IDAHO Department of Water Resources

Hagerman Valley Geology

A Focus on:

The Effect of Large-scale Heterogeneities and Geologic Structures on Spring Spatial Distribution

By: Neal Farmer
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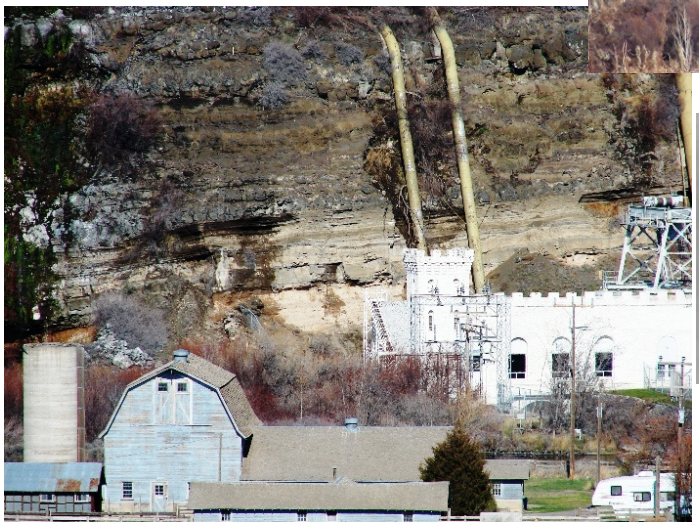


Maley, 2005

Southern Idaho Volcanic Fields

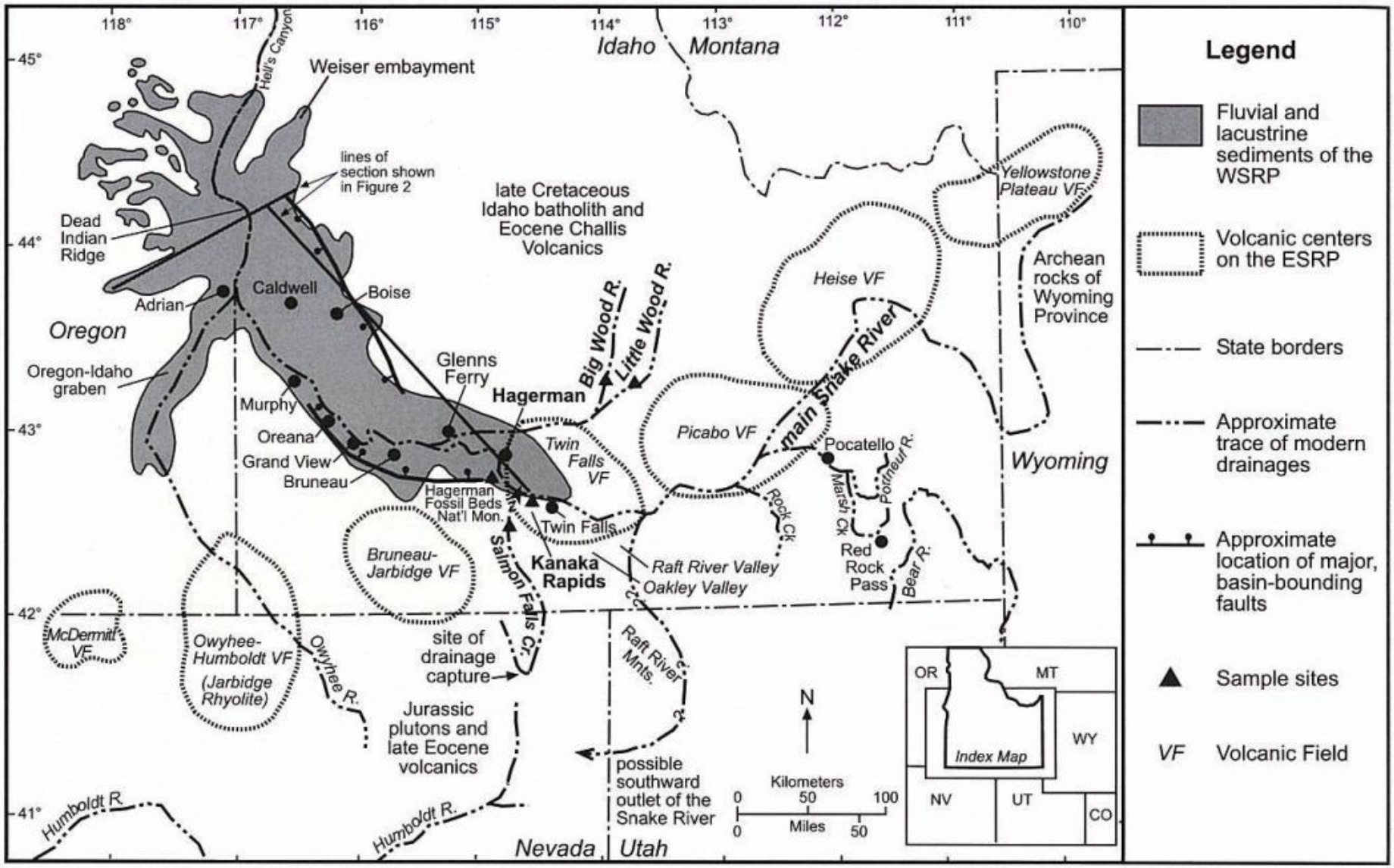


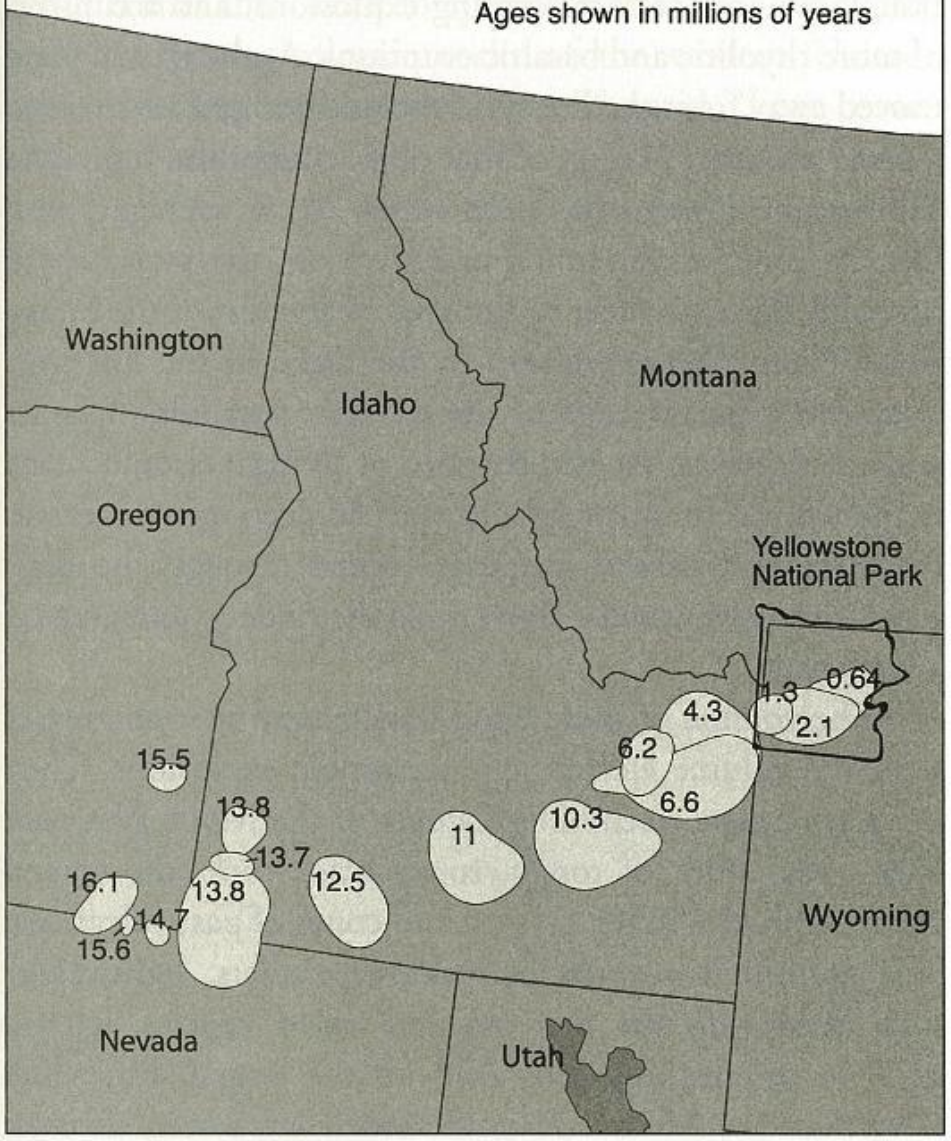
Figure 1. Location map for Snake River Plain (SRP) region showing localities mentioned in the text (modified from Middleton and others, 1985; Pierce and Morgan, 1992; Sadler and Link, 1996). Neogene volcanic fields are shown, as well as approximate fault boundaries of western SRP and extents of Lake Idaho. Stratigraphic cross section lines of Figure 2 are shown.

Source: Idaho Geological Survey – Tectonic and Magmatic Evolution of the Snake River Plain Volcanic Province by Bonnichsen et. al. 2002

Source: Super Volcano by Greg Breining 2007.

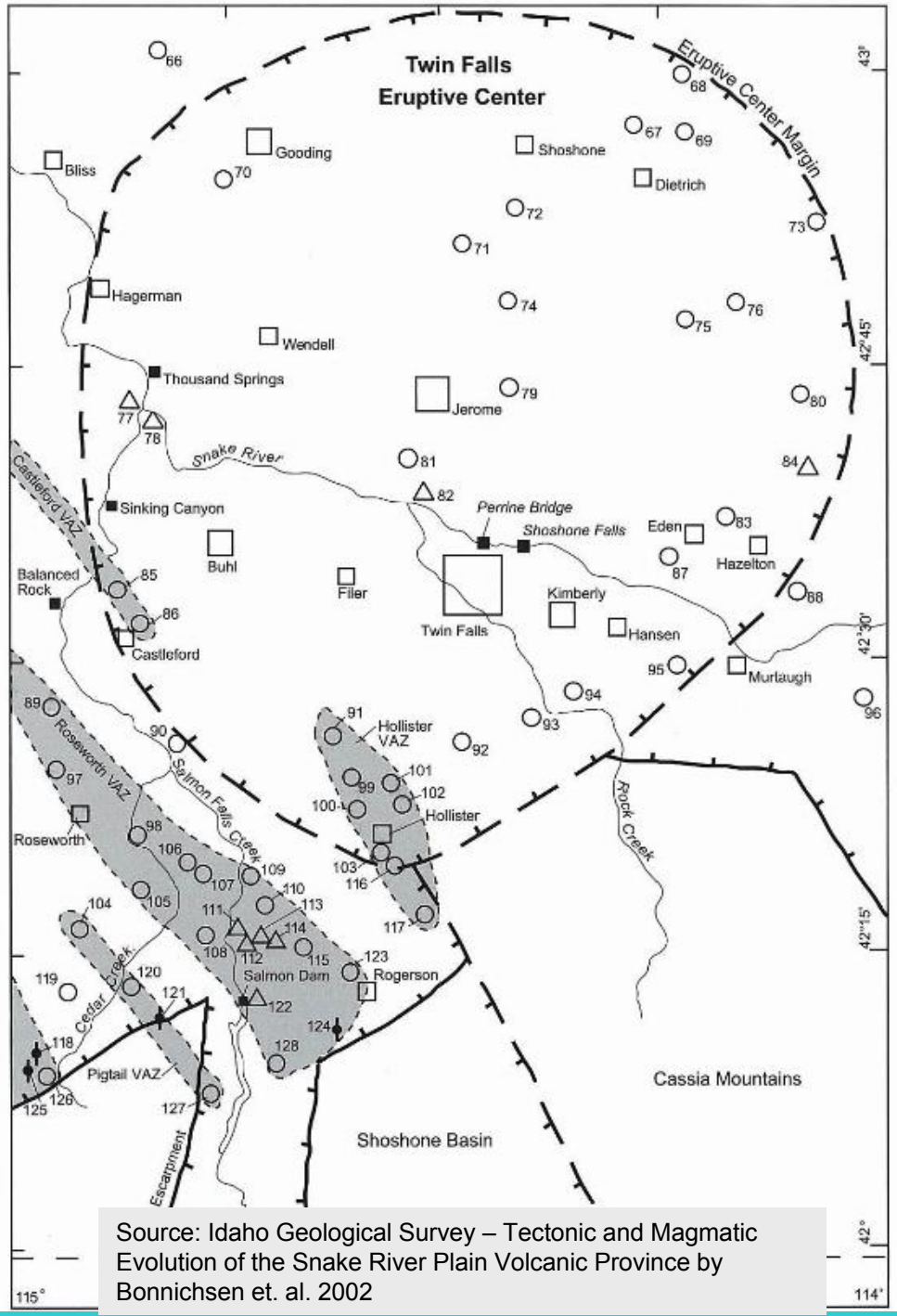
Volcanic Fields of the Yellowstone Hot Spot Track

Ages shown in millions of years

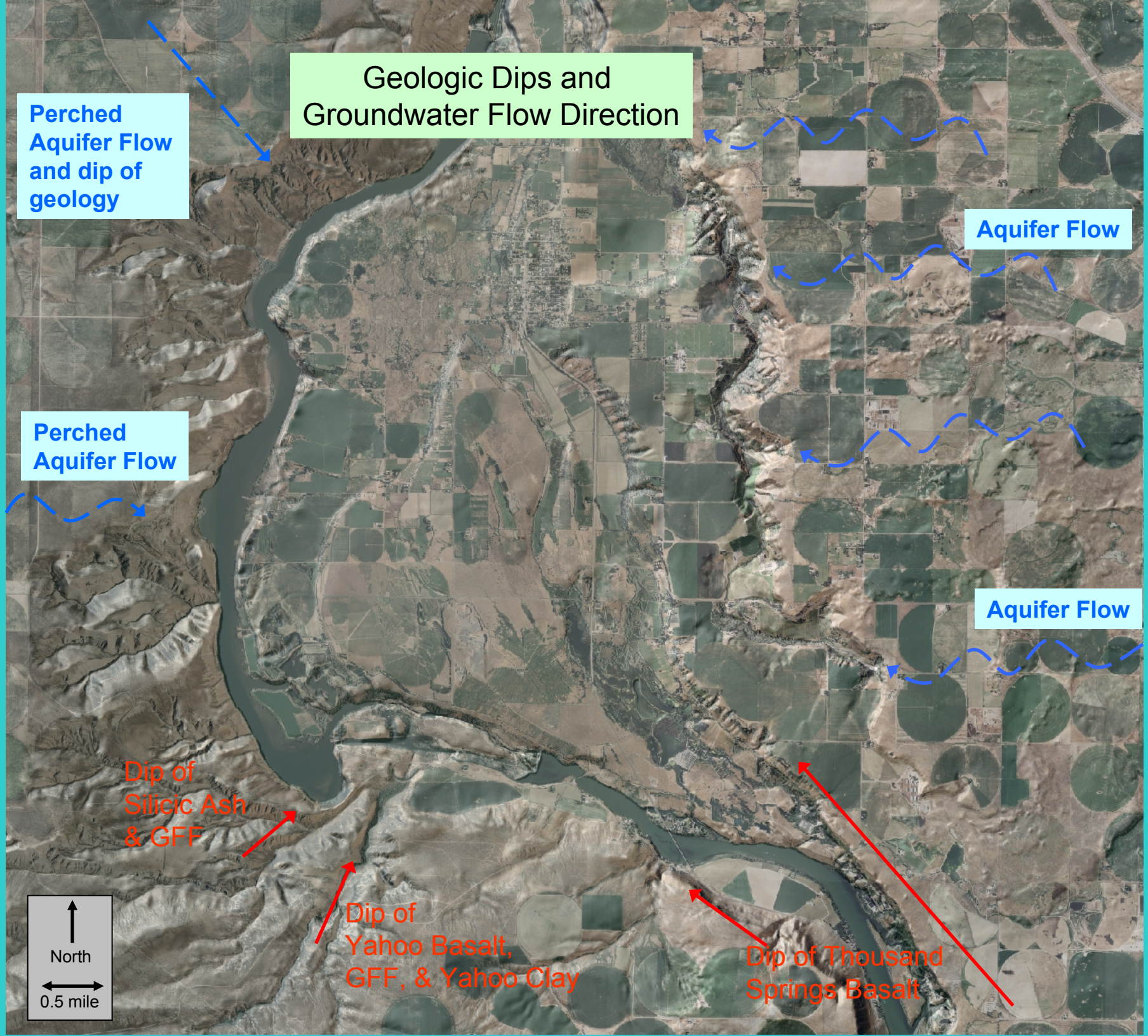


For nearly 17 million years, as the North American Plate has moved slowly southwestward over the Yellowstone hot spot, the rising plume of magma has triggered a series of at least 142 caldera-forming eruptions across southern Oregon, northern Nevada, southern Idaho, and western Wyoming. The major volcanic fields, some containing many calderas, are depicted here.

Twin Falls Eruption Center

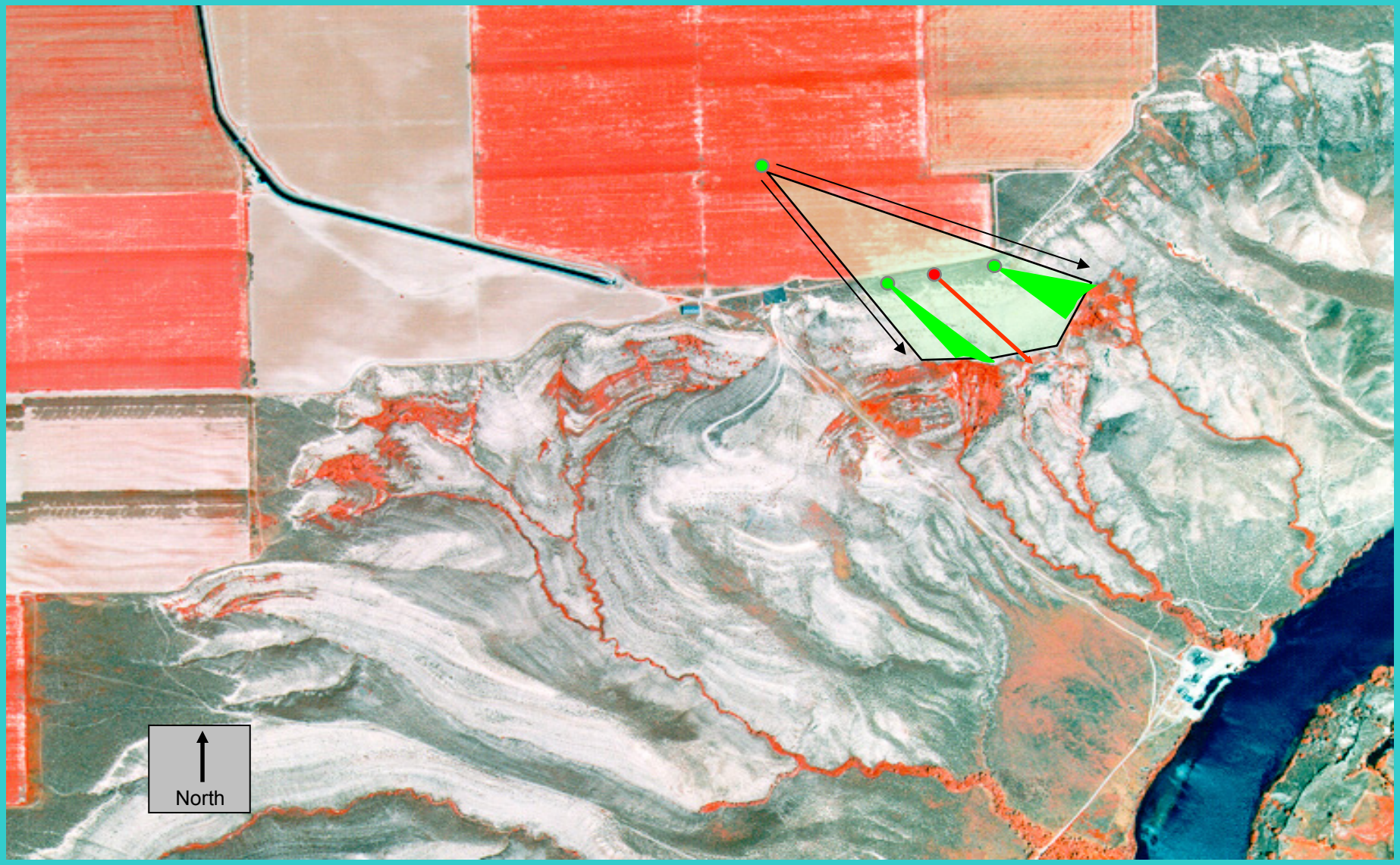


Source: Idaho Geological Survey – Tectonic and Magmatic Evolution of the Snake River Plain Volcanic Province by Bonnichsen et. al. 2002

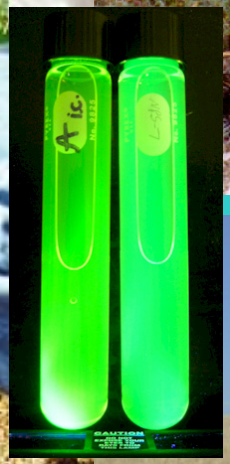

Geologic Dips and
Groundwater Flow Direction
Perched
Aquifer Flow
and dip of
geology
Aquifer Flow
Perched
Aquifer Flow
Aquifer Flow
Dip of
Silicic Ash
& GFF
Dip of
Yahoo Basalt,
GFF, & Yahoo Clay
Dip of Thousand
Springs Basalt
North
0.5 mile

Flourescent dye groundwater tracer tests document direction of groundwater flow is to southeast at up to 250 feet per day in Tertiary age ‘brown’ basalt, sometimes thought to have low permeability.

Surveyed geologic outcrops and well logs in this area support a southeast dipping architecture with in the lake sediments.



Fluorescent Dye Groundwater Tracer Tests Confirm Groundwater Flow

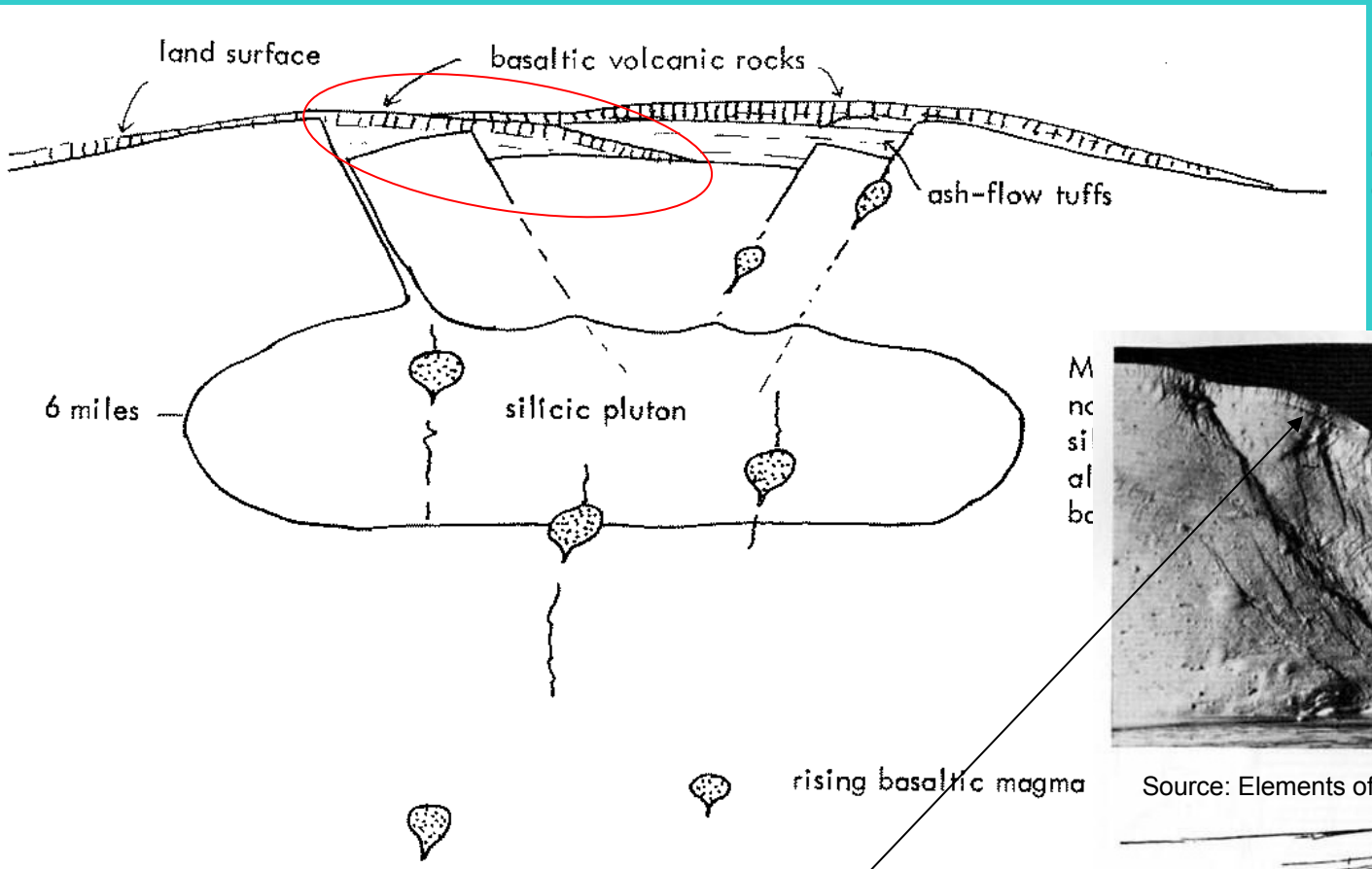


Northerly Dipping Ash Interbedded within Glenns Ferry Fm. Lake Sediments

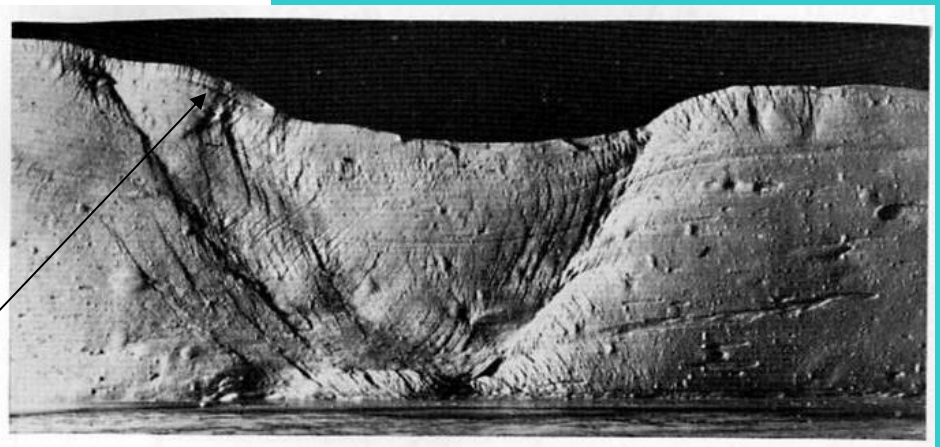
(view azimuth is west)

Idealized Caldera Collapse Structure as a Possible Model

(from Terry Maley 'Exploring Idaho Geology', 1987)



Geologic outcrops located in the south side of the Hagerman Valley indicate a structural downwarping.



Source: Elements of Structural Geology by E. Sherbon Hills, 1972, 502 p.

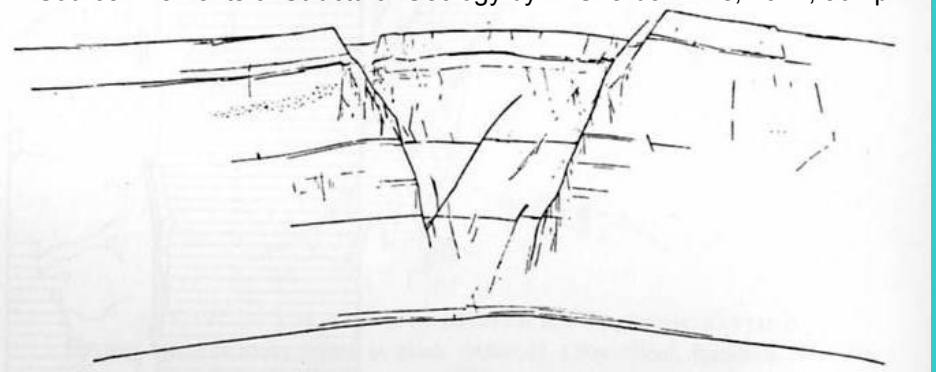


FIG. VII–28. EXPERIMENTAL GRABENS

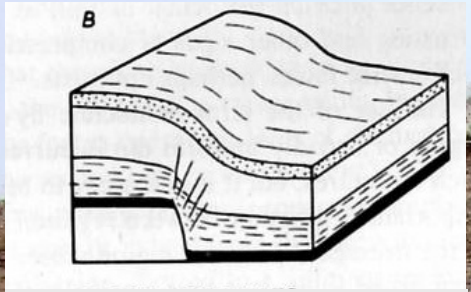
A. Produced in a cake of clay subjected to tension.

B. Produced in a cake of clay arched over a balloon. (*After H. Cloos*)

North Dipping Yahoo Clay Fm. on top of North Dipping Monocline of the Glenns Ferry Fm.

(view azimuth is east and location is Yahoo Creek)

- What "**Stage**" is missing from the diagram sequence below relevant to the outcrop?



(Source: Elements of Structural Geology by E. Sherbon Hills, 1972, 502 p.)

Animation

Yahoo Clay Fm. (YCF)

Glenns Ferry Fm. (GFF)

Geologic Contact

http://www.wwnorton.com/college/geo/egeo/flash/10_2.swf - Micros

Types of Unconformity

A sequence of sedimentary beds accumulates beneath a shallow sea.

Stage 1

Lake Idaho (3.5 m.y.)

5
4
3 GFF sediments
2
1

http://www.wwnorton.com/college/geo/egeo/flash/10_2.swf - Micros...

Types of Unconformity

The sea level rises, and new sediment accumulates over the eroded surface.

Stage 2

Erosion –i.e. 'high and dry'

4
3
2
1

http://www.wwnorton.com/college/geo/egeo/flash/10_2.swf - Micros...

Types of Unconformity

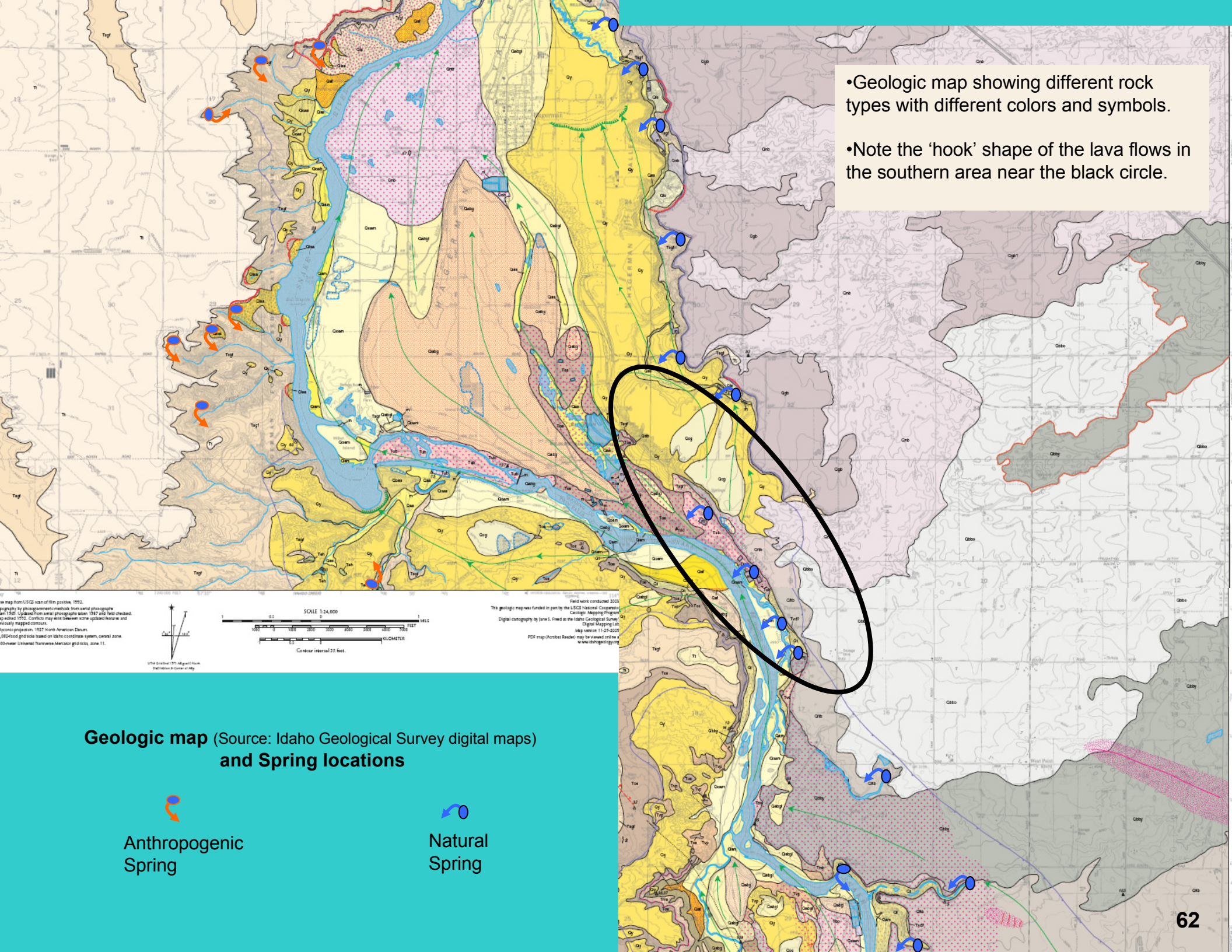
The boundary between the two sequences of sediment is a type of unconformity called a *disconformity*.

Stage 3

Lake Yahoo (50,000 years)

16
15 YCF sediments disconformity
4
3 GFF sediments
2
1

Strike = 263 degrees
Dip = 24 degrees
Dip Direction = 353 degrees
3,020.4
3,025.0
3,030.0
3,035.0
3,040.0
3,045.0
3,050.0
3,055.0
3,060.0
3,065.0
3,070.0
3,075.0
3,040.1
3,075.2
Location of outcrop photo



Geologic map (Source: Idaho Geological Survey digital maps)
and Spring locations

Anthropogenic Spring

Natural Spring

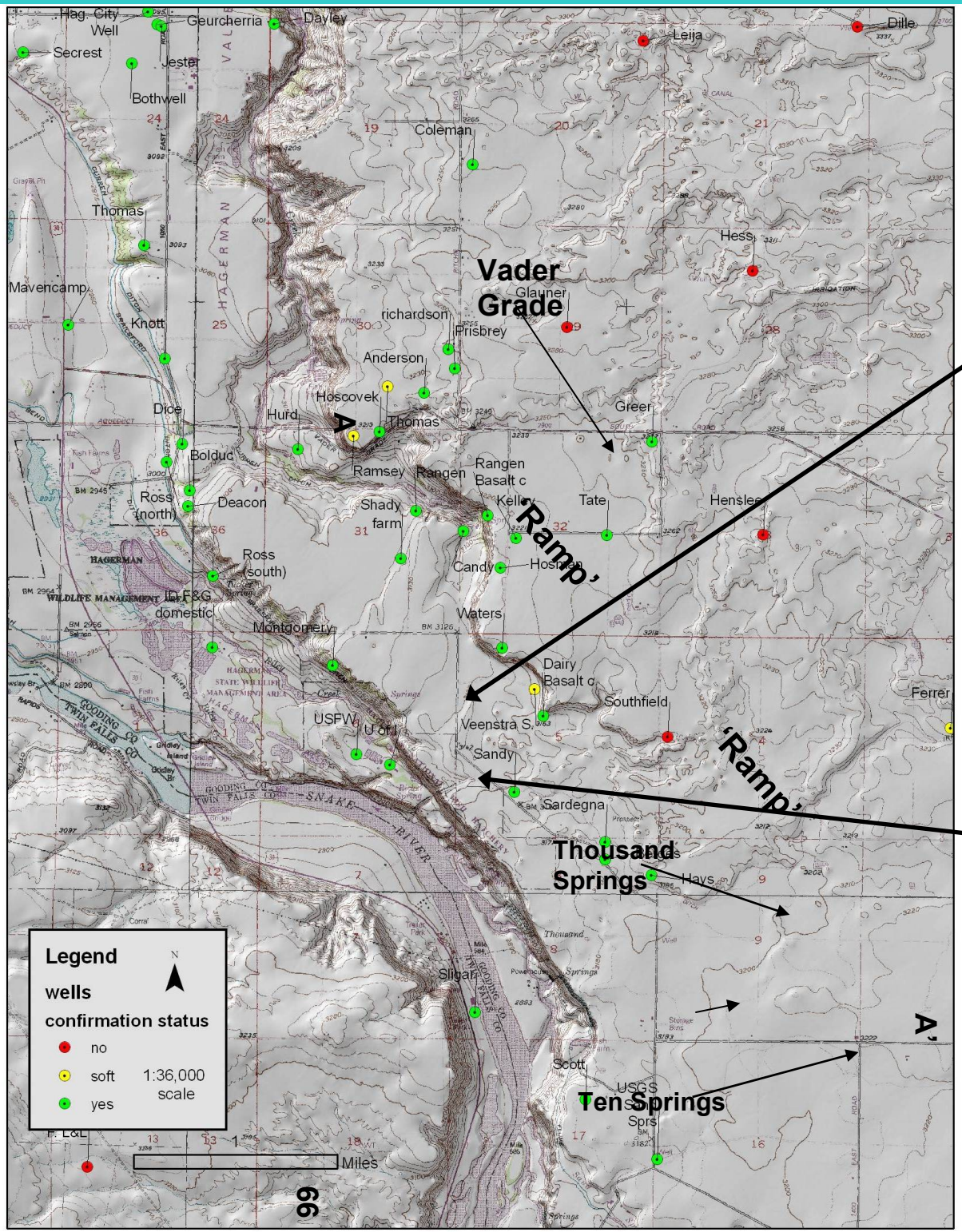
Northwest Dipping Basalt on west side of Snake River

(view azimuth is to the west from National Fish Hatchery)

Northwest Dipping Basalt near Thousand Springs

(view azimuth is east)

Conceptual Model for Geologic Structural Architecture



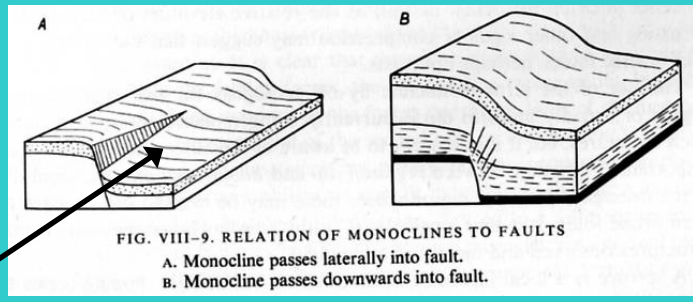


FIG. VIII–9. RELATION OF MONOCLINES TO FAULTS
A. Monocline passes laterally into fault.
B. Monocline passes downwards into fault.

(Source: Elements of Structural Geology by E. Sherbon Hills, 1972, 502 p.)

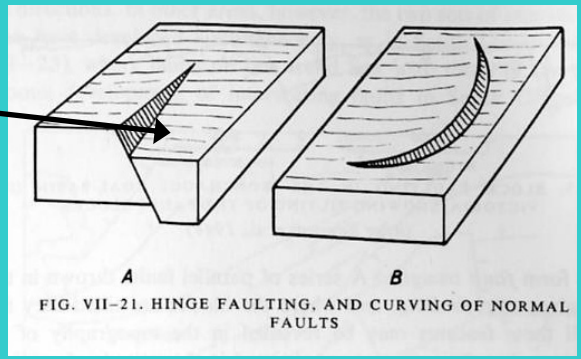
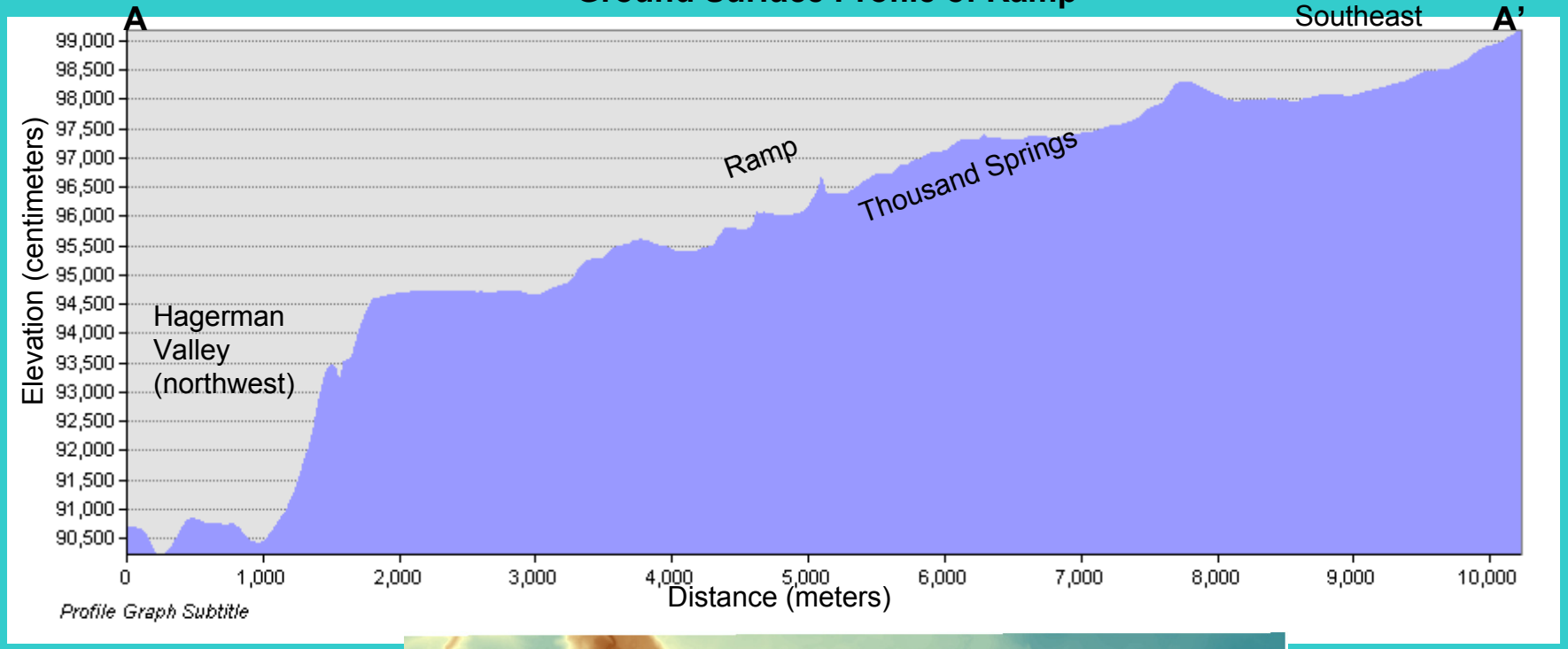
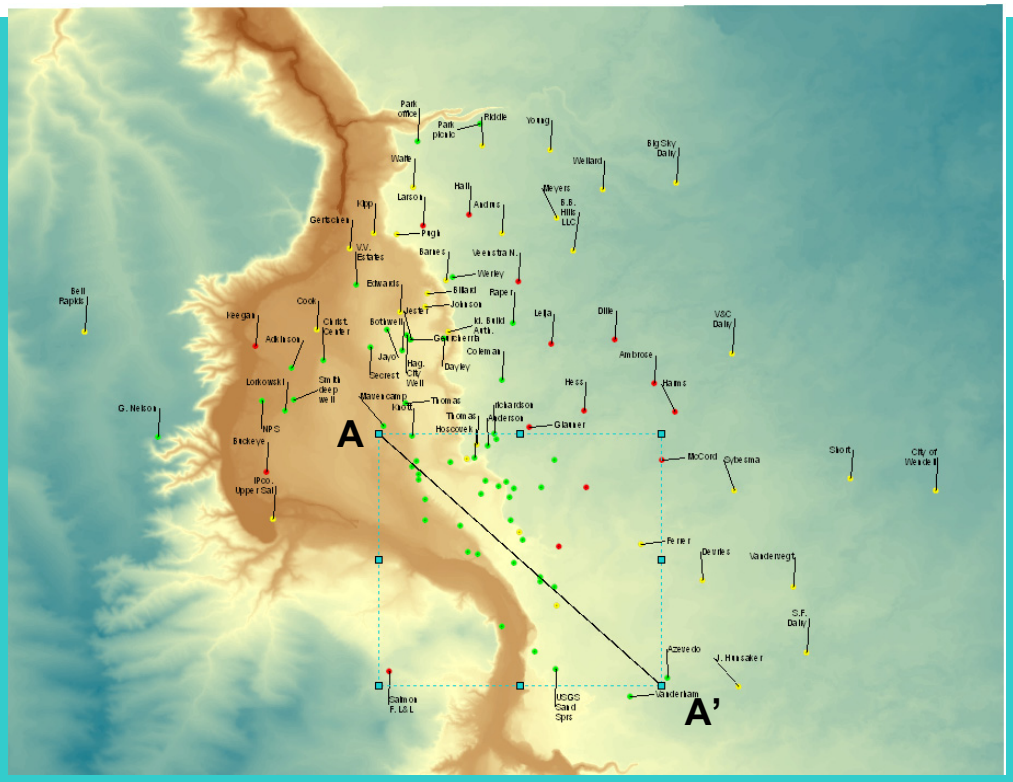


FIG. VII–21. HINGE FAULTING, AND CURVING OF NORMAL FAULTS

'Ramp'

Ground Surface Profile of Ramp

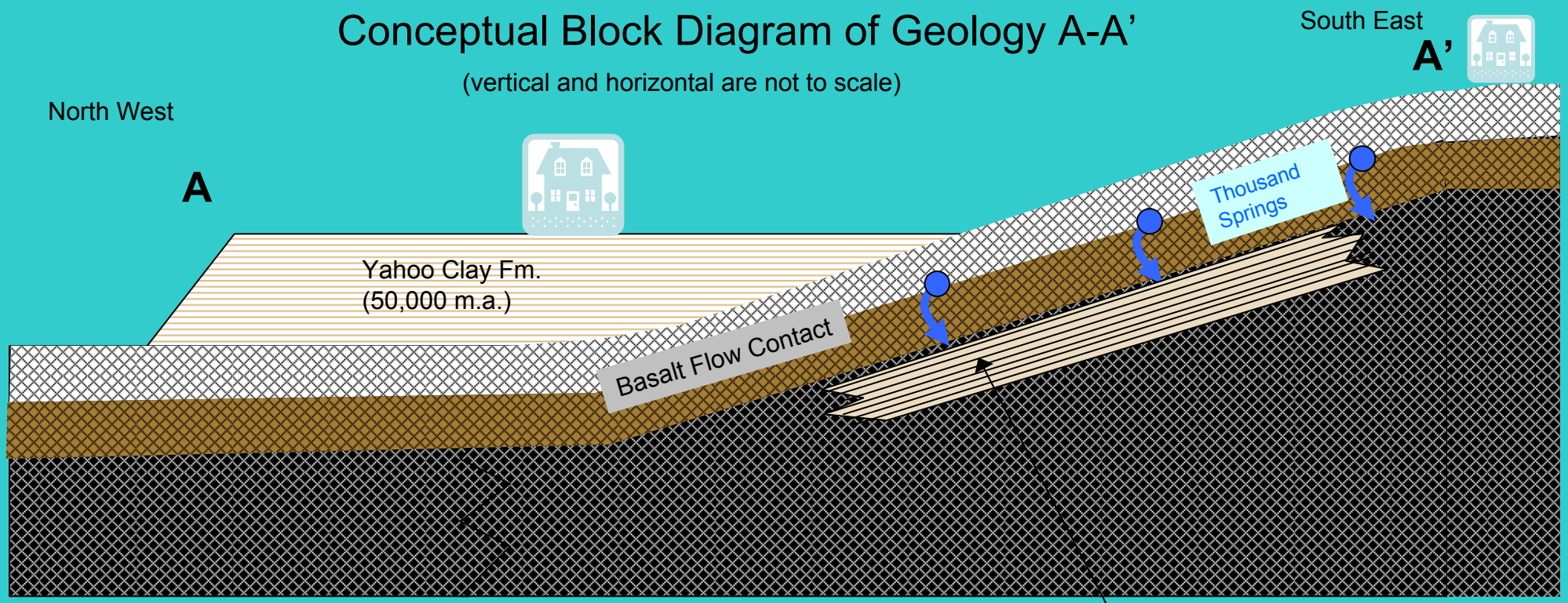


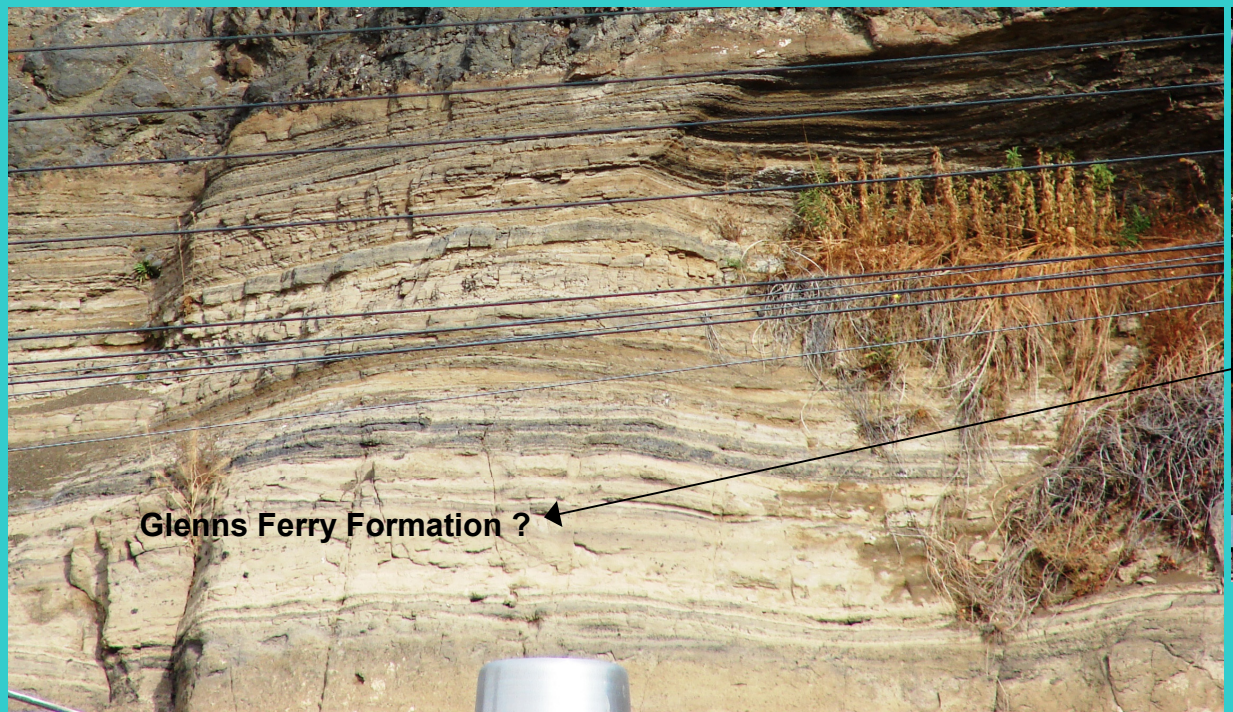


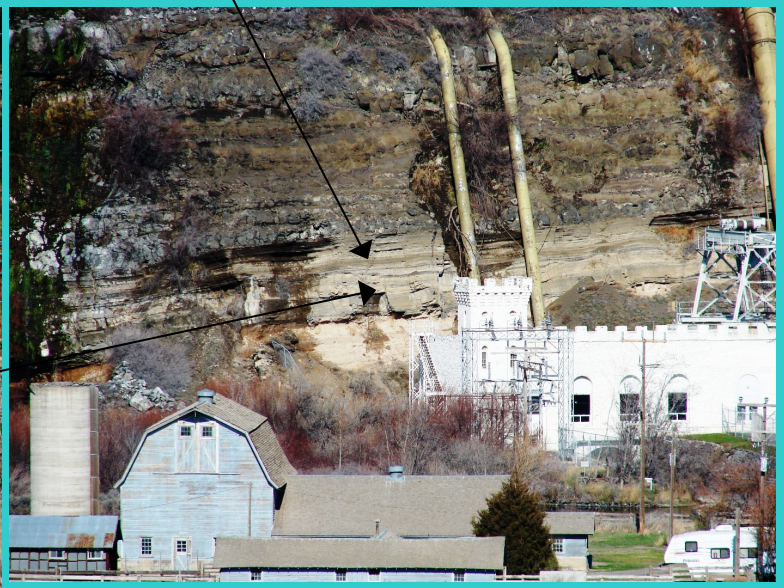
Thousand Springs – note the dip of the springs and contact.

Conceptual Block Diagram of Geology A-A'

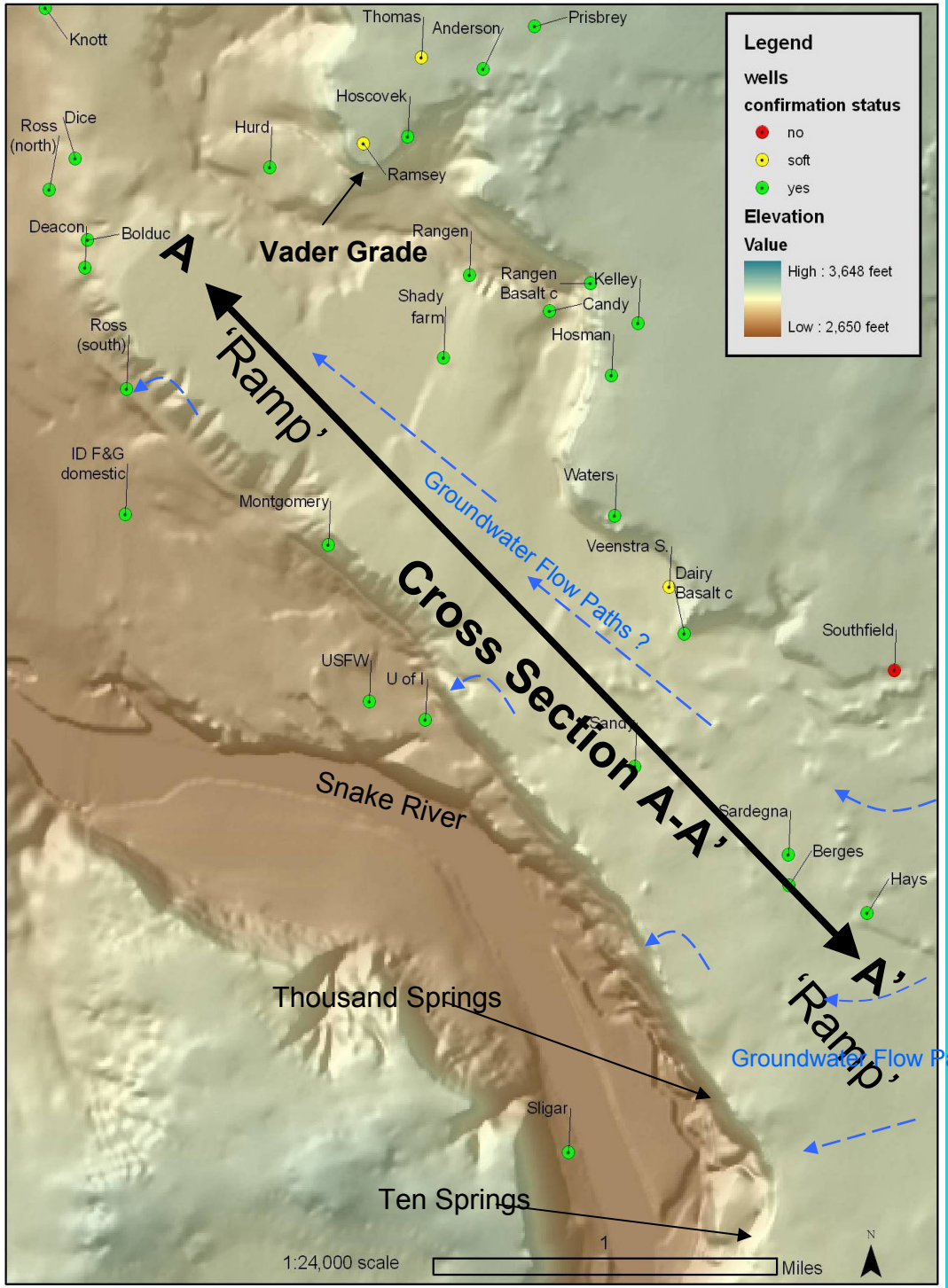
(vertical and horizontal are not to scale)





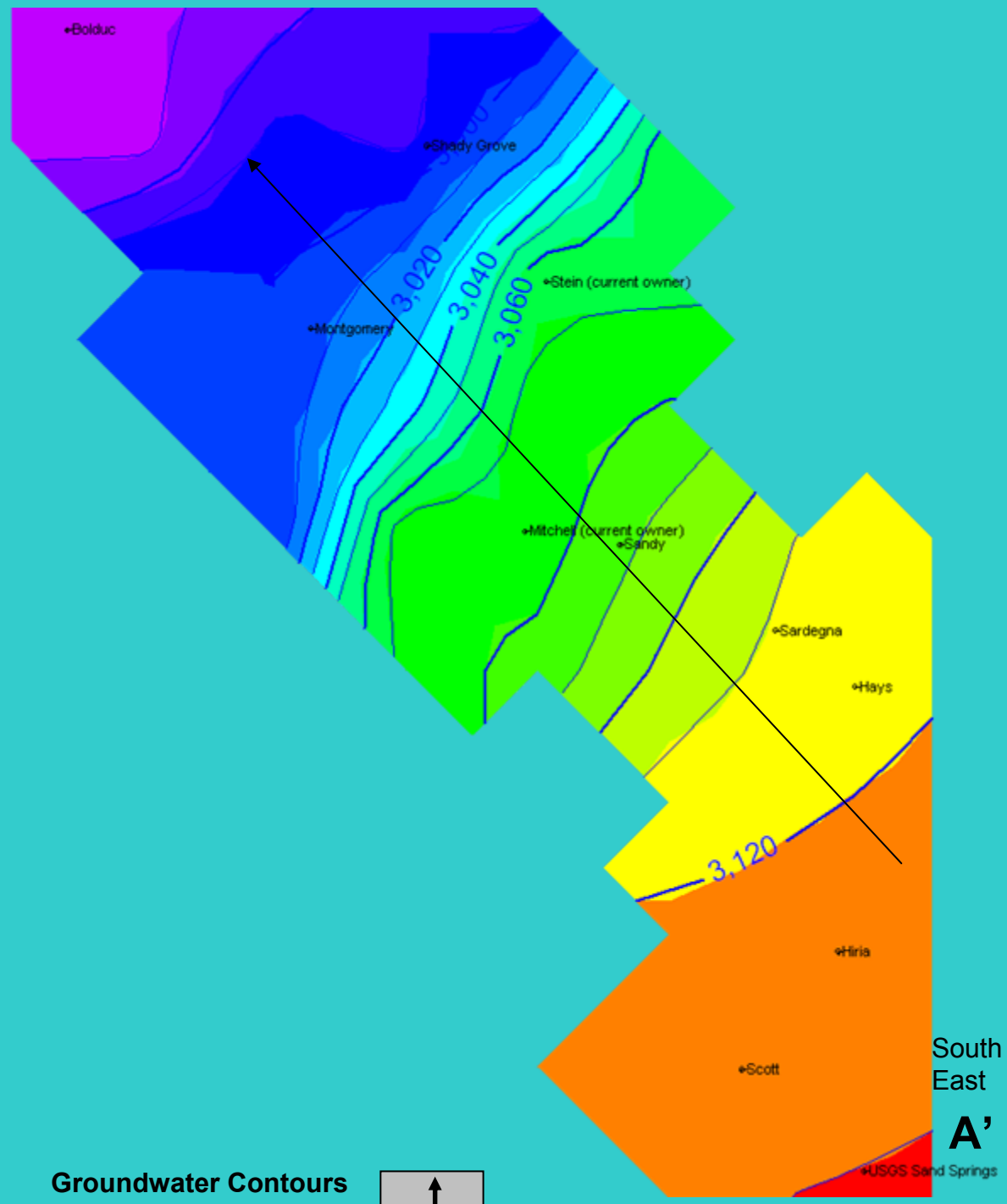


'Ramp' Area Wells



North West

A

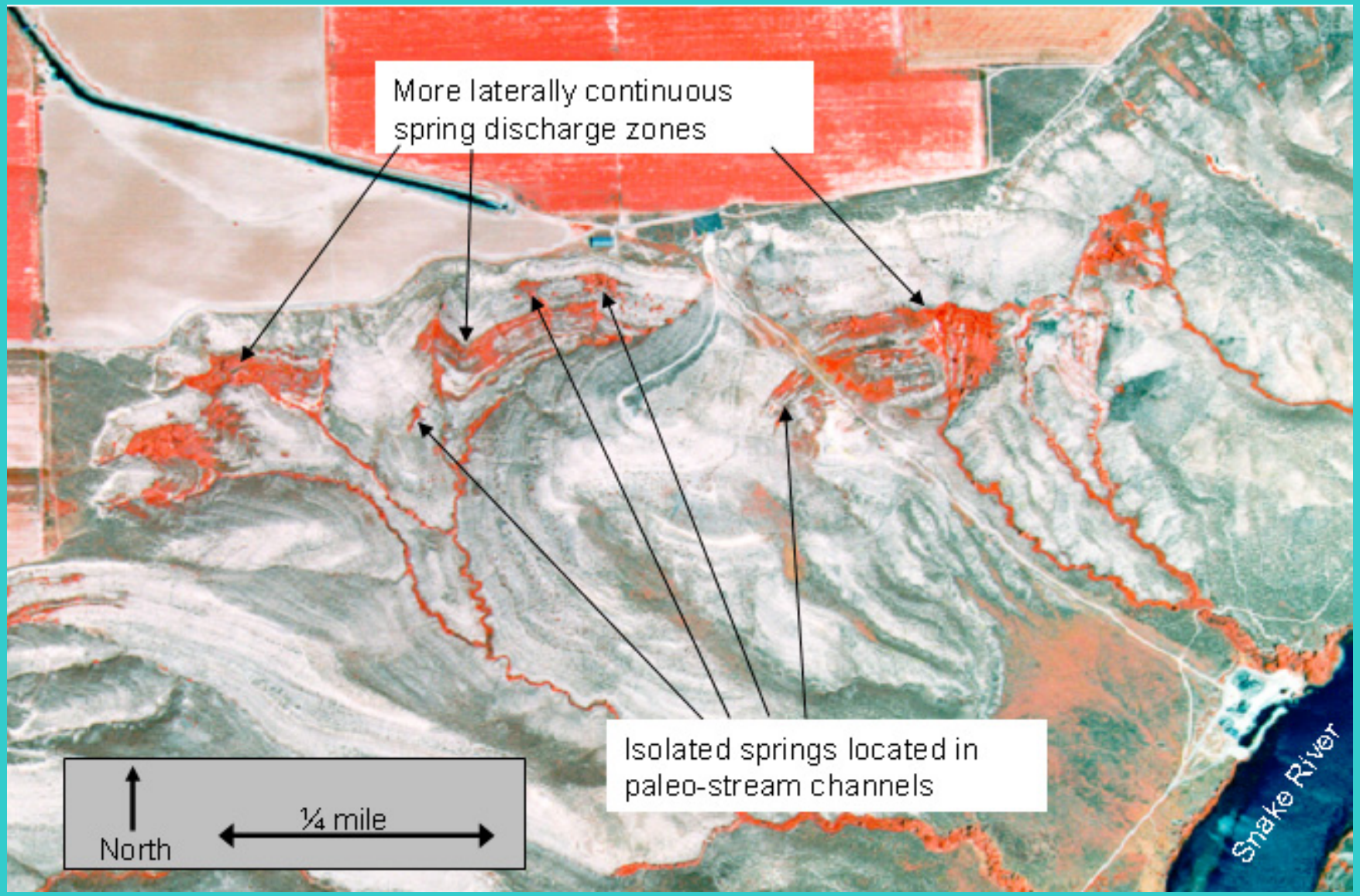


South East

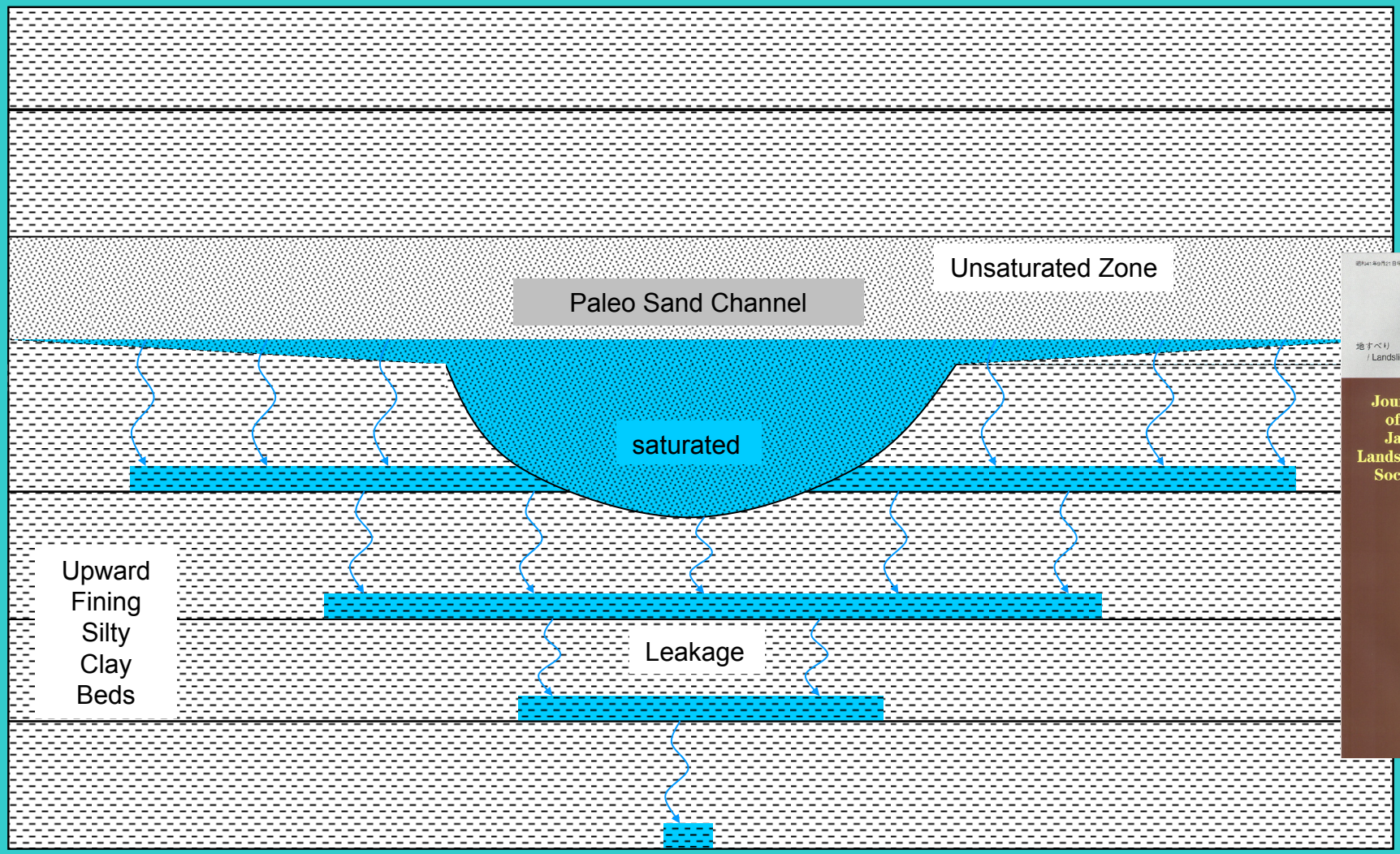
A'

Groundwater Contours down 'Ramp' Structure with flow line.

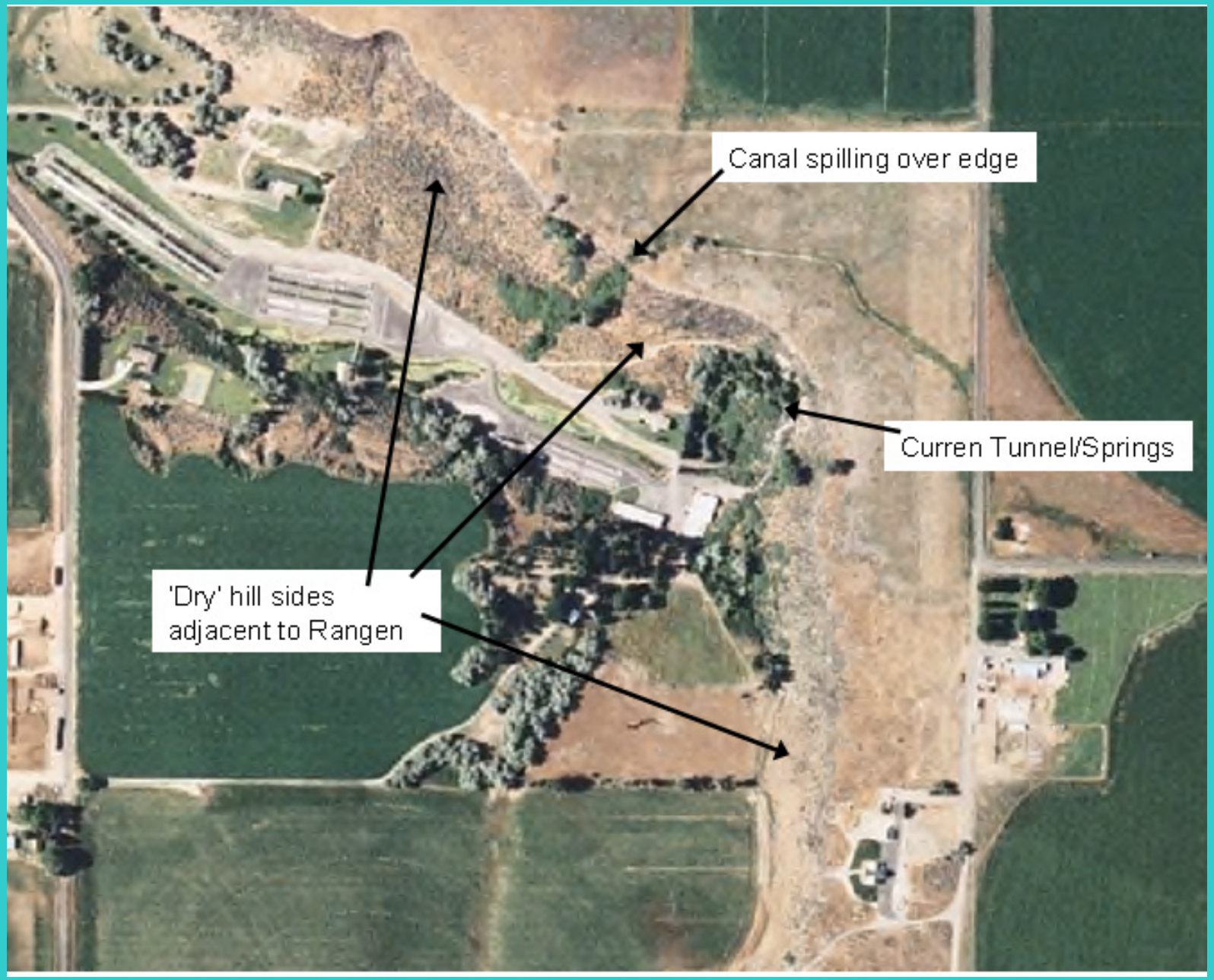
North



False color infrared air photo of springs at the Hagerman Fossil Beds N.M. (T7S R13E, section 16) showing spatial distribution pattern contrast between non-native and native vegetation which is a function of the geologic lithology and stratigraphy.

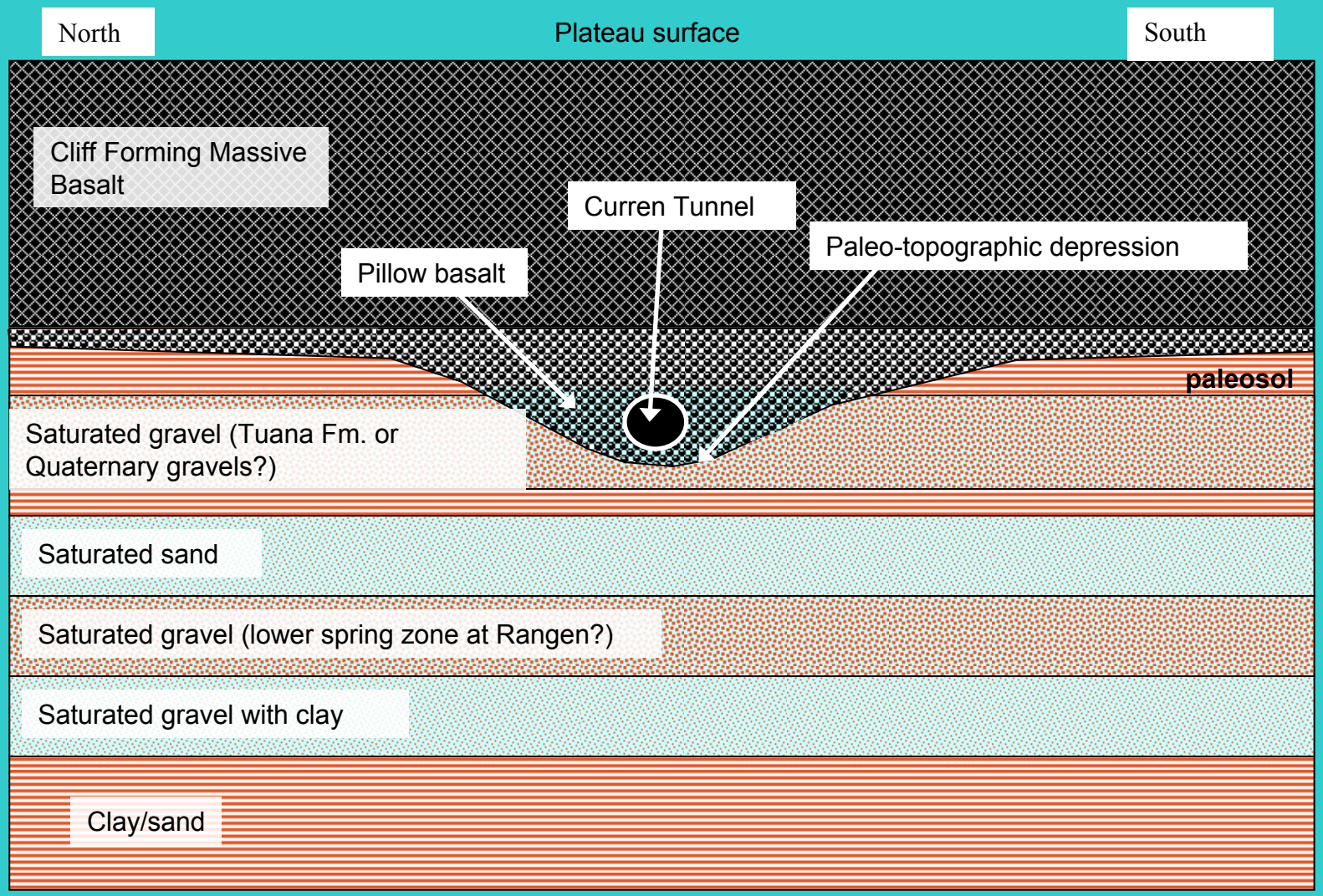


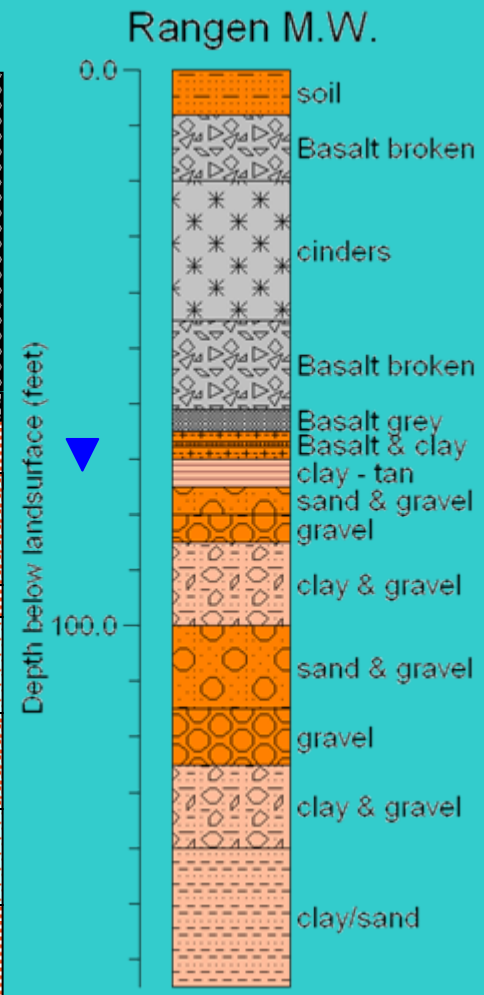
Model for leakage from a paleo stream channel with ponding on top of low permeable lithology and thus vegetation grows along these zones as seen in false color infrared air photo (Farmer and Nagai, 2004).



Hydrophilic vegetation at Rangen Spring is isolated by adjacent 'dry' hill sides at Rangen spring area.

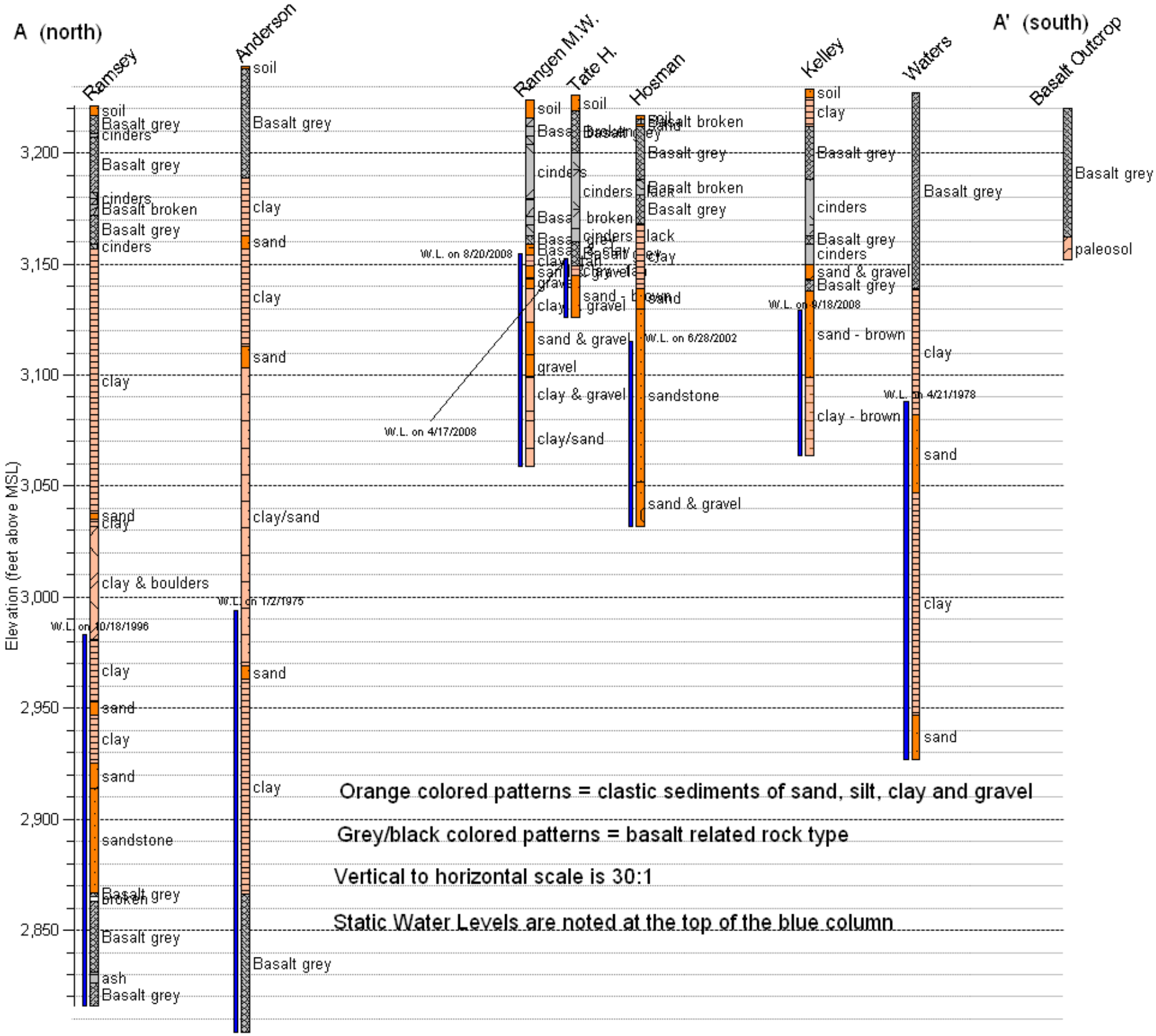
• Pillow lava features are common throughout the valley.





Draft Conceptual Model for Rangen Area Geology

Location of wells used in geologic cross section.

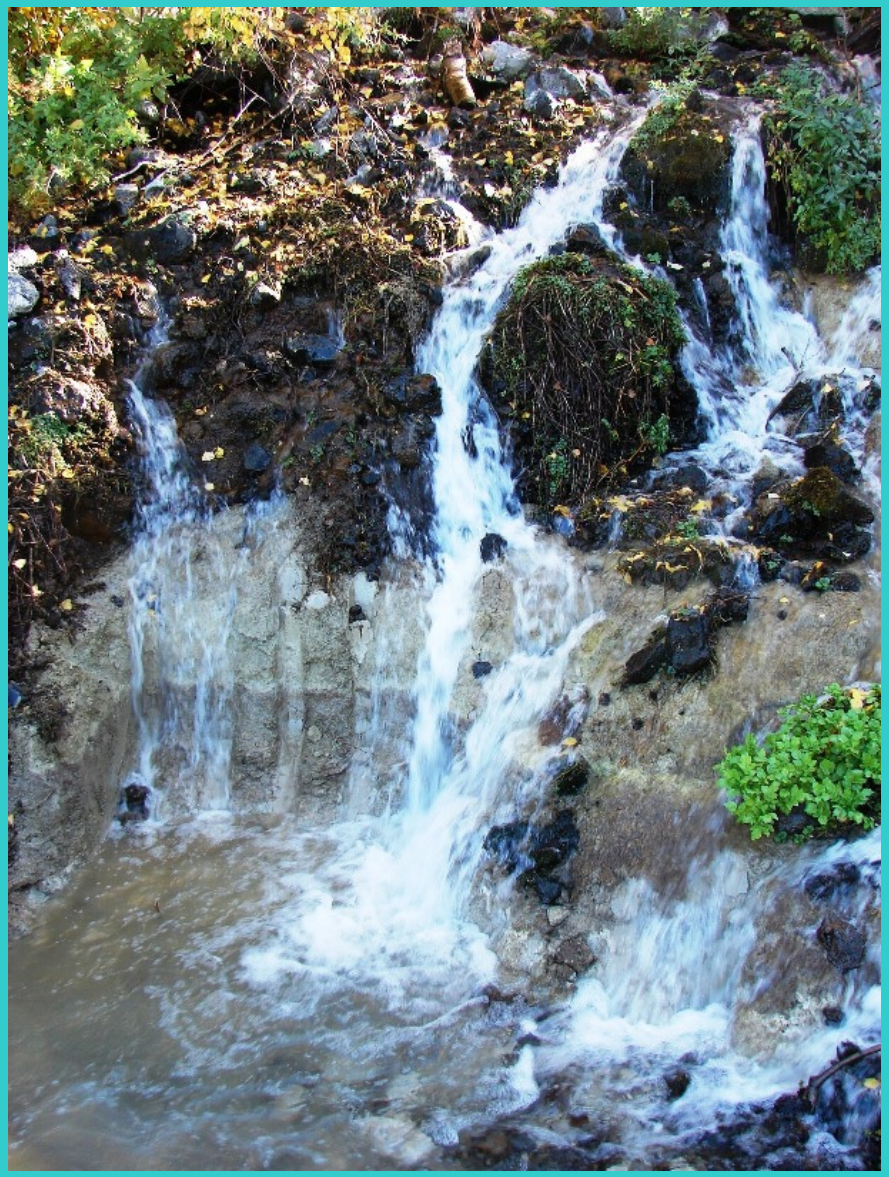

A (north)
A' (south)
Ramsey
Anderson
Rangen M.W.
Tate H.
Hosman
Kelley
Waters
Basalt Outcrop
Elevation (feet above MSL)
3,200
3,150
3,100
3,050
3,000
2,950
2,900
2,850
W.L. on 10/18/1996
W.L. on 1/2/1975
W.L. on 8/20/2008
W.L. on 4/17/2008
W.L. on 6/28/2002
W.L. on 9/18/2008
W.L. on 4/21/1978
Orange colored patterns = clastic sediments of sand, silt, clay and gravel
Grey/black colored patterns = basalt related rock type
Vertical to horizontal scale is 30:1
Static Water Levels are noted at the top of the blue column

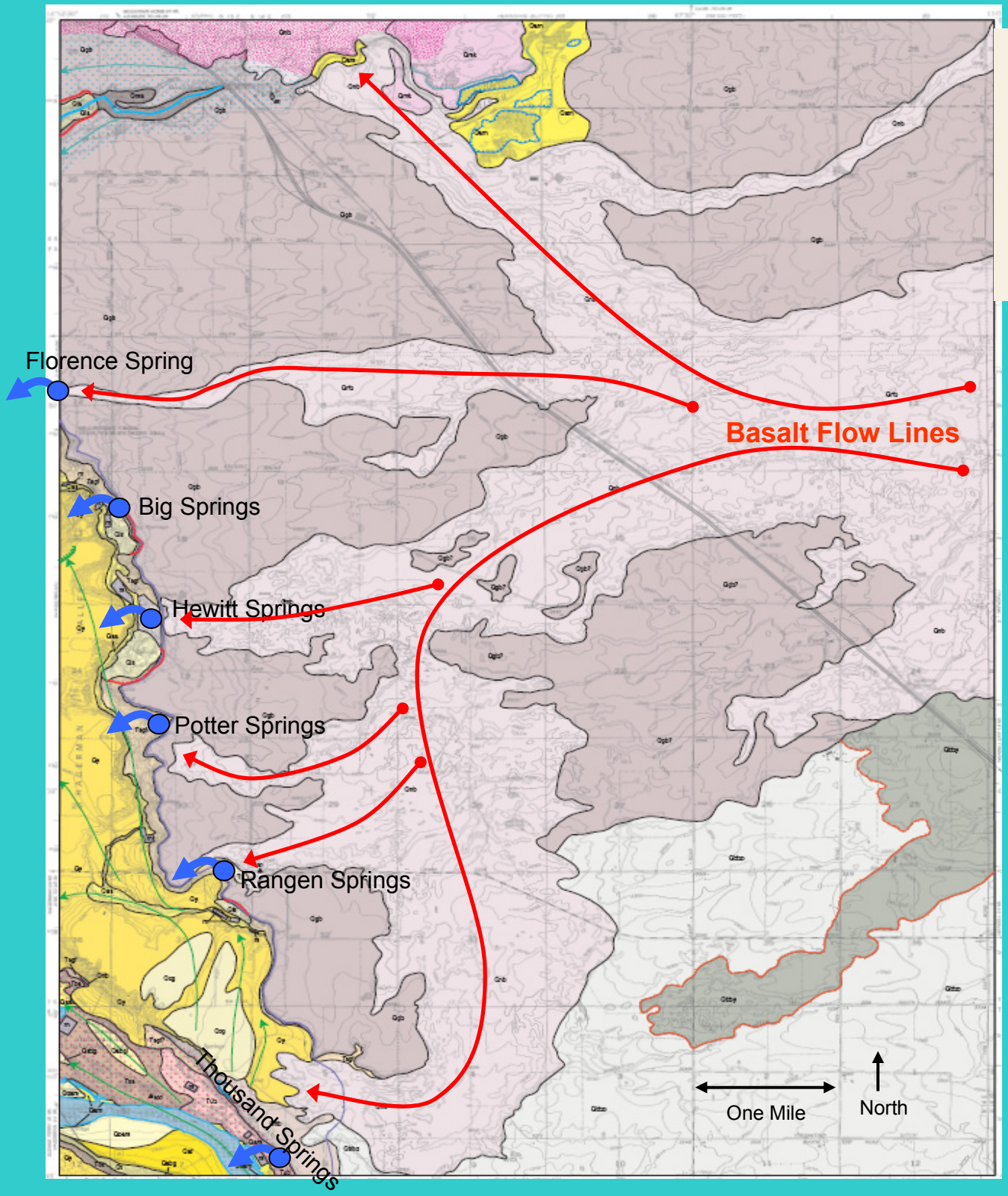
Vader Grade GFF Fossils

Vader Grade GFF Fossils

Fresh exposure of GFF at Vader Grade road cut and fossil willow leaves and a bivalve. Note the darker horizontal banding above and left of the pickup truck from groundwater flowing through the GFF but not from the overlying basalt at this location.

New Outcrop of Glenns Ferry Formation

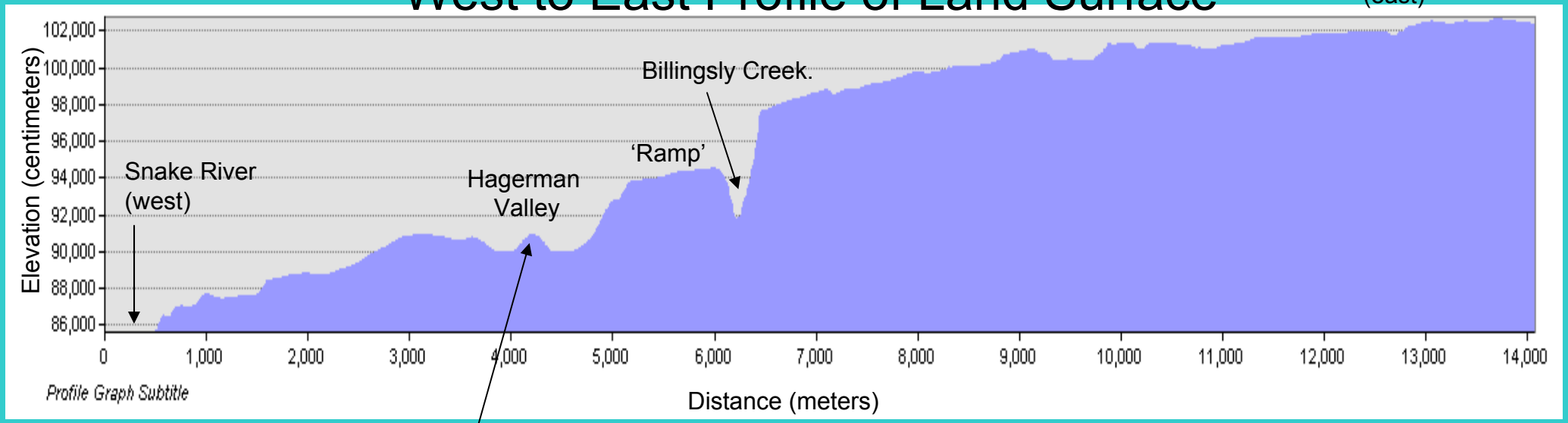




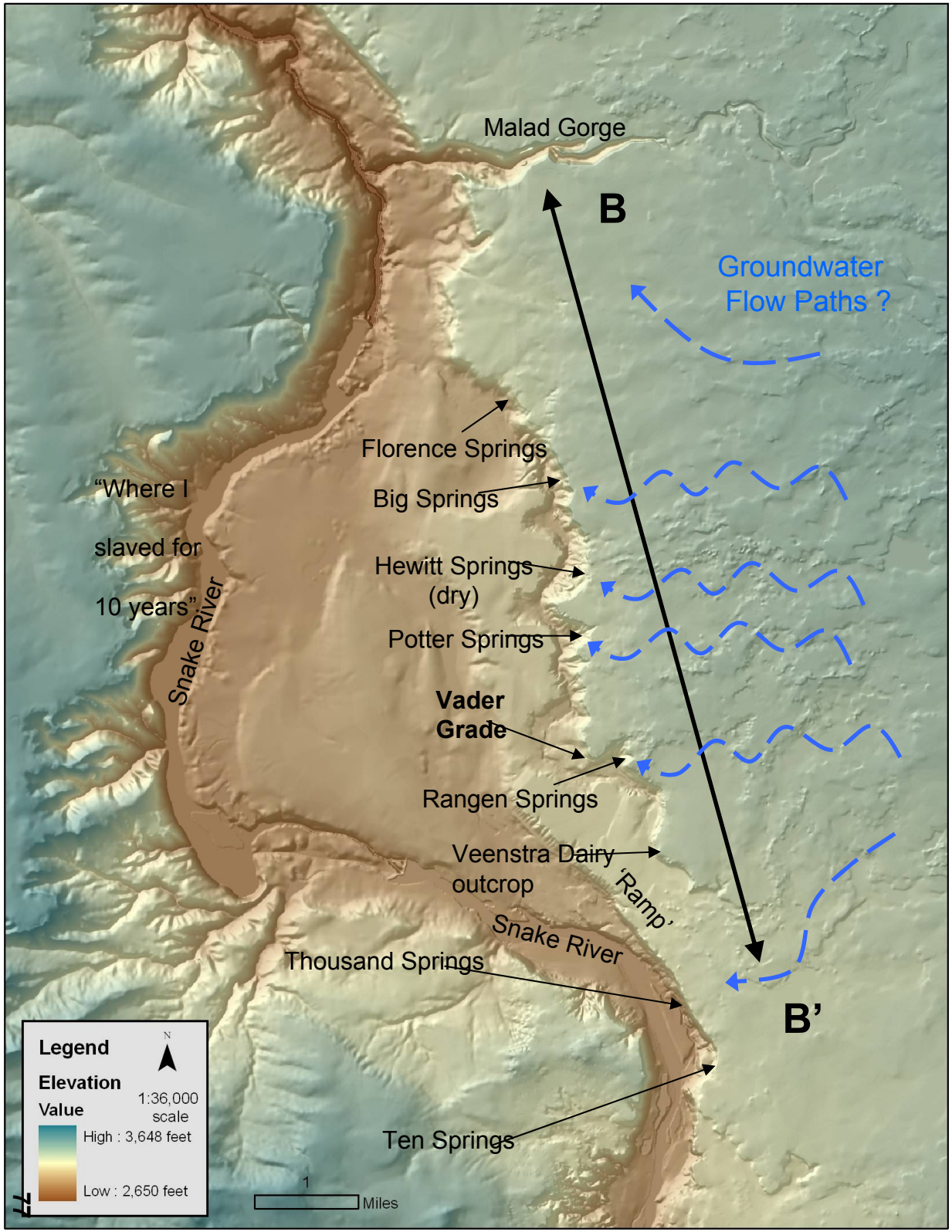
•Note 'fingers' of lava flow and association with springs.
•Note 'hook' shape of the lava flows near the Ramp.
•Many of the springs are located within an 'alcove'.

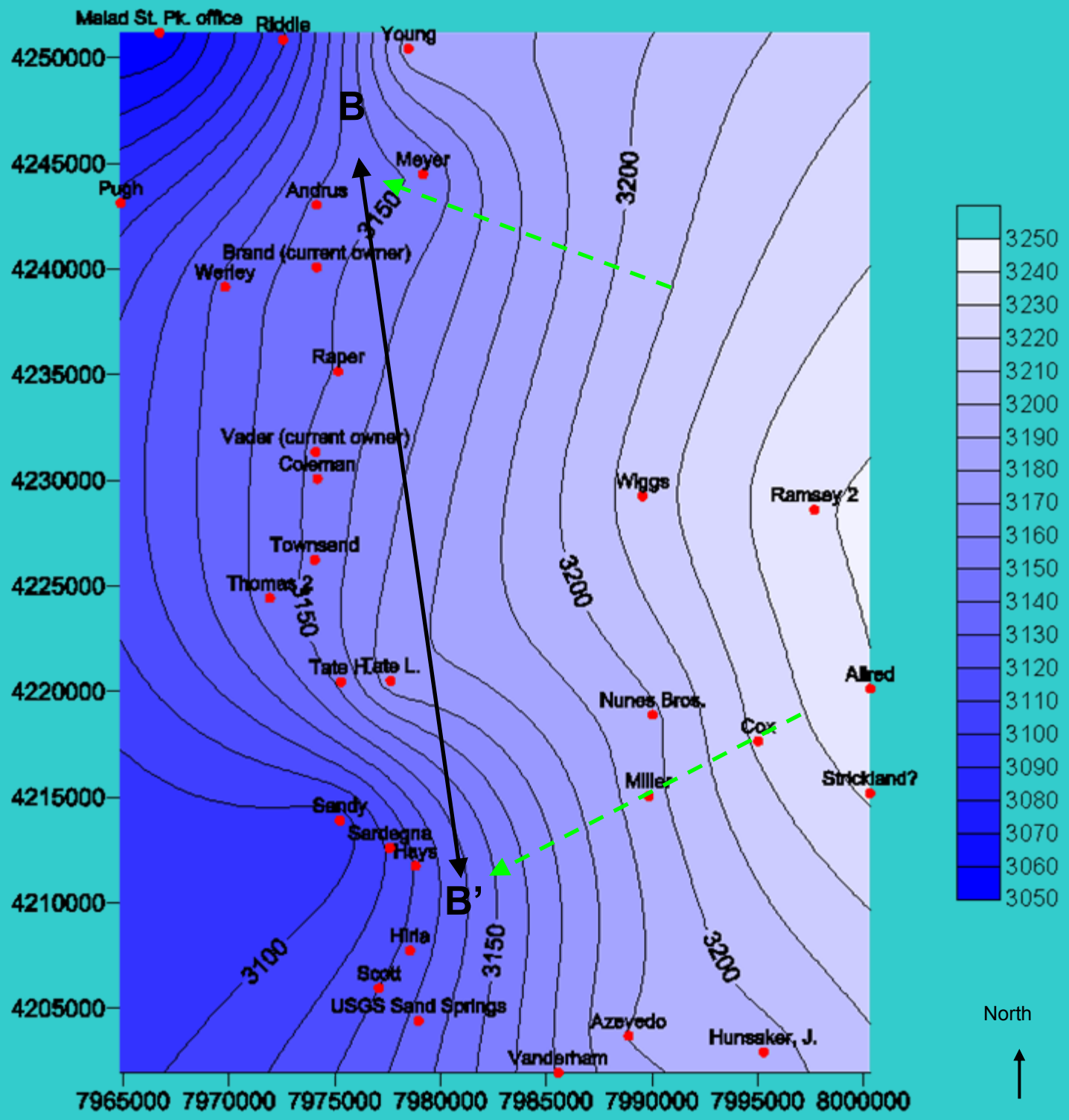
•(geologic map source: Idaho Geological Survey)

West to East Profile of Land Surface



Guess what this ridge is from or why it exists?


Malad Gorge
B
Groundwater
Flow Paths ?
Florence Springs
Big Springs
Hewitt Springs
(dry)
Potter Springs
Vader
Grade
Rangen Springs
Veenstra Dairy
outcrop
'Ramp'
Snake River
Thousand Springs
B'
Ten Springs
"Where I
slaved for
10 years"
Snake River
Legend
Elevation
Value
High : 3,648 feet
Low : 2,650 feet
1:36,000
scale
N
1
Miles


Malad St. Pk. office
Riddle
Young
B
Meyer
Pugh
Andrus
Brand (current owner)
Werley
Raper
Vader (current owner)
Coleman
Townsend
Thomas 2
Tate
Tate L.
Wiggs
Ramsey 2
Nunes Bros.
Cox
Allred
Miller
Strickland?
Sandy
Sardegna
Hays
B'
Hirla
Scott
USGS Sand Springs
Azevedo
Hunsaker, J.
Vanderham
3250
3240
3230
3220
3210
3200
3190
3180
3170
3160
3150
3140
3130
3120
3110
3100
3090
3080
3070
3060
3050
North
4250000
4245000
4240000
4235000
4230000
4225000
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4210000
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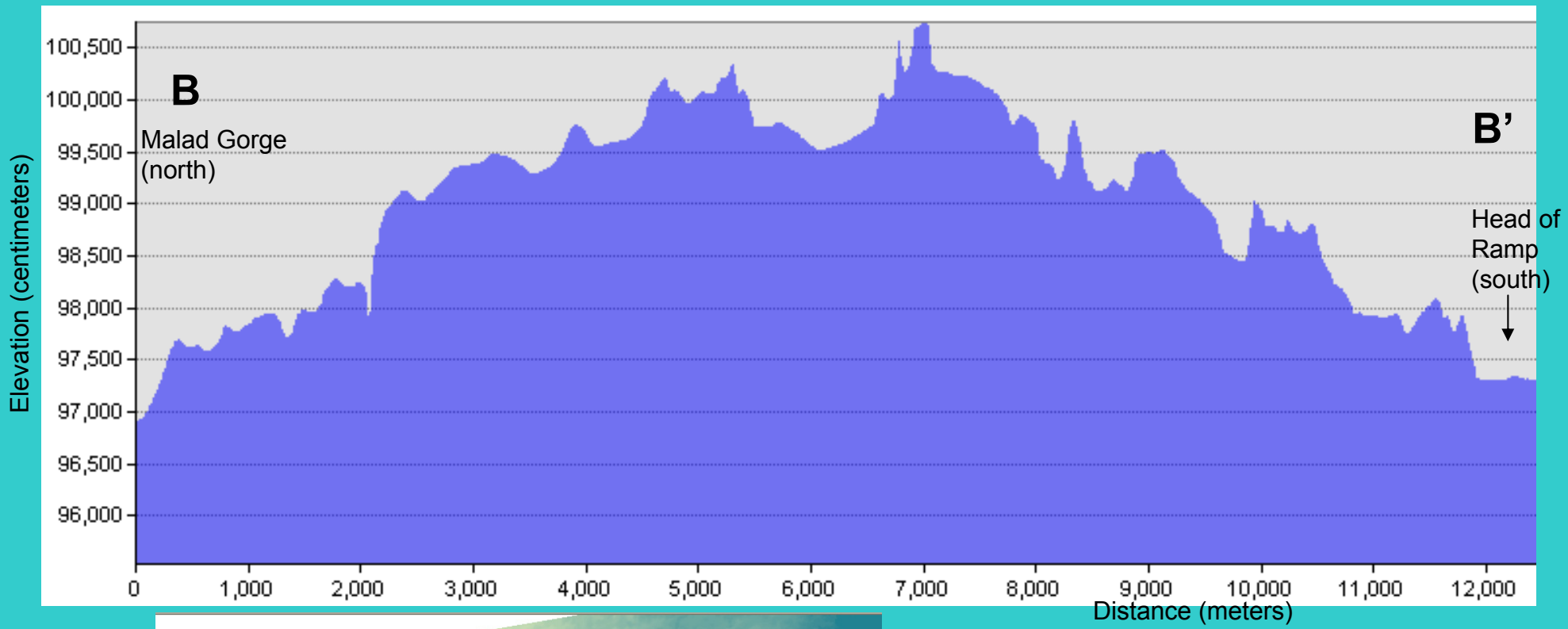
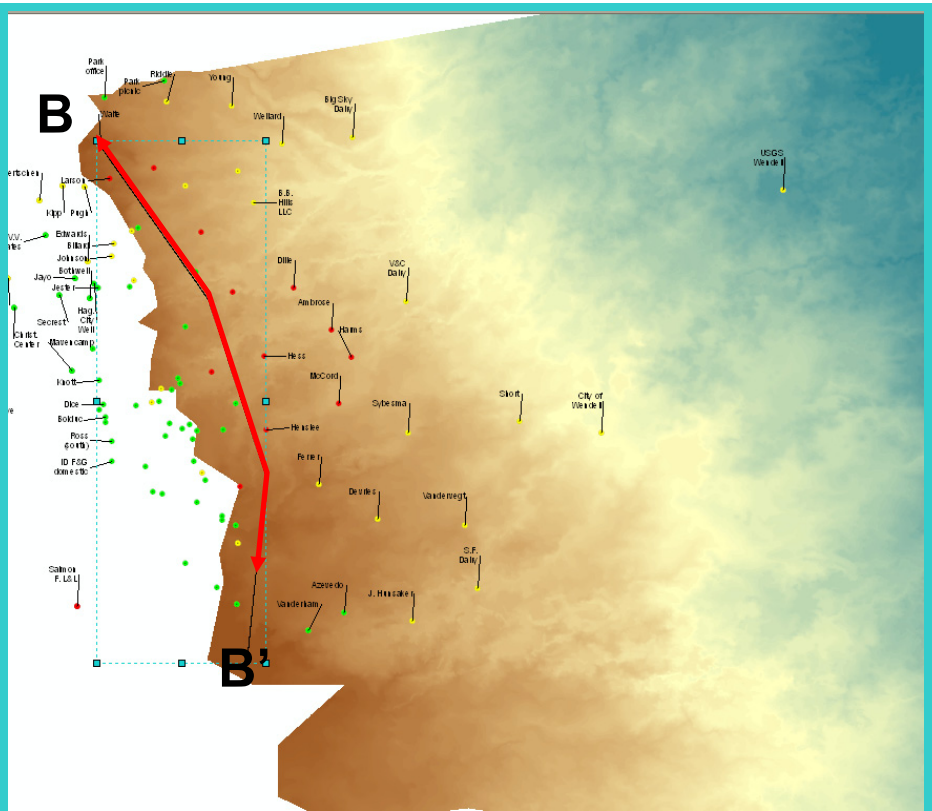
7965000
7970000
7975000
7980000
7985000
7990000
7995000
8000000

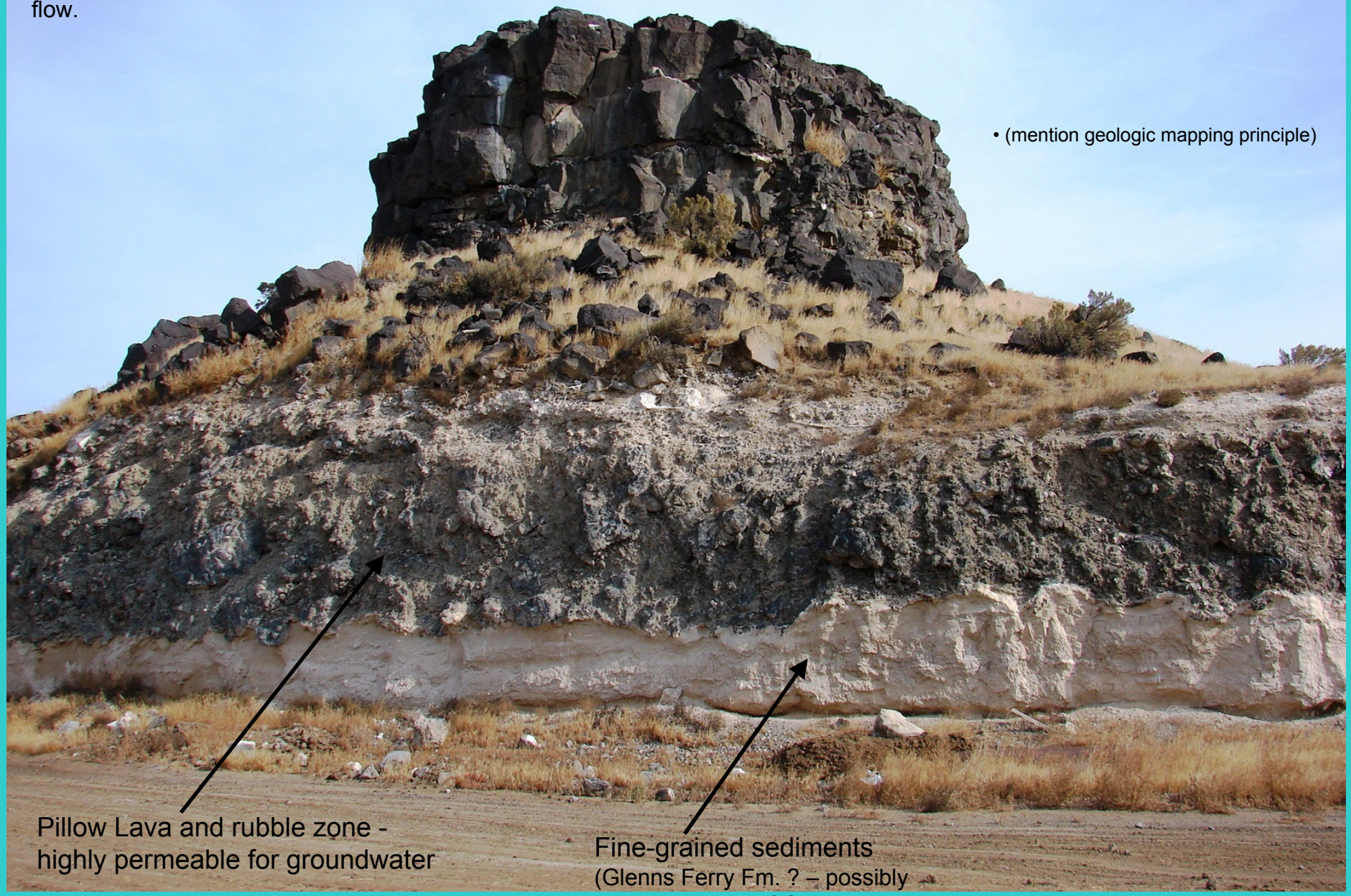




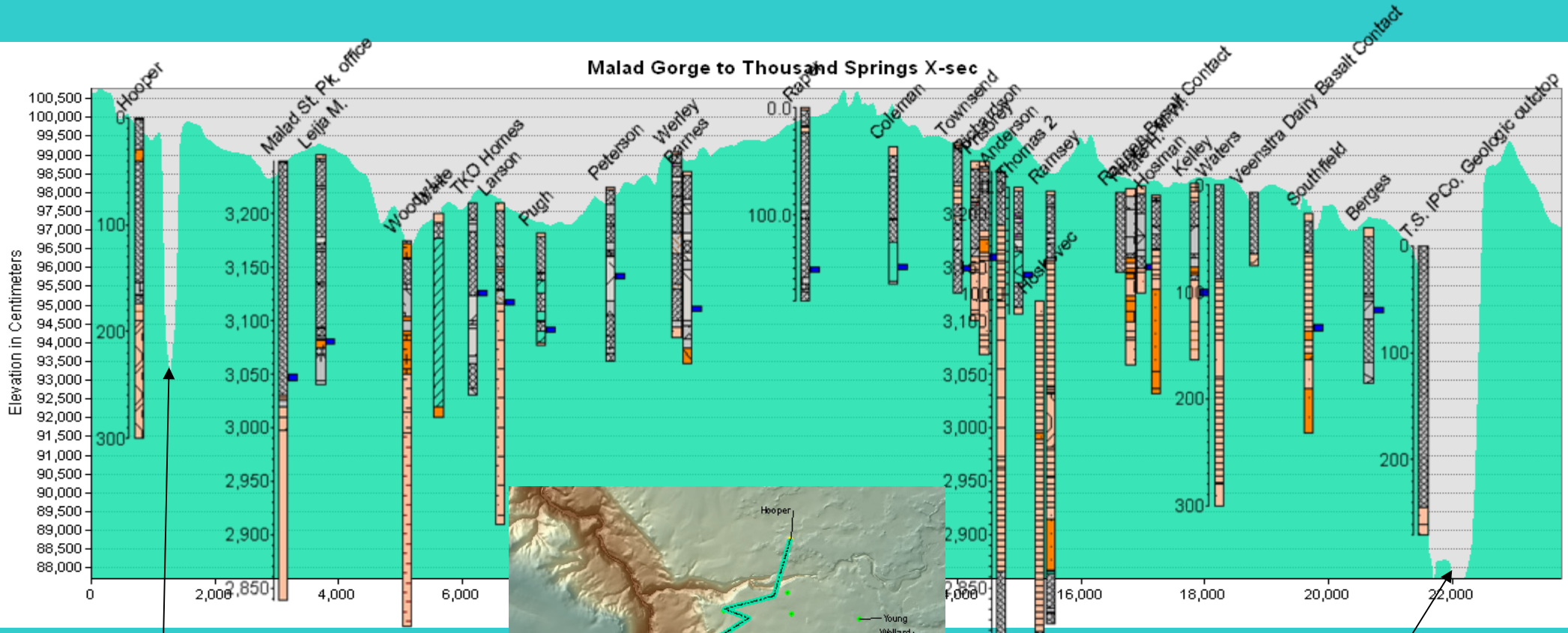
Ground surface profile from Malad Gorge (B) to Thousand Springs area (B') showing an arched Ground surface feature which correlates to the groundwater contours.

Geologic outcrop and contact south of Rangen.

Outcrop scale example of a basalt flow base in contact with underlying sediments. The contact is high in elevation relative the water table which therefore controls the absence of a spring at this location. This undulatory contact controls groundwater flow.



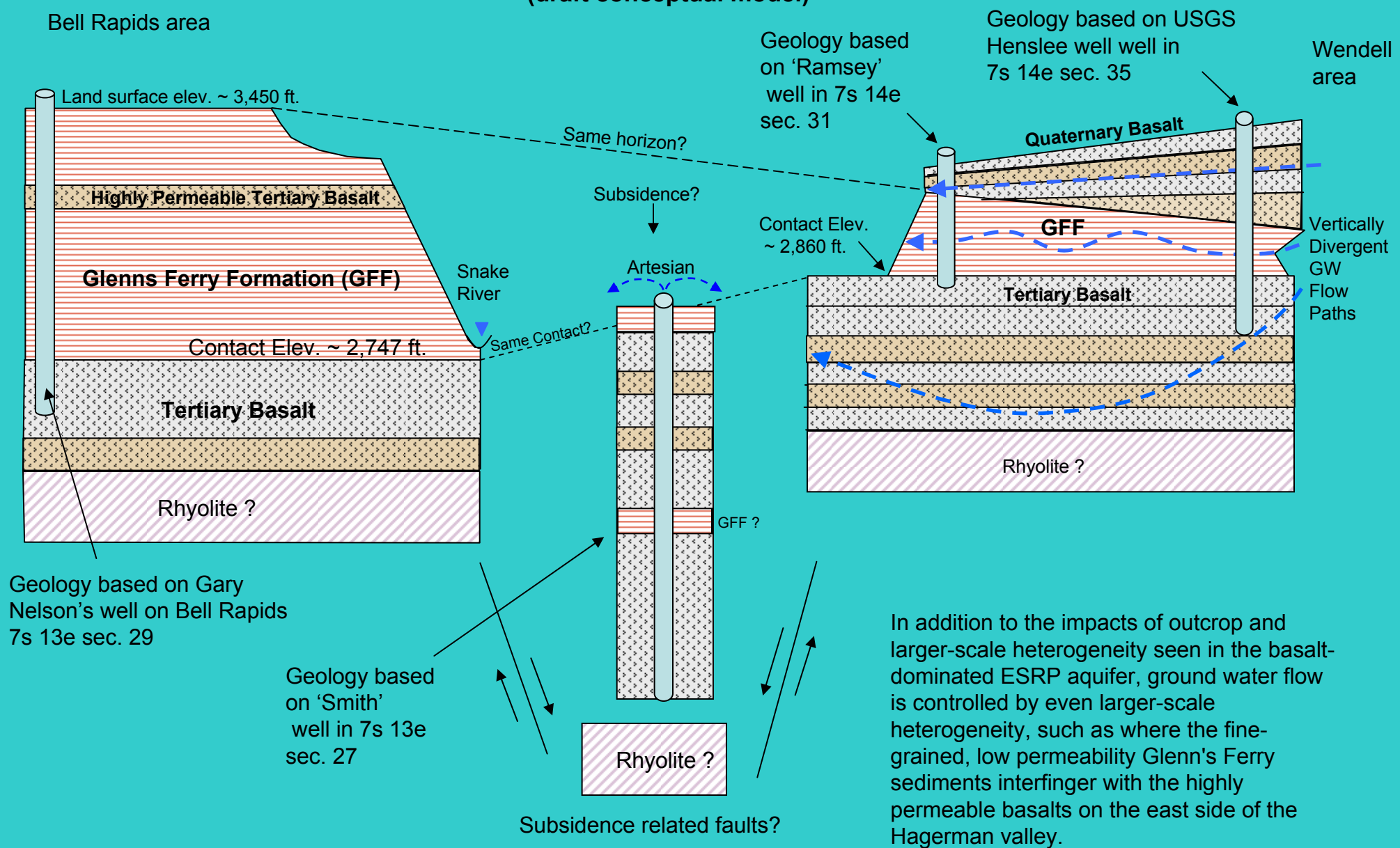
• (mention geologic mapping principle)


Malad Gorge to Thousand Springs X-sec
Elevation in Centimeters
Hooper
Malad St. Pk. office
Leija M.
Woodwright
TKO Homes
Larson
Pugh
Peterson
Werley
Barnes
Rapp
Coleman
Townsend
Richardson
Anderson
Thomas 2
Ramsey
Hosman
Kelley
Waters
Veenstra Dairy
Basalt Contact
Southfield
Berges
T.S. IPCo. Geologic outcrop
Malad River
Snake River

Hooper
Young
Wellard
Woody L.
Kipp
Gertschen
Pugh
Meyers
B.B. Hills LLC
ID Parks & Rec.
Estates
Jayo
Edwards
Keegan
Hag
City Well
Adkinson
Cook
Bothwell
Secrest
Dille
Leija
Lorkowski
Christ Center
Thomas
Hess
NPS
Smith deep well
Knott
Buckeye
Maven camp
Greer
IPco. Upper Sal
Tate
Tate H. irrig.
Southfield
Berges
S.-F. Dairy
Hria
USGS Sand Sprs
Salmon F. L&L
Scott

Hagerman Valley Geologic Transition Zone between the Western and Eastern Snake River Plain

(draft conceptual model)



In addition to the impacts of outcrop and larger-scale heterogeneity seen in the basalt-dominated ESRP aquifer, ground water flow is controlled by even larger-scale heterogeneity, such as where the fine-grained, low permeability Glenn's Ferry sediments interfinger with the highly permeable basalts on the east side of the Hagerman valley.

Not to scale

Idaho Department of Water Resources

Open File Report

FLUORESCENT DYE TRACER TESTS AT THE MALAD GORGE STATE PARK

By

Neal Farmer
Idaho Department of Water Resources

and

Dave Blew
Idaho Power

September 30, 2009

Gooding
Bliss
Gooding Butte
Malad Gorge State Park
84
Tuttle
Hagerman
Wendell
84
Jerome
84
Snake River
Sonnickson Butte
Buhl
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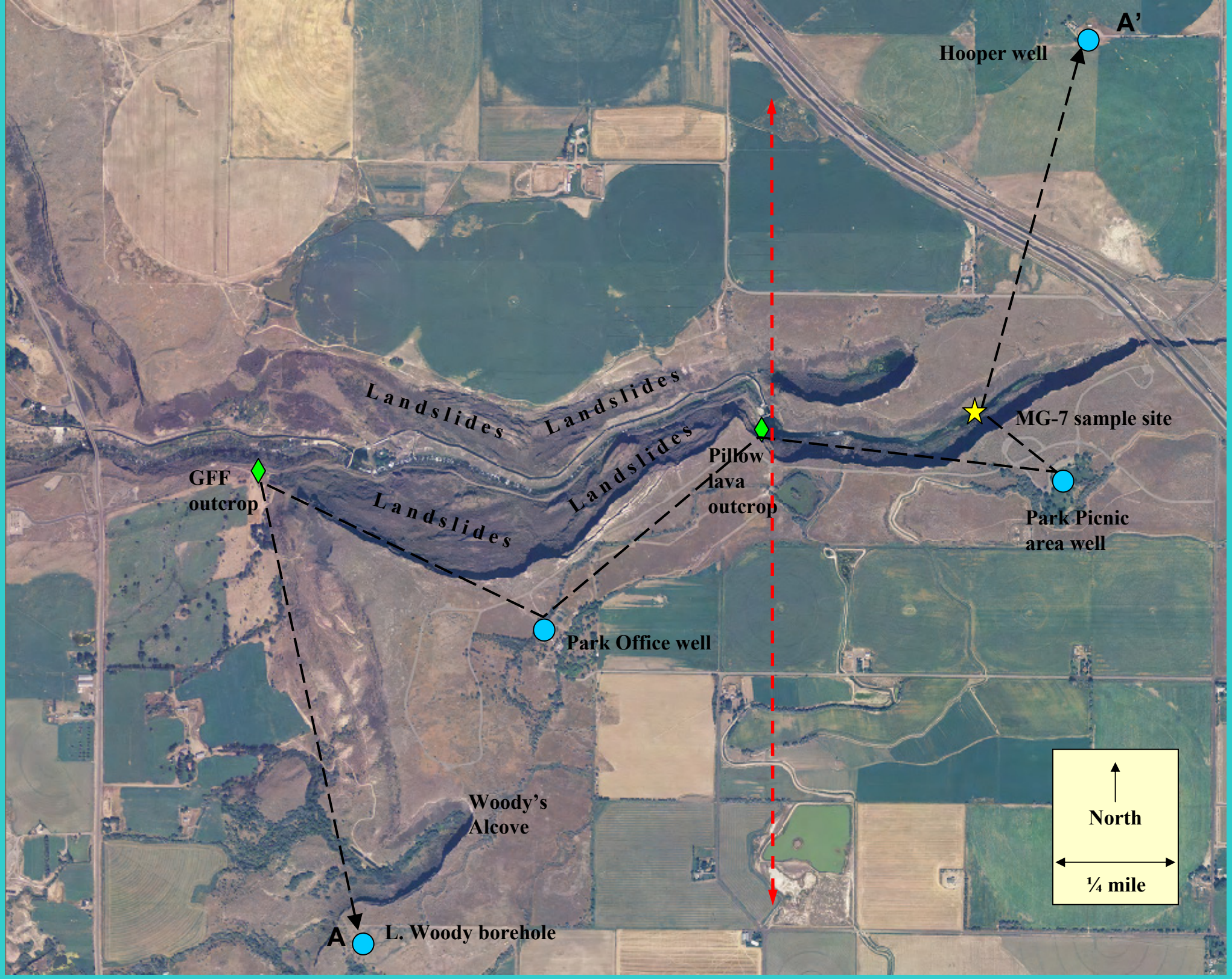
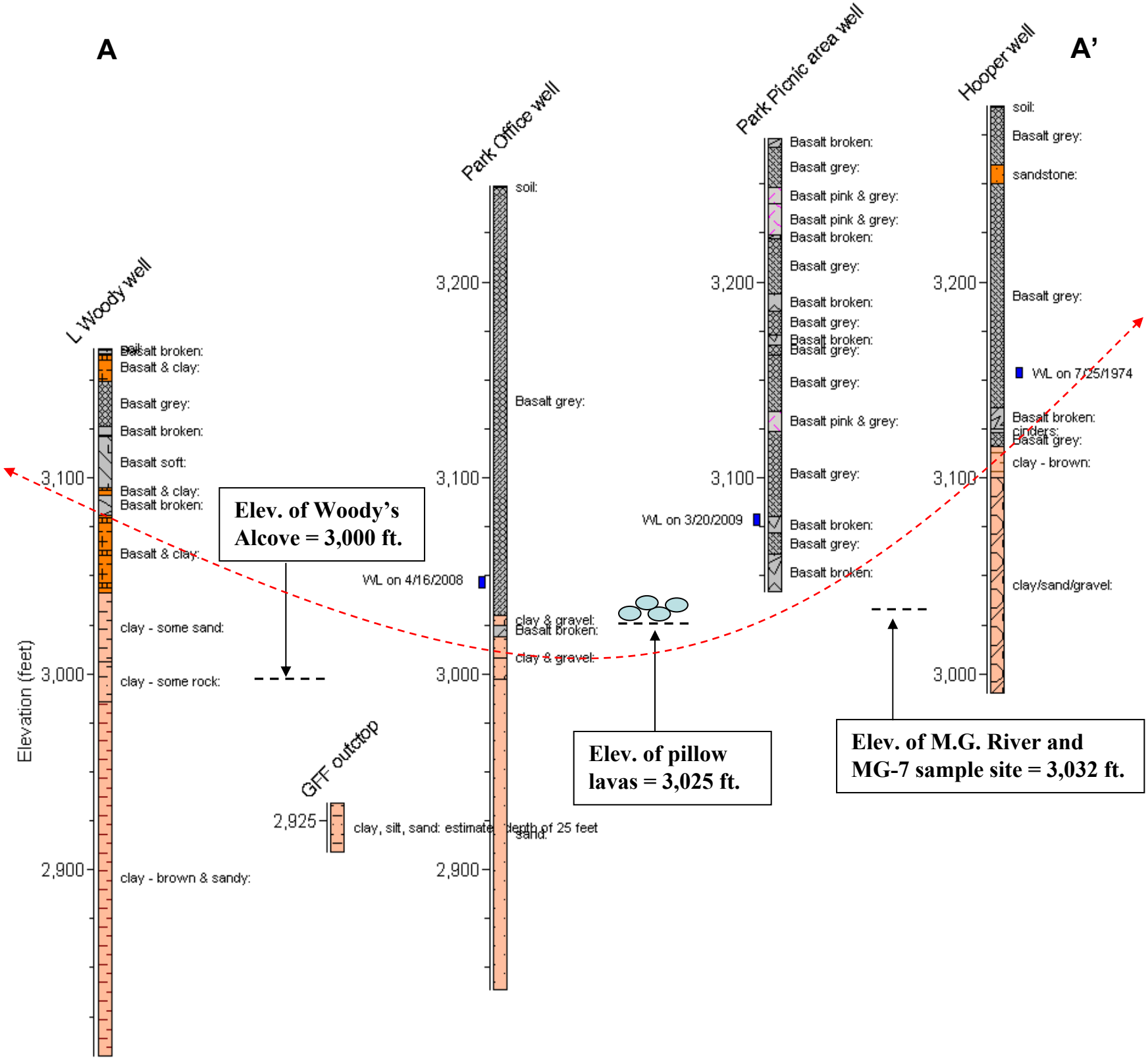

A'
Hooper well
Landslides
Landslides
Landslides
Landslides
MG-7 sample site
Pillow
lava
outcrop
GFF
outcrop
Park Picnic
area well
Park Office well
Woody's
Alcove
North
¼ mile
A
L. Woody borehole

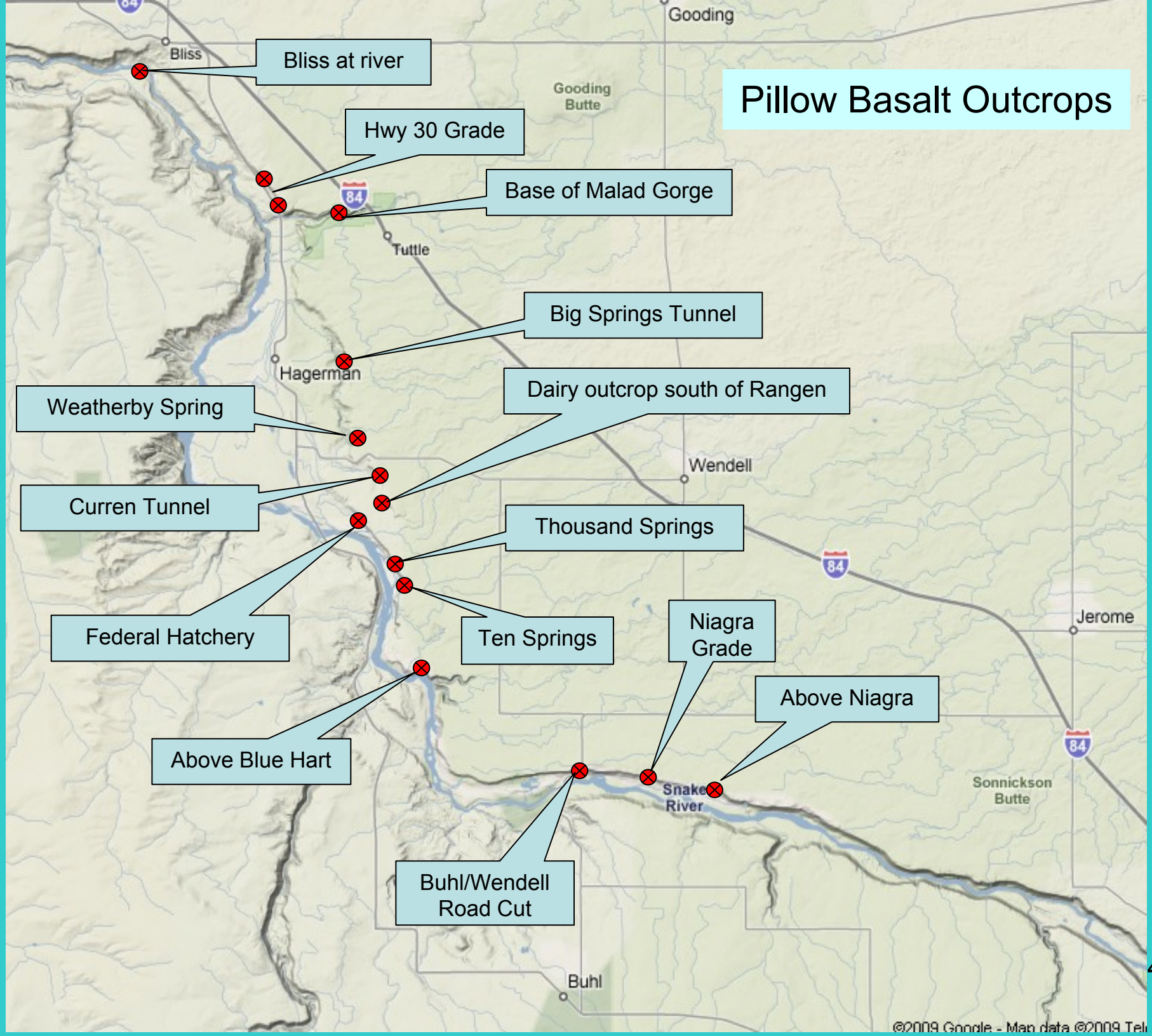

A
A'
L Woody well
Park Office well
Park Picnic area well
Hooper well
GFF outcrop
Elevation (feet)
3,200
3,100
3,000
2,900
2,925
soil:
Basalt broken:
Basalt & clay:
Basalt grey:
Basalt broken:
Basalt soft:
Basalt & clay:
Basalt broken:
Basalt & clay:
clay - some sand:
clay - some rock:
clay - brown & sandy:
Basalt grey:
WL on 4/16/2008
clay & gravel:
Basalt broken:
clay & gravel:
clay, silt, sand: estimate depth of 25 feet
sand:
Basalt broken:
Basalt grey:
Basalt pink & grey:
Basalt pink & grey:
Basalt broken:
Basalt grey:
Basalt broken:
Basalt grey:
Basalt broken:
Basalt grey:
Basalt grey:
Basalt pink & grey:
Basalt grey:
WL on 3/20/2009
Basalt broken:
Basalt grey:
Basalt broken:
soil:
Basalt grey:
sandstone:
Basalt grey:
WL on 7/25/1974
Basalt broken:
cinders:
Basalt grey:
clay - brown:
clay/sand/gravel:
Elev. of Woody's Alcove = 3,000 ft.
Elev. of pillow lavas = 3,025 ft.
Elev. of M.G. River and MG-7 sample site = 3,032 ft.

Malad Gorge Pillow Basalt Layer

Rangen Spring Pillows.

Tunnel to enhance spring flow

'Pillow Lava' – formed when lava flows into water. (hyperlink)


Pillow Basalt Outcrops
Bliss at river
Hwy 30 Grade
Base of Malad Gorge
Big Springs Tunnel
Weatherby Spring
Dairy outcrop south of Rangen
Curren Tunnel
Thousand Springs
Federal Hatchery
Ten Springs
Niagra Grade
Above Niagra
Above Blue Hart
Buhl/Wendell Road Cut
Bliss
Gooding
Gooding Butte
Tuttle
Hagerman
Wendell
Jerome
Snake River
Sonnickson Butte
Buhl
84
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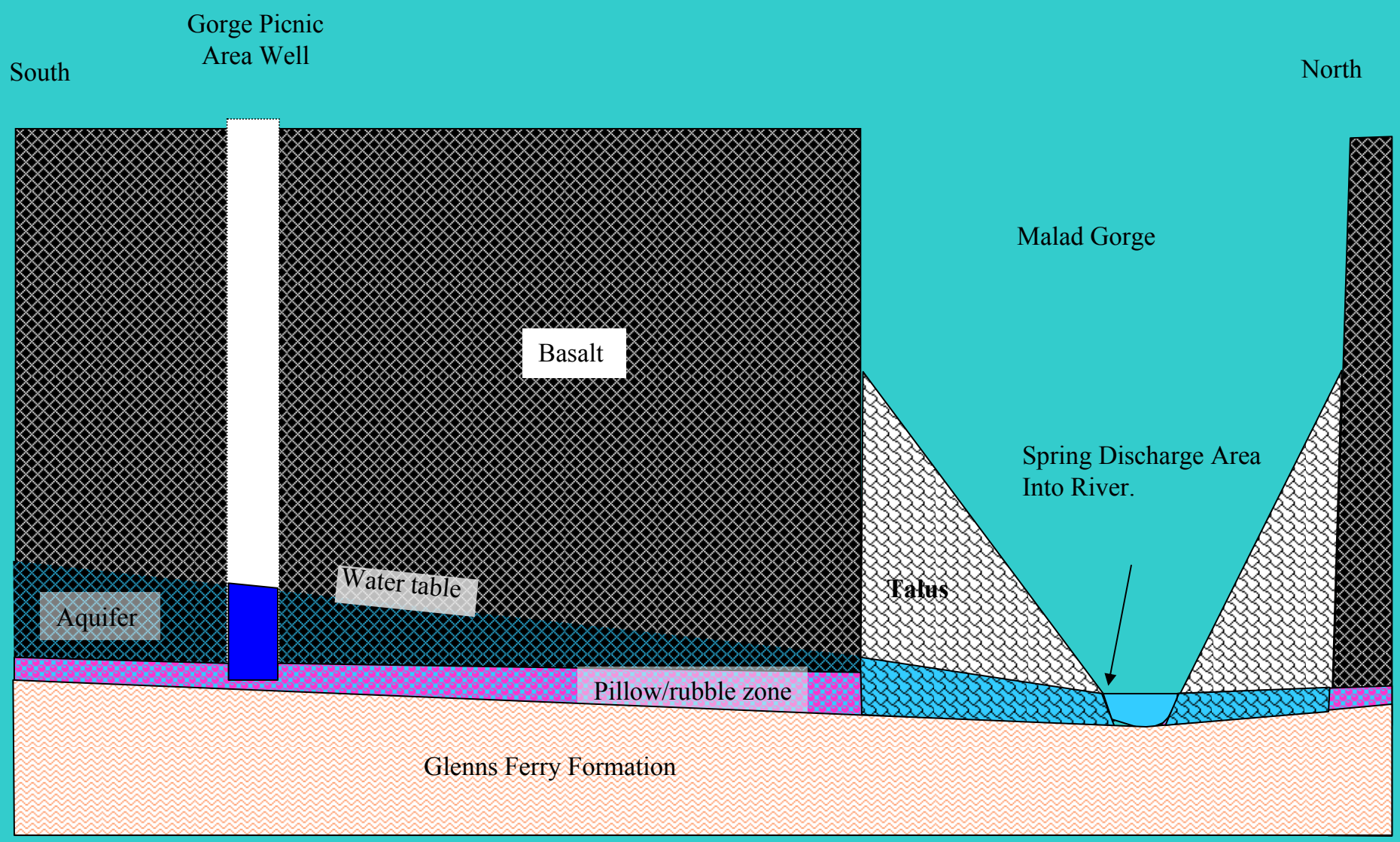
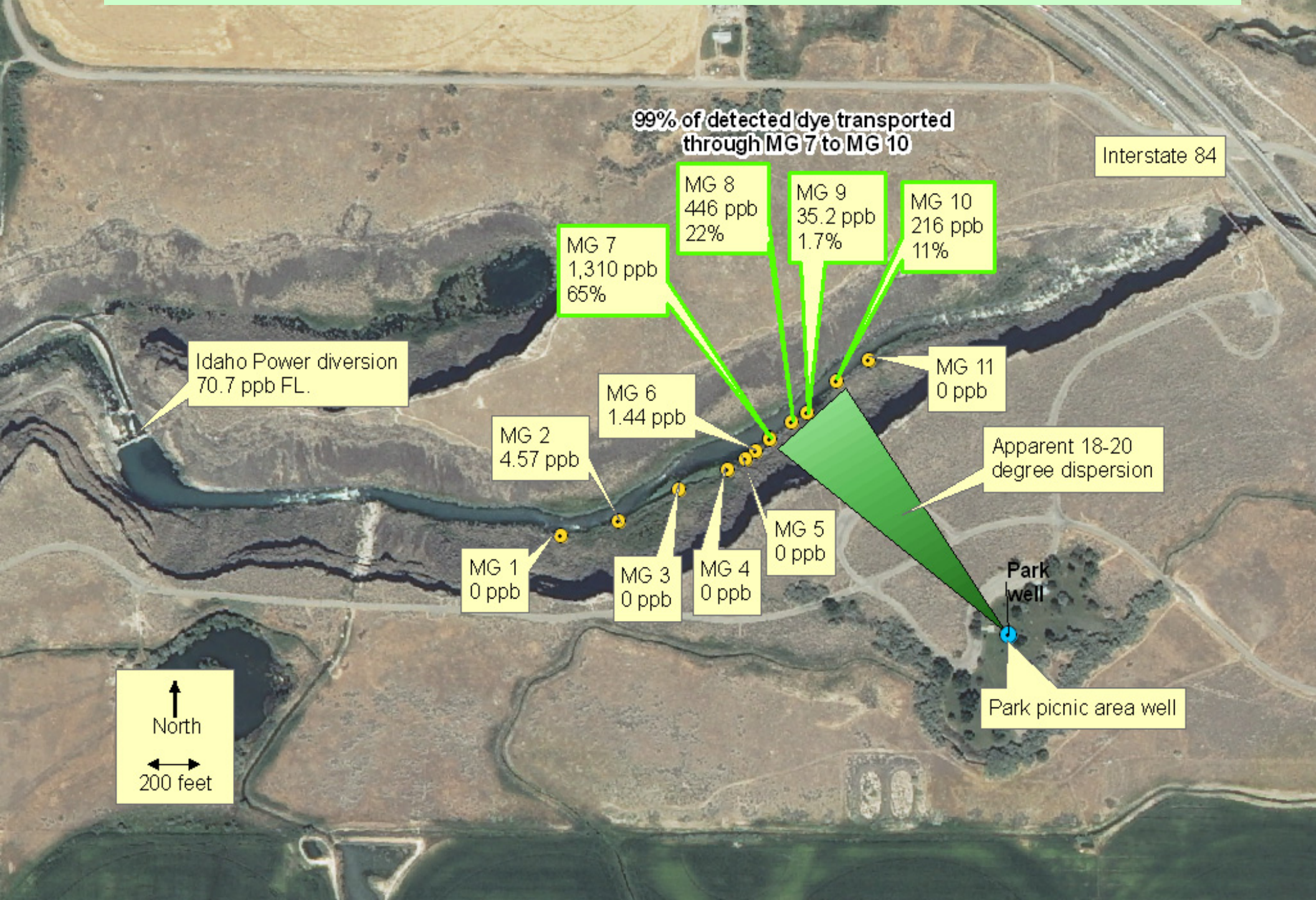

Gorge Picnic
Area Well
South
North
Malad Gorge
Basalt
Spring Discharge Area
Into River.
Water table
Talus
Aquifer
Pillow/rubble zone
Glenns Ferry Formation

Malad Gorge Tracer Test
Charcoal packet concentrations of Fluorescein dye
(not water concentration)



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