHANGE!

Boise River system (Anderson Ranch, Arrowrock, Lucky Peak) is at 62 % of capacity.
Total space available: 358974 AF
Total storage capacity: 949700 AF
Natural Flow: 749 CFS

Payette River system (Cascade, Deadwood) is at 68 % of capacity.
Total space available: 255930 AF
Total storage capacity: 800452 AF
Natural Flow: 1182 CFS



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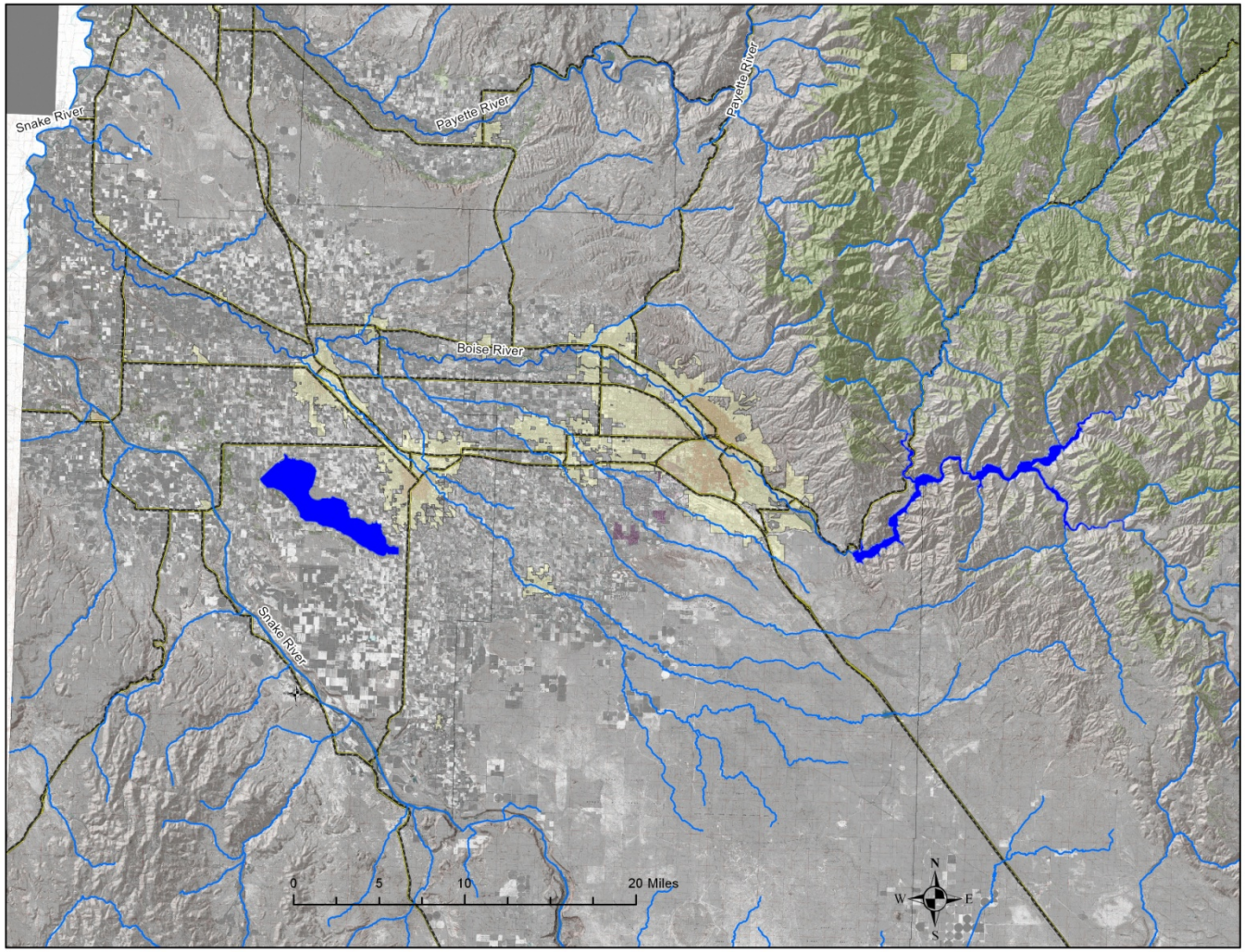
PROVISIONAL DATA - SUBJECT TO CHANGE!
Accessibility

Treasure Valley Surface Water Features

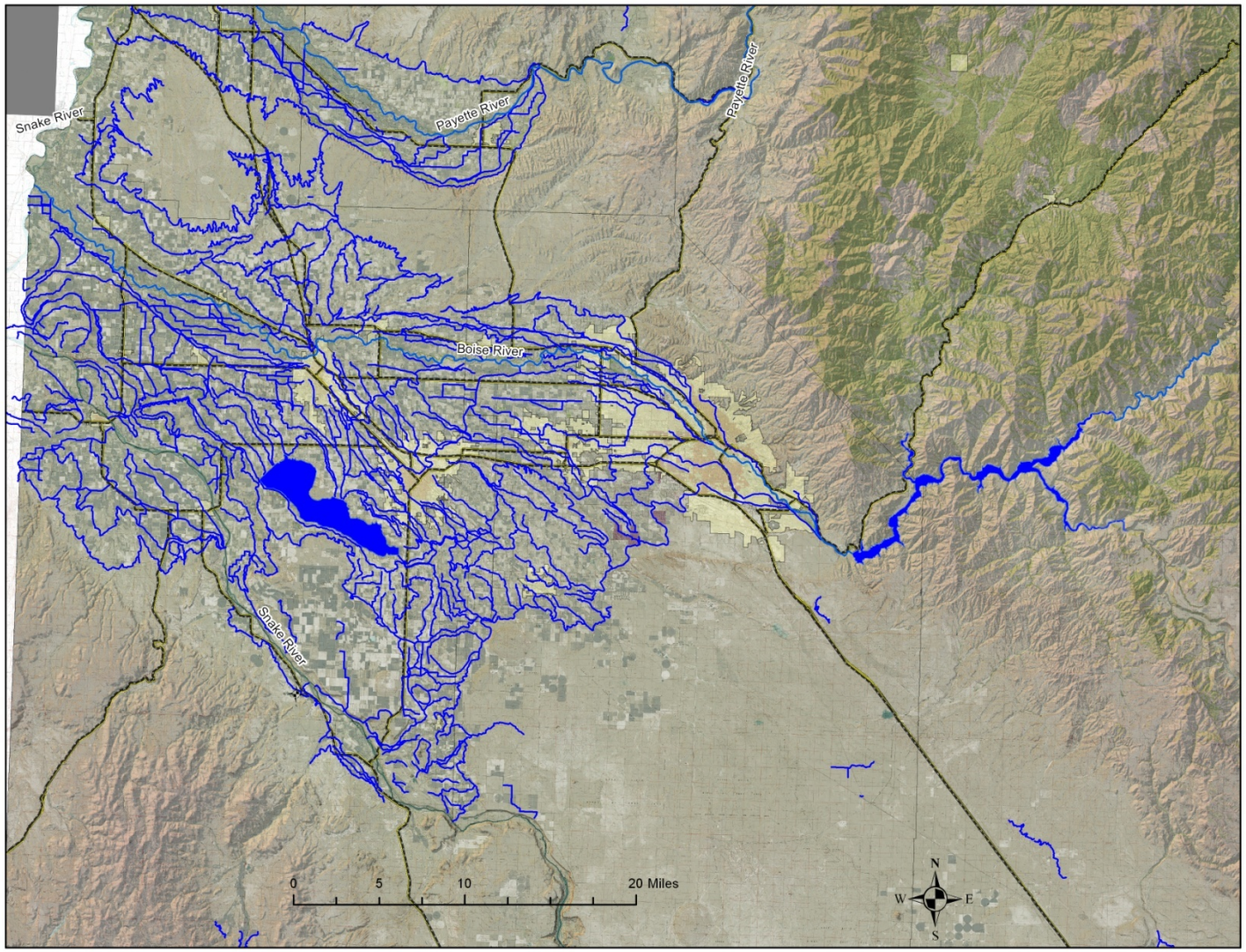


Irrigation Distribution

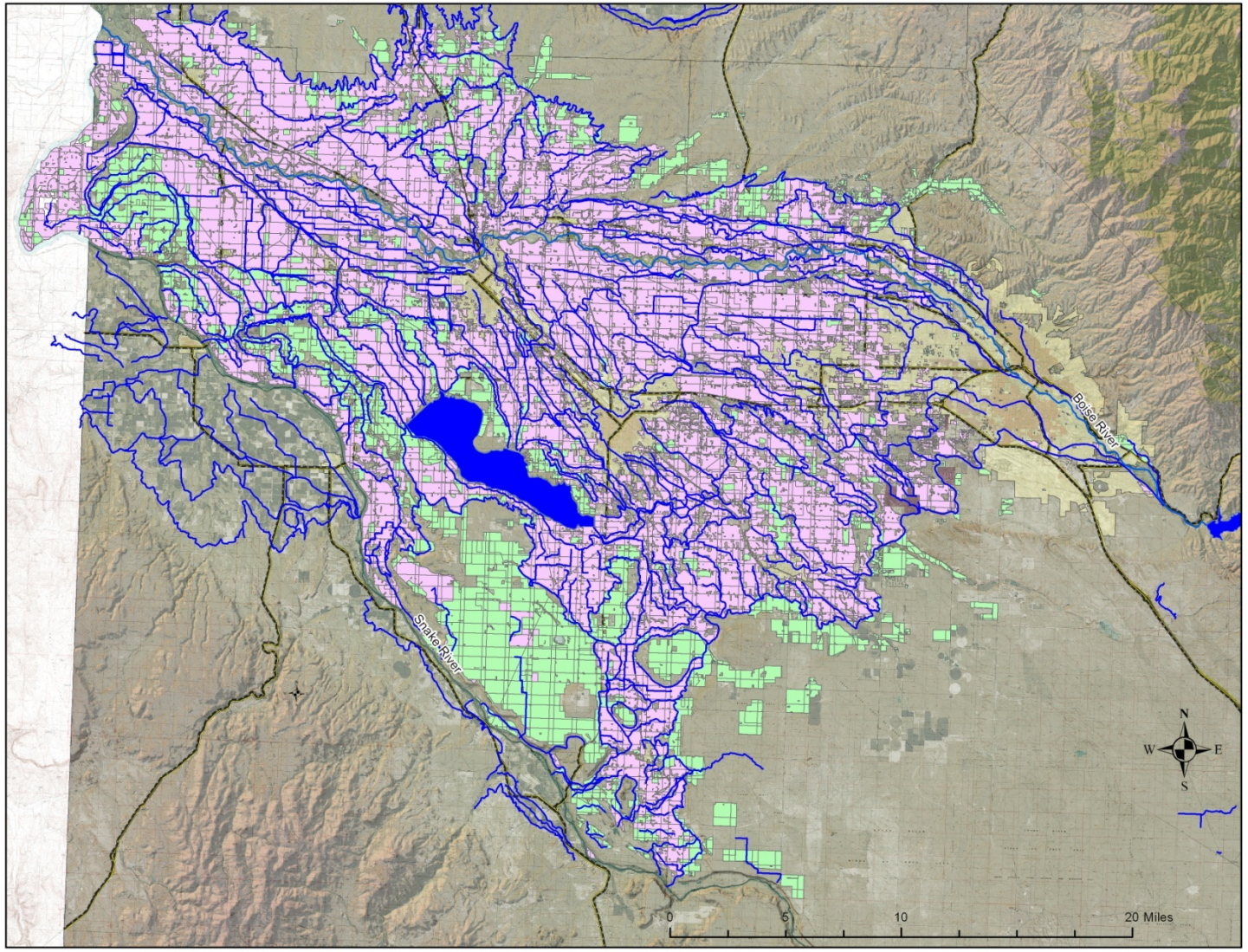
Approximately 1,170 miles of major irrigation canals

Major source of recharge to the aquifer system (loss of 0.75 cfs/mile)

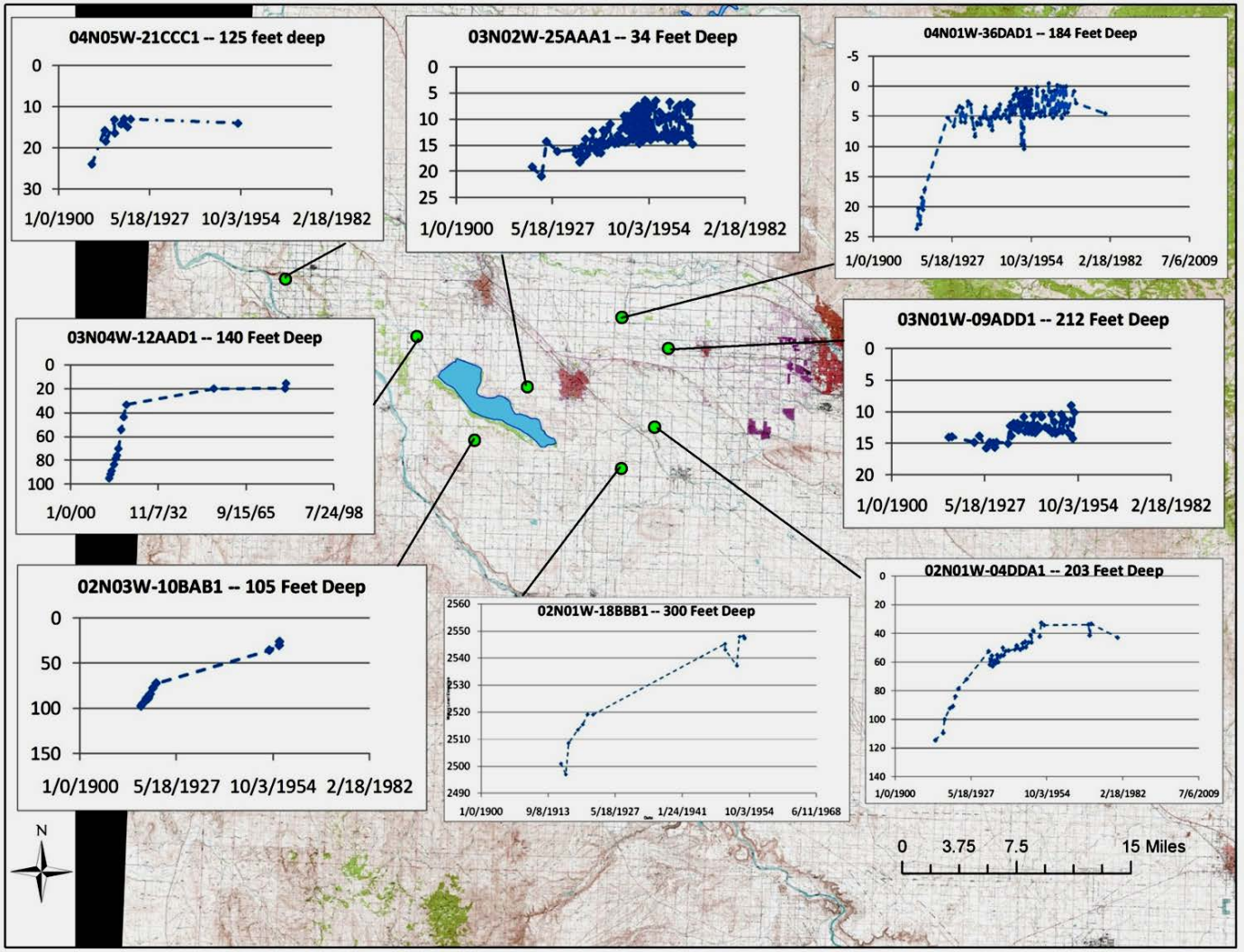
1.7 MAF Diverted Annually



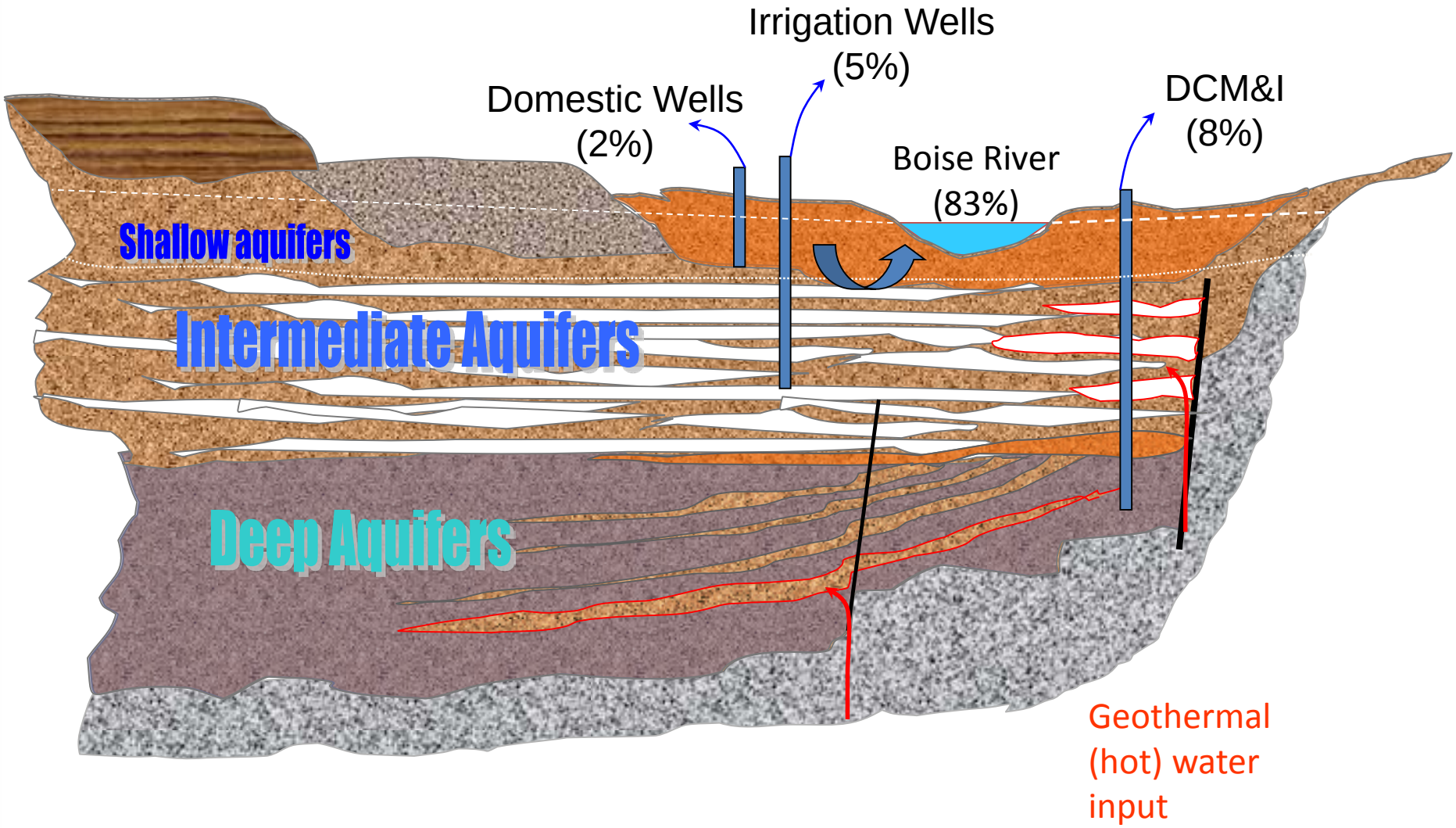
Irrigation Coverage



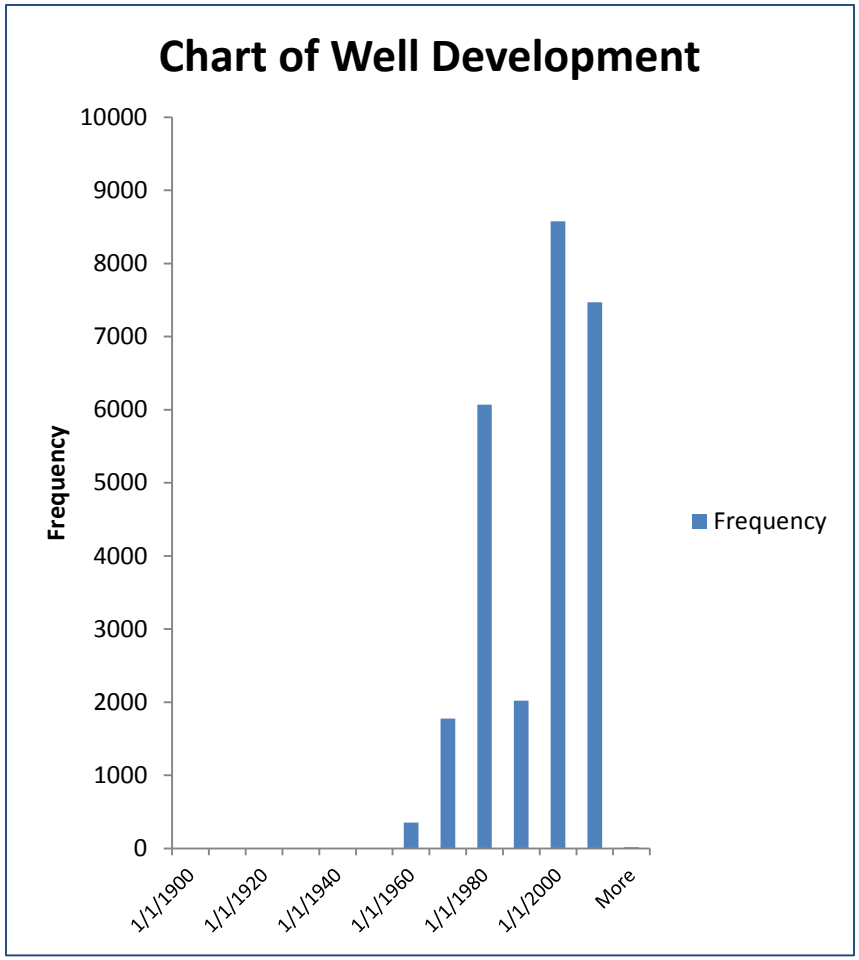
Response to irrigation



Treasure Valley Aquifers



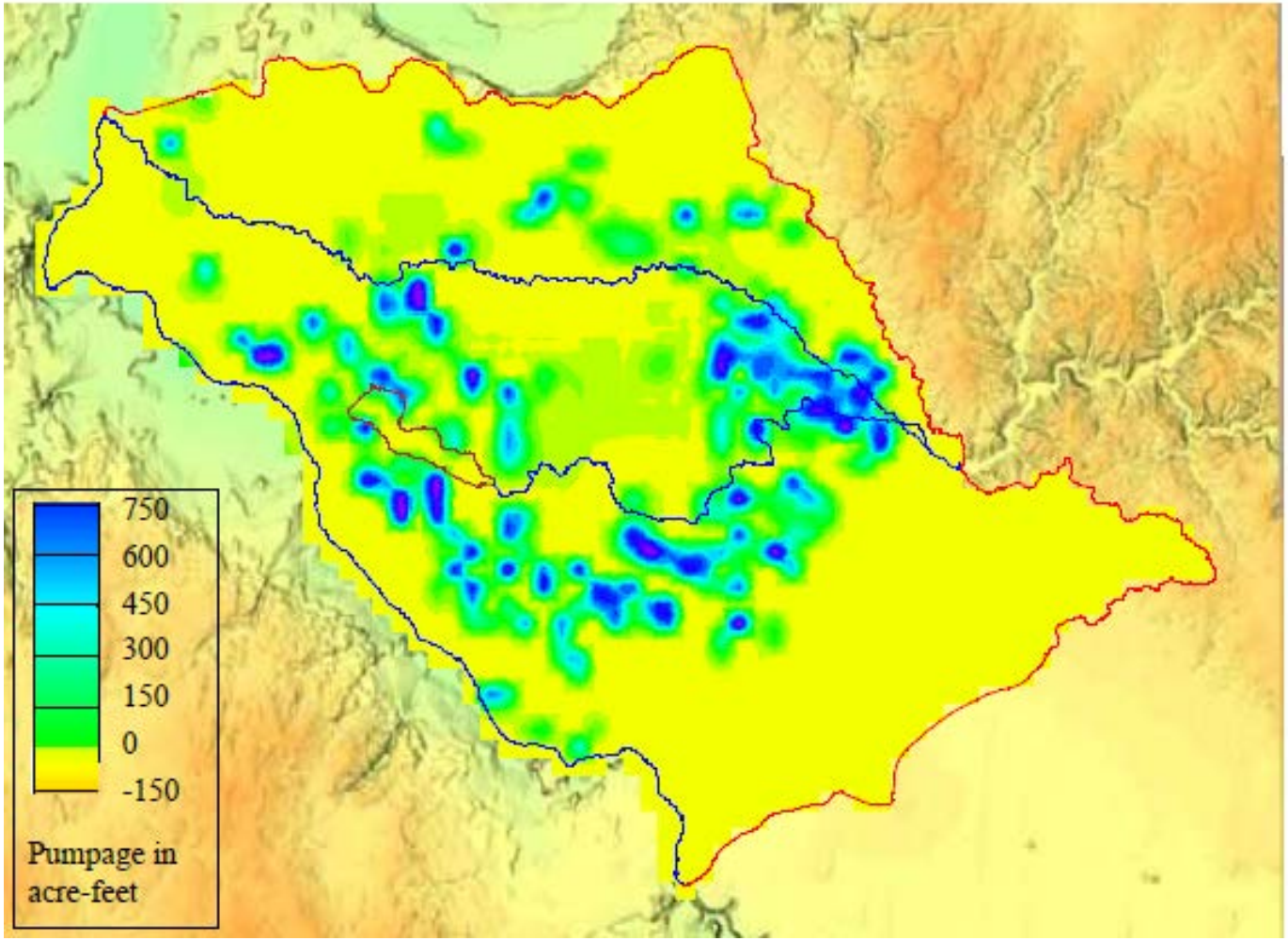
Well Development



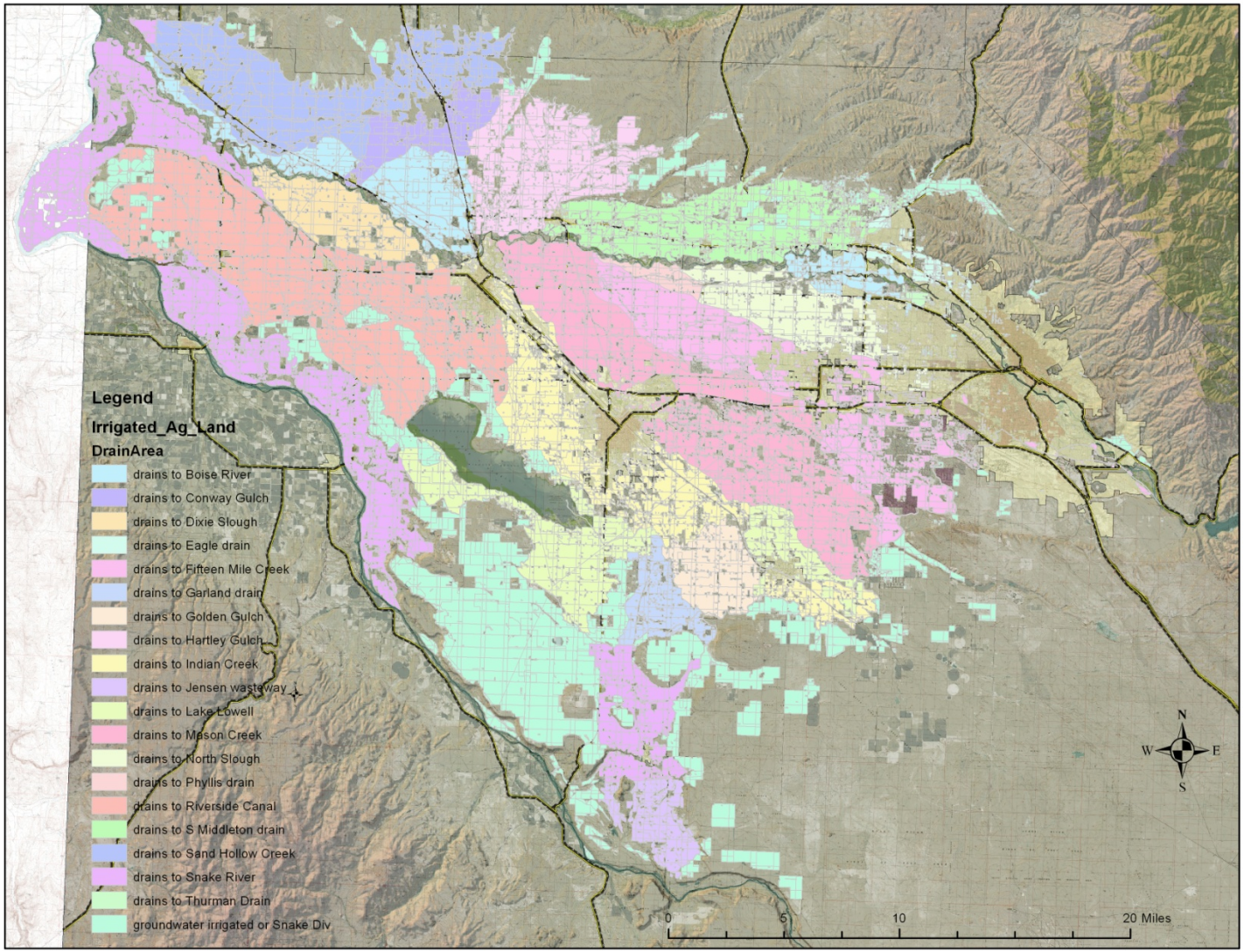
- There are 30,000 wells in the Treasure Valley.
- Unfortunately, well drillers have not always been required to file drilling reports so all of the wells in existence are not on file.
- Well construction standards have changed and improved over the years.

Ground Water Discharge -- Wells

Treasure Valley Pumping Diversions



Ground Water Discharge – Drainage areas

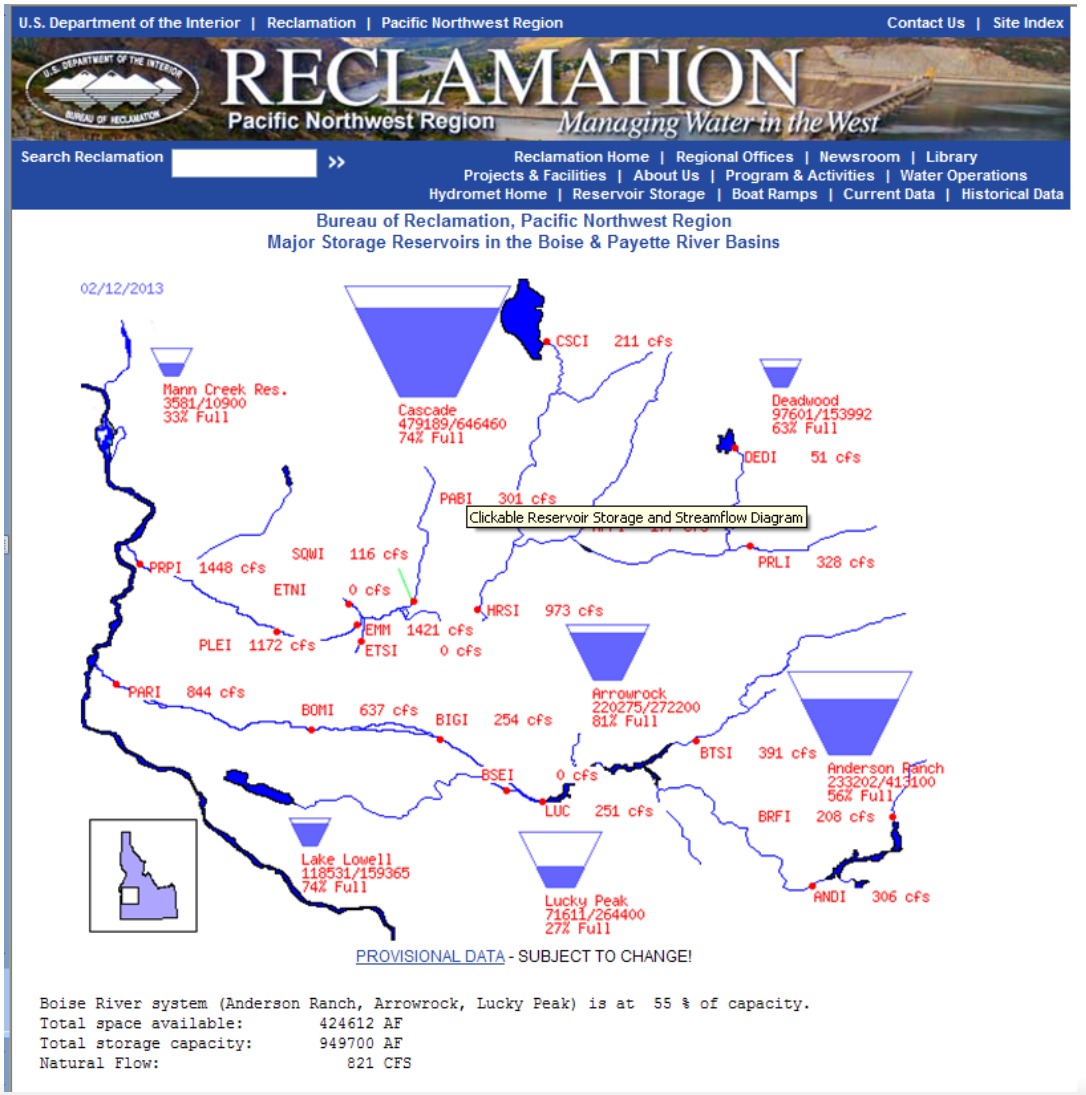


Ground Water Discharge -- Drains

Discharge to the Boise River

- "Teacup" diagram from BOR.
- Notice the river flows increase as you move down-river.
- Winter conditions (no significant precipitation or diversions)
- Data source:

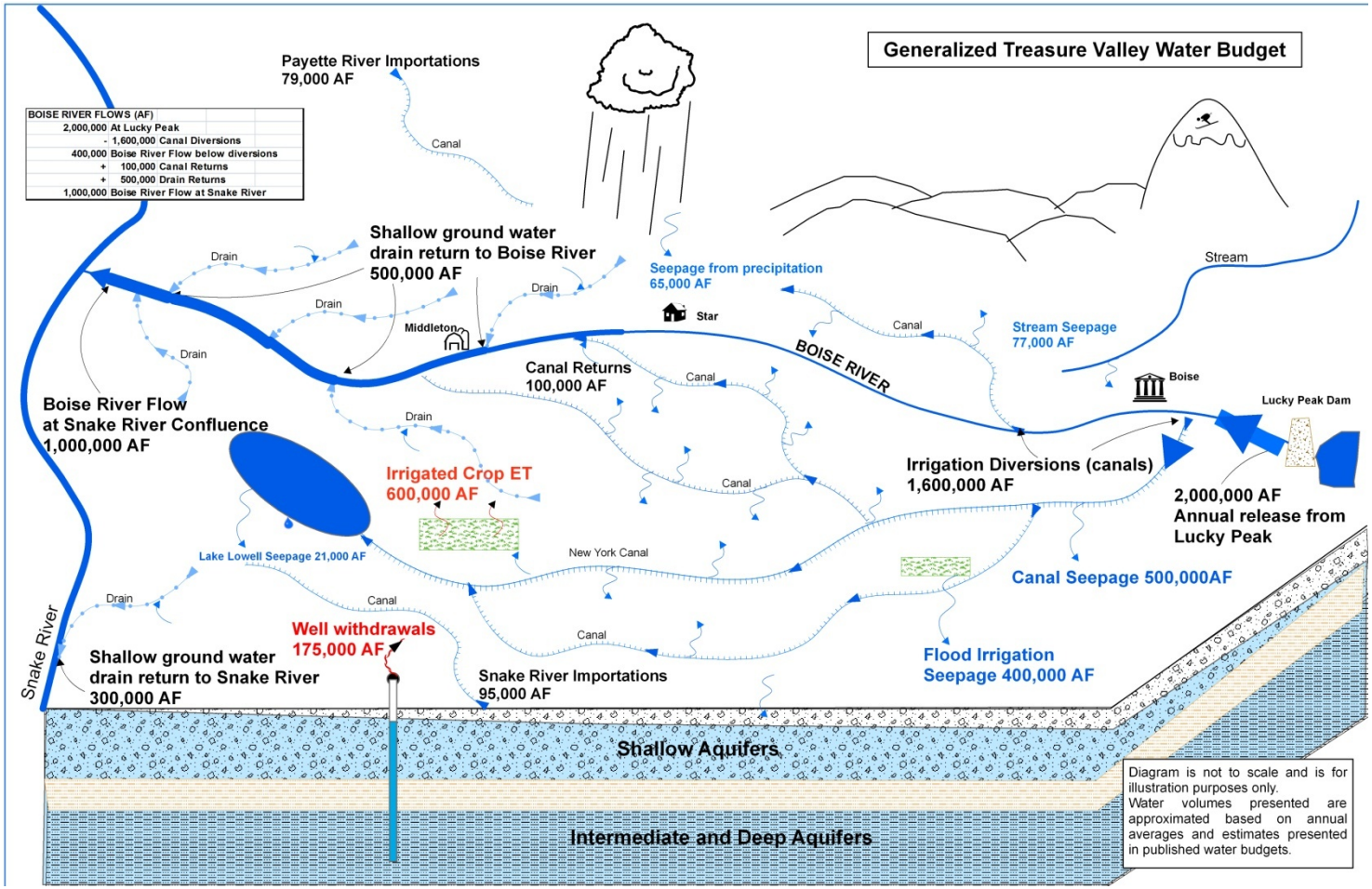
  http://www.usbr.gov/pn/hydromet/boipaytea.html



Ground Water Budget Details

Recharge Sources		**TVHP 1996**	**TVHP 2000**	**BOR 2008**	Averages
Canal Seepage		626,000	521,500	492,284	
Seepage from Rivers and Streams		16,000	77,000	NA	
Seepage from Lake Lowell		19,000	21,200	NA	
Underflow		4,300	4,300	NA	
Flood Irrigation and Precipitation		302,000	404,400	453,868	
Other Uses		48,000	65,700	NA	
Rural Domestic Septic Systems		5,000	4,600	NA	
	Total Inflows	1,020,300	1,098,700	997,657	**1,038,886**
Discharge Sources					
Domestic and Industrial Pumping		66,000	76,800	NA	
Municipal Irrigation		10,000	10,000	NA	
Self-Supplied Industrial		21,000	8,200	NA	
Agricultural Irrigation		72,000	53,000	128,962	
Rural Domestic Pumping		27,000	24,000	NA	
Stock Water Pumping		3,000	3,000	NA	
	Total Pumping	199,000	175,000	128,962	167,654
Discharge to Snake River		276,800	352,600	362,023	
Discharge to Boise River		523,200	529,000	489,105	
	Total Discharge to Rivers	800,000	881,600	851,128	844,243
	Total Outflows	999,000	1,056,600	980,090	**1,011,897**
	Net Difference	21,300	42,100	17,567	26,989

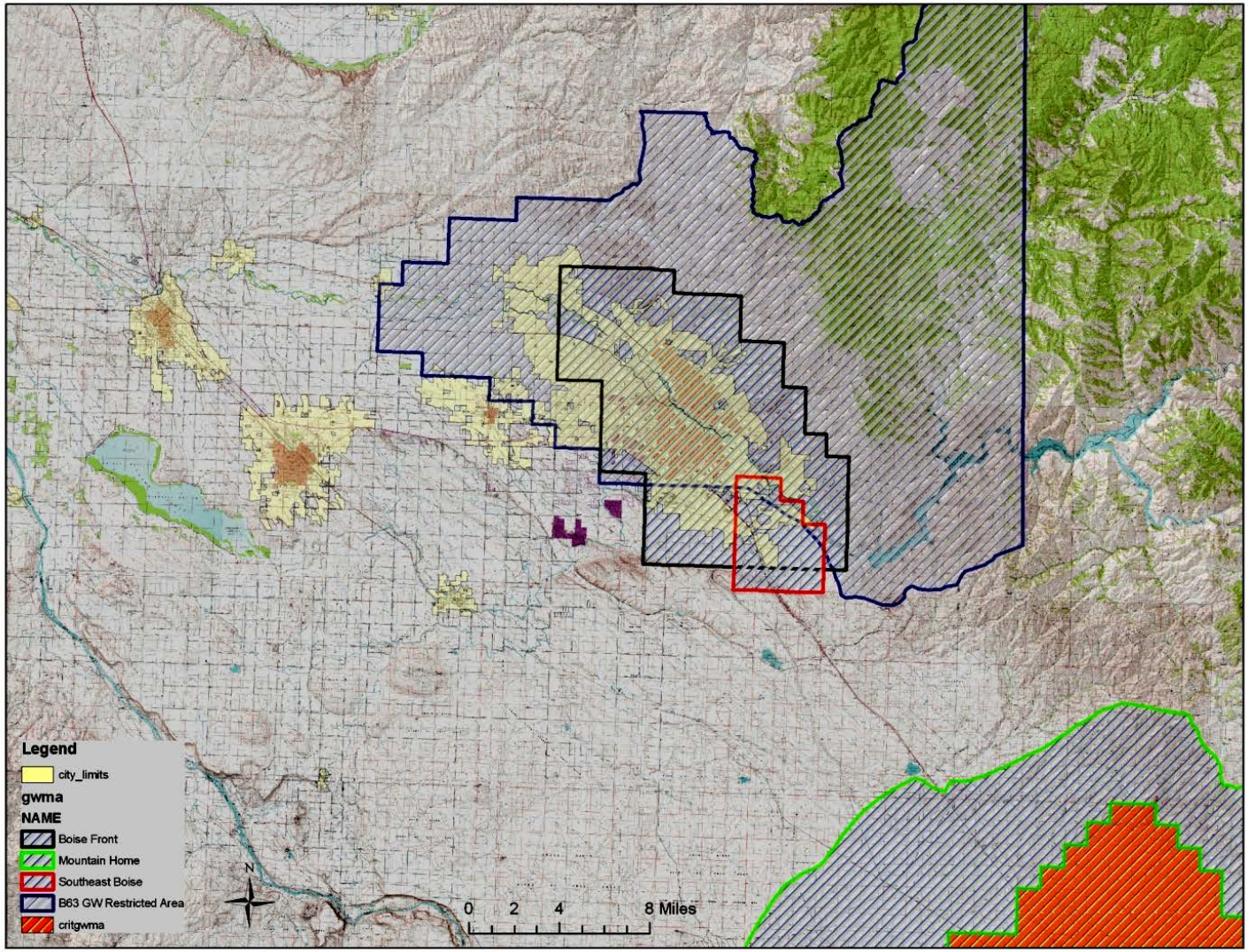
Ground Water Budget Summary



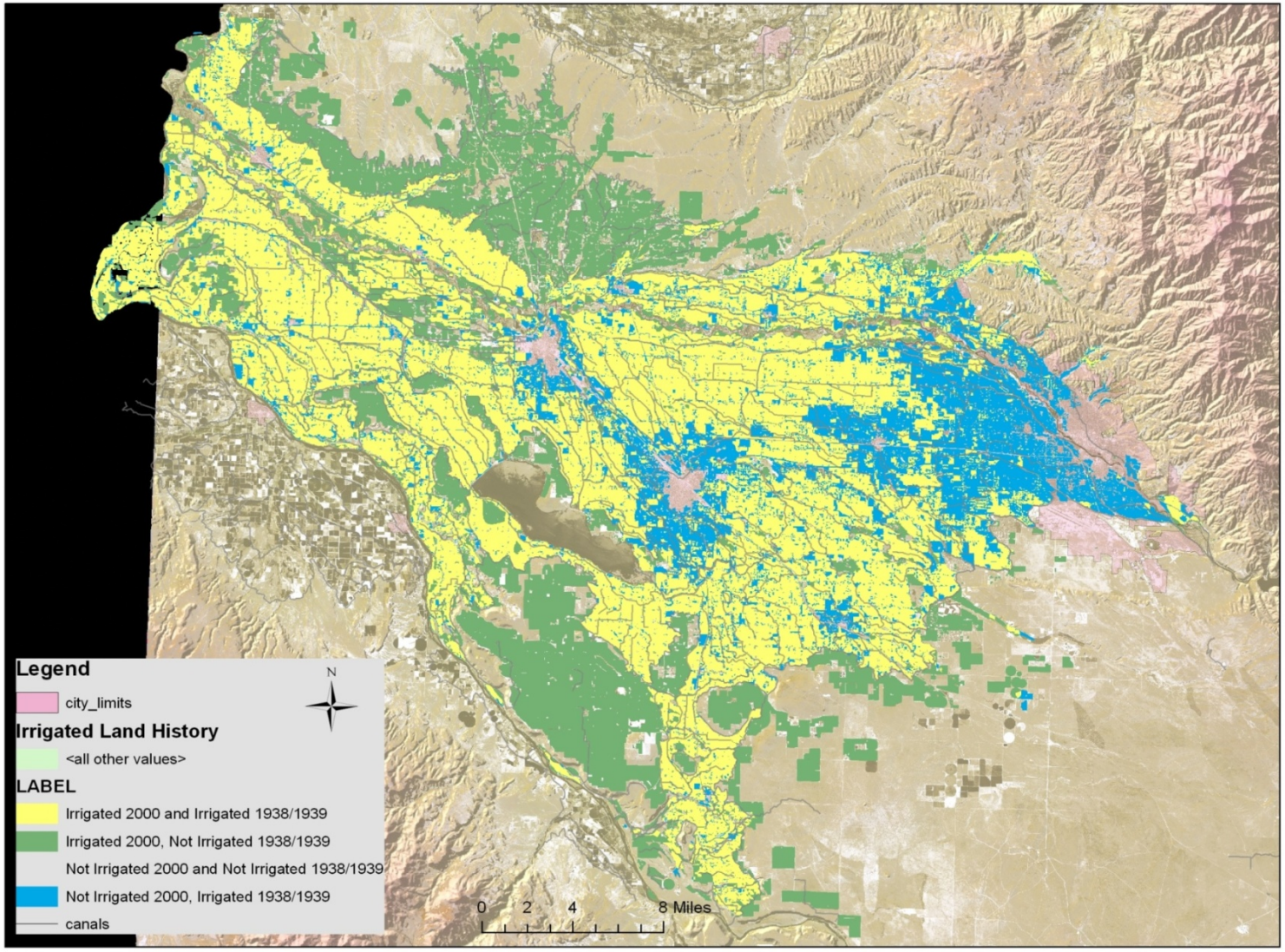
Current Status of Aquifer System

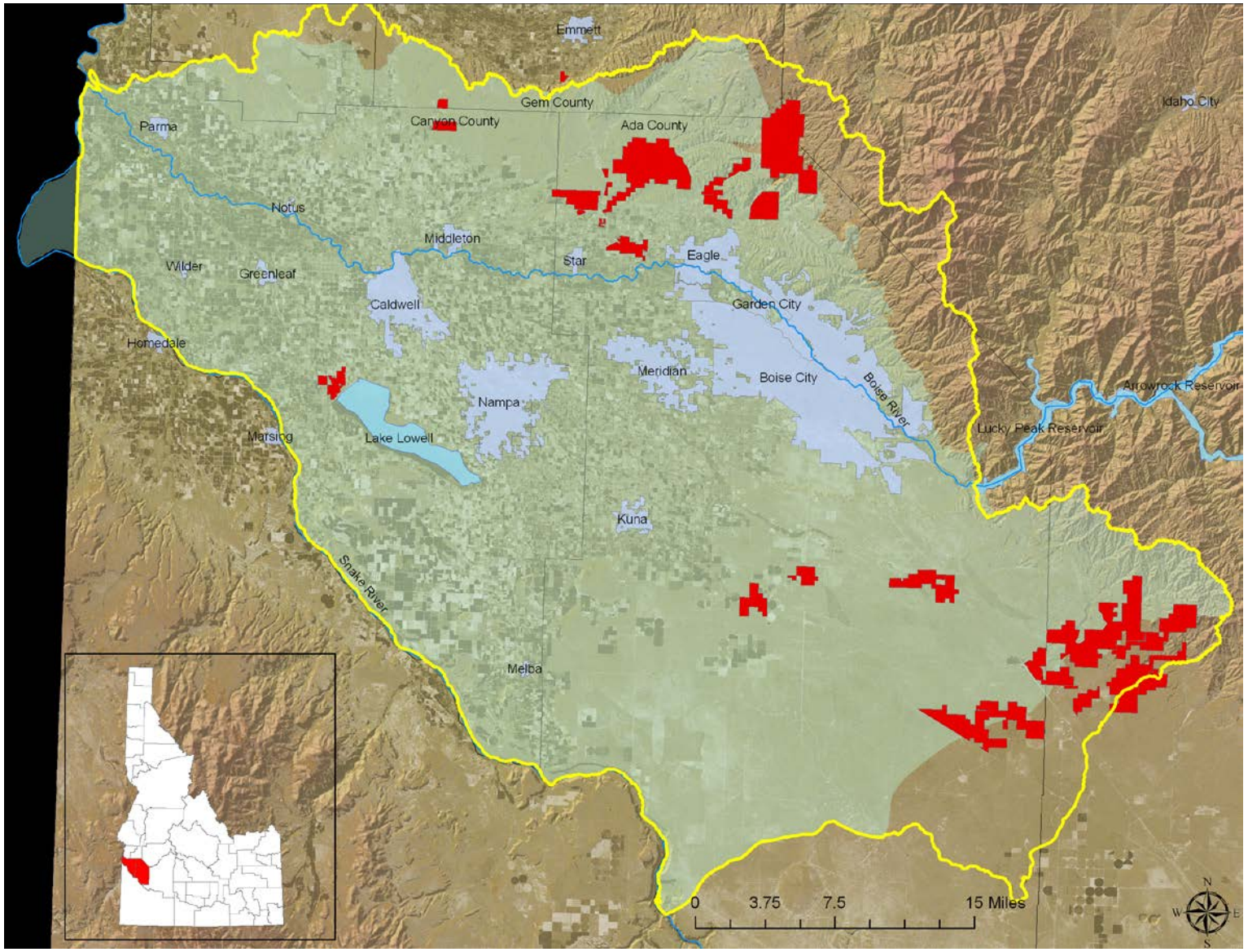
- Management Areas
- Residential Development
  - Changes in land use
  - Planned changes in land use

Management Areas



Changes in Irrigation…..

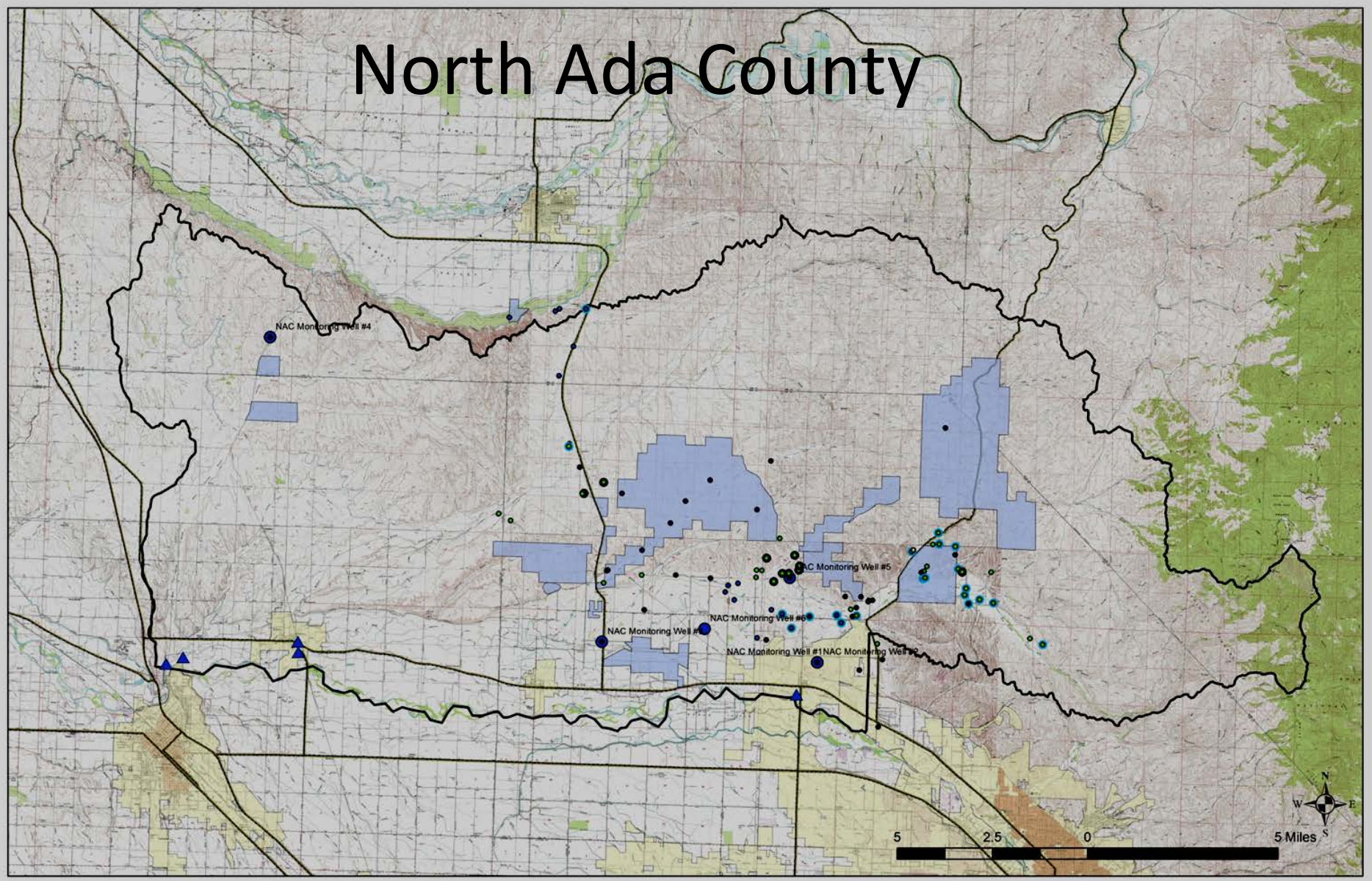



Emmett
Gem County
Canyon County
Ada County
Idaho City
Parma
Notus
Middleton
Star
Eagle
Wilder
Greenleaf
Caldwell
Garden City
Homedale
Meridian
Boise City
Boise River
Arrowrock Reservoir
Nampa
Lucky Peak Reservoir
Marsing
Lake Lowell
Kuna
Snake River
Melba
0
3.75
7.5
15 Miles
N
W
E
S

Current Investigations

- North Ada County
- East Ada County
- Revised Treasure Valley Ground Water Model

North Ada County



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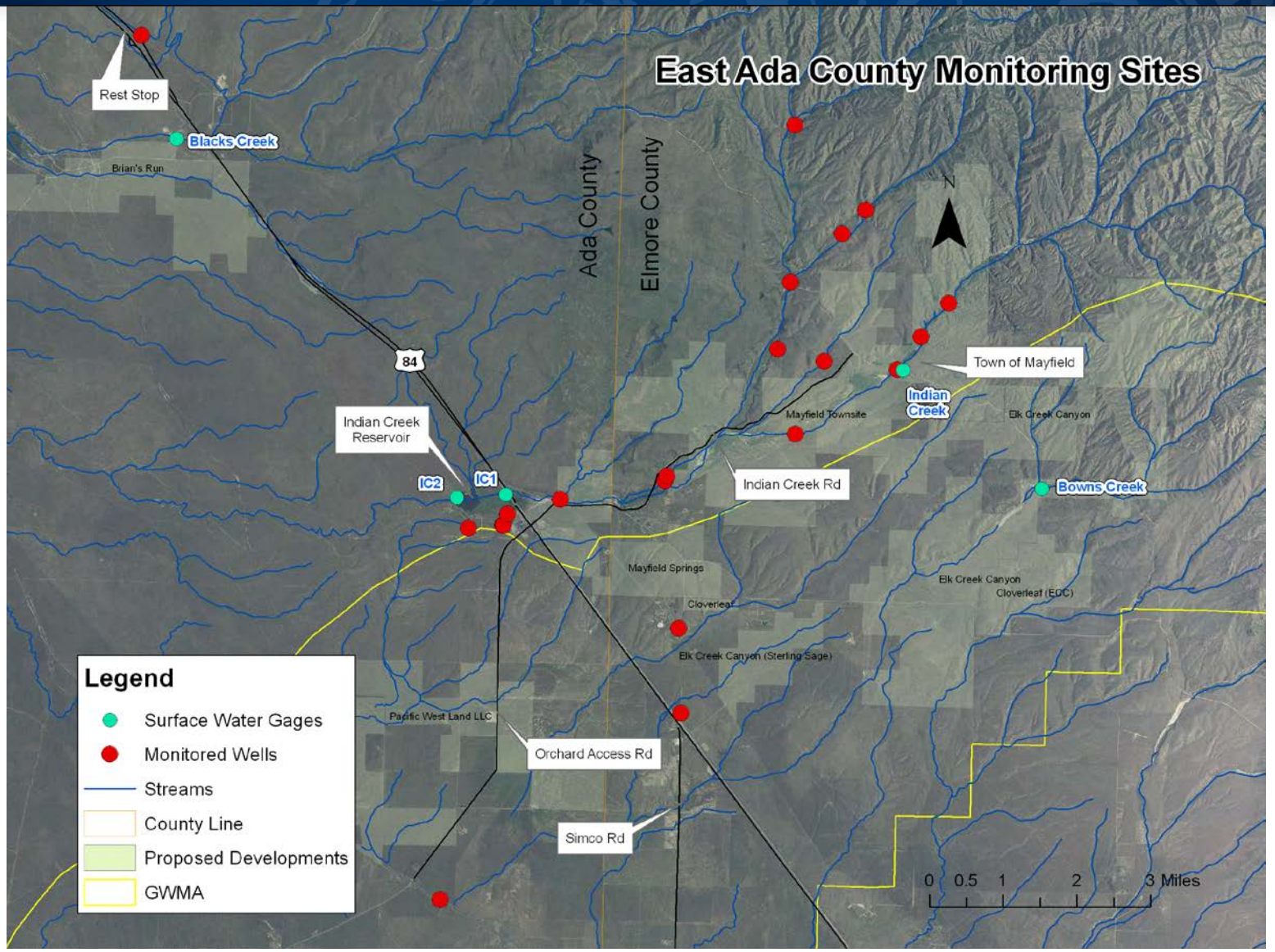
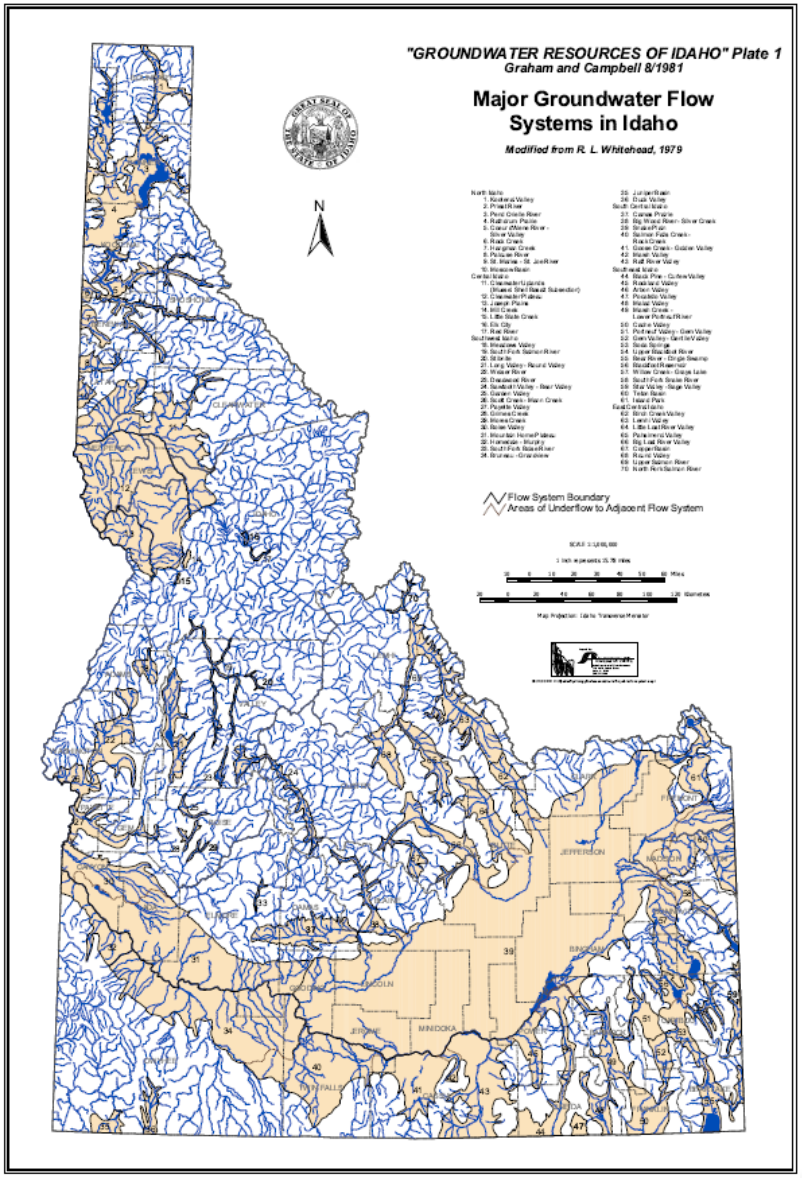
Water Resource Board



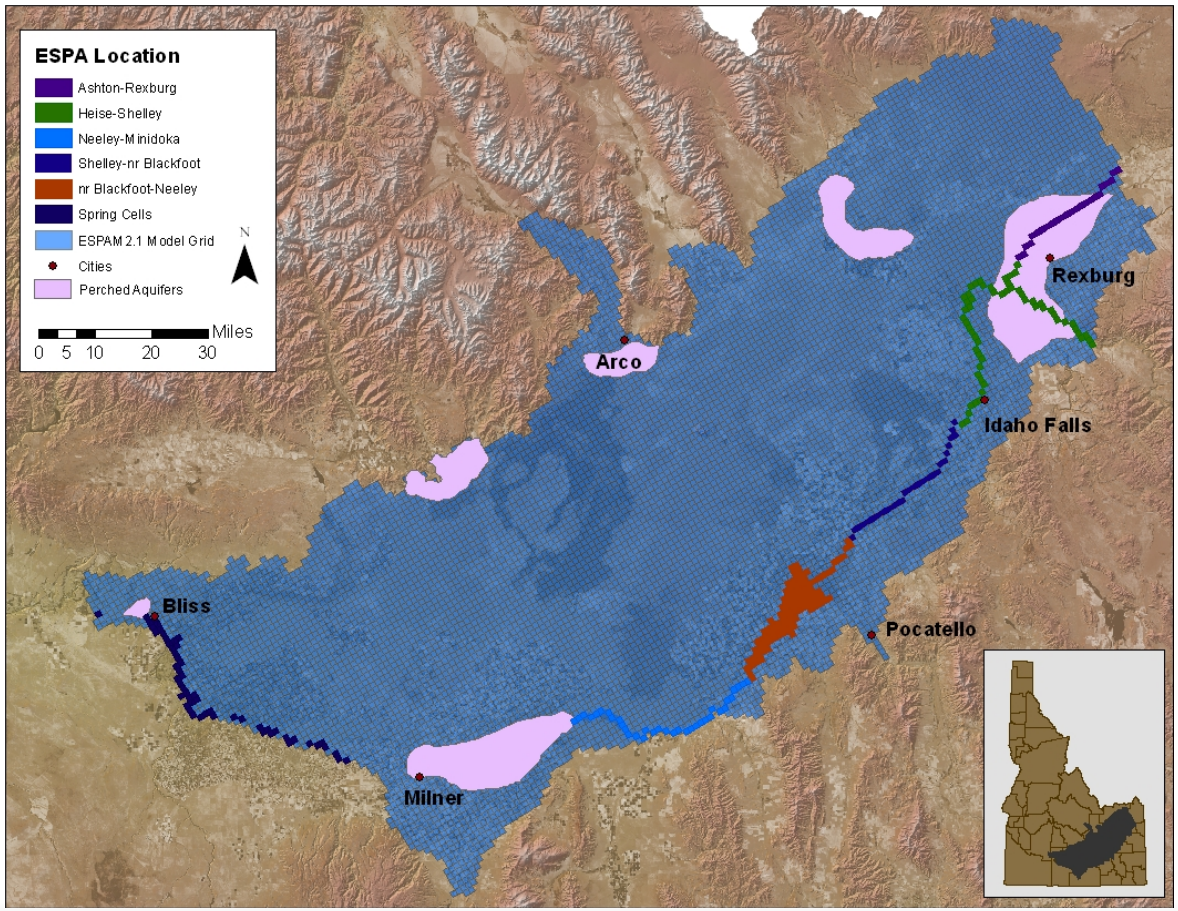


Idaho Aquifers

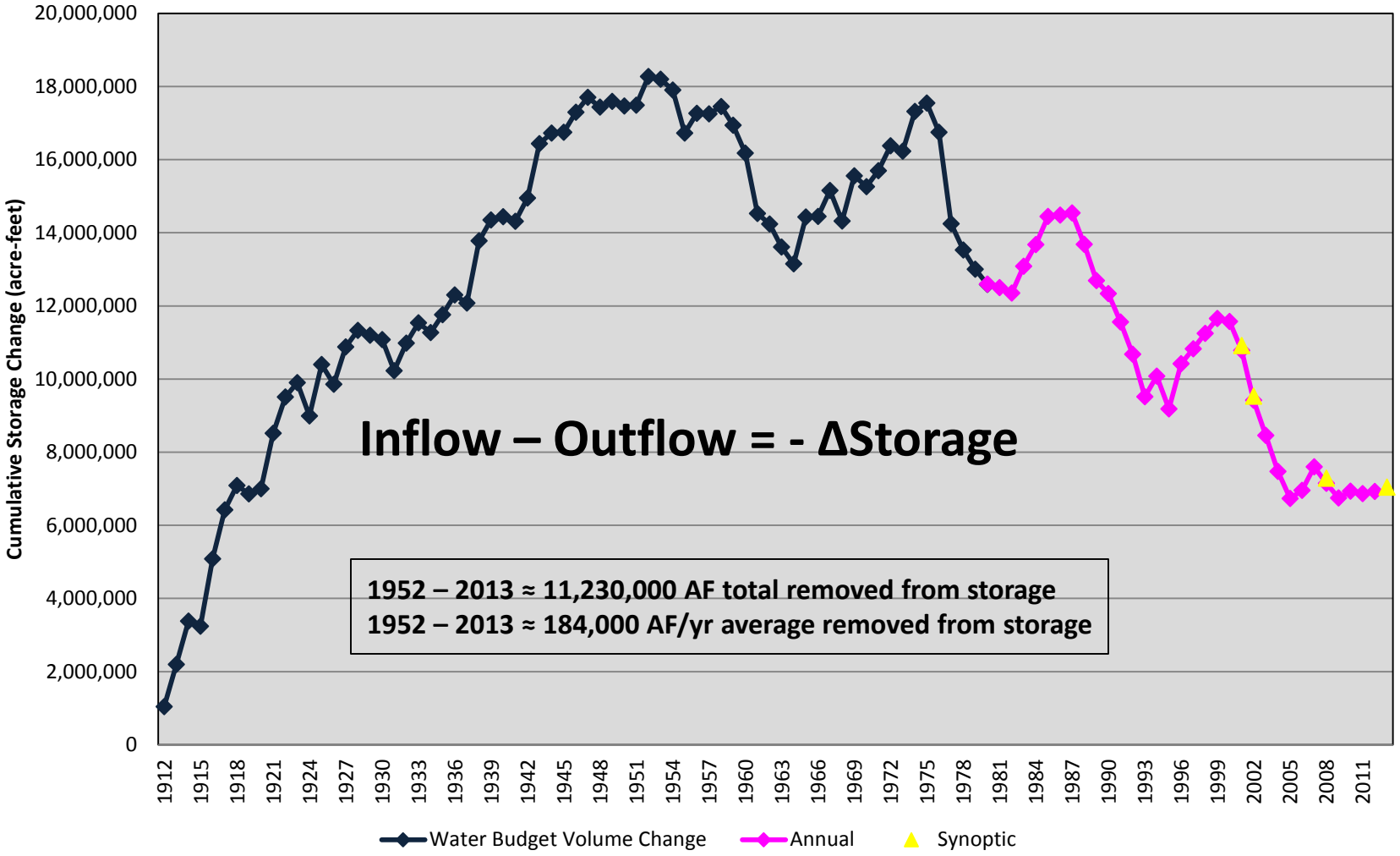
- ESPA
- Rathdrum Prairie
- Moscow
- Tributary Basins
- Management Areas

Eastern Snake Plain Aquifer:

- Aquifer composed primarily of basalt.
- Aquifer is generally unconfined with local confined conditions.
- Some locally perched areas.
- Depth to water ranges from a few feet in places near the river to over 900 feet in the center of the plain.
- Recharge due primarily to irrigation and stream seepage, tributary underflow, and precipitation.
- Water moves very easily (fast) through this aquifer
- Largest aquifer in Idaho.
- Very important to Idaho.

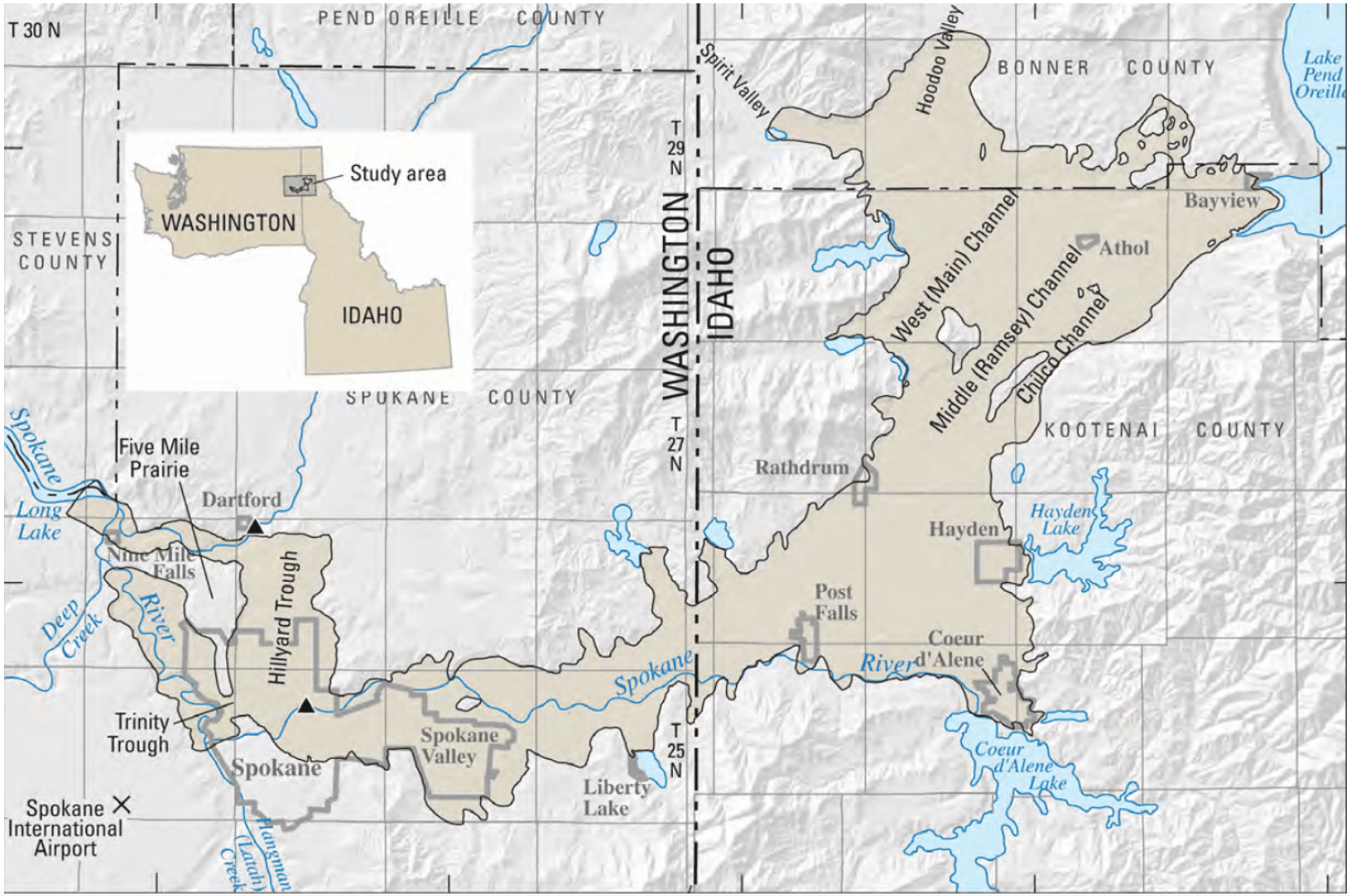


Cumulative Volume Change of Water Stored Within ESPA – ESPAM2.1



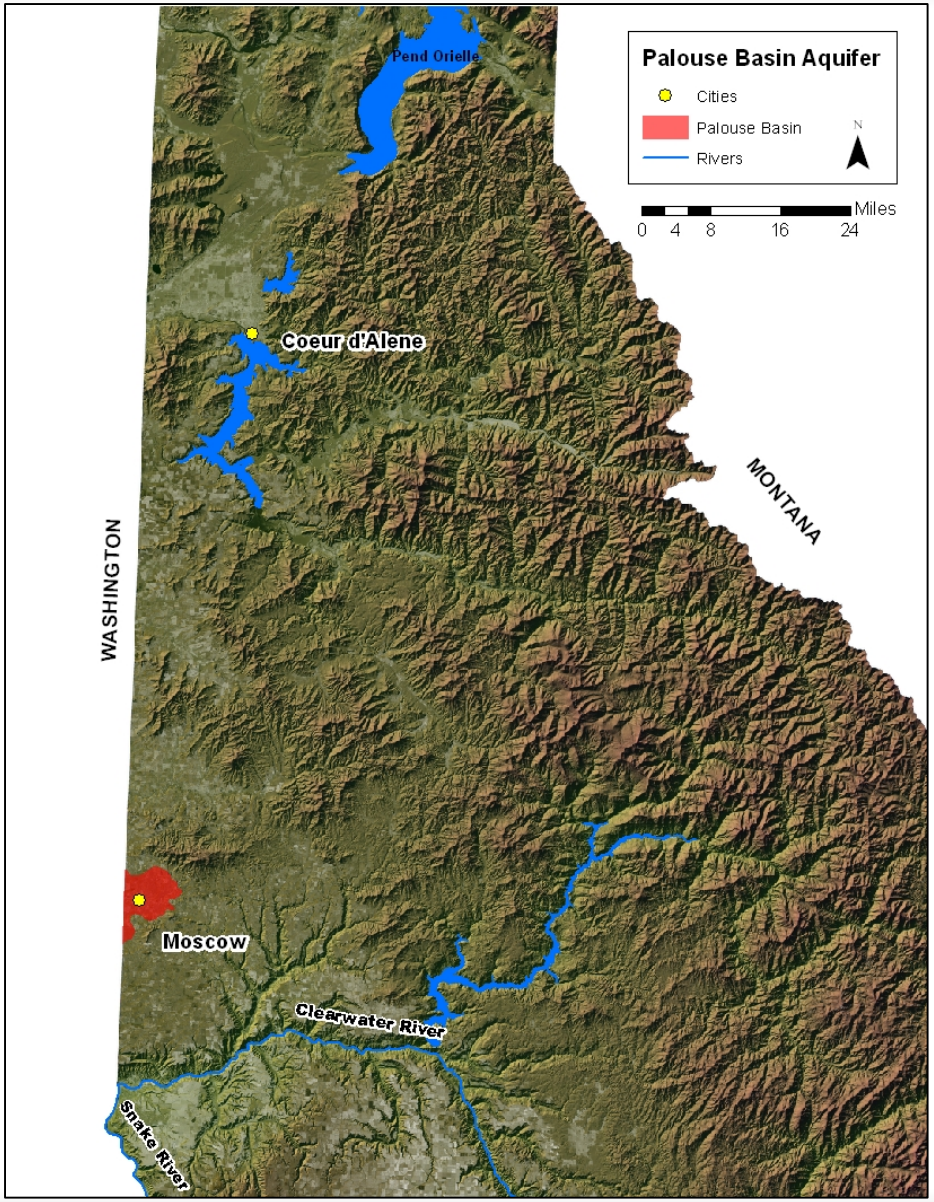
Rathdrum Prairie Aquifer:

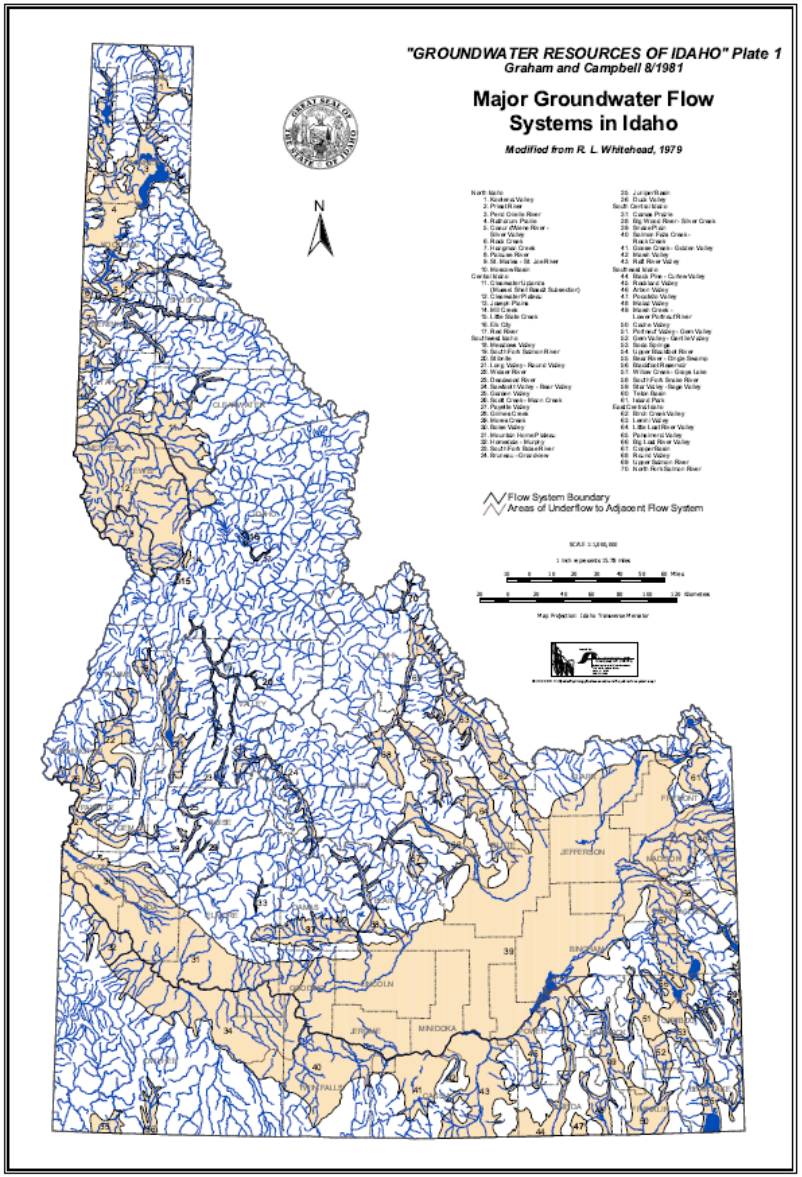
- Aquifer extends across Idaho and Washington.



Palouse Basin Aquifer:

- Generally made up of two aquifers:
  - Upper unconfined: located in surface sediments (limited extent, only minor stock water uses), and in shallow basalts (Wanapum) and interbeds to approx. 500 feet. Some domestic and municipal development.
  - Lower confined: located in deeper basalts (Grande Ronde) to approx 1,000 ft. Accounts for 95% of municipal and university supply.
- Limited recharge from precipitation and stream leakage.





Idaho Aquifers

- Tributary Basins

Thank you. Any Questions?

dennis.owsley@idwr.idaho.gov

http://www.idwr.idaho.gov/