IDAHO
Water Resource Board

Allocation of Managed Recharge Impacts and Capacity Limitations – ESPAM2.1

Prepared by Mike McVay, Neal Farmer, Mat Weaver

Presented by Mike McVay

November 19, 2013

Aquifer Water Balance

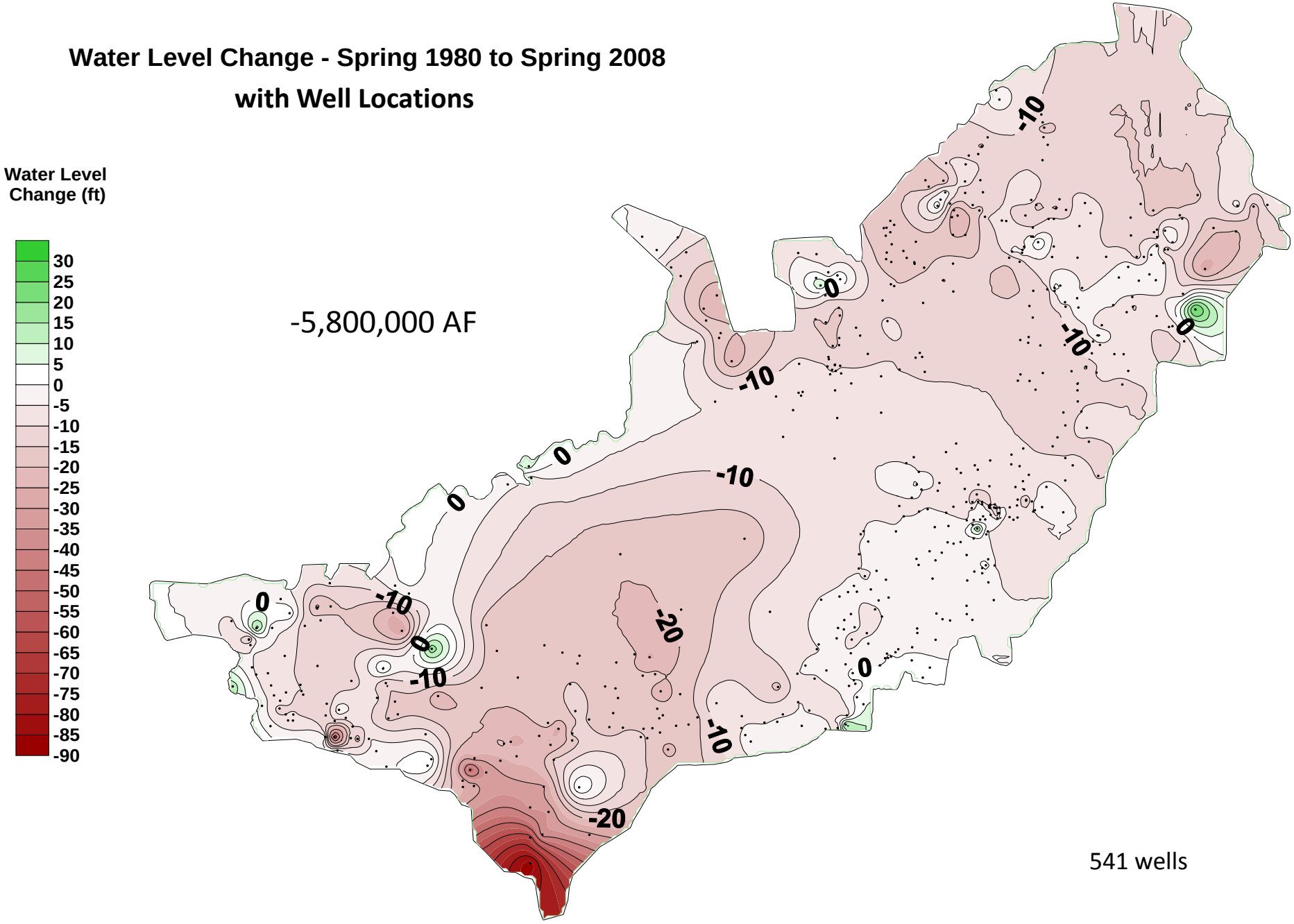
Inflow – Outflow = ΔStorage

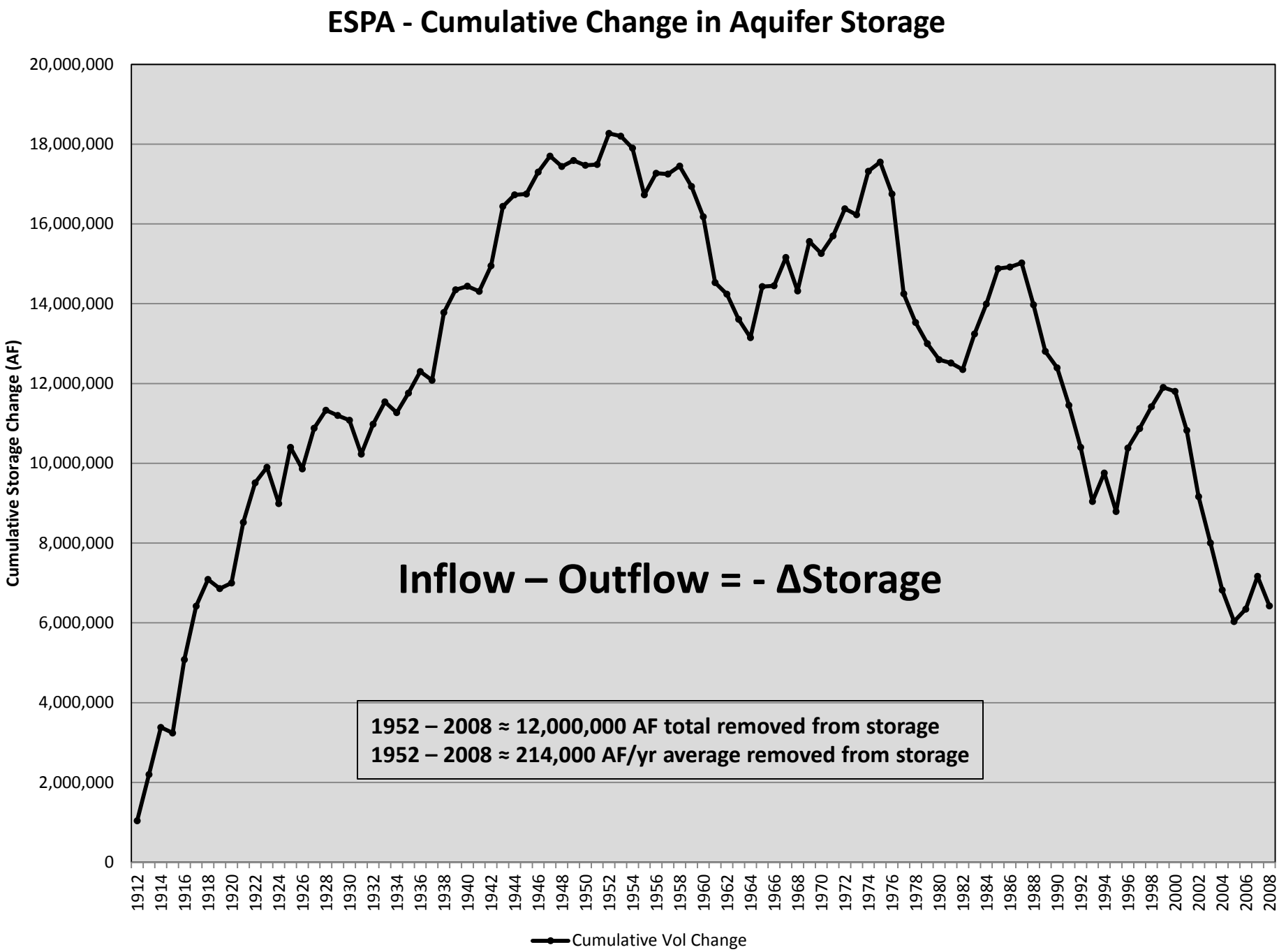
ESPA Inflows = Incidental recharge from SW irrigation, Canal Seepage, Perched River Seepage, Tributary Underflow, Precipitation.

ESPA Outflows = Evapotranspiration, Spring Discharge, Well Pumping

We can use estimates of aquifer storage to generate an aquifer "history."

Water Level Change - Spring 1980 to Spring 2008
with Well Locations




ESPA - Cumulative Change in Aquifer Storage
Cumulative Storage Change (AF)
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
1912 1914 1916 1918 1920 1922 1924 1926 1928 1930 1932 1934 1936 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008
Inflow – Outflow = - ΔStorage
1952 – 2008 ≈ 12,000,000 AF total removed from storage
1952 – 2008 ≈ 214,000 AF/yr average removed from storage
Cumulative Vol Change

How can we “balance the budget?”

The [CAMP] water budget adjustment mechanisms include:

A. Ground water to surface water conversions.
B. Managed aquifer recharge.
C. Demand reduction.
D. Pilot weather modification program.
E. Minimizing loss of incidental recharge.

-ESPA CAMP January 2009

This presentation is based upon modeling efforts and analysis that were started by Dr. Johnson.

Re-run with ESPAM2.1.

Prioritization of Aquifer Recharge Sites Based on Hydrologic Benefits

Prepared for the
Idaho Department of Water Resources
and
Idaho Water Resource Board

by
Gary S. Johnson
Idaho Water Resources Research Institute
University of Idaho, Dept. of Geological Sciences
April, 2012

Where to Recharge?

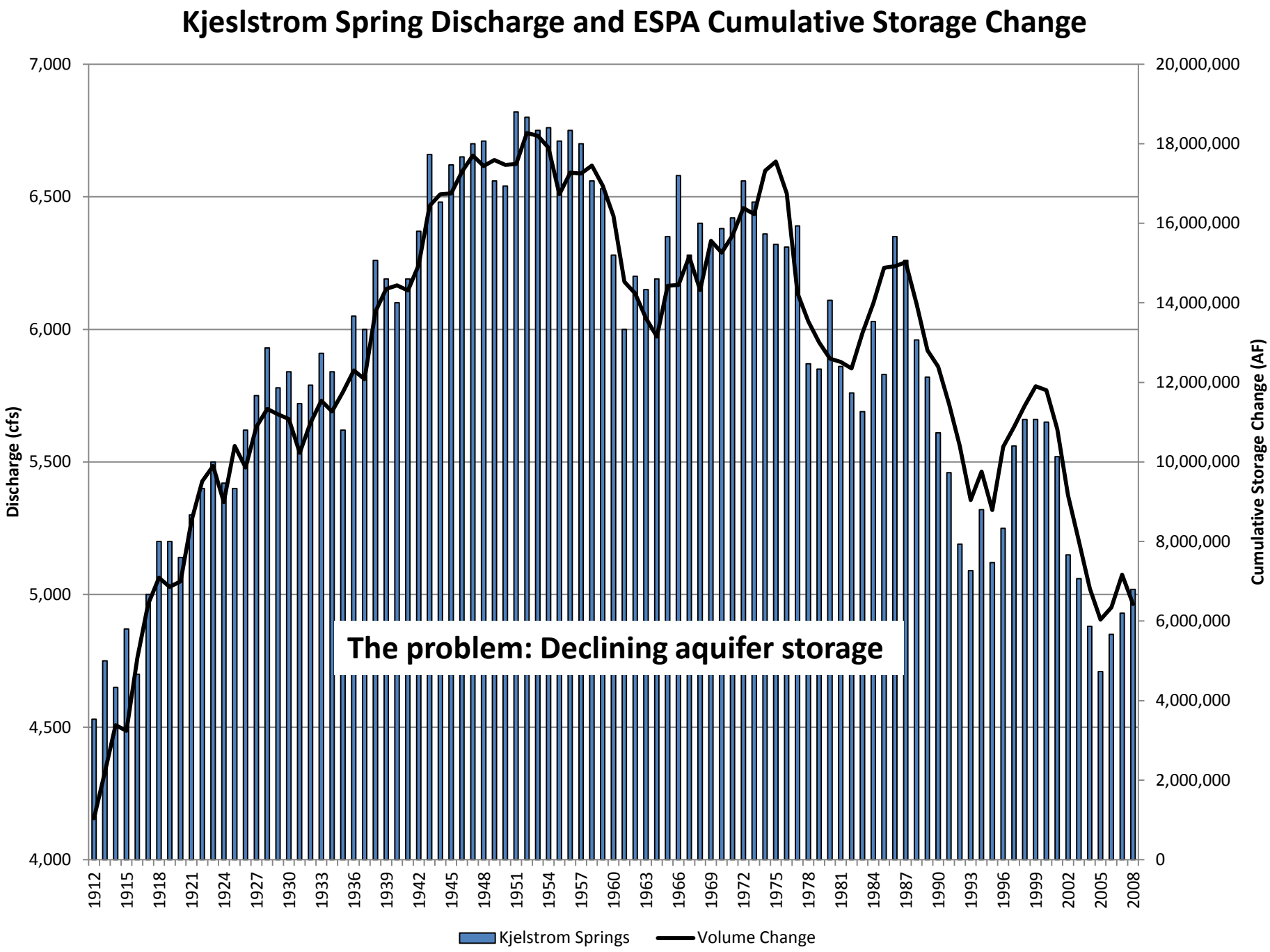
Criterion 1A: Percent of a single, one-month recharge discharged in the below Milner reach within 3 years.
Criterion 1B: Percent of continuous recharge as additional spring discharge below Milner after one year.
Criterion 2A: Percent of a single, one-month recharge discharged below Milner between 3 and 30 years.
Criterion 2B: Percent of long-term, continuous recharge in springs below Milner three years after recharge ends.
Criterion 3: Percent of annual recurring March recharge discharge above Minidoka July through September. The values are calculated for the 30th year of recurring recharge.
Criterion 4: Same as Criterion 3 except for returns in the months of November through February.
Criterion 5: Percent of a single, one-month recharge discharged above Minidoka between 3 and 30 years after the recharge activity.
Criterion 6: Average water level in the A&B area after 10 years of continuous recharge at 100,000 AF/yr.
Criterion 7A: Percent of single, one-month recharge volume retained in aquifer storage 10 years after the recharge activity.
Criterion 7B: Average water level change in the Snake River Plain aquifer after 10 years of continuous recharge at 100,000 AF/yr.

Dr. Johnson was asked to evaluate recharge sites in an effort to prioritize IWRB managed recharge.

Where to Recharge: Depends

The general message from Dr. Johnson's work is:

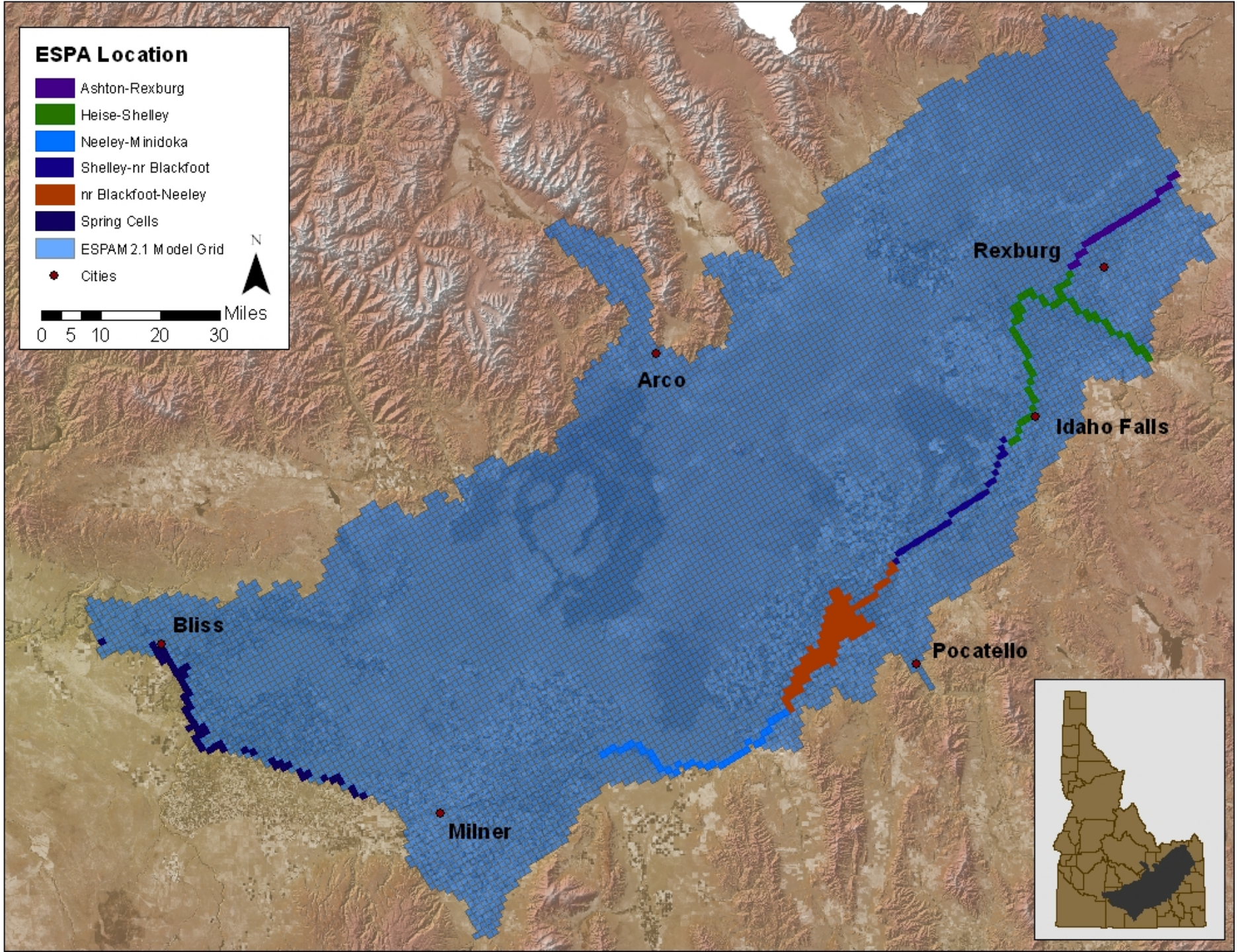
Where best to recharge depends on the goal of recharge.

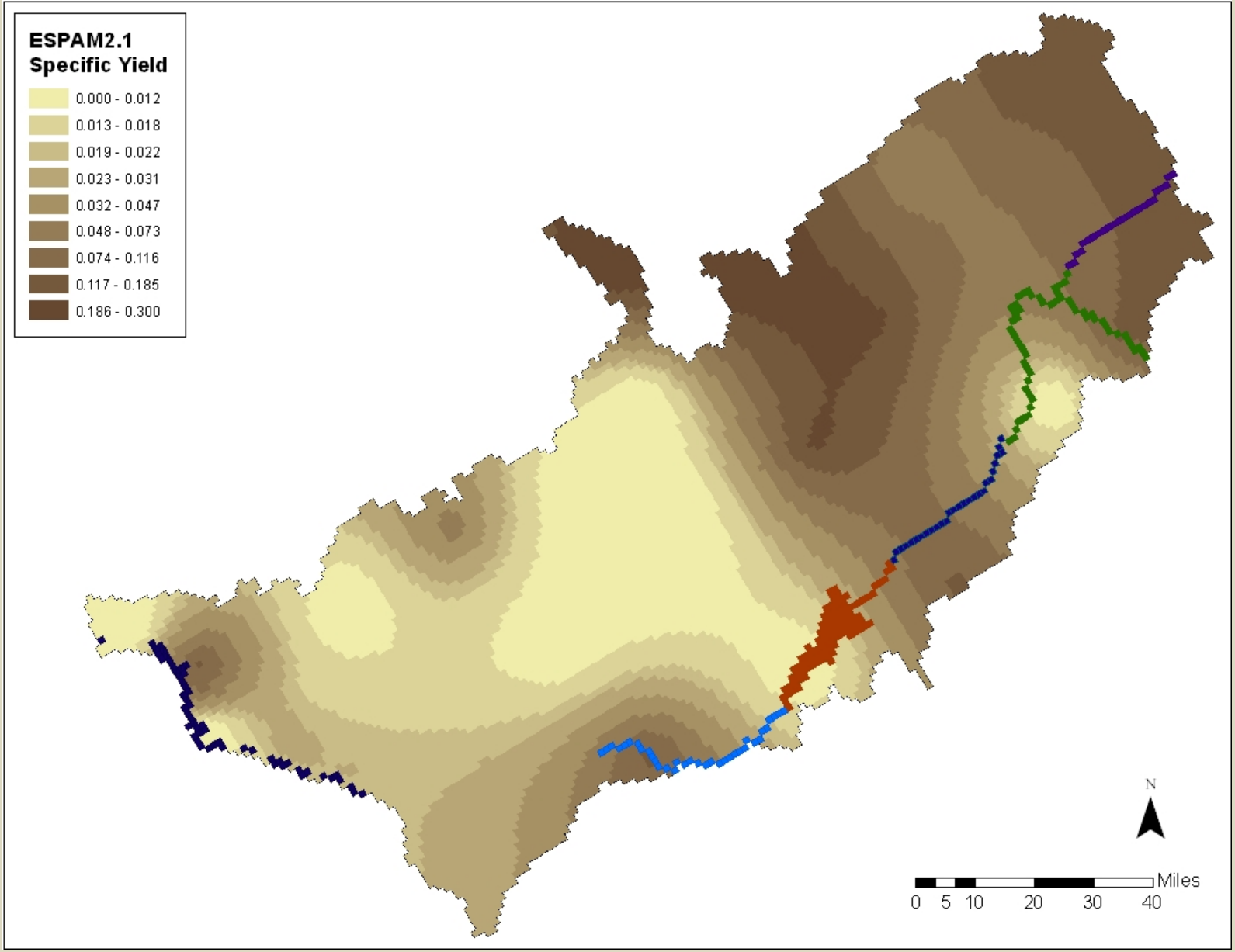

Kjeslstrom Spring Discharge and ESPA Cumulative Storage Change
Discharge (cfs)
Cumulative Storage Change (AF)
7,000
6,500
6,000
5,500
5,000
4,500
4,000
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
1912
1915
1918
1921
1924
1927
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
The problem: Declining aquifer storage
Kjelstrom Springs
Volume Change

The IWRB Recharge Goal

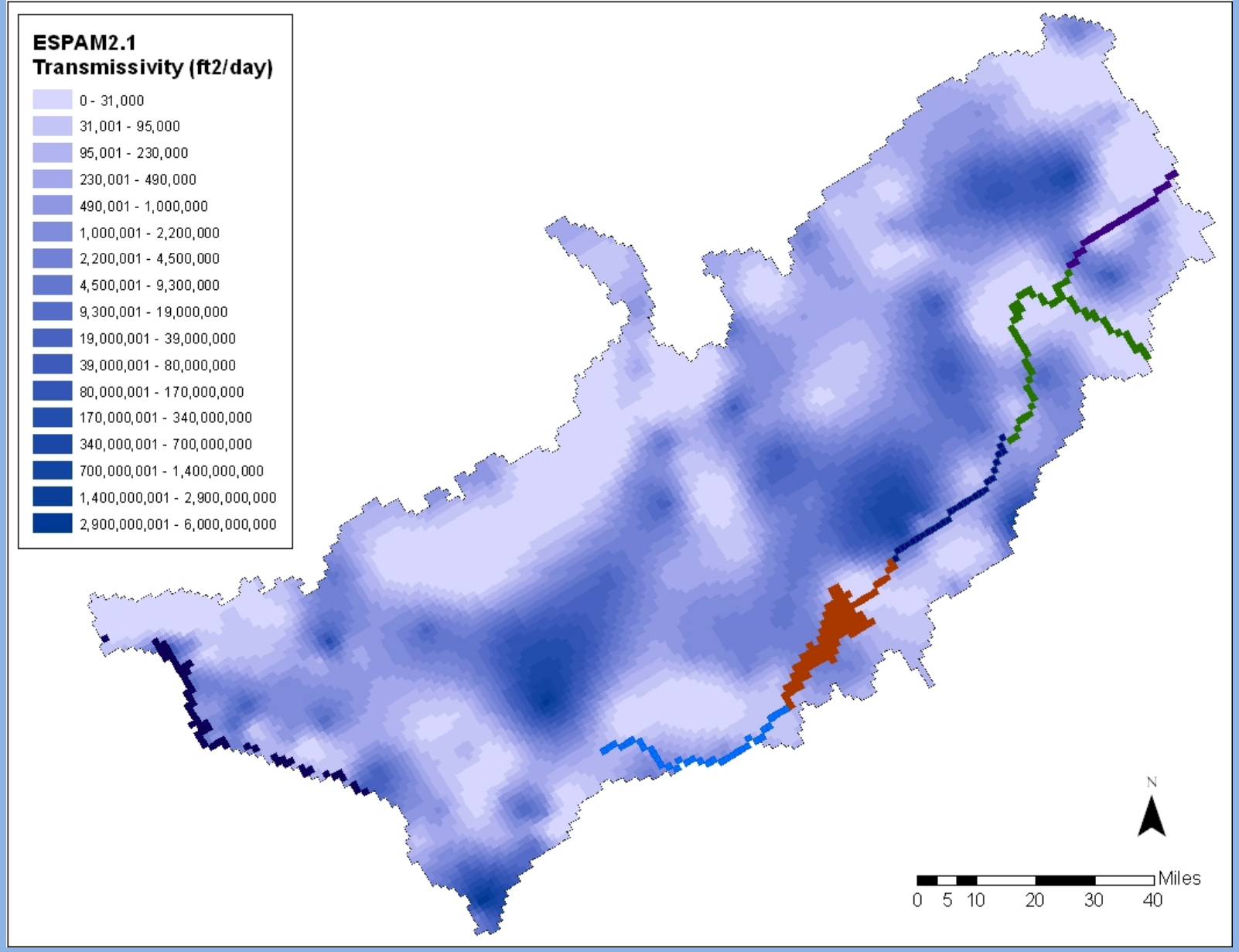
"The long-term objective of the [ESPA Comprehensive Aquifer Management] Plan is to incrementally achieve a net ESPA water budget change of 600 thousand acre-feet annually."

-ESPA CAMP January 2009

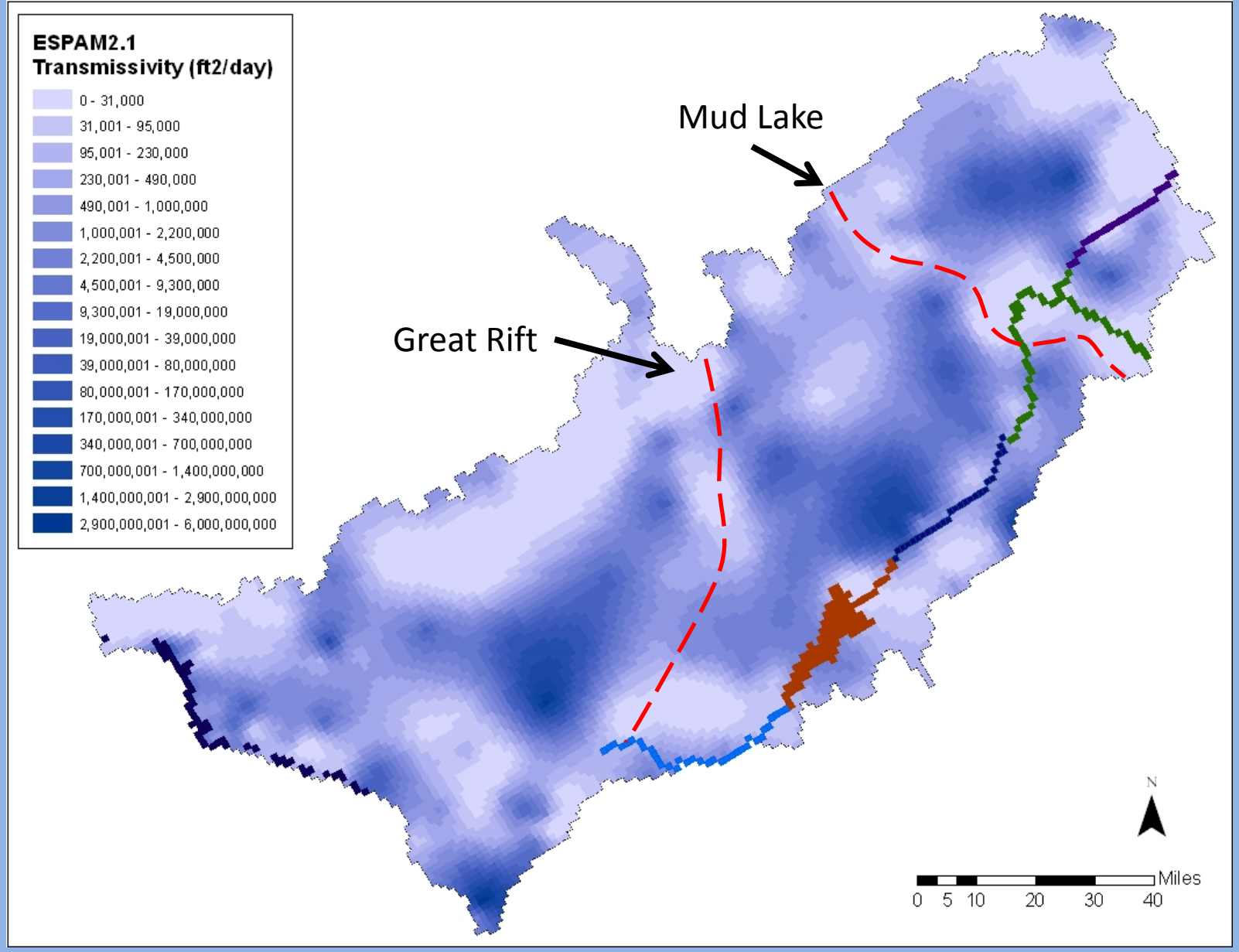

ESPA Location
Ashton-Rexburg
Heise-Shelley
Neeley-Minidoka
Shelley-nr Blackfoot
nr Blackfoot-Neeley
Spring Cells
ESPAM 2.1 Model Grid
Cities
N
Miles
0 5 10 20 30
Rexburg
Arco
Idaho Falls
Bliss
Pocatello
Milner



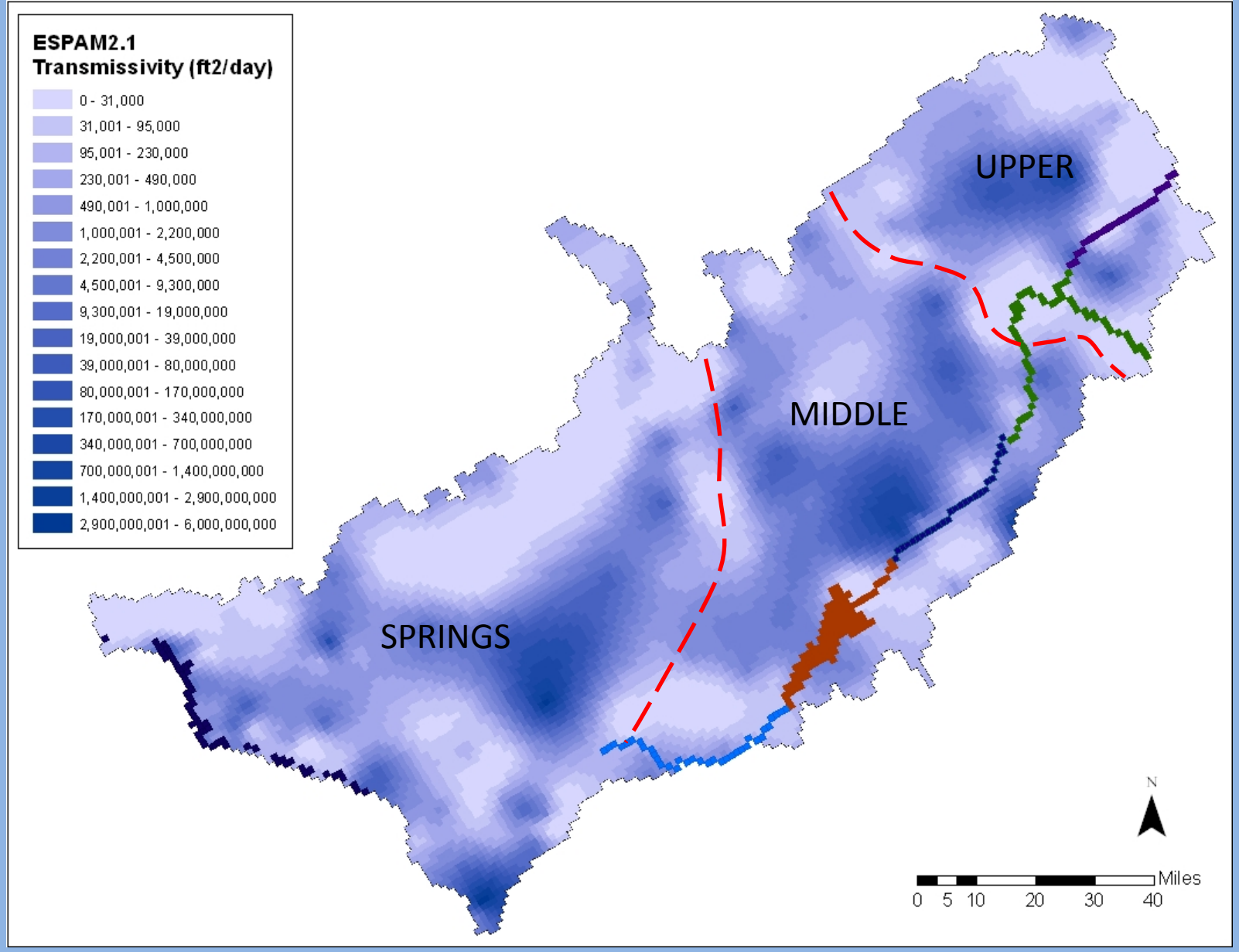
Lower Specific Yield results in less change in storage per change in water level.



Higher Transmissivity results in more widespread, smaller magnitude water-level responses.



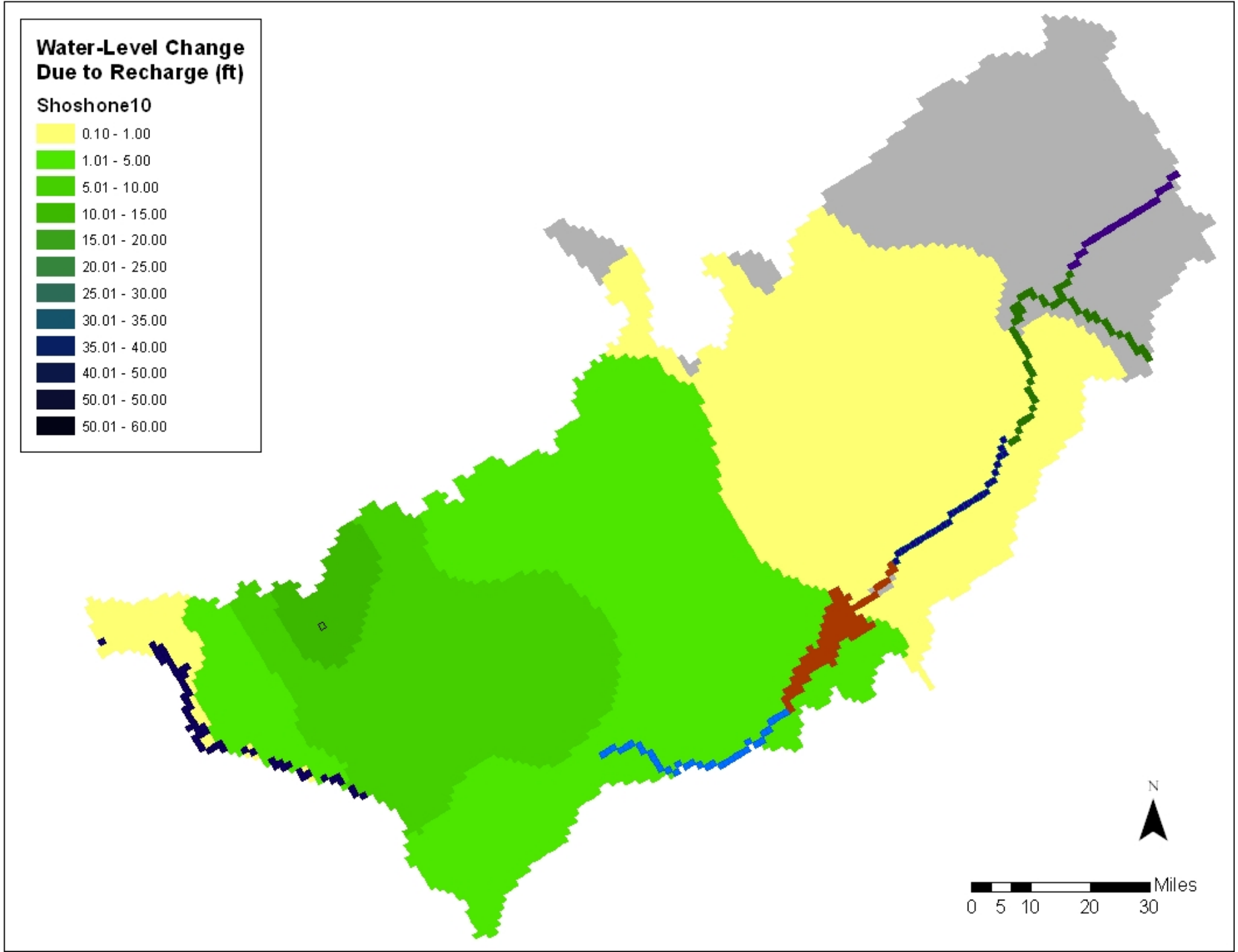
The Great Rift and Mud Lake "Barriers" are important controls on the impacts due to recharge.

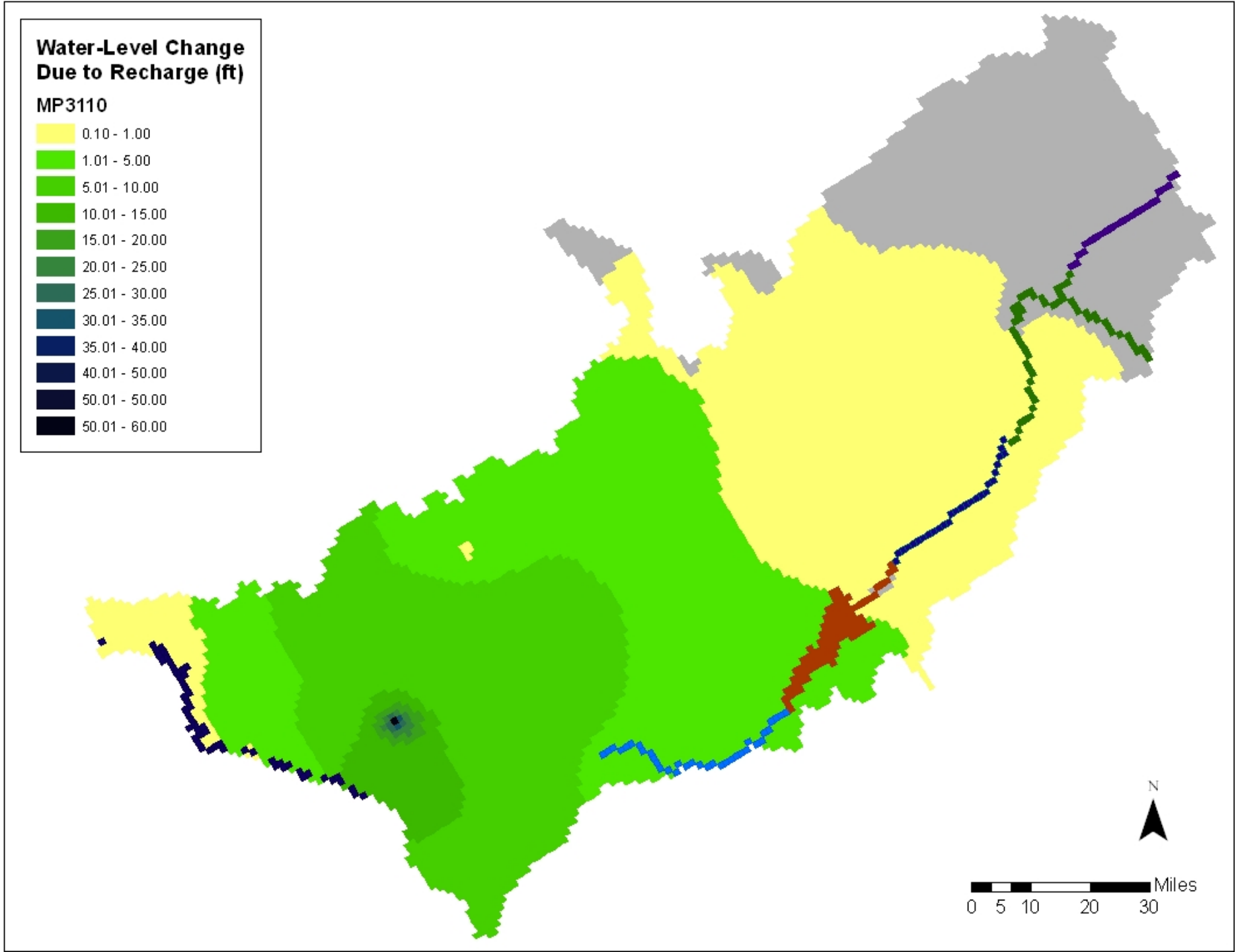


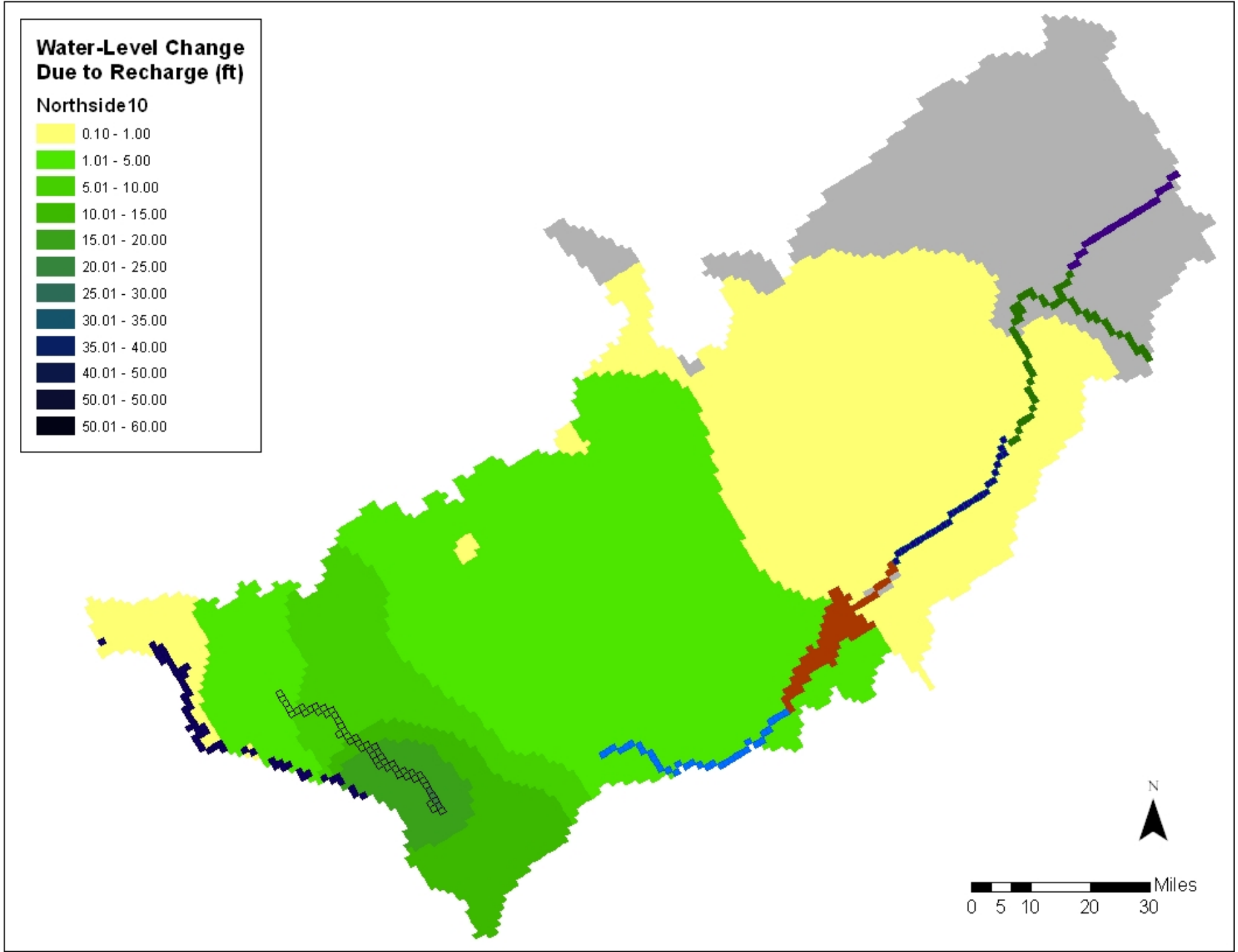
The Great Rift and Mud Lake "Barriers" are important controls on the impacts due to recharge.

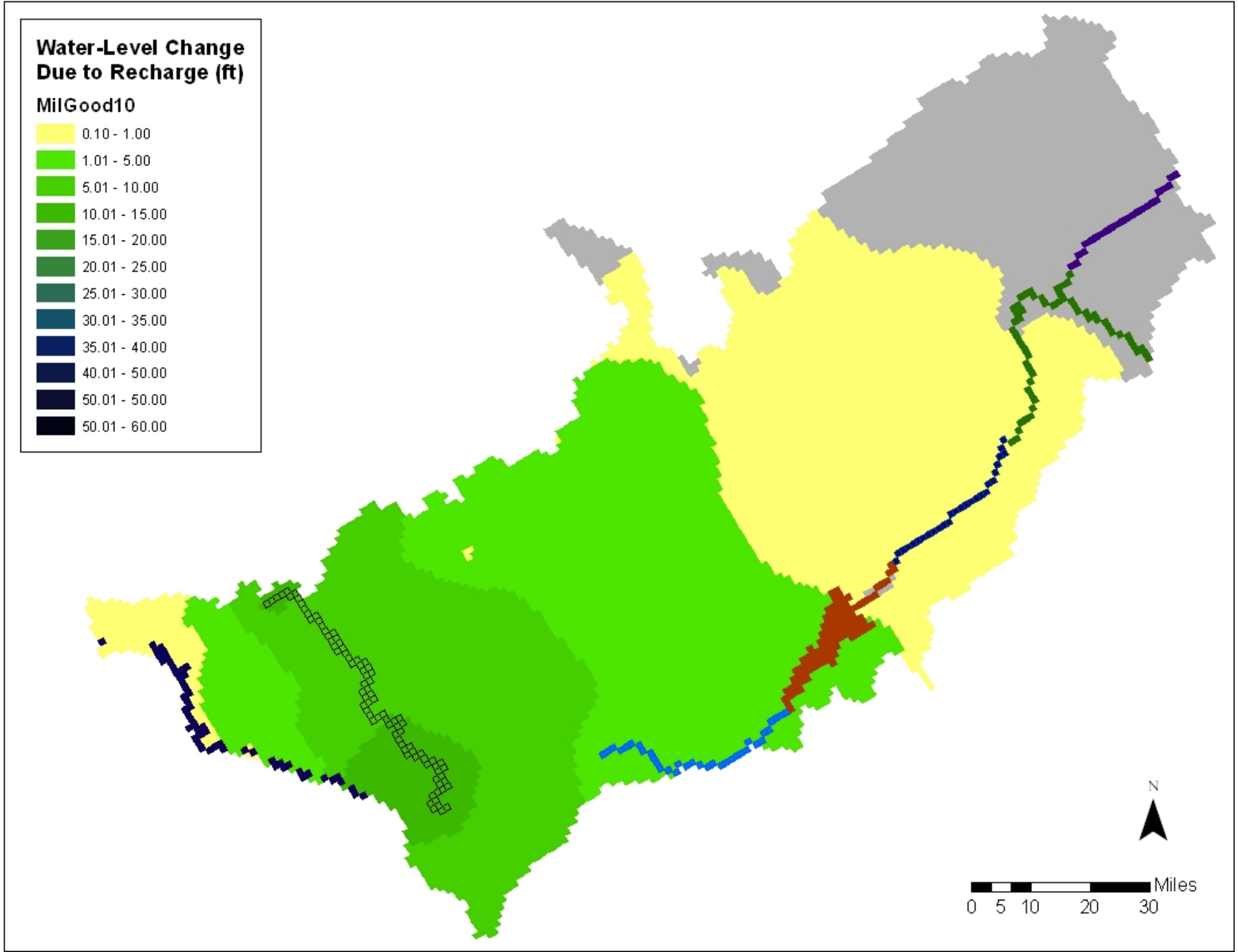
"Johnson" Recharge Evaluation

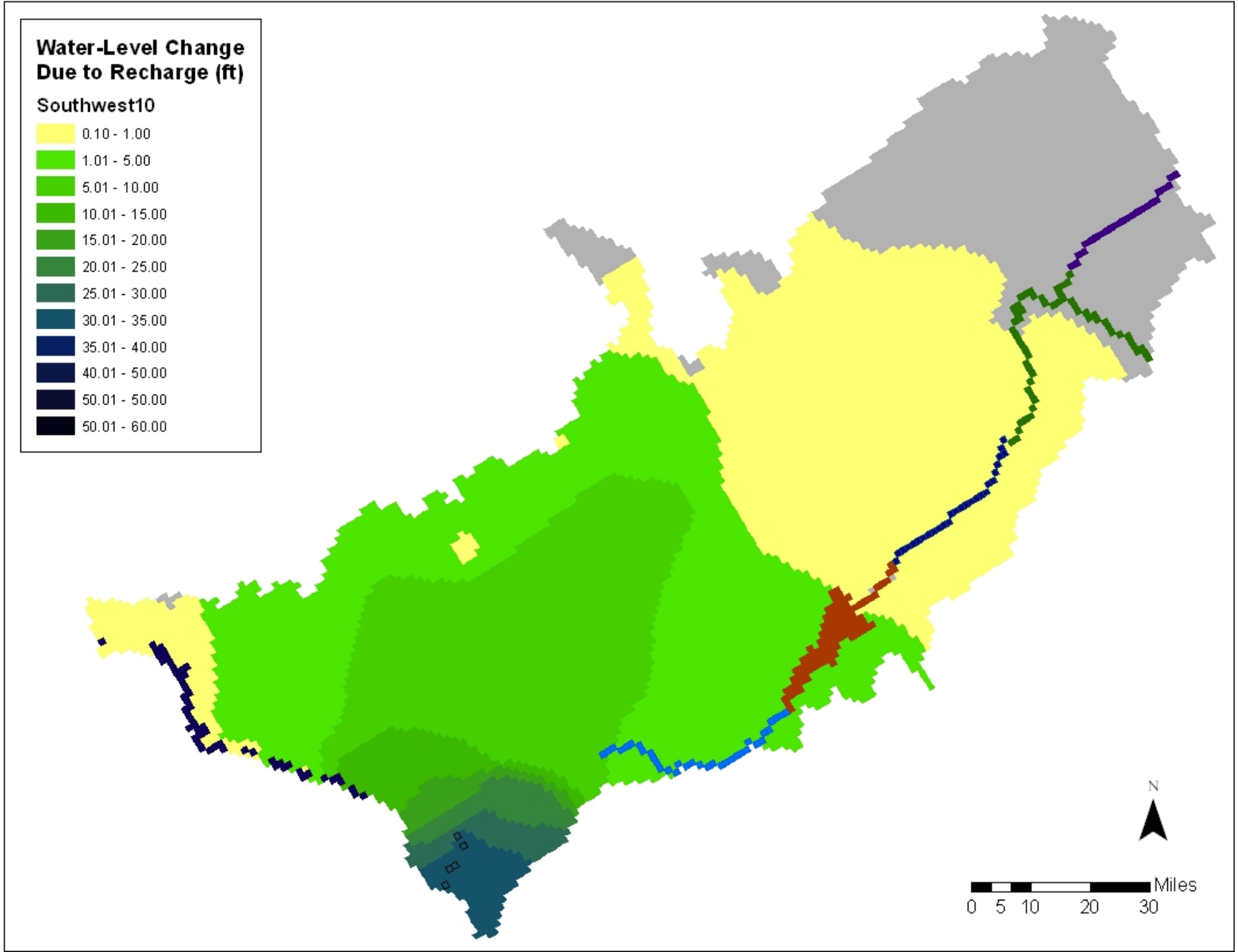
- Recharge each site at 100,000 AF/year
  - Model run in Superposition Mode.
  - Model represents recharge as direct injection into regional aquifer.
  - **Exaggerated rate allows illustration of aquifer behavior.**
  - Does not include transmission losses to discrete sites.

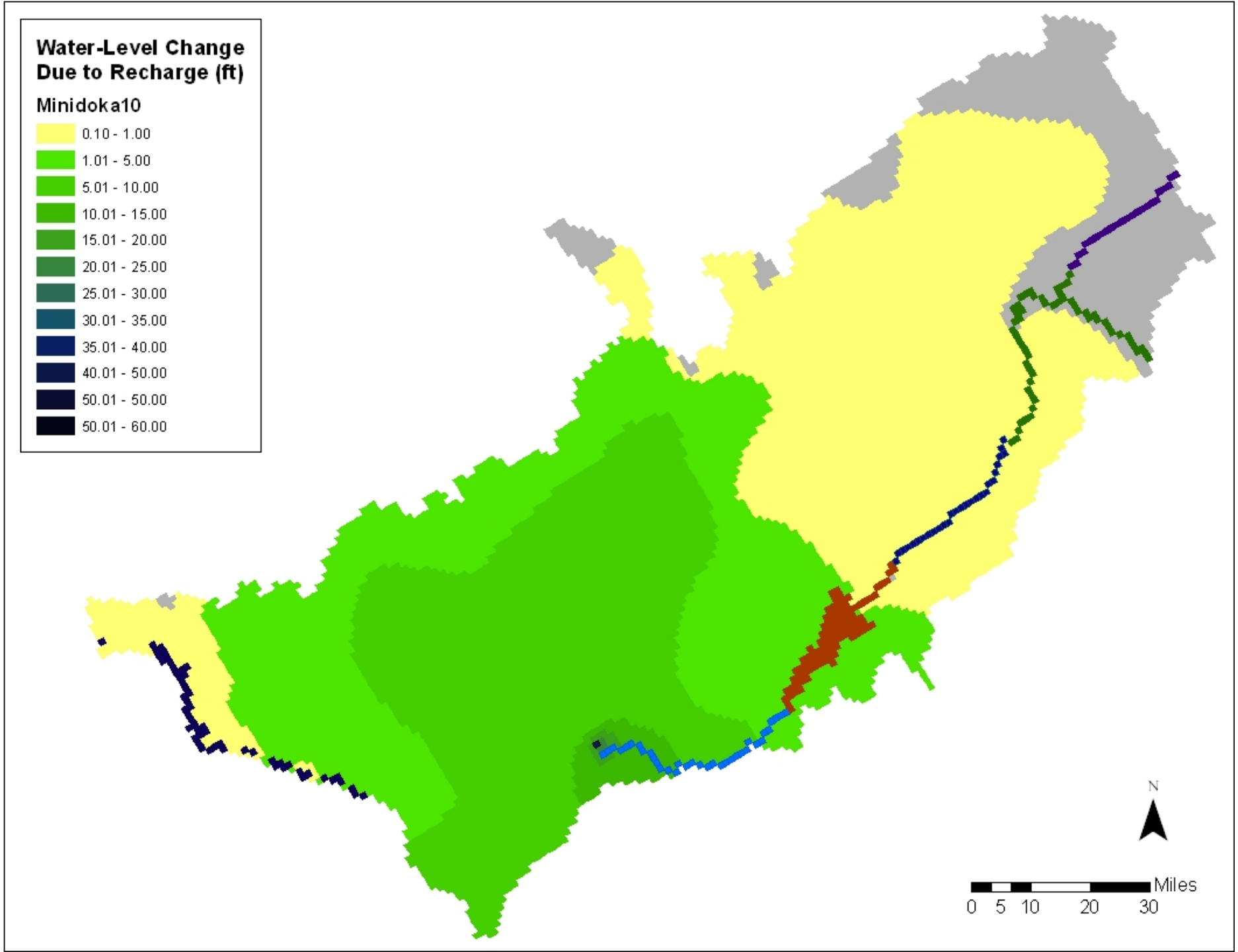

Water-Level Change Due to Recharge (ft)
Shoshone10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

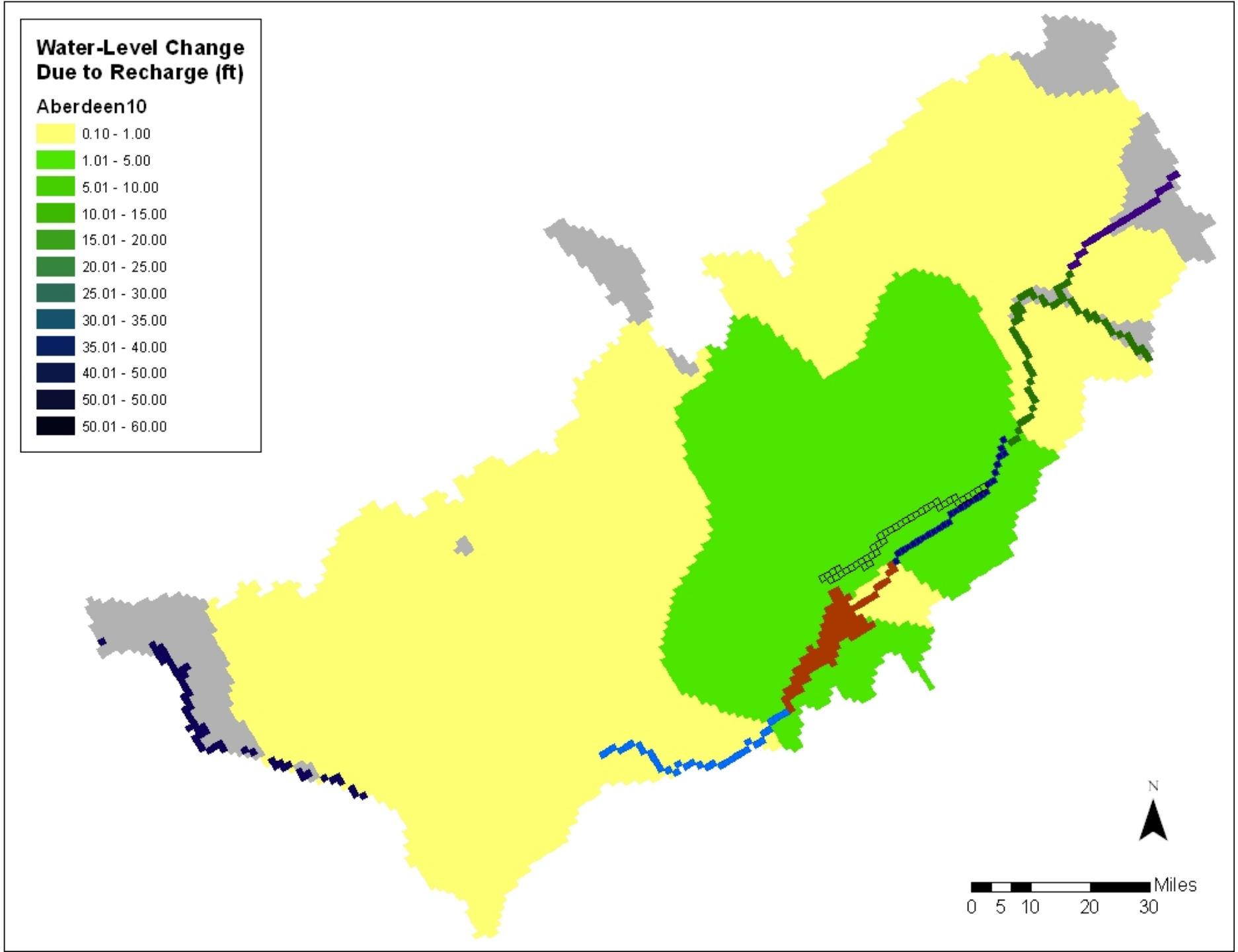

Water-Level Change
Due to Recharge (ft)
MP3110
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

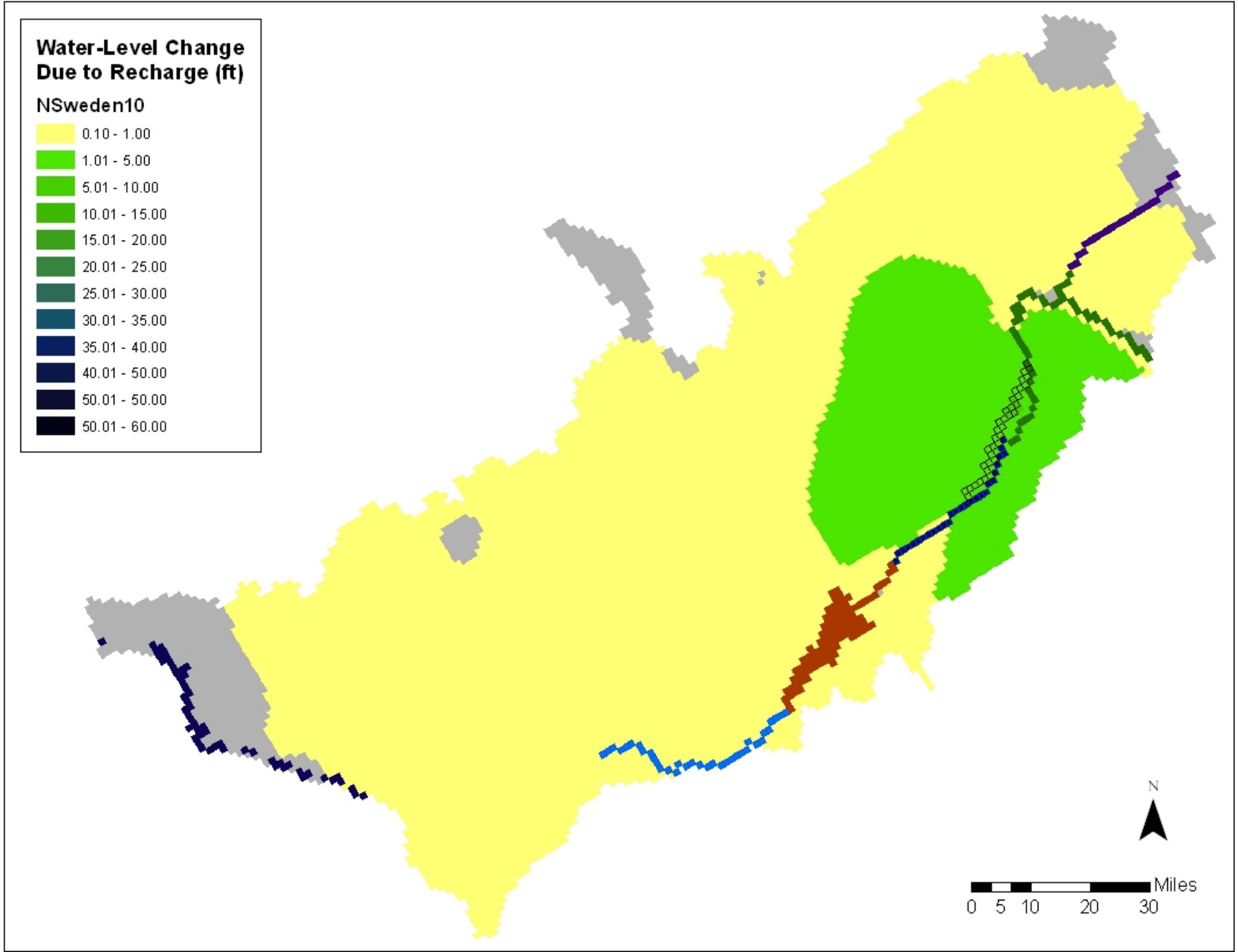

Water-Level Change
Due to Recharge (ft)
Northside10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

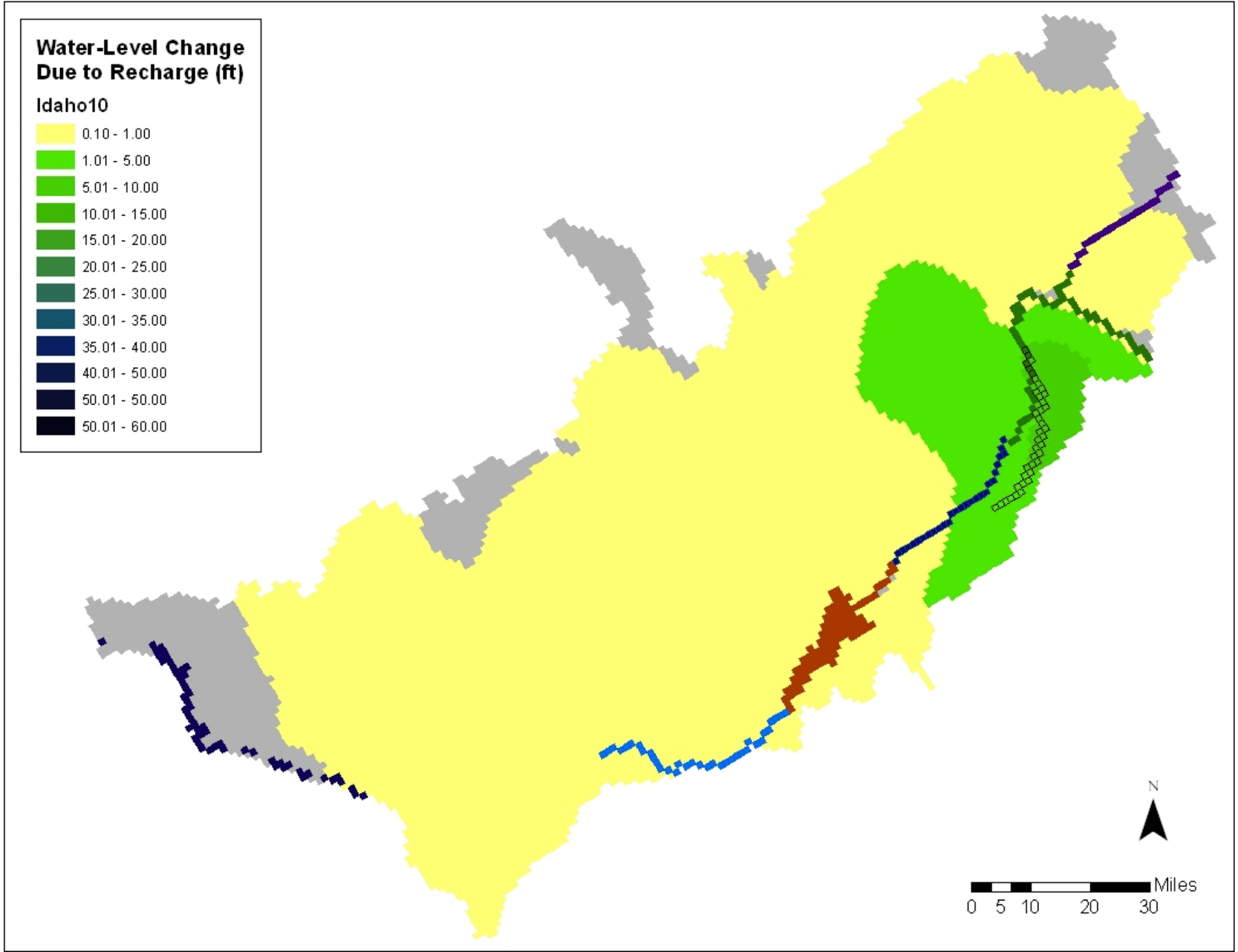

Water-Level Change
Due to Recharge (ft)
MilGood10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

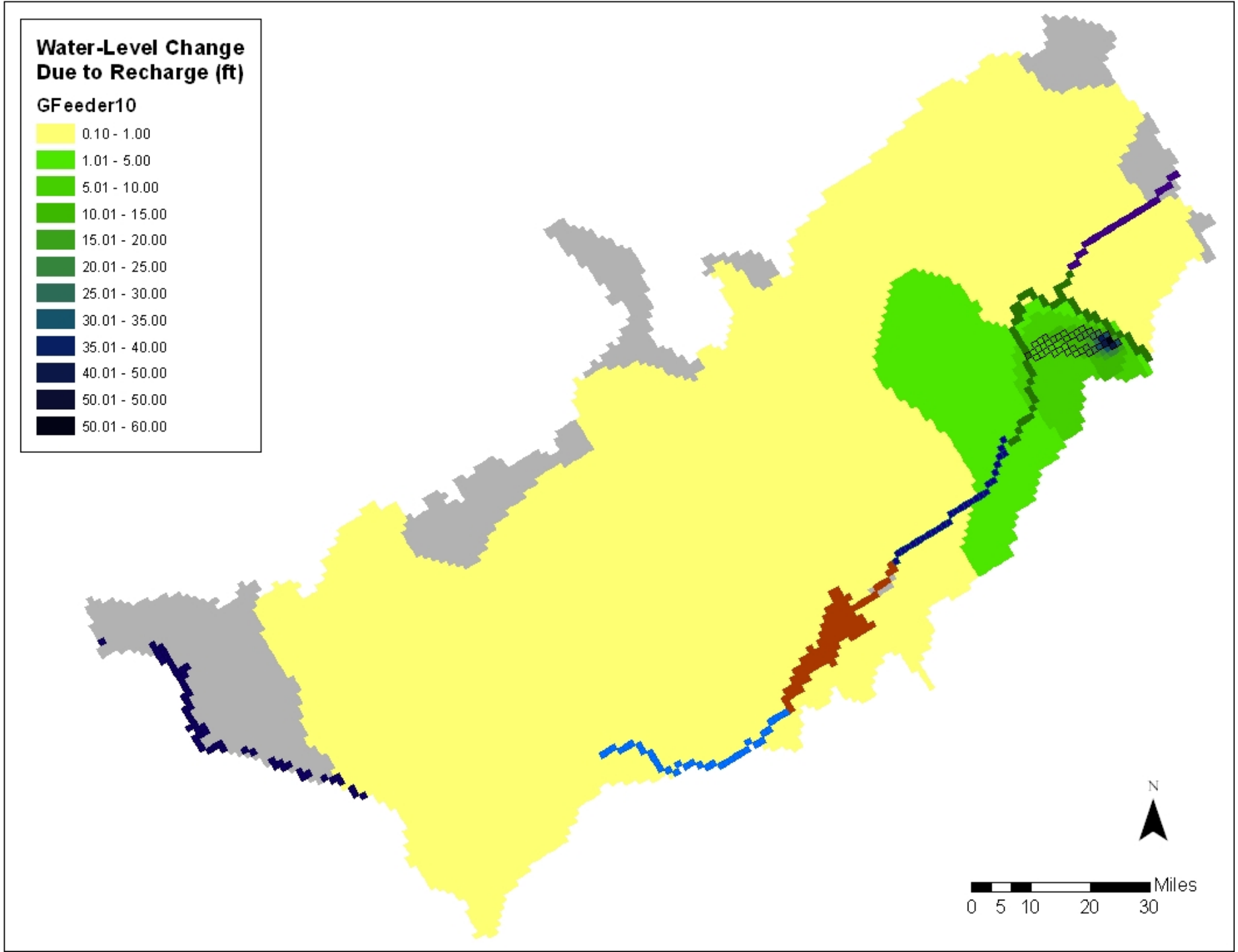

Water-Level Change Due to Recharge (ft)
Southwest10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

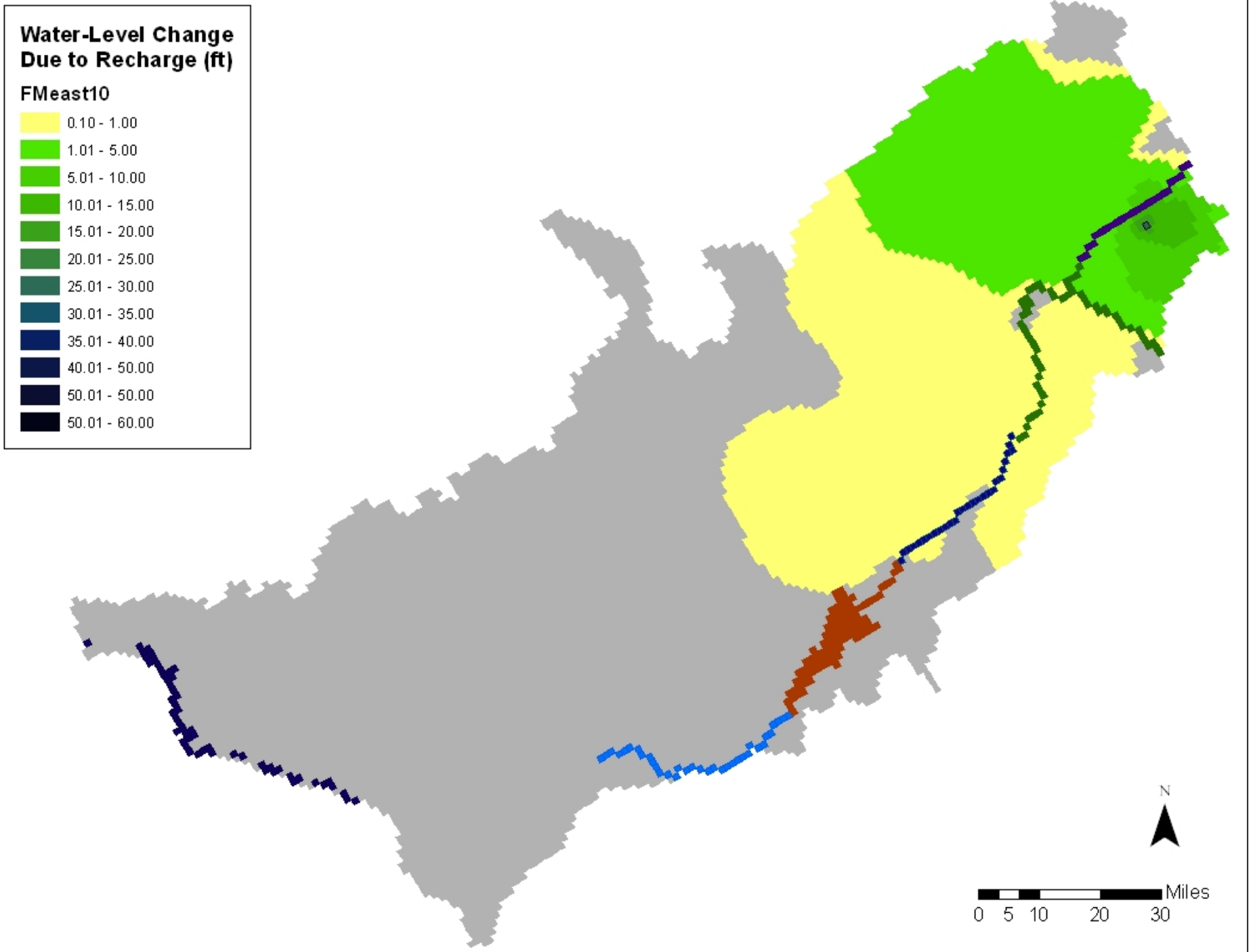

Water-Level Change
Due to Recharge (ft)
Minidoka10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

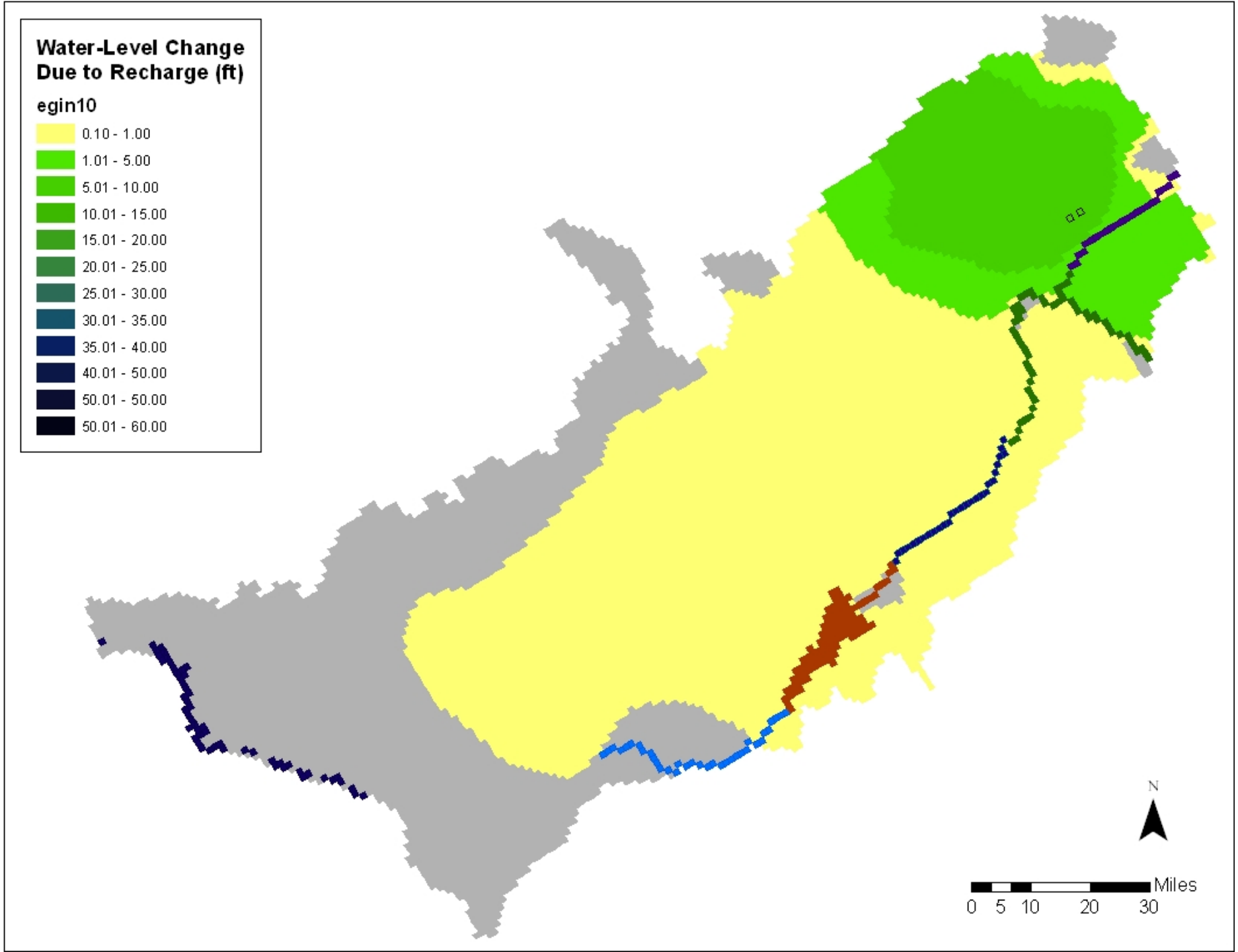

Water-Level Change
Due to Recharge (ft)
Aberdeen10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
NSweden10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
Idaho10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
GFeeder10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

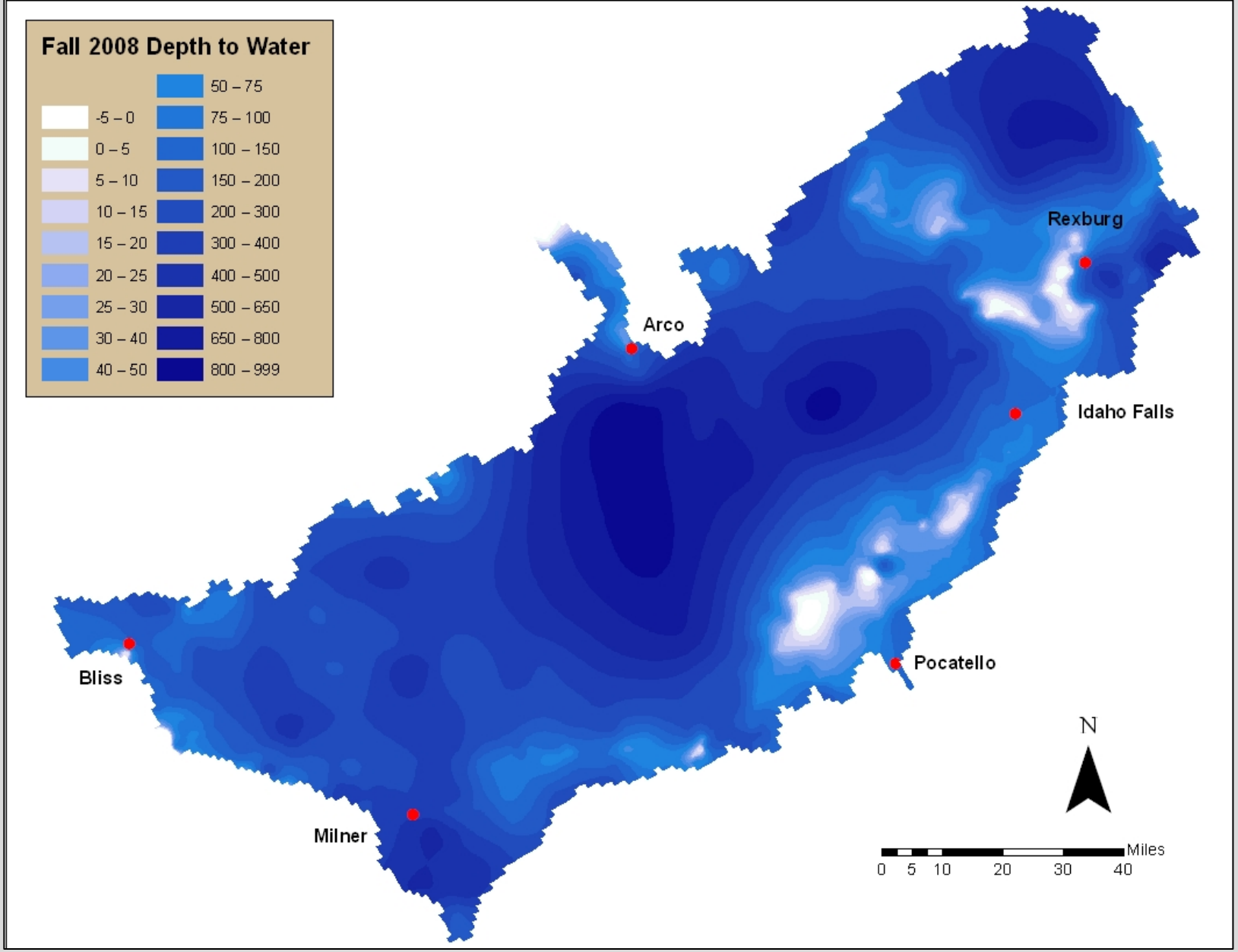

Water-Level Change Due to Recharge (ft)
FMeast10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
egin10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

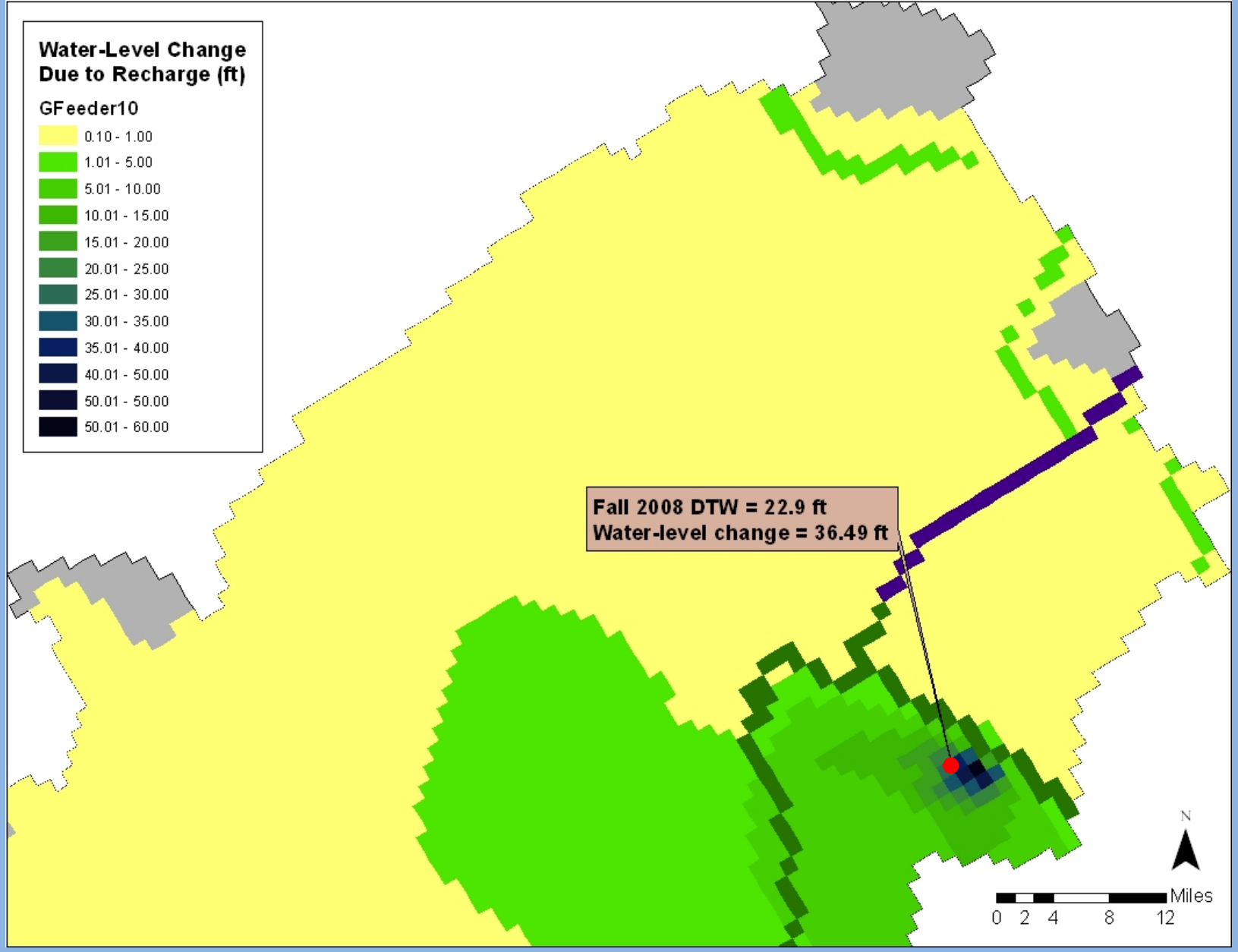
Value of Modeling Continuous 100,000 AF/yr Recharge at Individual Sites for Ranking Managed Recharge Sites

- Good way to *illustrate* the effects of Managed Recharge. The large, constant stress allows us to visualize how the aquifer responds to recharge.

- May be misleading as to the ability of a site to ***divert*** **and** ***accept*** recharge. Model can predict favorable Aquifer Storage benefits at sites that do not have the physical capacity to place large amounts of recharge into aquifer storage.



Observation: Several locations exhibit shallow groundwater that may make Managed Recharge less effective than modeled results.



Example of a location where the model predicts water-level changes above land surface.

Is the ESPAM2.1 Predicting Geysers?

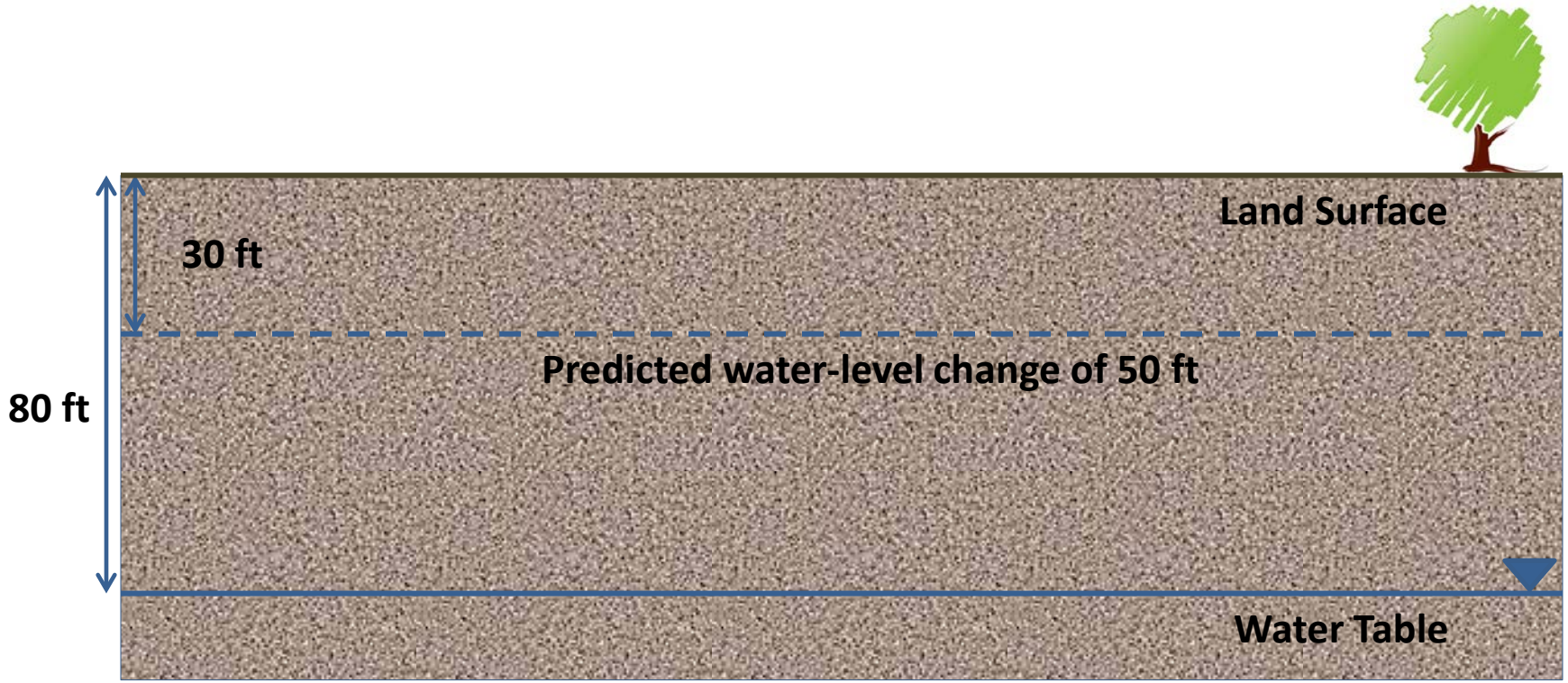
No. The model has not been given any information about land surface.
We must remember we are the brain, the model is the tool.

In the areas where the model predicts water-level changes that are at or above land surface, it is important to remember the model is not wrong.

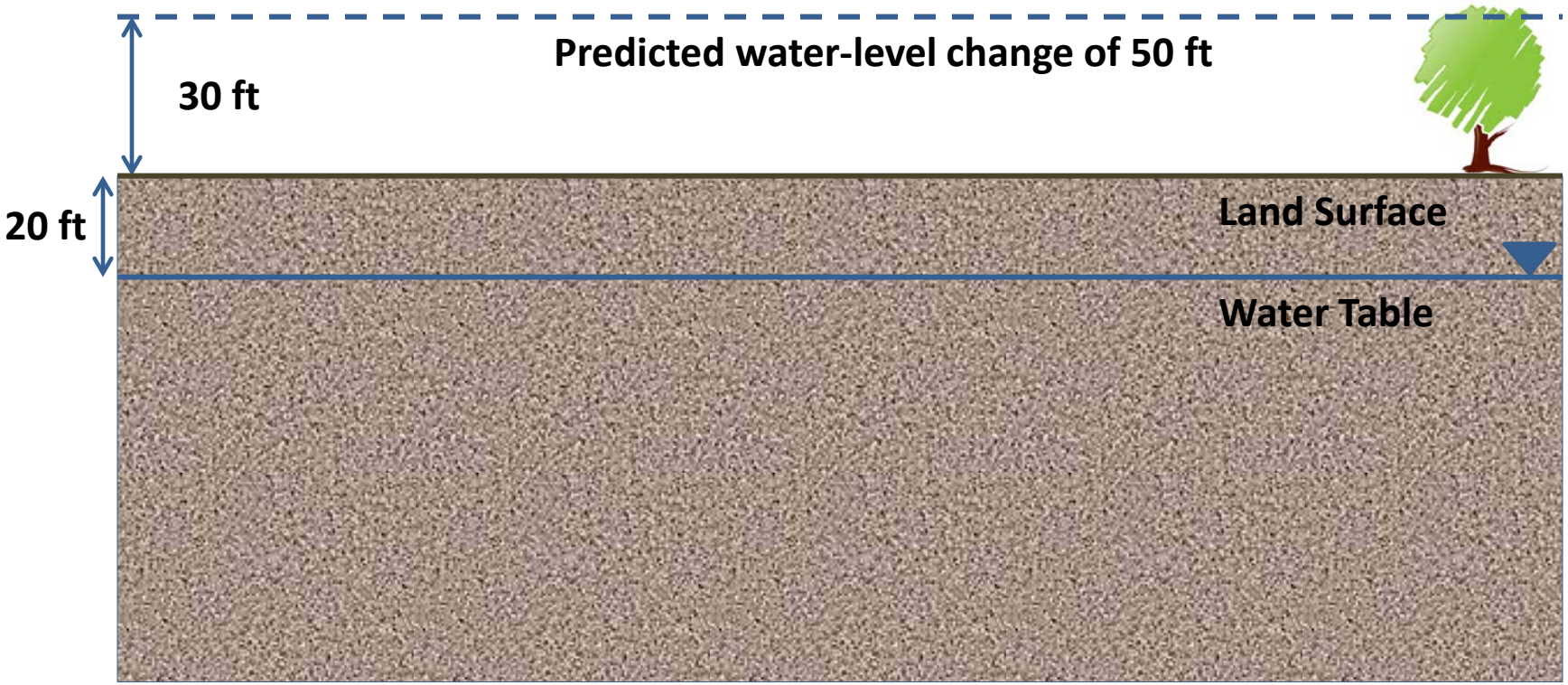
The model is telling us something. That something is **Recharge Capacity.**

50 ft water-level change at 100,000 AF/yr Recharge

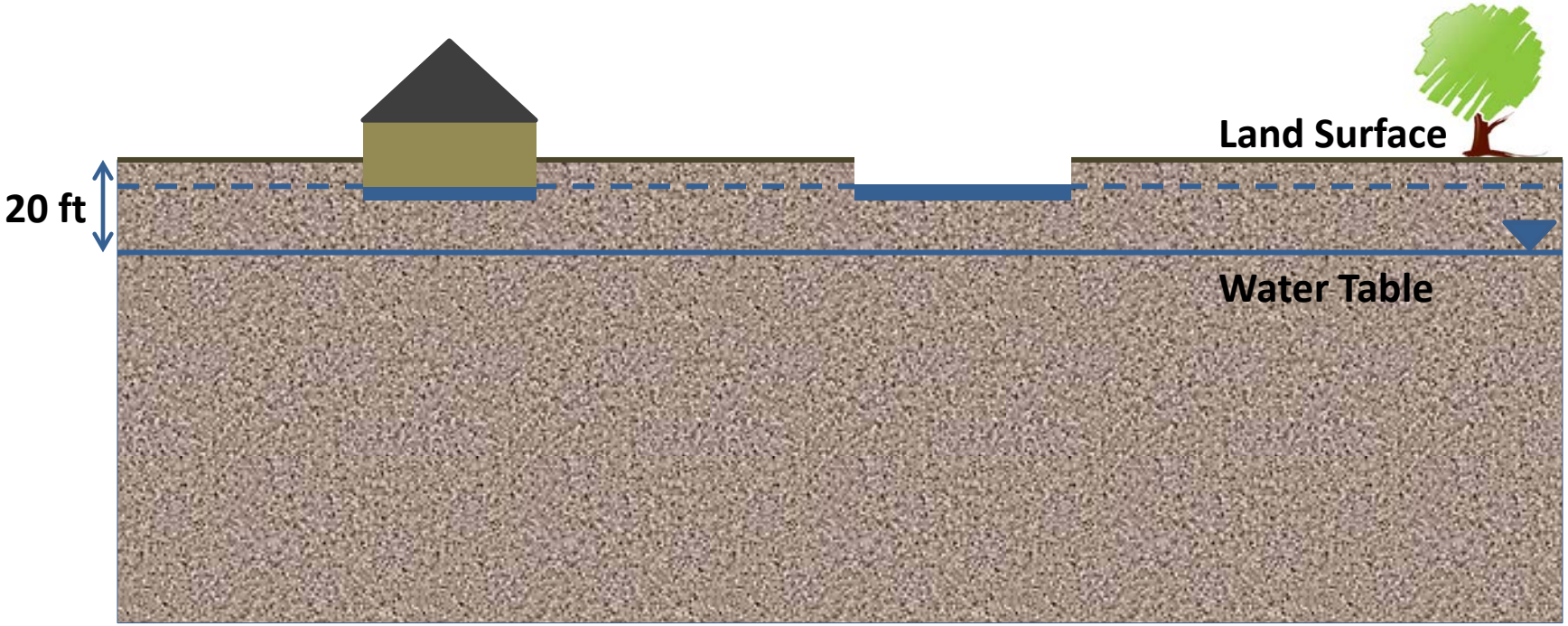
Recharge Capacity ≈ 100,000+ AF/yr



50 ft water-level change at 100,000 AF/yr Recharge
20 ft water-level change at 40,000 AF/yr Recharge
Recharge Capacity ≈ 40,000- AF/yr

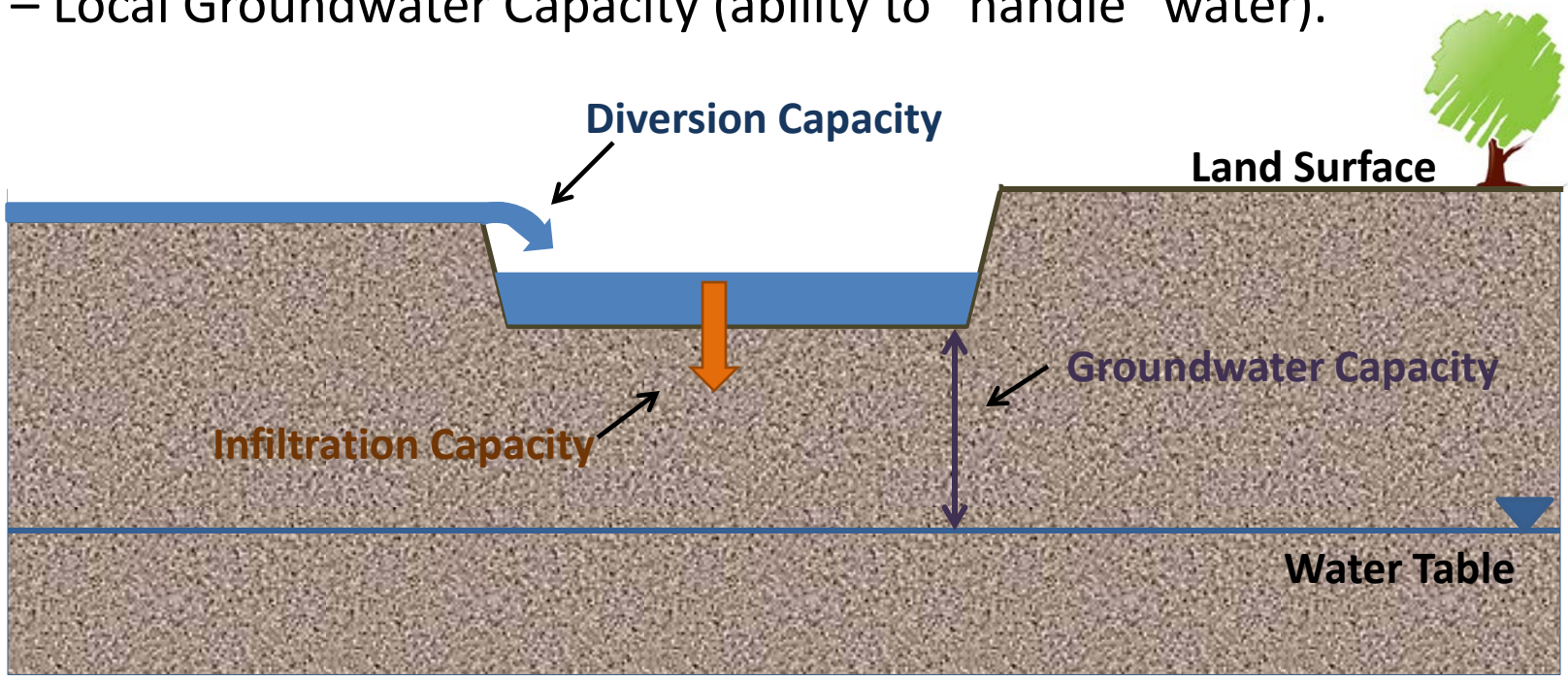


In determining if there is “enough room” for recharge, we must also consider factors like drains and basements, time of year, and site characteristics. Furthermore, depth-to-water is only one factor in determining Recharge Capacity.



Recharge Capacity Factors

- Recharge Capacity involves several factors.
  - Site Diversion Capacity (ability to get water).
  - Site Infiltration Capacity (ability to accept water).
  - Local Groundwater Capacity (ability to "handle" water).



Assessing Recharge Capacity

- Assessing Recharge Capacity involves several steps.
  - Assess the Local Hydrogeologic Setting by looking at geology and infiltration information (Infiltration Capacity).
  - Assess the Local Groundwater Conditions by looking at seasonal depth-to-water (Groundwater Capacity).
  - Assess Site Diversion Capacity by talking to managers and reviewing diversion data (Diversion Capacity).
  - Model runs with site appropriate data and realistic time-frames.

Assessment of Site Diversion Capacity

Diversion Capacity		
Site	**Diversion Capacity (AF/month)**	**Comments**
Aberdeen	10,900	Based on historic recharge diversions.
Egin	15,300	Based on historic recharge diversions.
FMeast	10,900	Based on historic recharge diversions.
GFeeder	14,800	Based on historic recharge diversions.
Hilton	7,700	Based on historic recharge diversions.
Idaho	1,000	Based on historic recharge diversions.
MilGood	46,500	Based on historic recharge diversions and MP31 design.
Minidoka	6,100	Based on proposed capacity of recharge site.
MP31	18,400	Based on proposed capacity of recharge site.
Northside	30,700	Based on estimated 500 cfs diversion capacity.
Nsweden	3,200	Based on historic recharge diversions.
Shoshone	19,900	Based on historic recharge diversions.
Southwest	3,600	Based on historic recharge diversions.

Assessment of Infiltration Capacity

Infiltration Capacity		
Site	**Infiltration Cap (AF/month)**	**Source**
Aberdeen	6,600	Calibrated ESPAM2.1 canal seepage rate.
Egin	2,200	Published data from 2009 IWRRI recharge report.
FMeast	6,500	Calibrated ESPAM2.1 canal seepage rate.
GFeeder	5,600	Calibrated ESPAM2.1 canal seepage rate.
Hilton	7,600	Published data from 1996 IWRRI recharge report.
Idaho	300	Calibrated ESPAM2.1 canal seepage rate.
MilGood	8,200	Discussions with canal company manager.
Minidoka	6,100	Assumed from design, injected.
MP31	24,200	Discussions with canal company manager.
Northside	22,200	Published data from 1996 IWRRI recharge report.
Nsweden	1,600	Calibrated ESPAM2.1 canal seepage rate plus recharge pond infiltration data.
Shoshone	21,200	Discussions with canal company manager.
Southwest	3,600	Assumed from diversion, injected.

Assessment of Groundwater Conditions

- Groundwater conditions vary by season, and are based on the depth-to-water.
- Recharging in areas of deep groundwater means there is "enough room" to accept the recharge.
- Recharging in areas of shallow groundwater results in water **not going into aquifer storage**. In areas of shallow groundwater, recharge water is likely:
  - **AT RISK** of causing or exacerbating problems.
    - Water in basements, water in sewer system, foundations, etc.
  - **AT RISK** of being wasted (effort and money).
    - Cycling recharge directly into drains, into returns, into places where attempts to dewater are already occurring.

Assessment of Groundwater Conditions

- Based on depth-to-water from the 2008 Spring and Fall Synoptic water levels.
- Used ESPAM2.1 to monitor water-level changes relative to land surface (with a 15-foot buffer).
- Groundwater capacity reached when 5% or 100 AF of recharge is enters the buffer area.

Recharge Limits due to Shallow Groundwater Conditions

FALL Recharge Limit

Site	GW Recharge Capacity
Aberdeen	< 100
Egin	3,800
FMeast	12,300
GFeeder	< 100
Hilton	2,800
Idaho	< 100
MilGood	20,000 +
Minidoka	20,000 +
MP31	20,000 +
Northside	20,000 +
Nsweden	3,800
Shoshone	20,000 +
Southwest	20,000 +

SPRING Recharge Limit

Site	GW Recharge Capacity
Aberdeen	2,300
Egin	5,000
FMeast	17,000
GFeeder	20,000 +
Hilton	3,200
Idaho	8,500
MilGood	20,000 +
Minidoka	20,000 +
MP31	20,000 +
Northside	20,000 +
Nsweden	20,000 +
Shoshone	20,000 +
Southwest	20,000 +

Physical Limitations to Recharge

The highlighted cells illustrate the physical limitation to Recharge at each site.

SPRING Physical Limitations to Recharge			
Site	Diversion Capacity	Infiltration Capacity	GW Capacity
Aberdeen	10,900	6,600	2,300
Egin	15,300	2,200	5,000
FMeast	10,900	6,500	17,000
Gfeeder	14,800	5,600	20,000
Hilton	7,700	7,600	3,200
Idaho	1,000	300	8,500
MilGood	46,500	8,200	20,000
Minidoka	6,100	6,100	20,000
MP31	18,400	24,200	20,000
Northside	30,700	22,200	30,000
Nsweden	3,200	1,600	20,000
Shoshone	19,900	21,200	20,000
Southwest	3,600	3,600	20,000

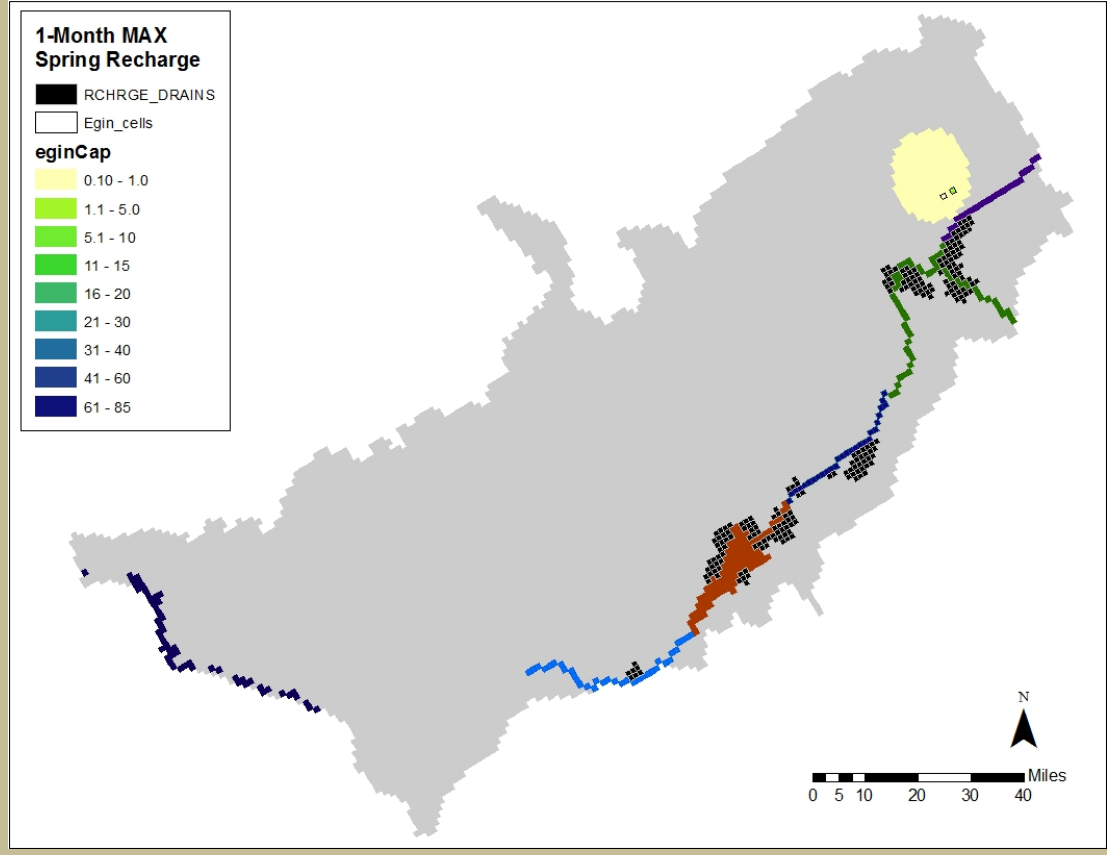
FALL Physical Limitations to Recharge			
Site	Diversion Capacity	Infiltration Capacity	GW Capacity
Aberdeen	10,900	6,600	100
Egin	15,300	2,200	3,800
FMeast	10,900	6,500	12,300
Gfeeder	14,800	5,600	100
Hilton	7,700	7,600	2,800
Idaho	1,000	300	100
MilGood	46,500	8,200	20,000
Minidoka	6,100	6,100	20,000
MP31	18,400	24,200	20,000
Northside	30,700	22,200	30,000
Nsweden	3,200	1,600	3,800
Shoshone	19,900	21,200	20,000
Southwest	3,600	3,600	20,000

Recharge Site Evaluations

- The limiting factors for recharge at each site.
- The hydrogeology that governs the response to recharge at each site.
- Summary of recharge at each site.

Recharge at Egin

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
15,300	2,200	5,000

SPRING 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
2,200	4

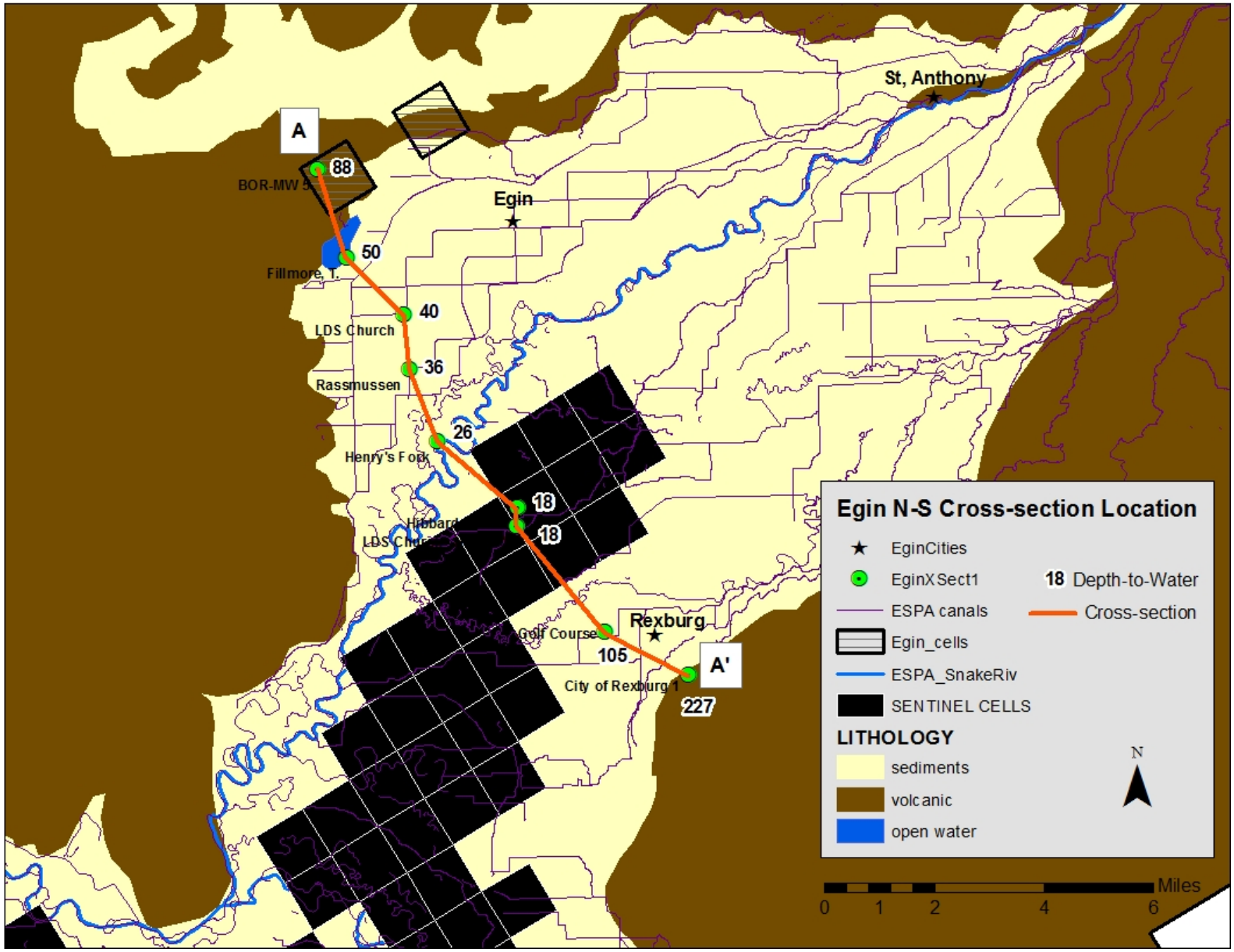
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
15,300	2,200	3,800

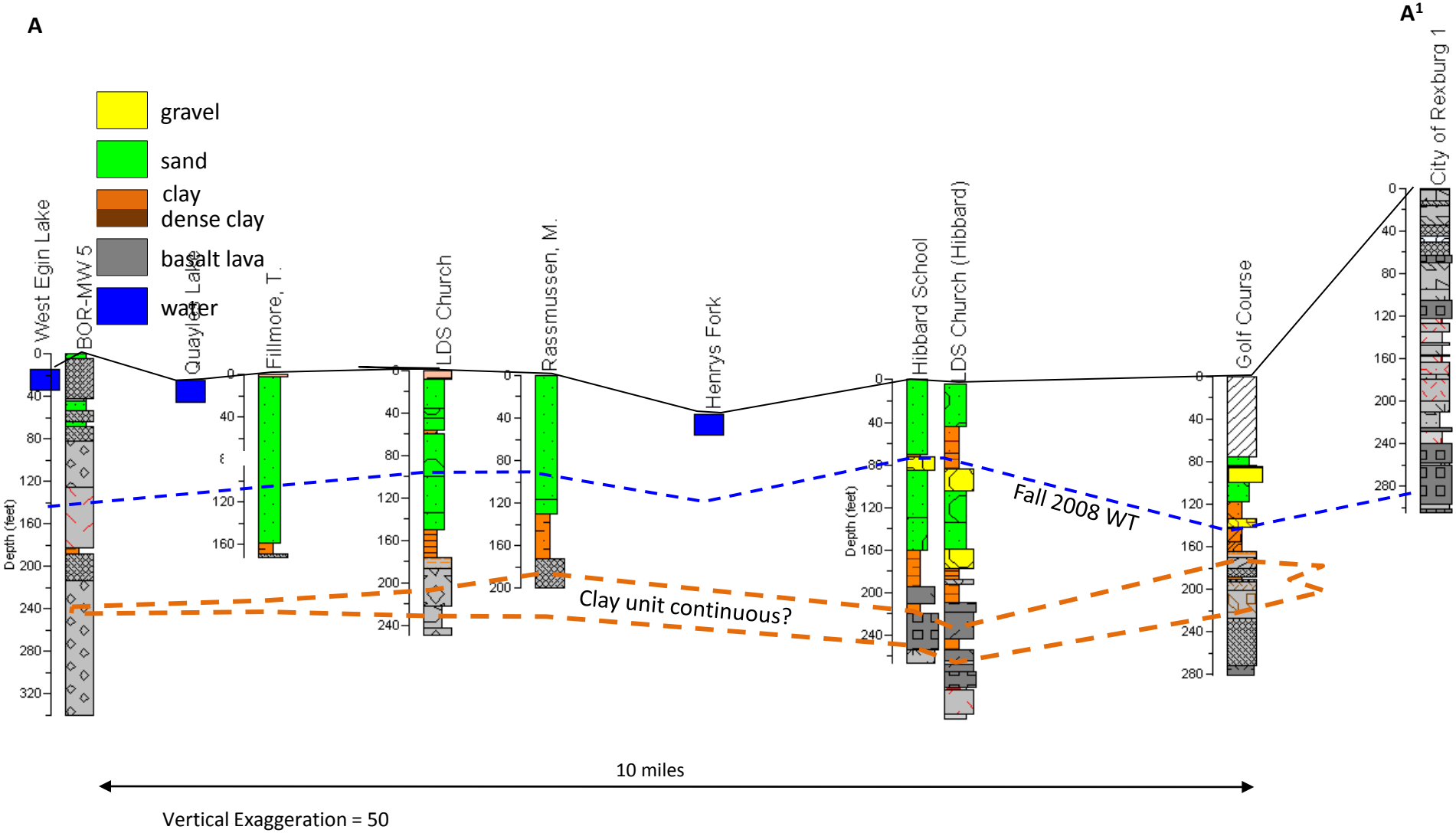
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
2,200	3

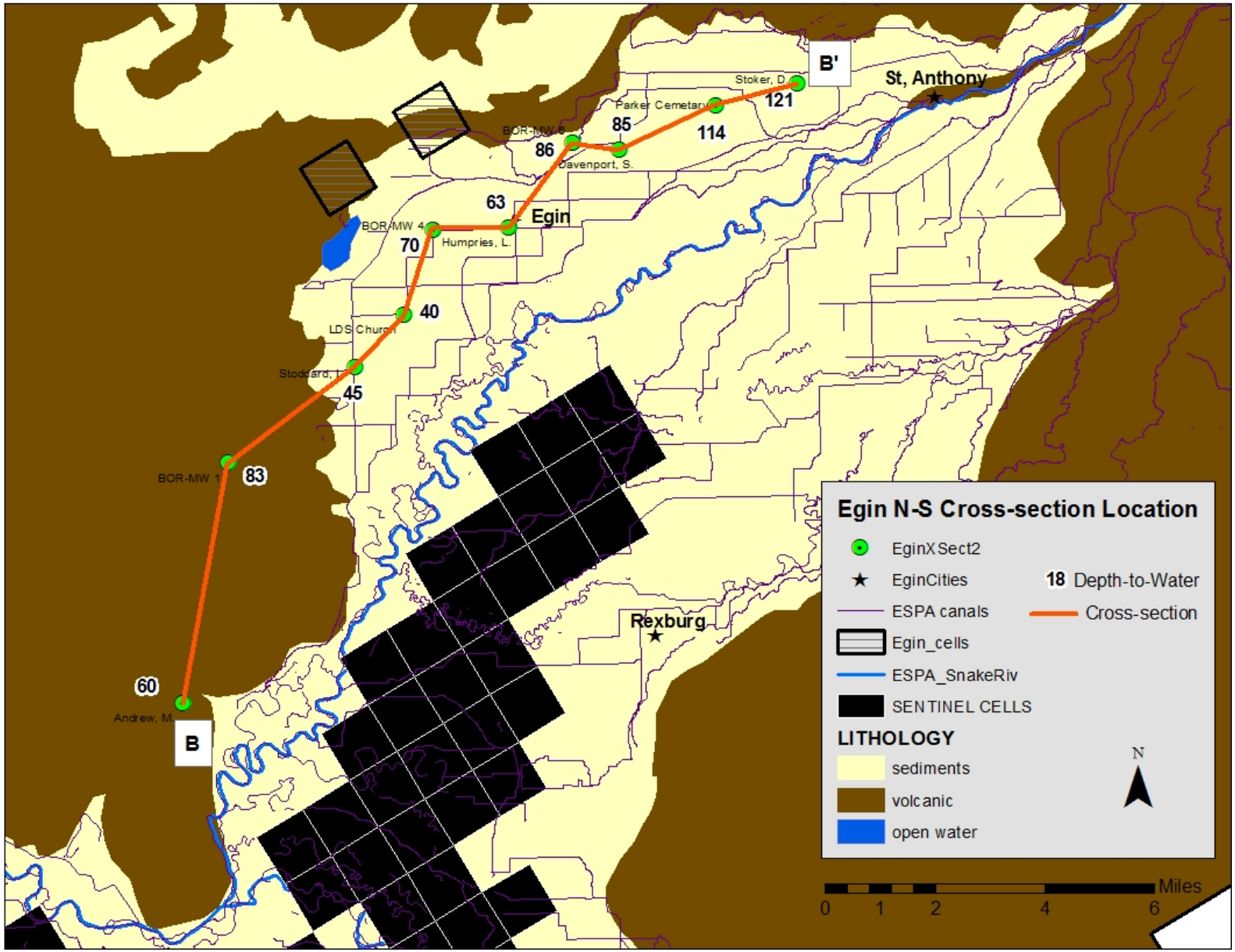
Egin Recharge Area: N – S Cross Section



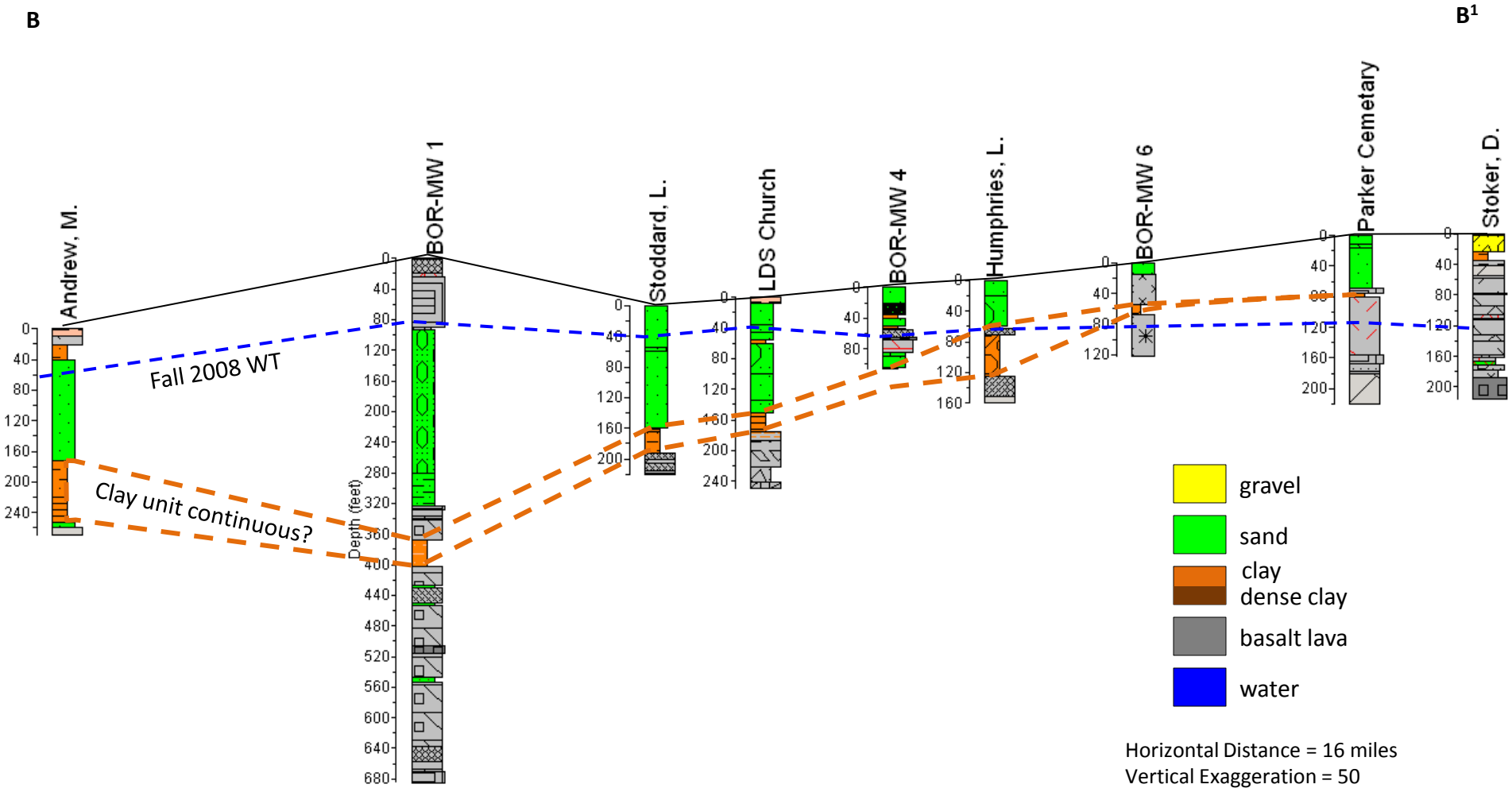
Egin Bench to Rexburg Cross Section



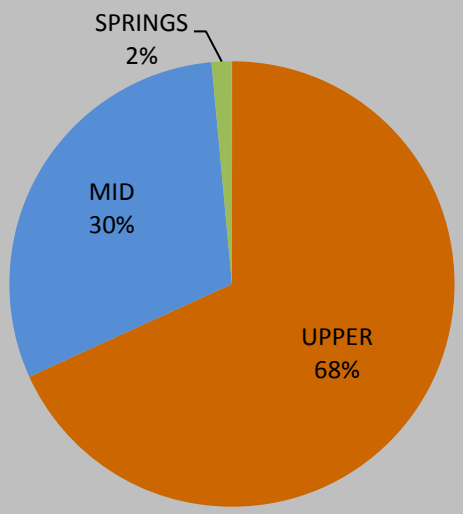
Egin Recharge Area: W – E Cross Section



Egin Bench Cross Section



Summary of Recharge at Egin



Ultimate Fate of Recharged Water

- Recharge via off-canal sites.
- Subsurface is primarily sediments.
- Located near an area of shallow groundwater.
- Site lies on the edge of the regional aquifer and a shallow system.
- Majority of recharge water discharges: Upper Reaches (Henry's Fork).
- Recharge Limited by: **Infiltration Capacity**.

Aquifer Retention 5 years

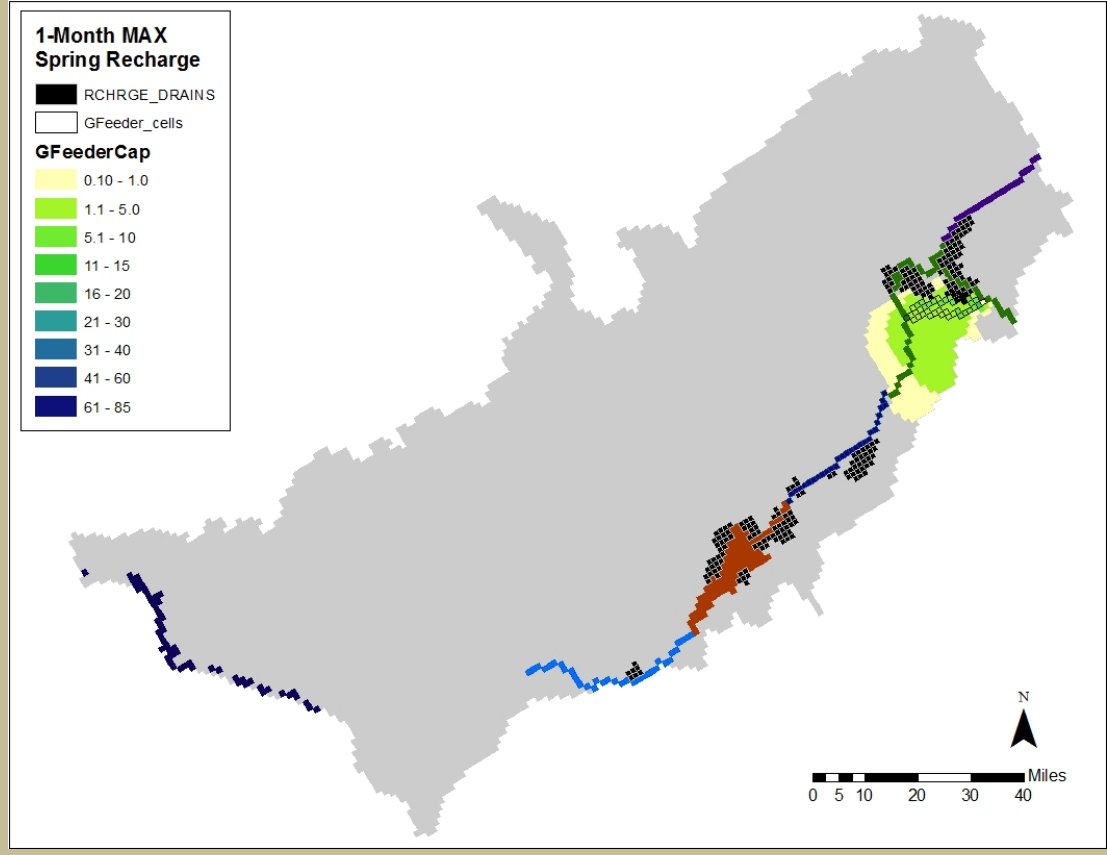
	Rank (of 13)	Retention (%)
SPRING	1	59
FALL	1	59

Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
2,200	1,300	4
2,200	1,300	3

Recharge at GFeeder

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
14,800	5,600	20,000+

SPRING 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
5,600	10

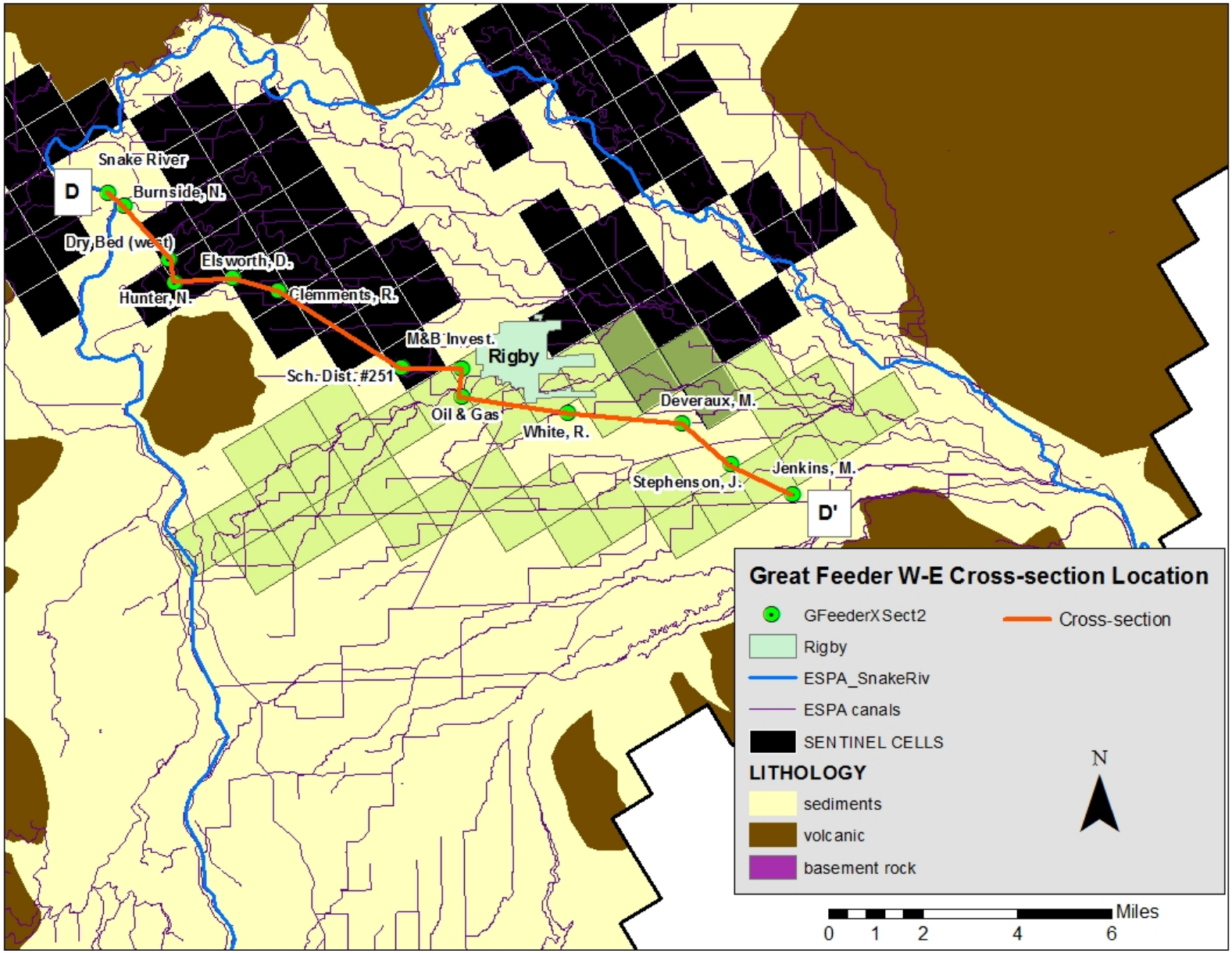
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
14,800	5,600	No Recharge

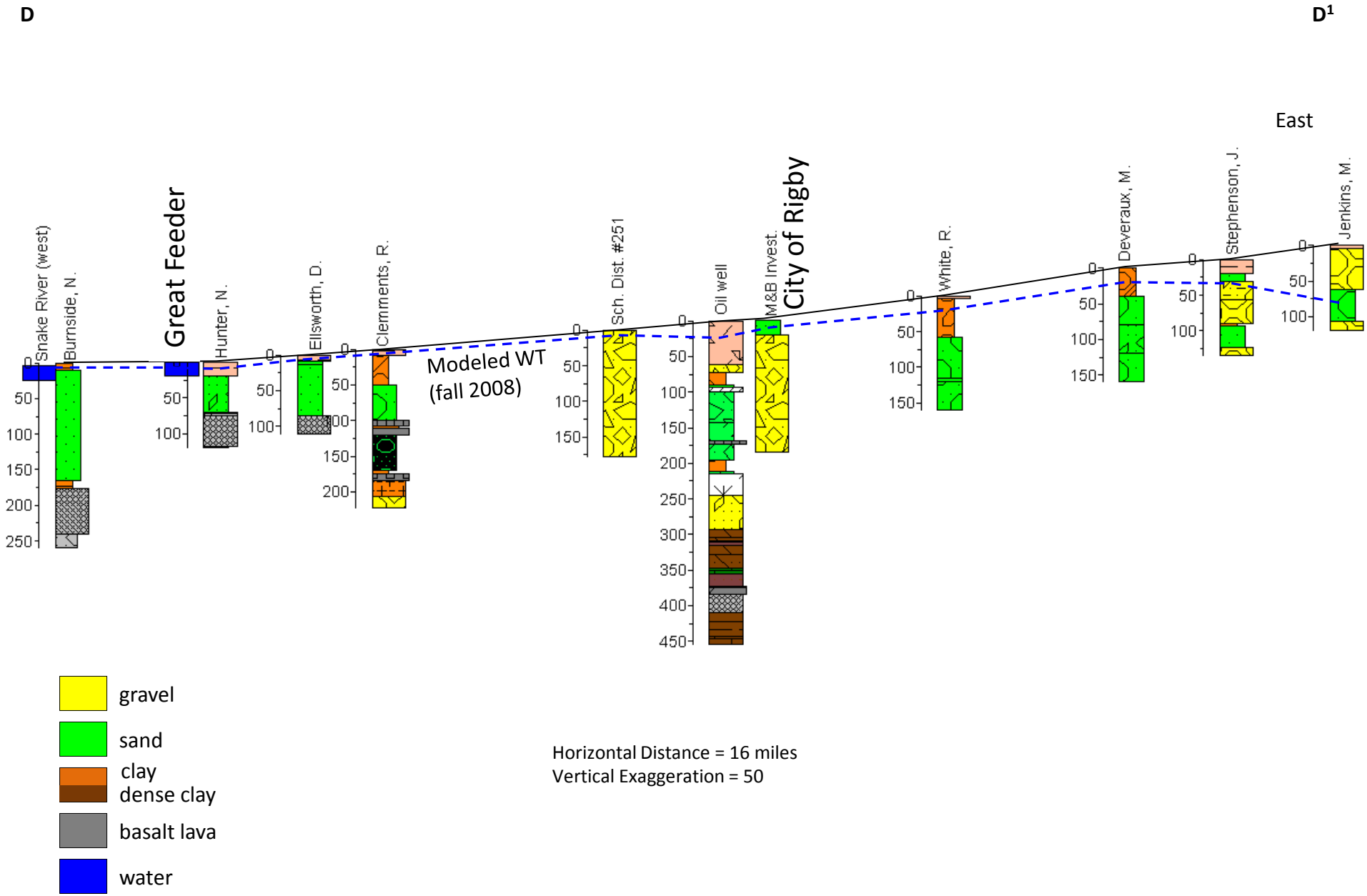
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
No Recharge	0

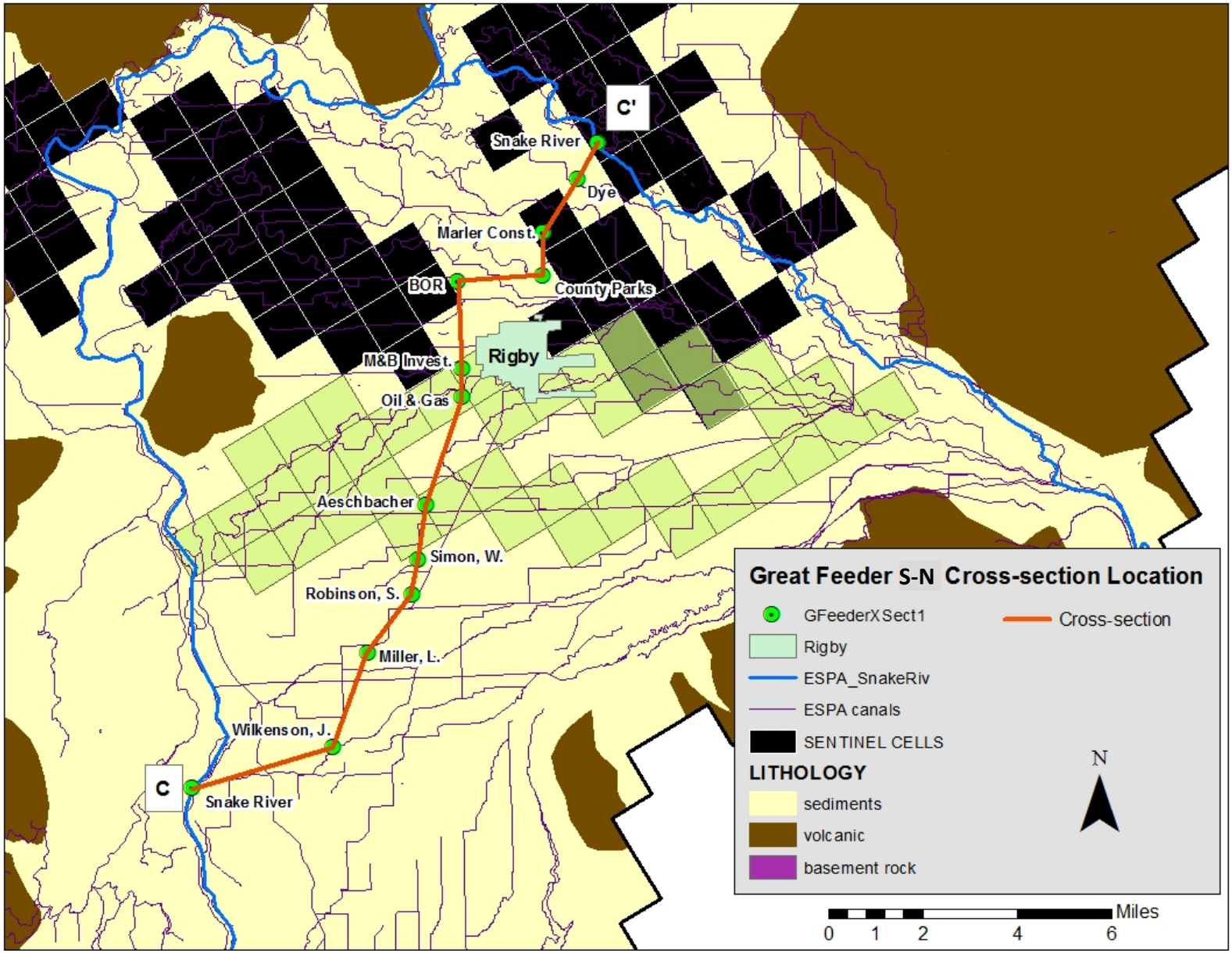
Great Feeder Recharge Area: W – E Cross-Section



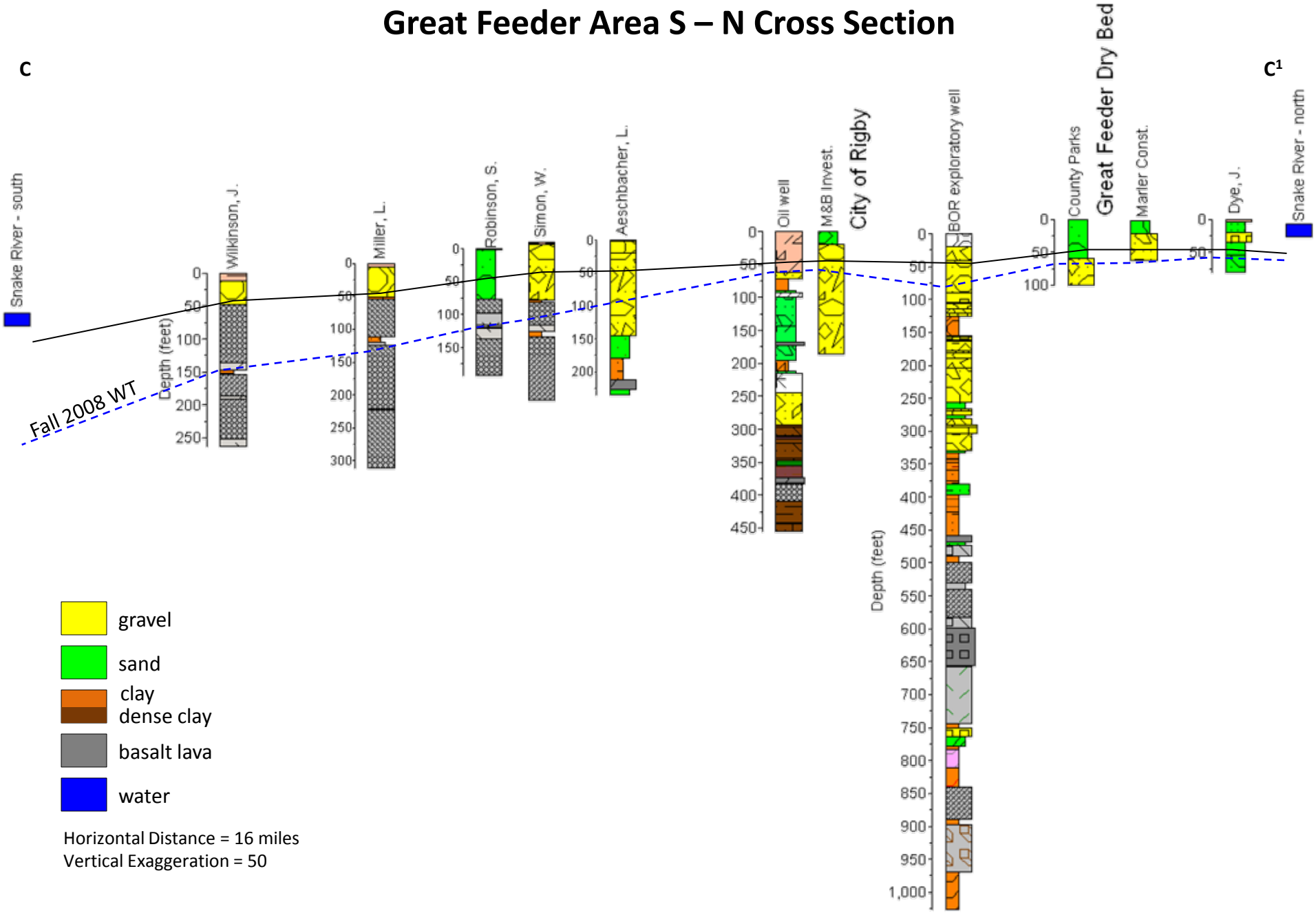
Great Feeder Area W – E Cross Section



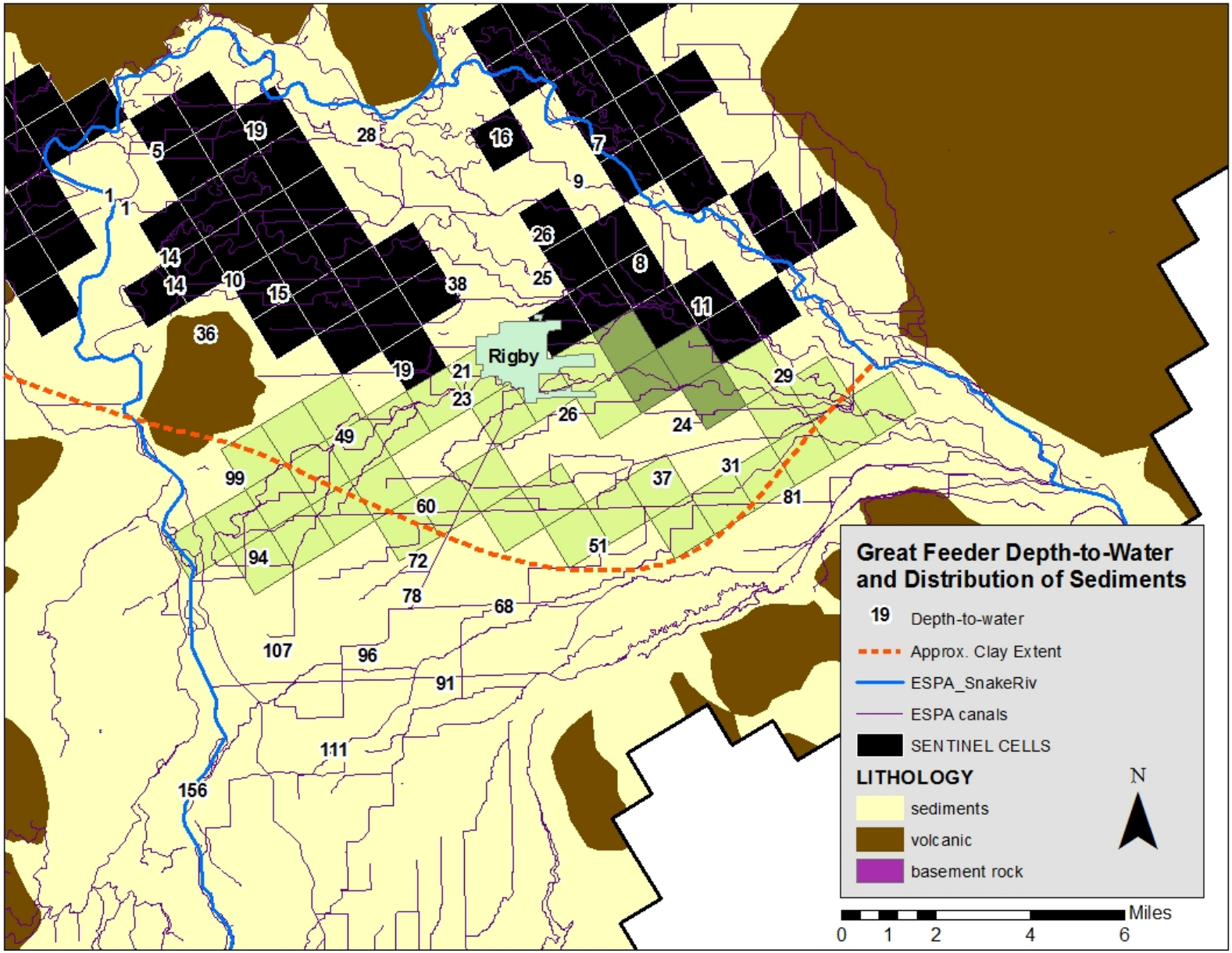
Great Feeder Recharge Area: S – N Cross-Section



Great Feeder Area S – N Cross Section



Great Feeder Depth-to-Water and Sediment Extent



Ag Weekly Online: Twin Falls, Idaho - Windows Internet Explorer

http://www.agweekly.com/articles/2008/11/02/news/ag_news/news48.txt

AG WEEKLY

Home | News | Classifieds | Calendars | Commodities | Country Life | Subscribe | About Us

Search Ads | Search News/Recipes

MarketWatchOnline
Market insights emailed to you twice daily.

USDA Podcast
NASS audio broadcasts

Entertainment
Gas Prices, Soduku, Horoscopes

Urban-rural interests squabble over water

By Cindy Snyder, Ag Weekly correspondent

Friday, October 24, 2008 2:02 PM CDT

BOISE, Idaho — Neighbors across the West have squabbled over water and

Tools | Share | Relat

Story Tools

Comment

Print this story

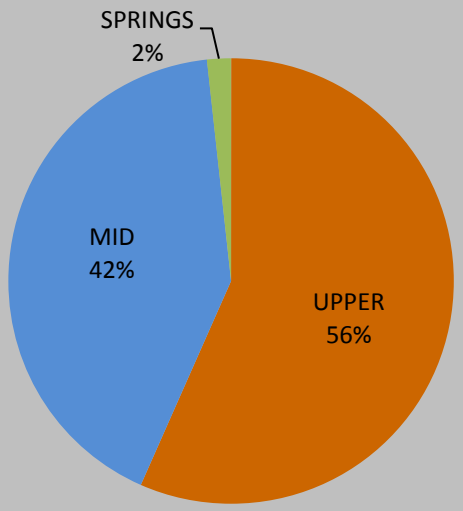
E-mail this story

In eastern Idaho, flooding is an issue for an entirely different reason. A high ground-water table — 3 feet t o 4 feet — in the Rigby area means many homes have flooded basements starting around the 4th of July and lasting through the rest of the irrigation year.

The city of Rigby has built a pump station to pipe subwater from areas within city limits to a pond outside of town. H. Roger Warner, a hydrologist from Rigby, questions the wisdom of a state law that encourages the use of surface water over ground water to irrigate subdivisions.

Shallow depths-to-groundwater already cause problems in some areas.

Summary of Recharge at Great Feeder



Ultimate Fate of Recharged Water

- Recharge via canal seepage.
- Subsurface is primarily sediments.
- Located in an area of shallow groundwater.
- Northern portion in shallow system, grades to regional aquifer to the south.
- Majority of recharge water discharges: Upper Reaches.
- Recharge Limited by: Spring-**Infiltration Capacity**; Fall- **Shallow Groundwater**.

Aquifer Retention 5 years

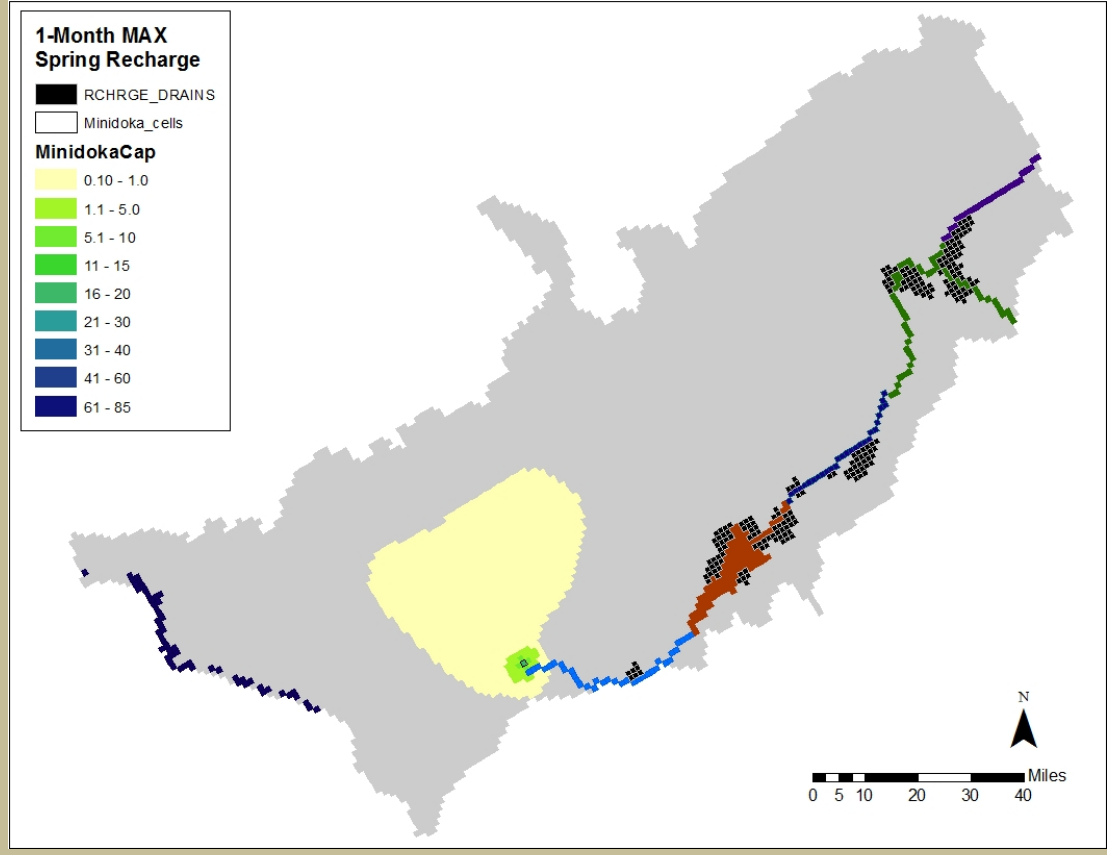
	Rank (of 13)	Retention (%)
SPRING	13	17
FALL	No Recharge	NA

Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
5,600	1,000	10
No Recharge	NA	No Recharge

Recharge at Minidoka

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
6,100	6,100	20,000+

SPRING 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
6,100	10

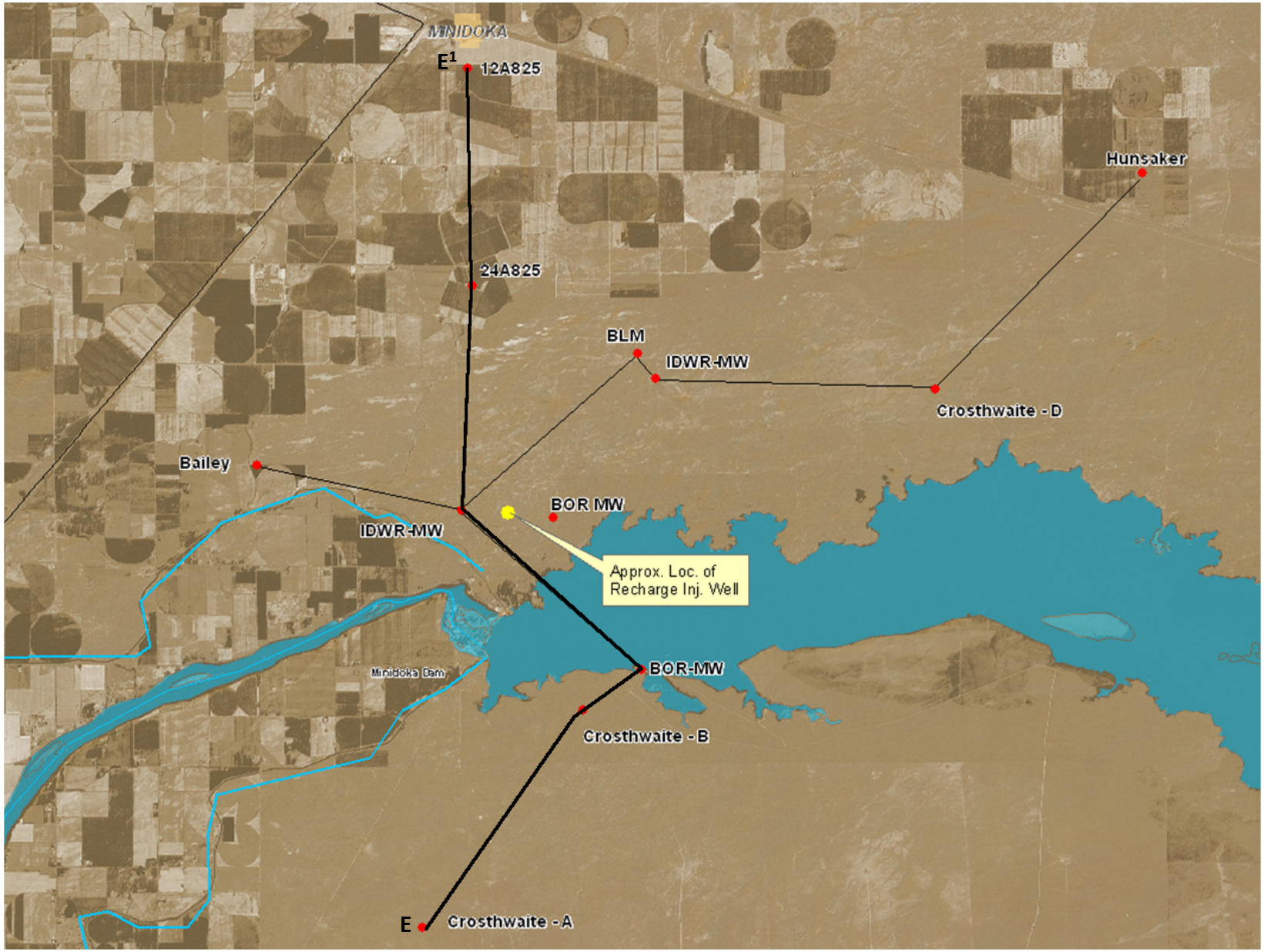
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
6,100	6,100	20,000+

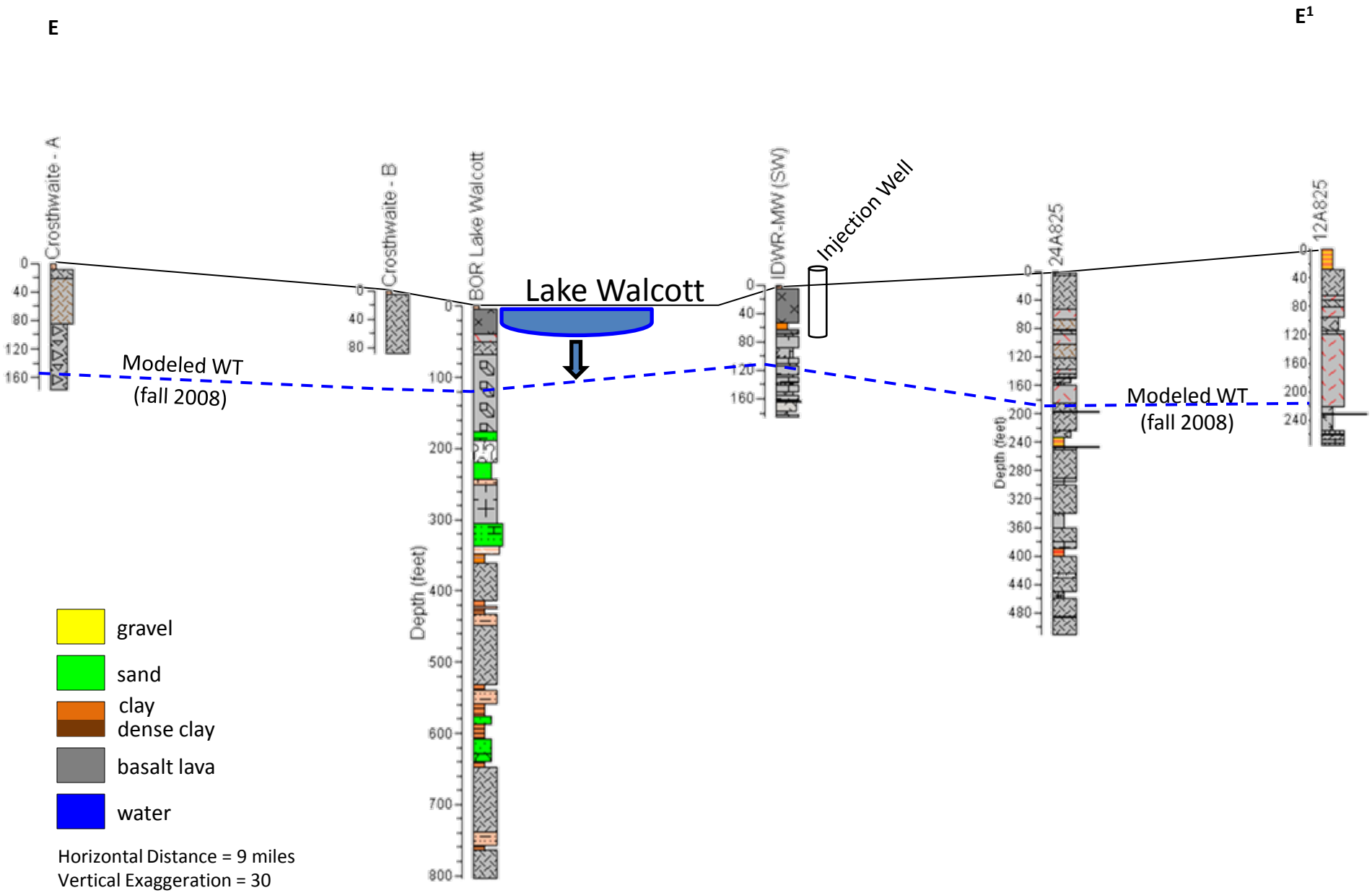
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
6,100	10

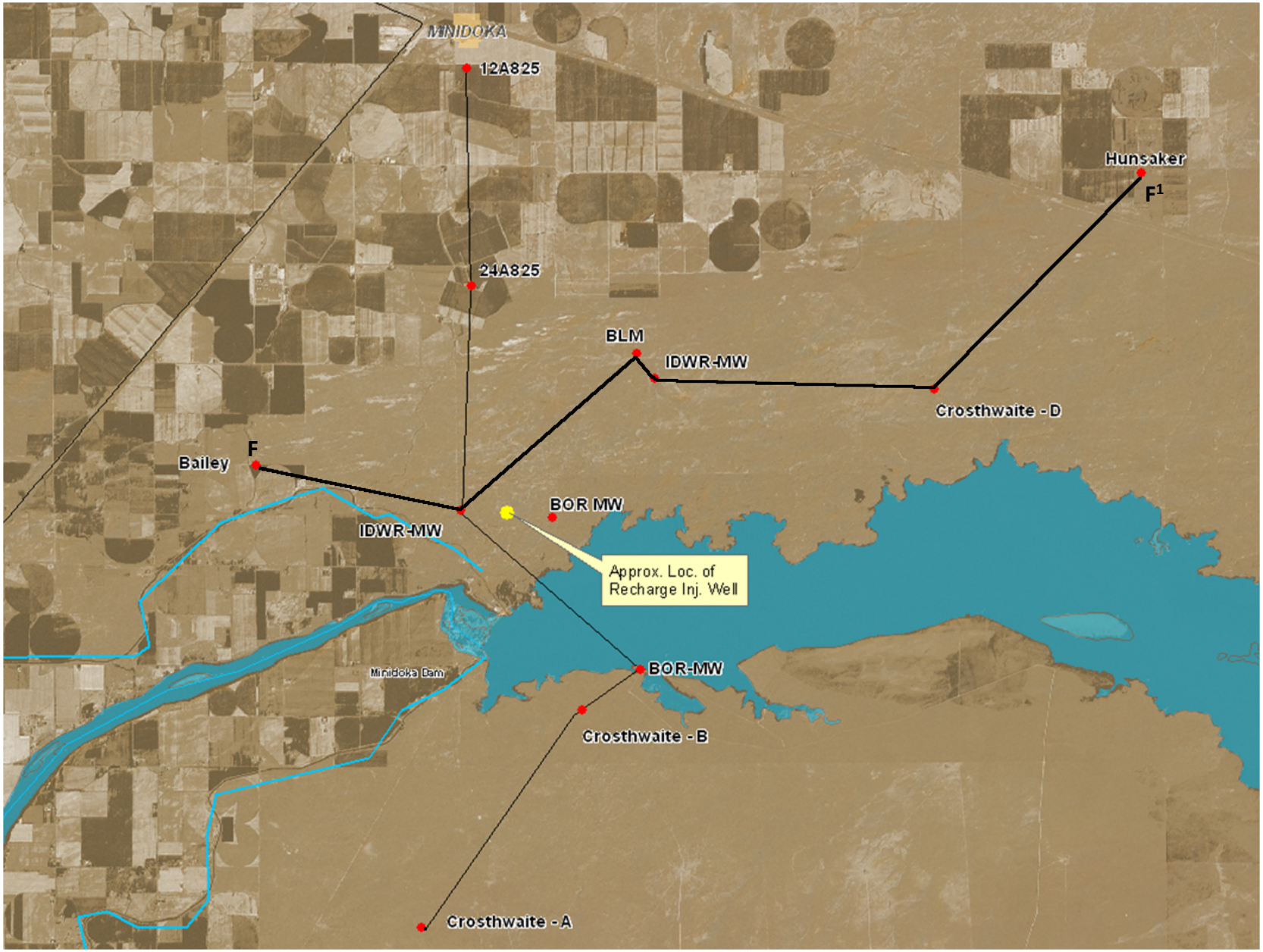
Minidoka Recharge Area S – N Cross-Section



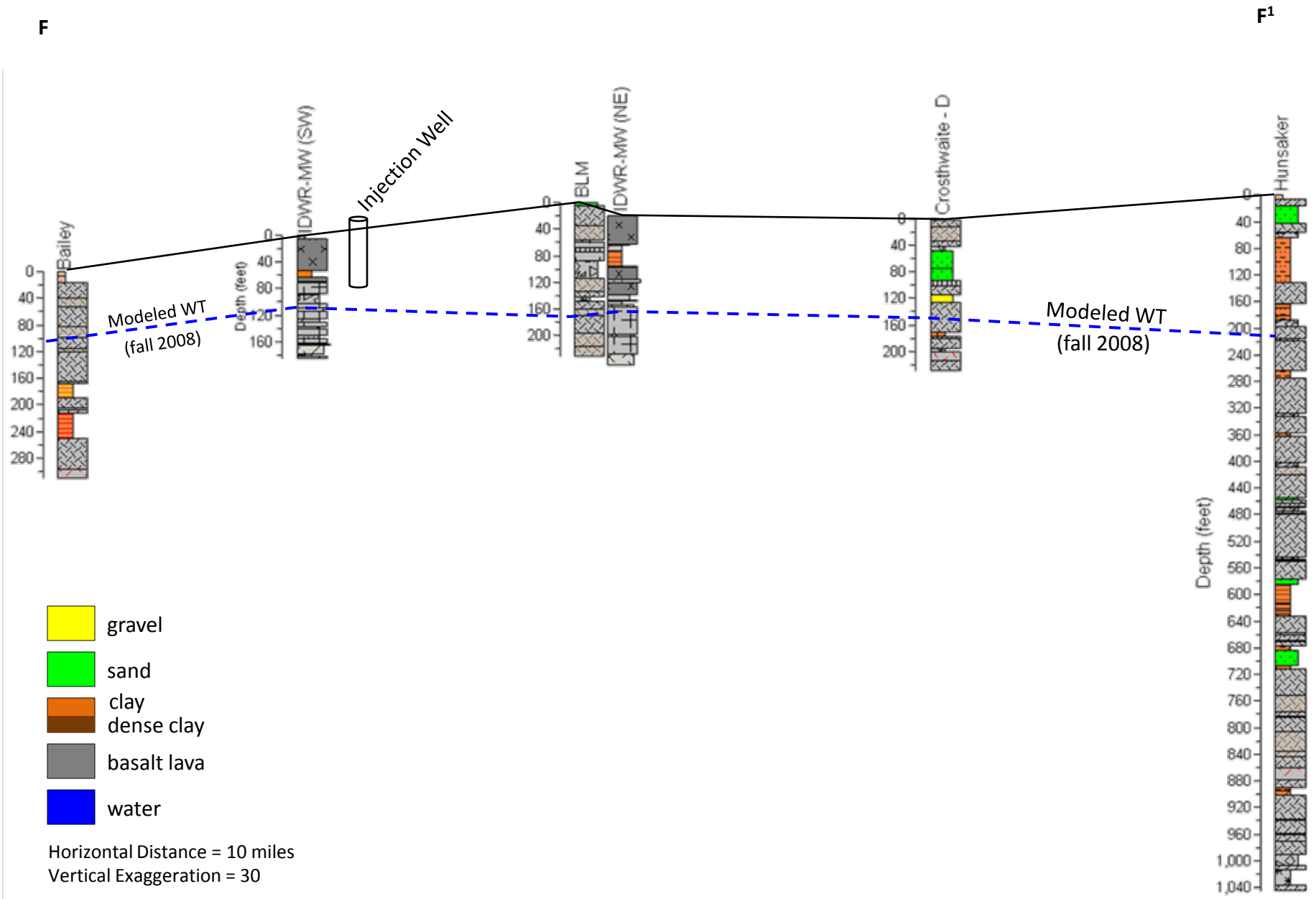
Minidoka Recharge Area S – N Cross-Section



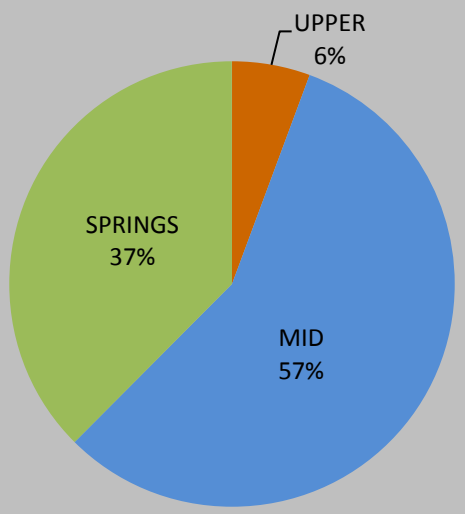
Minidoka Recharge Area W – E Cross-Section



Minidoka Recharge Area W – E Cross-Section



Summary of Recharge at Minidoka



Ultimate Fate of Recharged Water

- Recharge via injection well at off-canal site.
- Subsurface is primarily basalt.
- Located in an area of deep groundwater.
- Must inject below confining layer.
- Majority of recharge water discharges: Middle Reaches.
- Recharge Limited by: **Diversion/Injection Capacity.**

Aquifer Retention 5 years

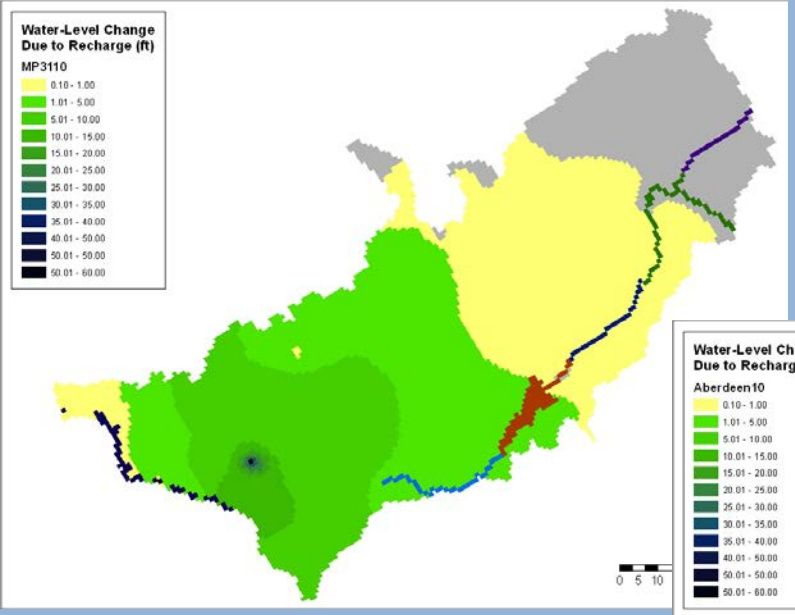
	Rank (of 13)	Retention (%)
SPRING	3	49
FALL	3	49

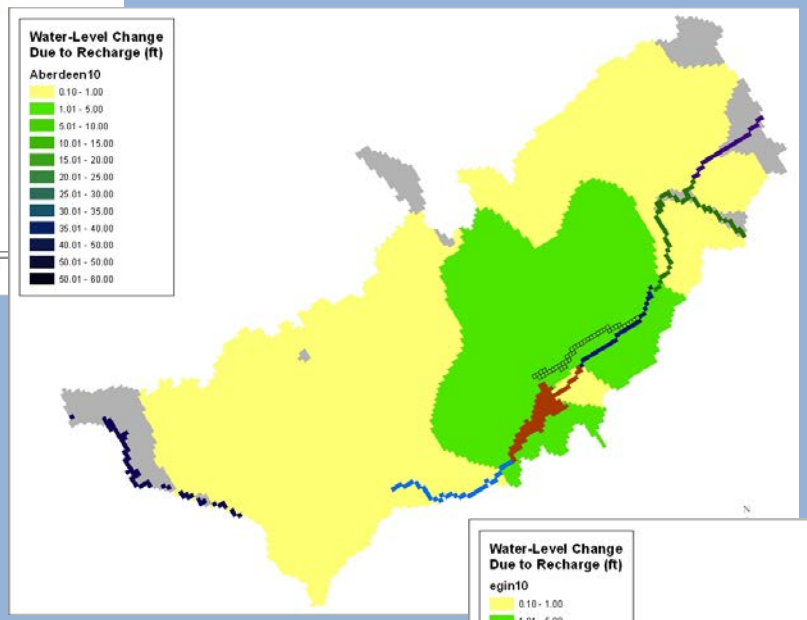
Ability to Benefit Aquifer

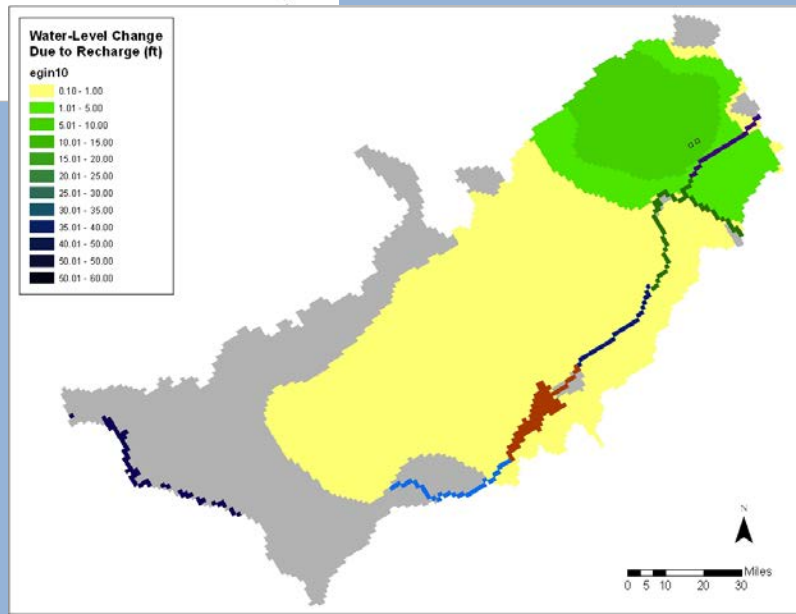
Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
6,100	3,000	10
6,100	3,000	10

Lets put it all together

Recharge at 100,000 AF/yr is instructive; Illustrating how the aquifer responds to Recharge.



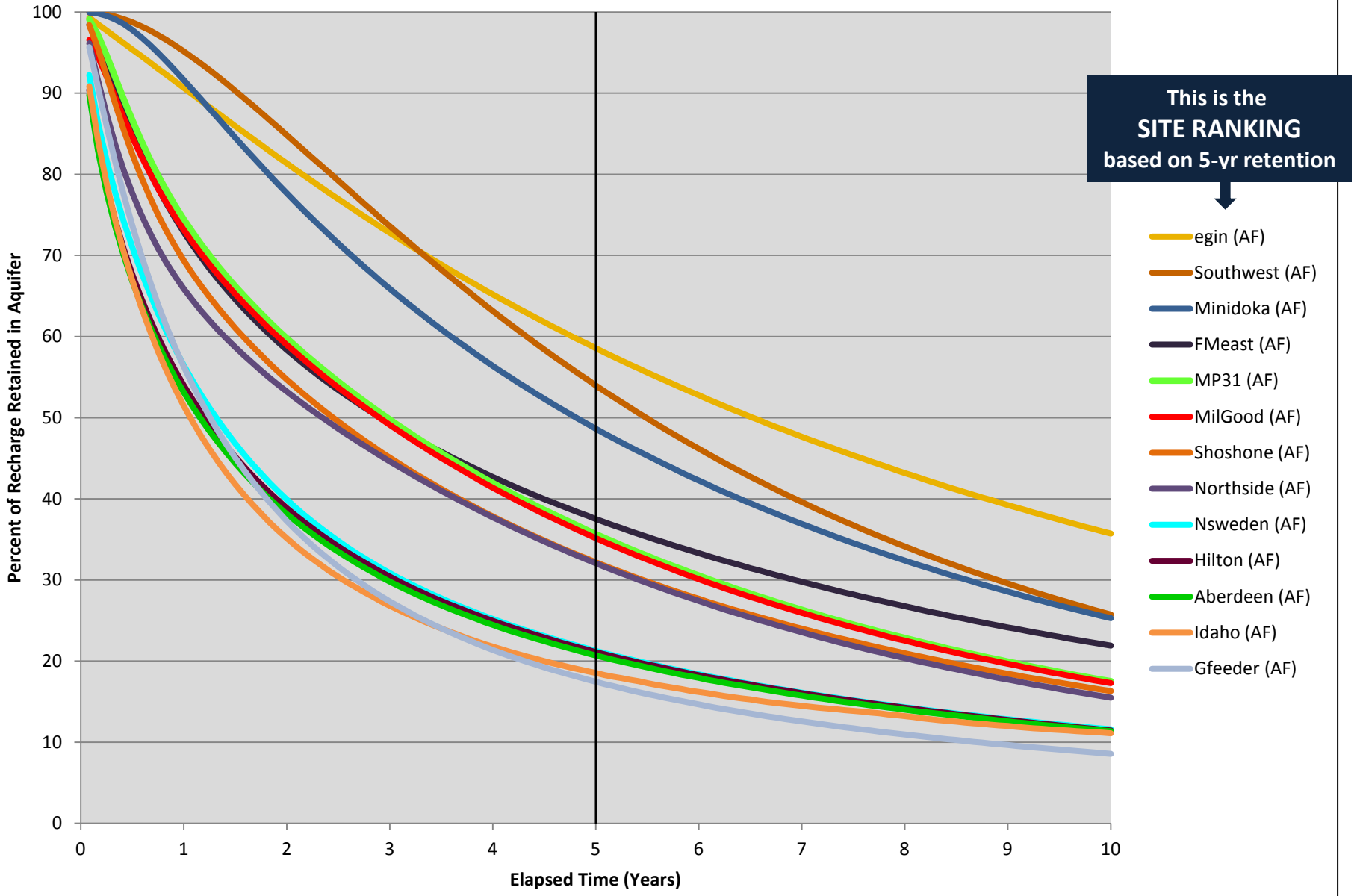




100,000 AF/yr allows us to see how the aquifer Properties influence Recharge Benefits.

- Location is key
- Mud Lake “Barrier” and Great Rift
- Proximity to connected river reach

Retention of Recharged Water within the Aquifer



Physical Limitations to Recharge

The highlighted cells illustrate the physical limitation to Recharge at each site.

SPRING Physical Limitations to Recharge			
Site	Diversion Capacity	Infiltration Capacity	GW Capacity
Aberdeen	10,900	6,600	2,300
Egin	15,300	2,200	5,000
FMeast	10,900	6,500	17,000
Gfeeder	14,800	5,600	20,000
Hilton	7,700	7,600	3,200
Idaho	1,000	300	8,500
MilGood	46,500	8,200	20,000
Minidoka	6,100	6,100	20,000
MP31	18,400	24,200	20,000
Northside	30,700	22,200	30,000
Nsweden	3,200	1,600	20,000
Shoshone	19,900	21,200	20,000
Southwest	3,600	3,600	20,000

FALL Physical Limitations to Recharge			
Site	Diversion Capacity	Infiltration Capacity	GW Capacity
Aberdeen	10,900	6,600	100
Egin	15,300	2,200	3,800
FMeast	10,900	6,500	12,300
Gfeeder	14,800	5,600	100
Hilton	7,700	7,600	2,800
Idaho	1,000	300	100
MilGood	46,500	8,200	20,000
Minidoka	6,100	6,100	20,000
MP31	18,400	24,200	20,000
Northside	30,700	22,200	30,000
Nsweden	3,200	1,600	3,800
Shoshone	19,900	21,200	20,000
Southwest	3,600	3,600	20,000

Rank: Aquifer Storage Retention

SPRING Priority List

Rank	5-year Retention	Recharge Limit (AF/month)
1. Egin	59%	2,200
2. Southwest	54%	3,600
3. Minidoka	49%	6,100
4. FMeast	38%	6,500
5. MP31	36%	18,400
6. MilGood	35%	8,200
7. Shoshone	32%	19,900
8. Northside	32%	22,200
9. NSweden	21%	1,600
10. Hilton	21%	3,200
11. Aberdeen	21%	2,300
12. Idaho	19%	300
13. GFeeder	17%	5,600

FALL Priority List

Rank	5-year Retention	Recharge Limit (AF/month)
1. Egin	59%	2,200
2. Southwest	54%	3,600
3. Minidoka	49%	6,100
4. FMeast	38%	6,500
5. MP31	36%	18,400
6. MilGood	35%	8,200
7. Shoshone	32%	19,900
8. Northside	32%	22,200
9. NSweden	21%	1,600
10. Hilton	21%	2,800
11. Aberdeen	21%	NA
12. Idaho	19%	NA
13. GFeeder	17%	NA

Rank: Retention and Recharge Limitations

SPRING Priority List

Rank	5-year Retention	Recharge Limit (AF/month)	Volume in Aquifer after 5 Years (AF)
1. Northside	32%	22,200	7,100
2. MP31	36%	18,400	6,600
3. Shoshone	32%	19,900	6,400
4. Minidoka	49%	6,100	3,000
5. MilGood	35%	8,200	3,000
6. FMeast	38%	6,500	2,400
7. Southwest	54%	3,600	1,900
8. Egin	59%	2,200	1,300
9. GFeeder	17%	5,600	1,000
10. Hilton	21%	3,200	700
11. Aberdeen	21%	2,300	500
12. NSweden	21%	1,600	300
13. Idaho	19%	300	<100

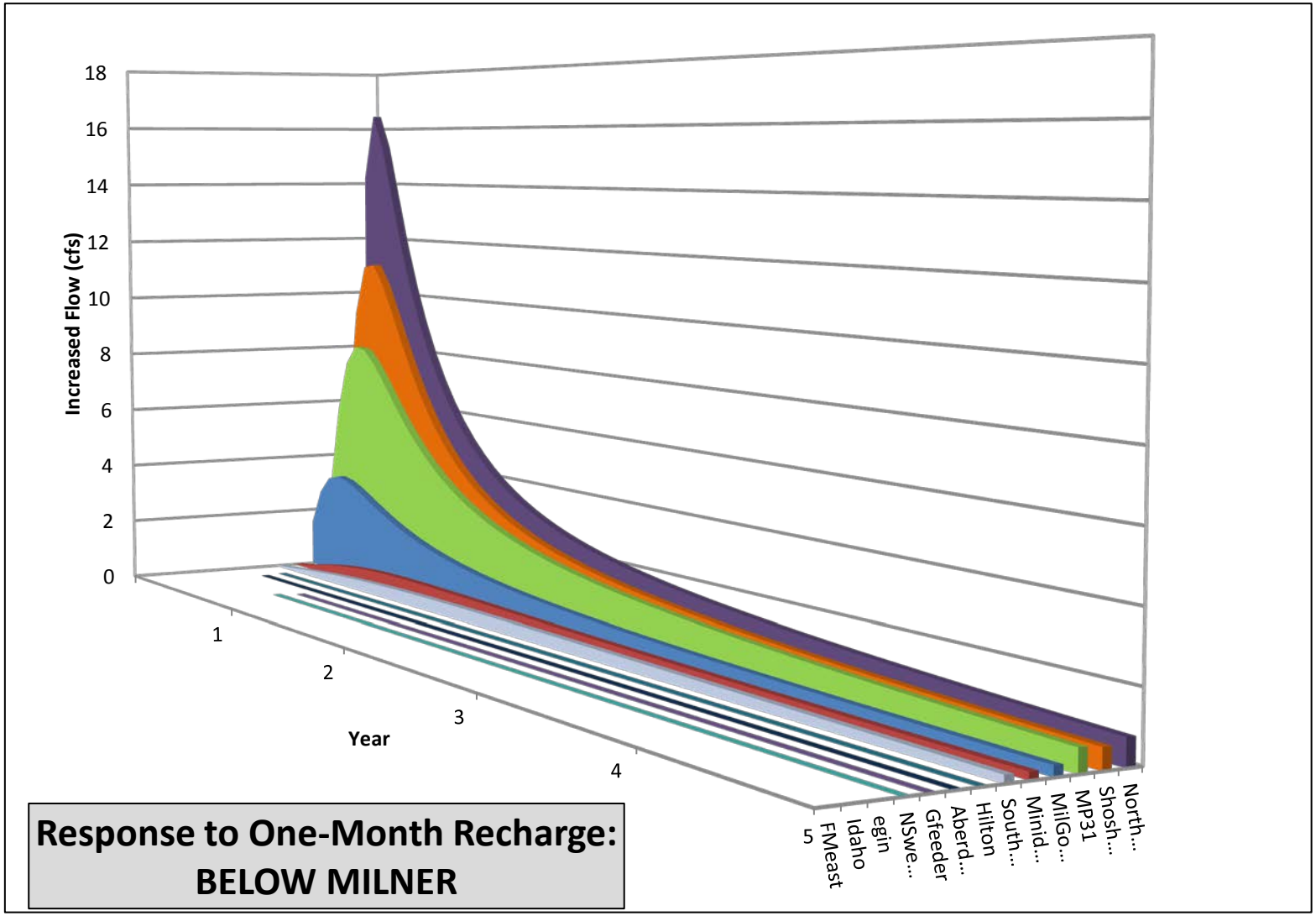
FALL Priority List

Rank	5-year Retention	Recharge Limit (AF/month)	Volume in Aquifer after 5 Years (AF)
1. Northside	32%	22,200	7,000
2. MP31	36%	18,400	6,600
3. Shoshone	32%	19,900	6,400
4. Minidoka	49%	6,100	3,000
5. MilGood	35%	8,200	3,000
6. FMeast	38%	6,500	2,400
7. Southwest	54%	3,600	1,900
8. Egin	59%	2,200	1,300
9. Hilton	21%	2,800	600
10. NSweden	21%	1,600	300
11. Aberdeen	21%	NA	0
12. Idaho	19%	NA	0
13. GFeeder	17%	NA	0

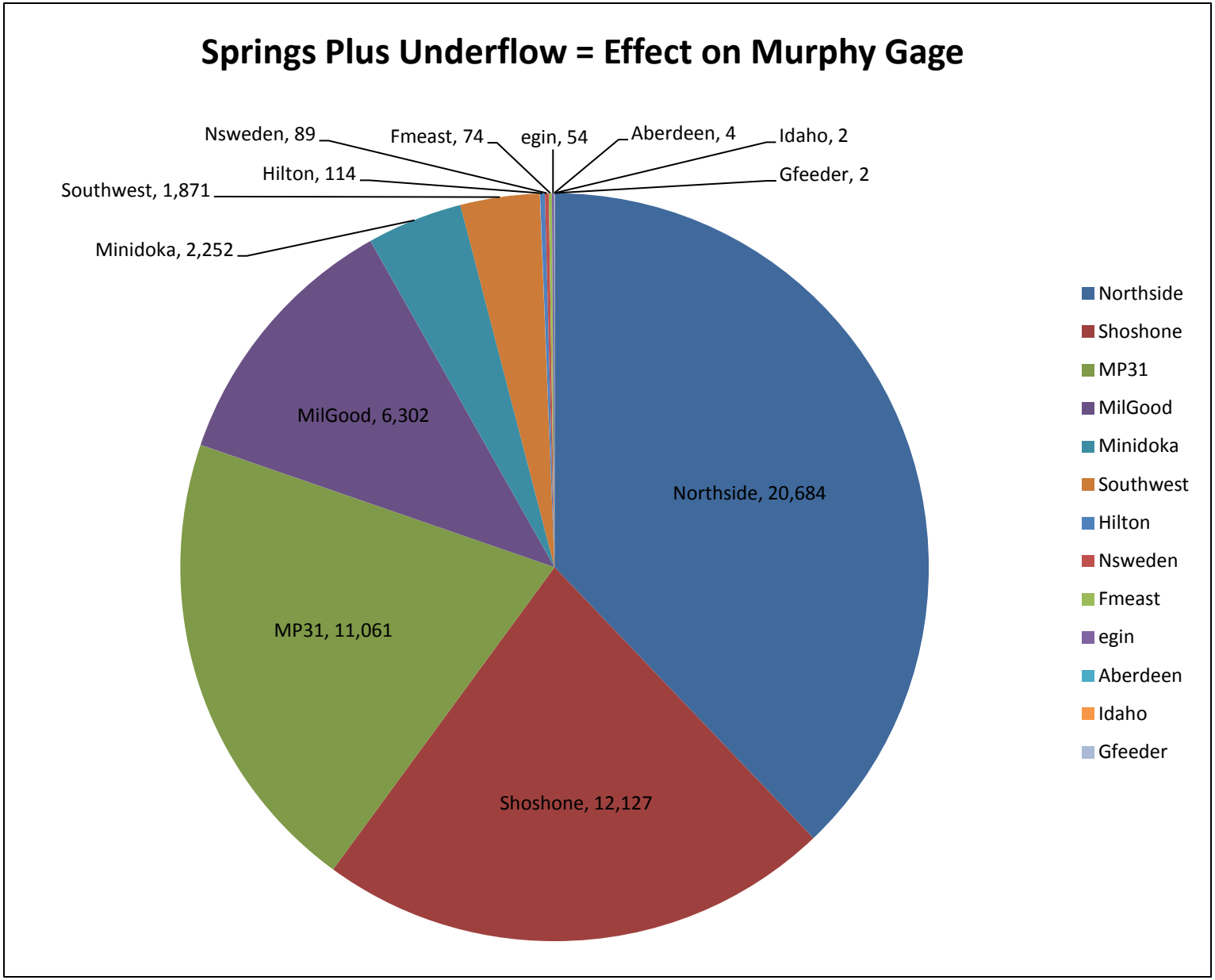
Hold for new slide

Hold for new slide

Spring-flow response to recharge at site capacity

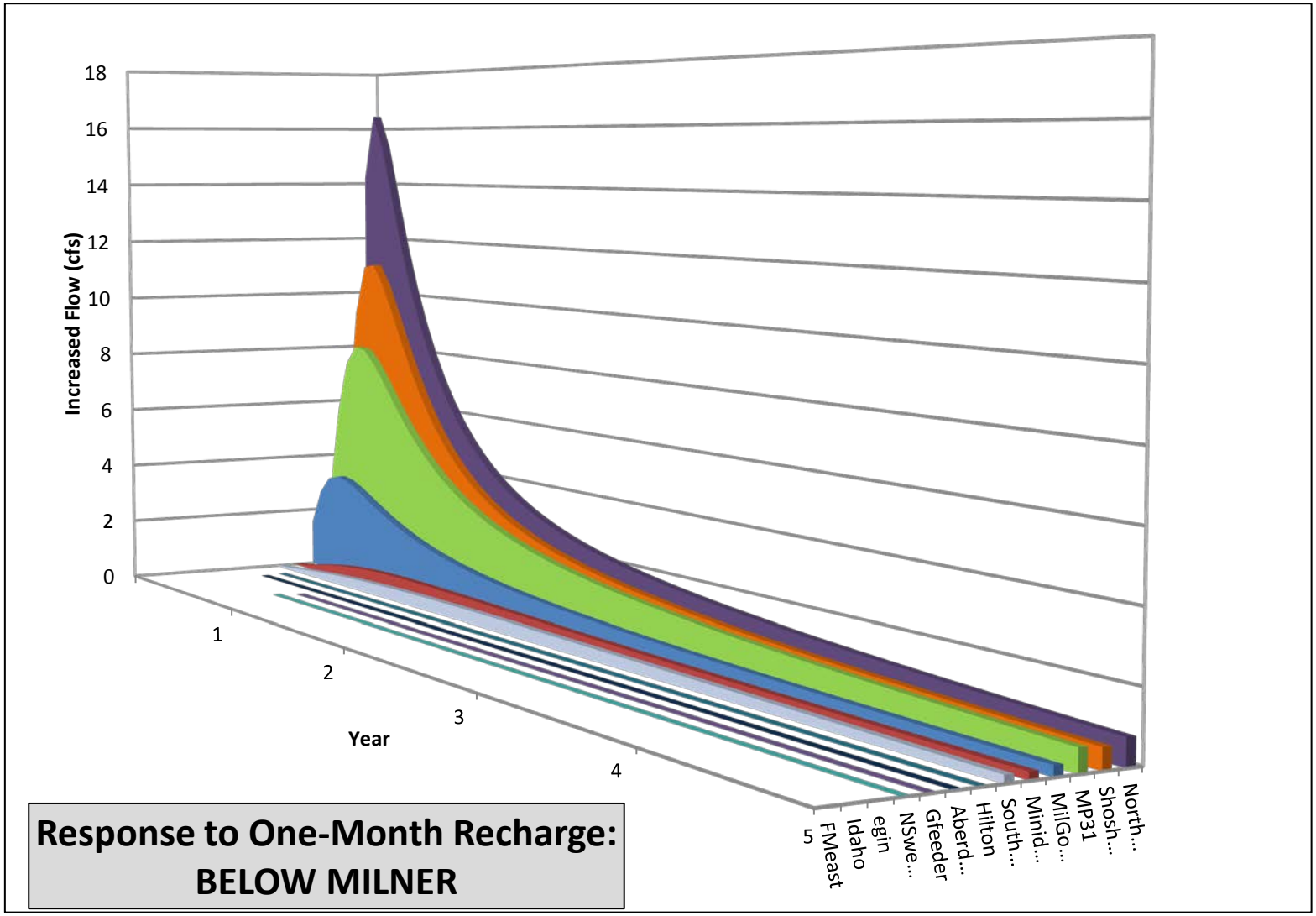


Ultimate fate of recharged water (at site capacity)

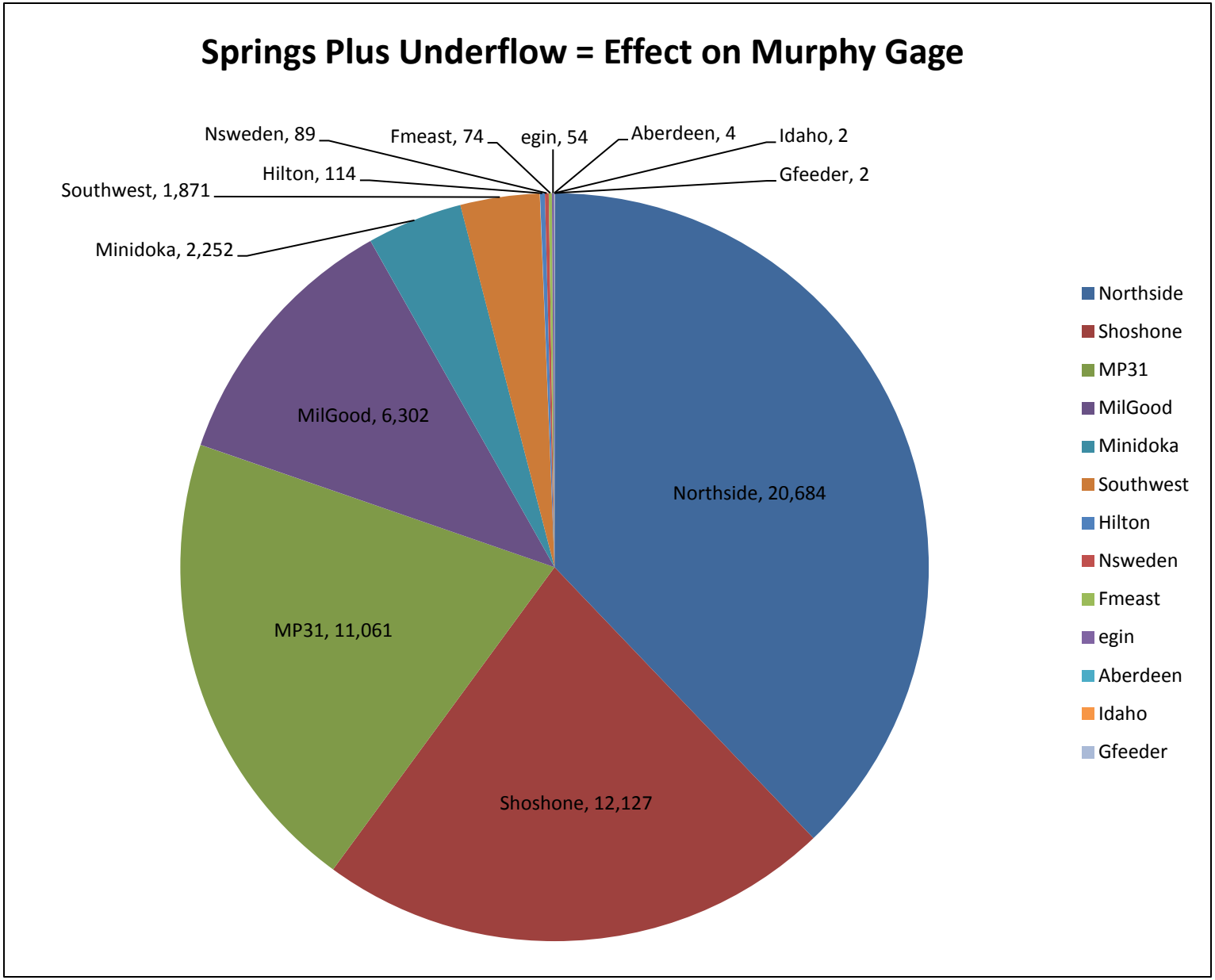


Any Questions?

Spring-flow response to recharge at site capacity

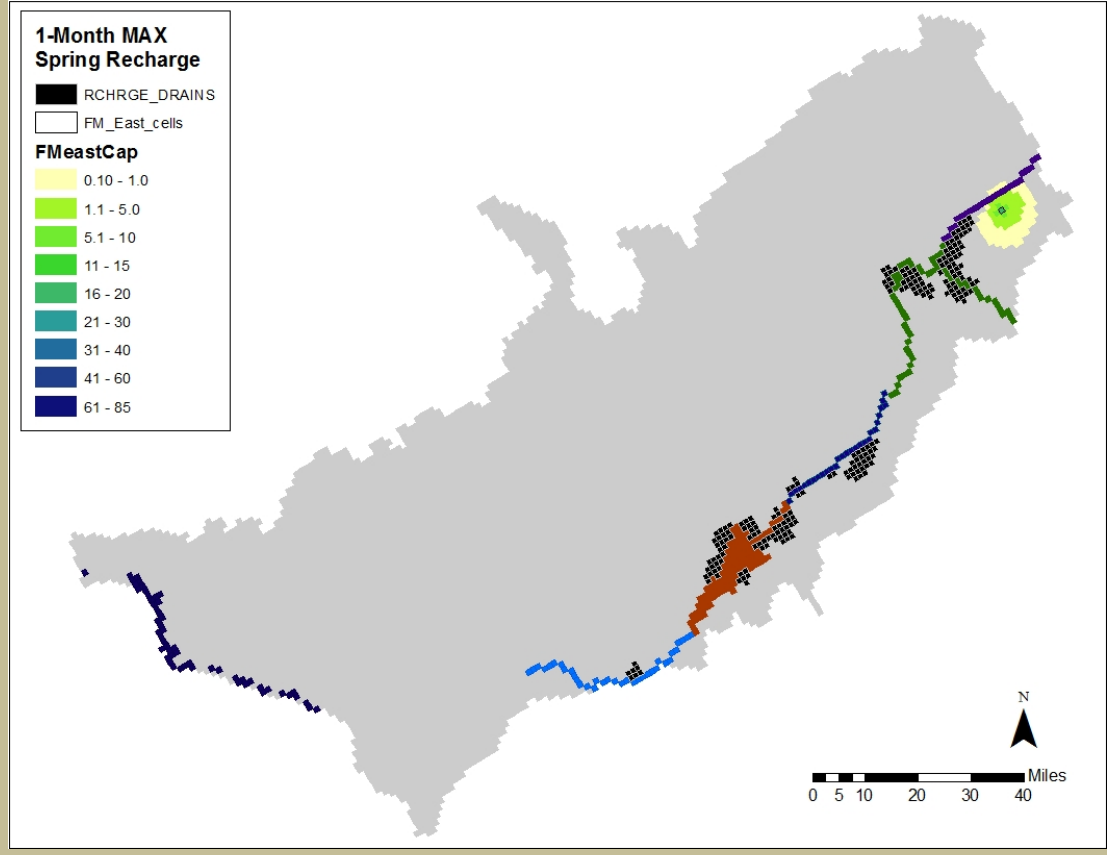


Ultimate fate of recharged water (at site capacity)



Recharge at FMeast

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
10,900	6,500	17,000

SPRING 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
6,500	10

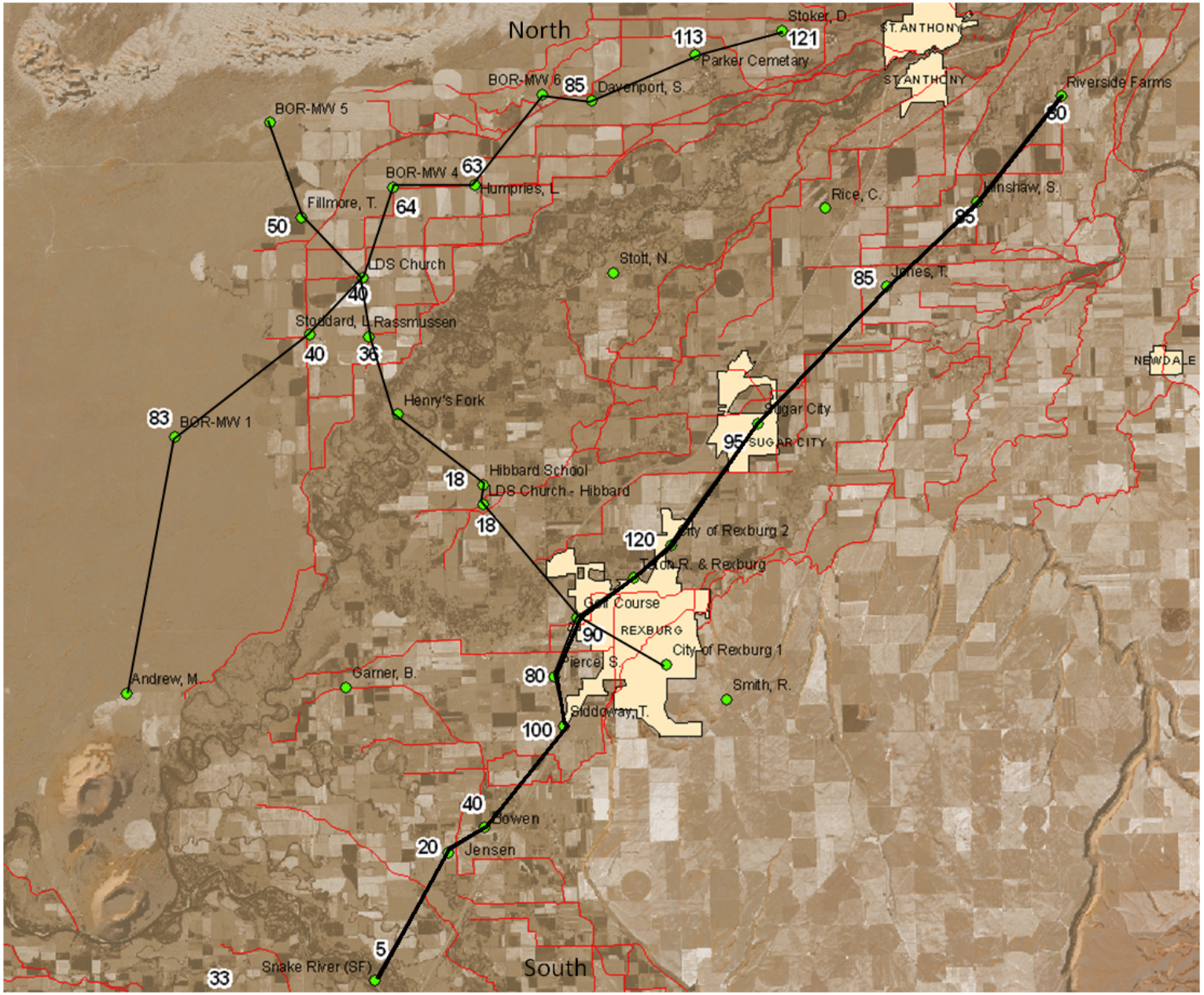
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
10,900	6,500	12,250

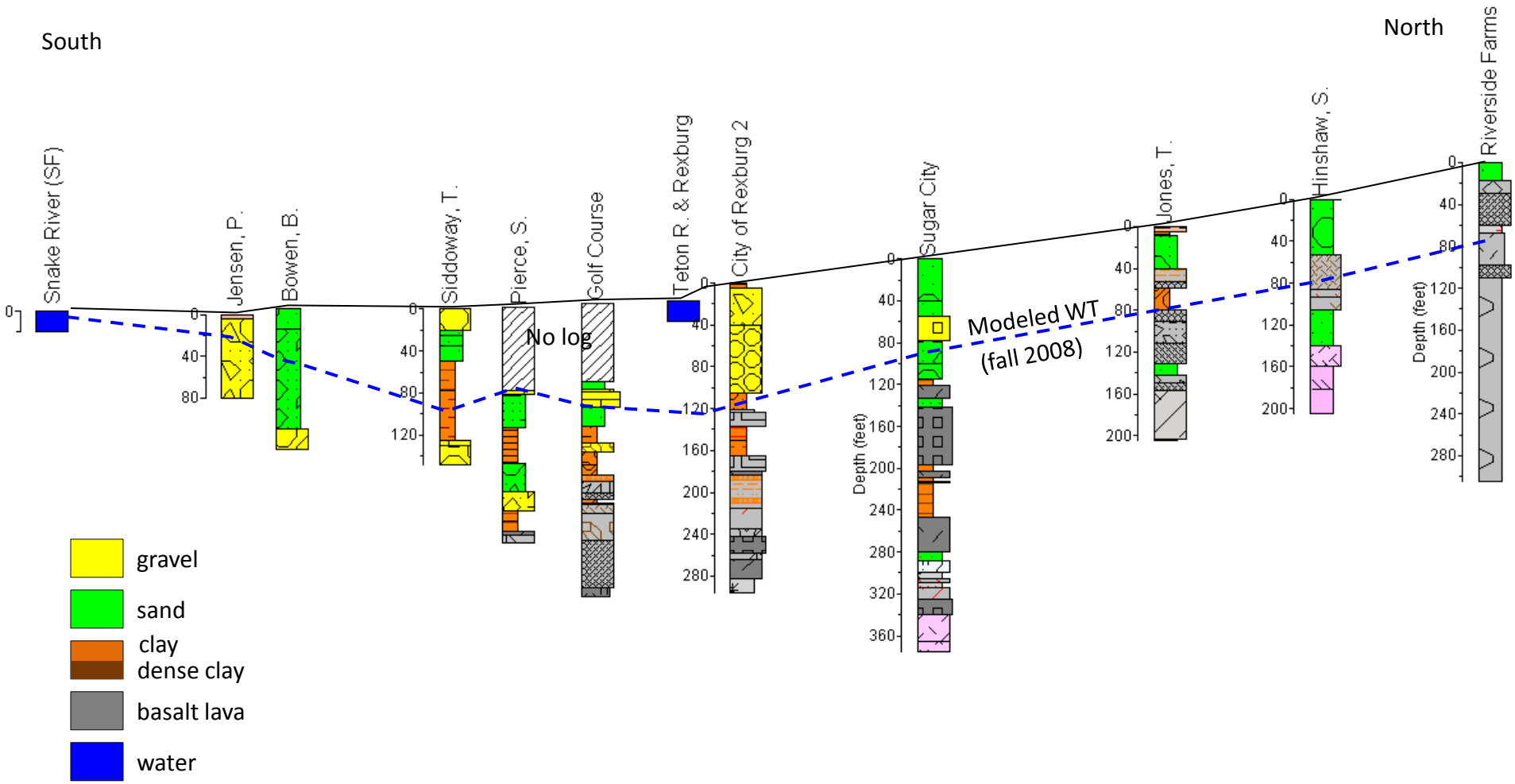
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
6,500	10

Fremont-Madison East Recharge Area

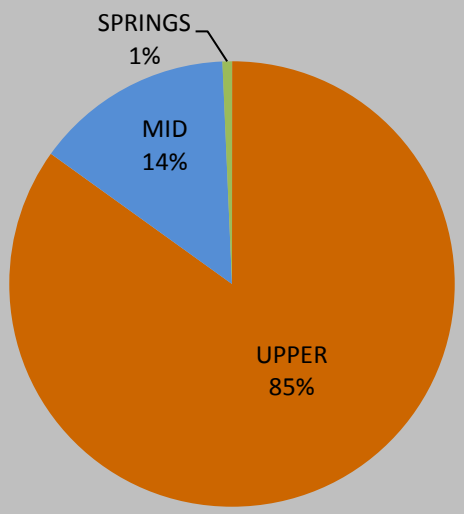


Rexburg Area Cross Section



Horizontal Distance = 19 miles
Vertical Exaggeration = 75

Summary of Recharge at Fremont-Madison East



Ultimate Fate of Recharged Water

- Recharge via canal seepage and off-canal site.
- Subsurface is primarily sediments over basalt.
- Located near an area of shallow groundwater.
- Majority of recharge water discharges: Upper Reaches (Henry's Fork).
- Recharge Limited by: **Infiltration Capacity**.

Aquifer Retention 5 years

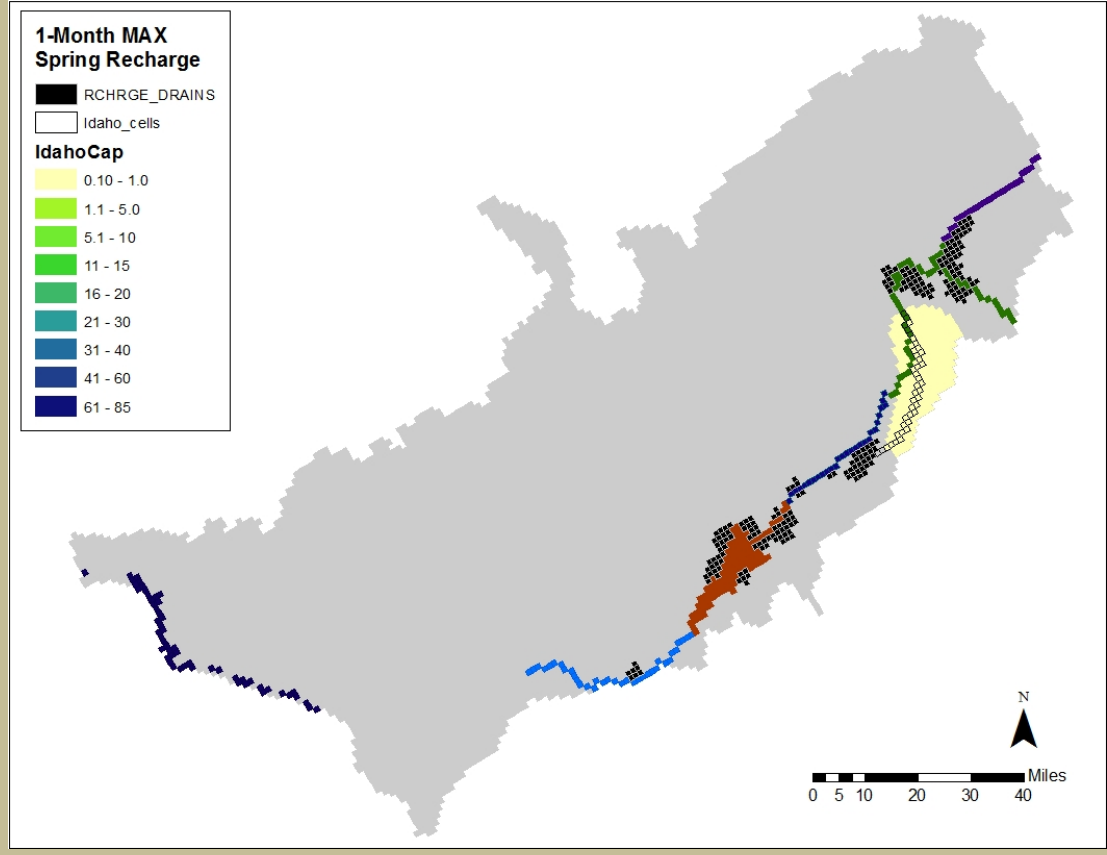
	Rank (of 13)	Retention (%)
SPRING	4	38
FALL	4	38

Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
6,500	2,400	10
6,500	2,400	10

Recharge at Idaho

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
1,000	300	8,500

SPRING 1-month Annual

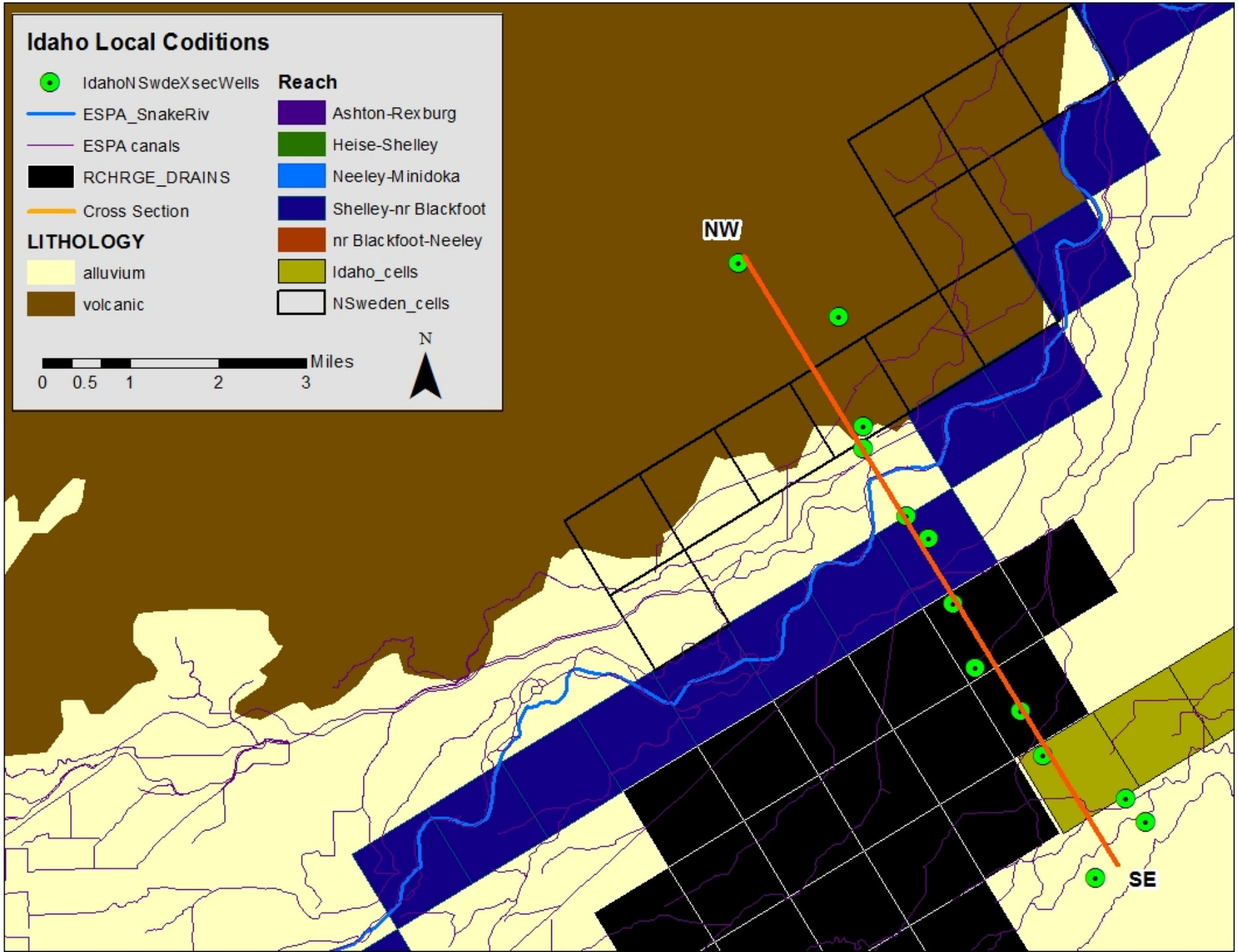
Annual Recharge Limit (AF)	Number of Consecutive Years
300	10

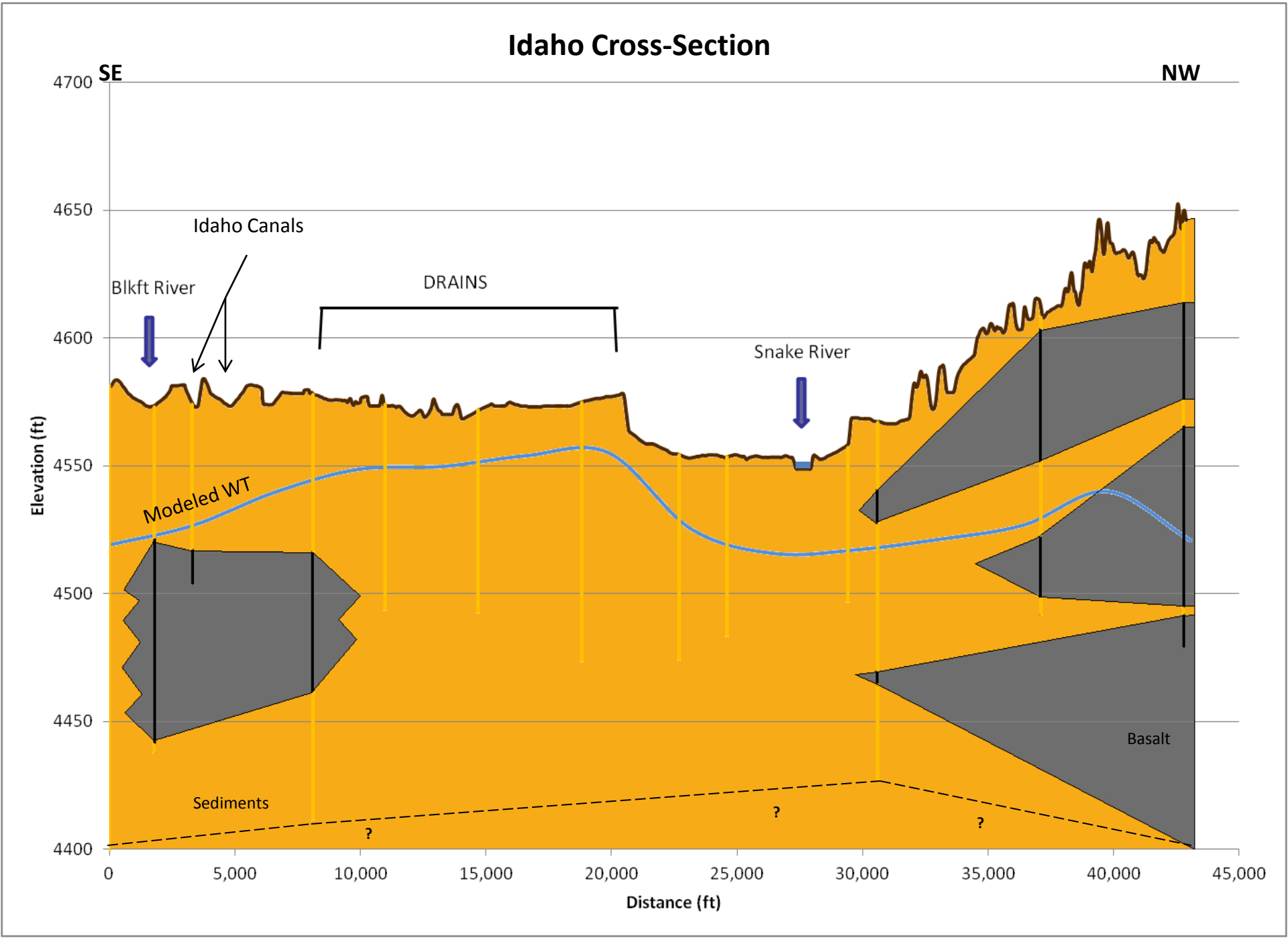
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
1,000	300	No Recharge

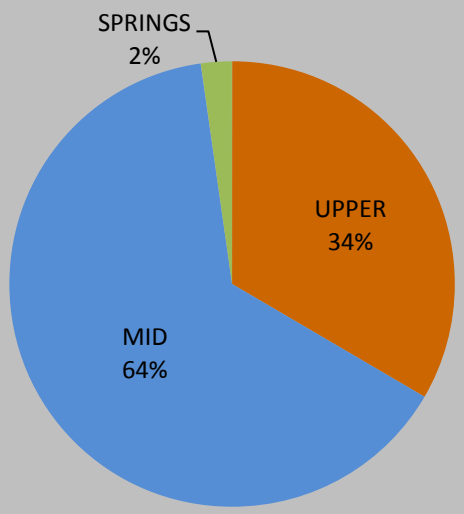
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
No Recharge	0


Idaho Local Coditions
IdahoNSwdeXsecWells
ESPA_SnakeRiv
ESPA canals
RCHRGE_DRAINS
Cross Section
LITHOLOGY
alluvium
volcanic
Reach
Ashton-Rexburg
Heise-Shelley
Neeley-Minidoka
Shelley-nr Blackfoot
nr Blackfoot-Neeley
Idaho_cells
NSweden_cells
Miles
0 0.5 1 2 3
N
NW
SE


Idaho Cross-Section
SE
NW
4700
4650
4600
4550
4500
4450
4400
Elevation (ft)
Idaho Canals
Blkft River
DRAINS
Snake River
Modeled WT
Basalt
Sediments
?
?
?
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
Distance (ft)

Summary of Recharge at Idaho



Ultimate Fate of Recharged Water

- Recharge via canal seepage.
- Subsurface is primarily sediments.
- Located near an area of shallow groundwater.
- Majority of recharge water discharges: Middle Reaches.
- Recharge Limited by: Spring-**Infiltration Capacity**; Fall- **Shallow Groundwater**.

Aquifer Retention 5 years

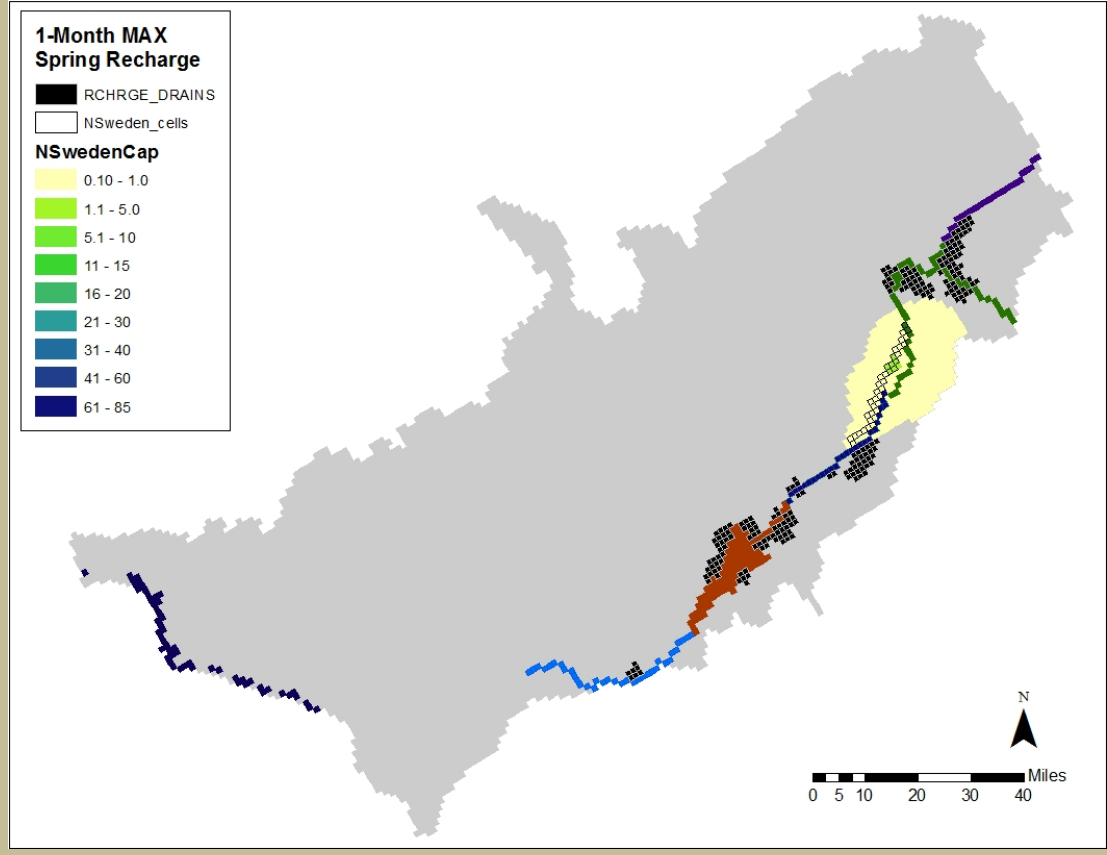
	Rank (of 13)	Retention (%)
SPRING	12	19
	Rank (of 13)	**Retention (%)**
FALL	No Recharge	NA

Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
300	< 100	2,250
Recharge Limit (AF)	**Storage at 5 yrs (AF)**	**Consecutive Years**
No Recharge	NA	No Recharge

Recharge at NSweden

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
3,200	1,600	20,000+

SPRING 1-month Annual

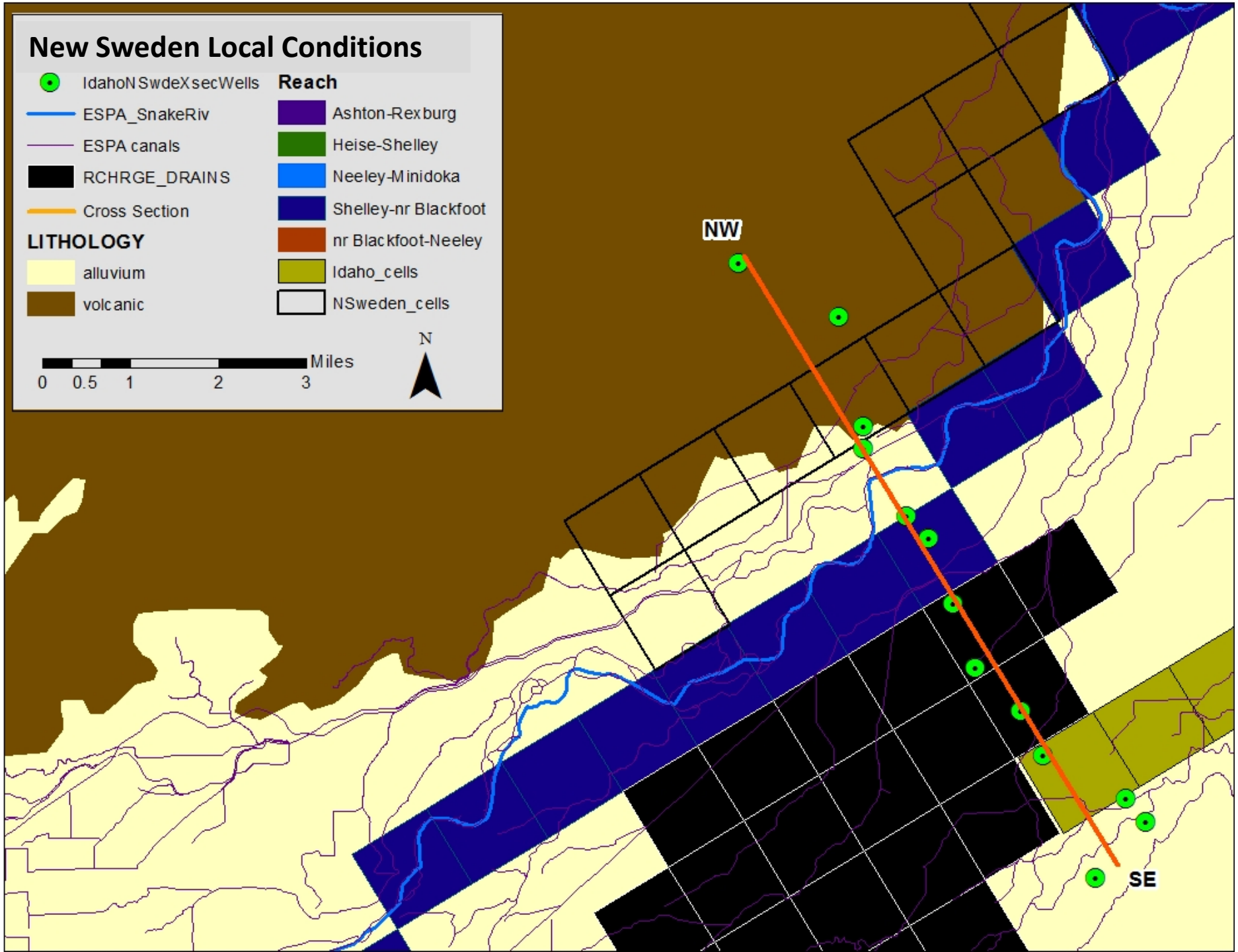
Annual Recharge Limit (AF)	Number of Consecutive Years
1,600	10

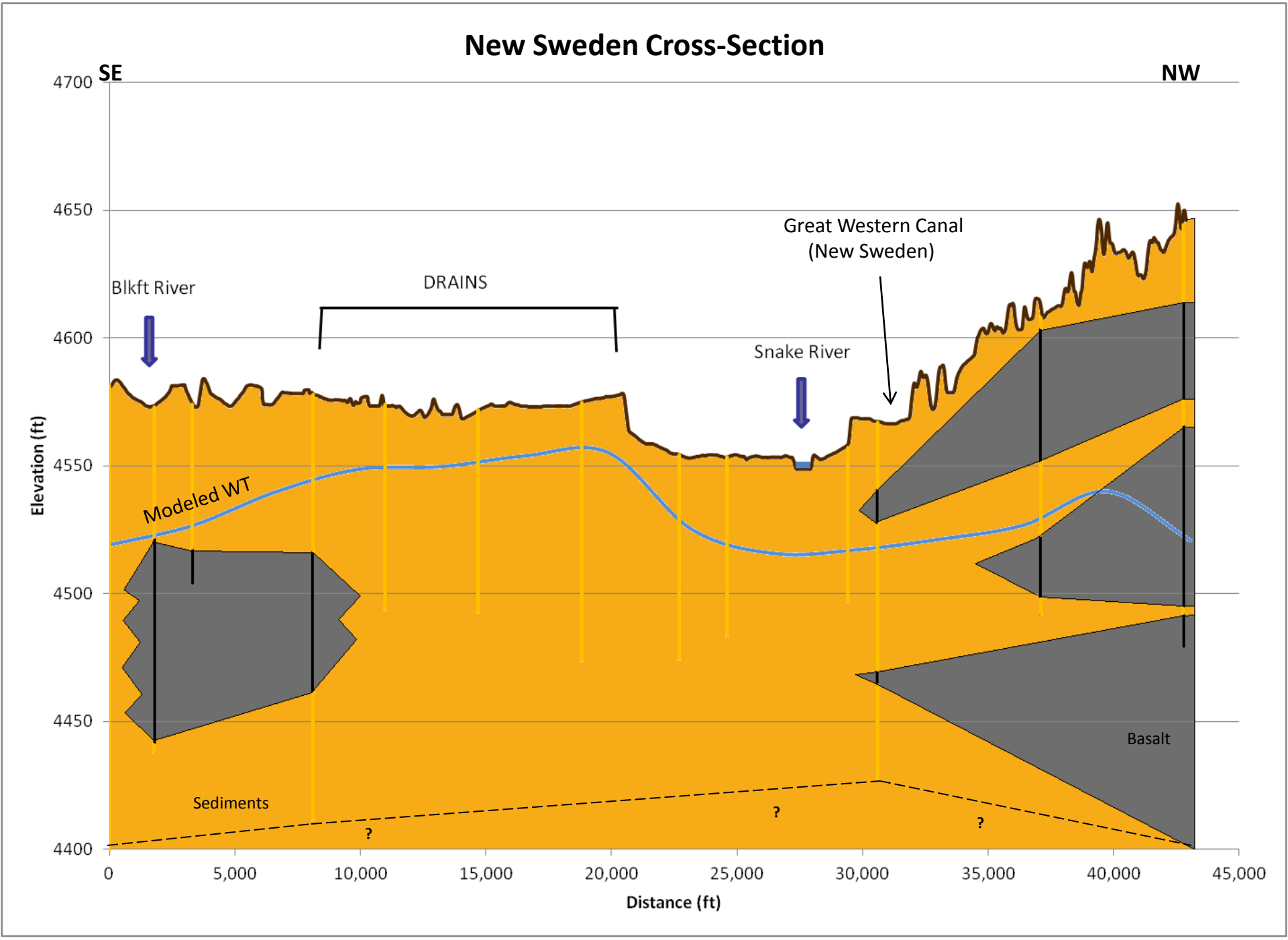
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
3,200	1,600	3,750

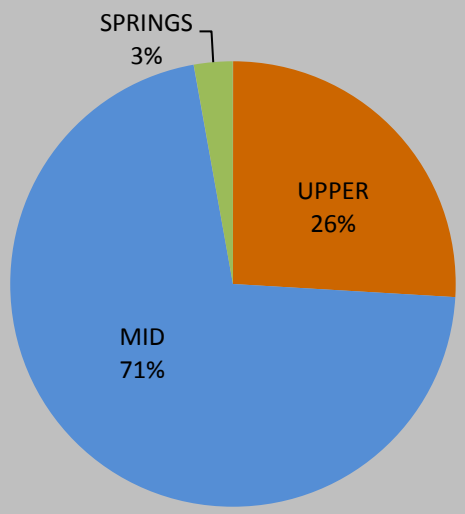
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
1,600	10


New Sweden Local Conditions
IdahoNSwdeXsecWells
ESPA_SnakeRiv
ESPA canals
RCHRGE_DRAINS
Cross Section
LITHOLOGY
alluvium
volcanic
Reach
Ashton-Rexburg
Heise-Shelley
Neeley-Minidoka
Shelley-nr Blackfoot
nr Blackfoot-Neeley
Idaho_cells
NSweden_cells
Miles
0 0.5 1 2 3
N
NW
SE


New Sweden Cross-Section
SE
NW
4700
4650
4600
4550
4500
4450
4400
Elevation (ft)
Blkft River
DRAINS
Great Western Canal
(New Sweden)
Snake River
Modeled WT
Sediments
Basalt
?
?
?
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
Distance (ft)

Summary of Recharge at New Sweden



Ultimate Fate of Recharged Water

- Recharge via canal seepage and off-canal sites.
- Subsurface is primarily sediments.
- Located near an area of shallow groundwater.
- Majority of recharge water discharges: Middle Reaches.
- Recharge Limited by: **Infiltration Capacity**.

Aquifer Retention 5 years

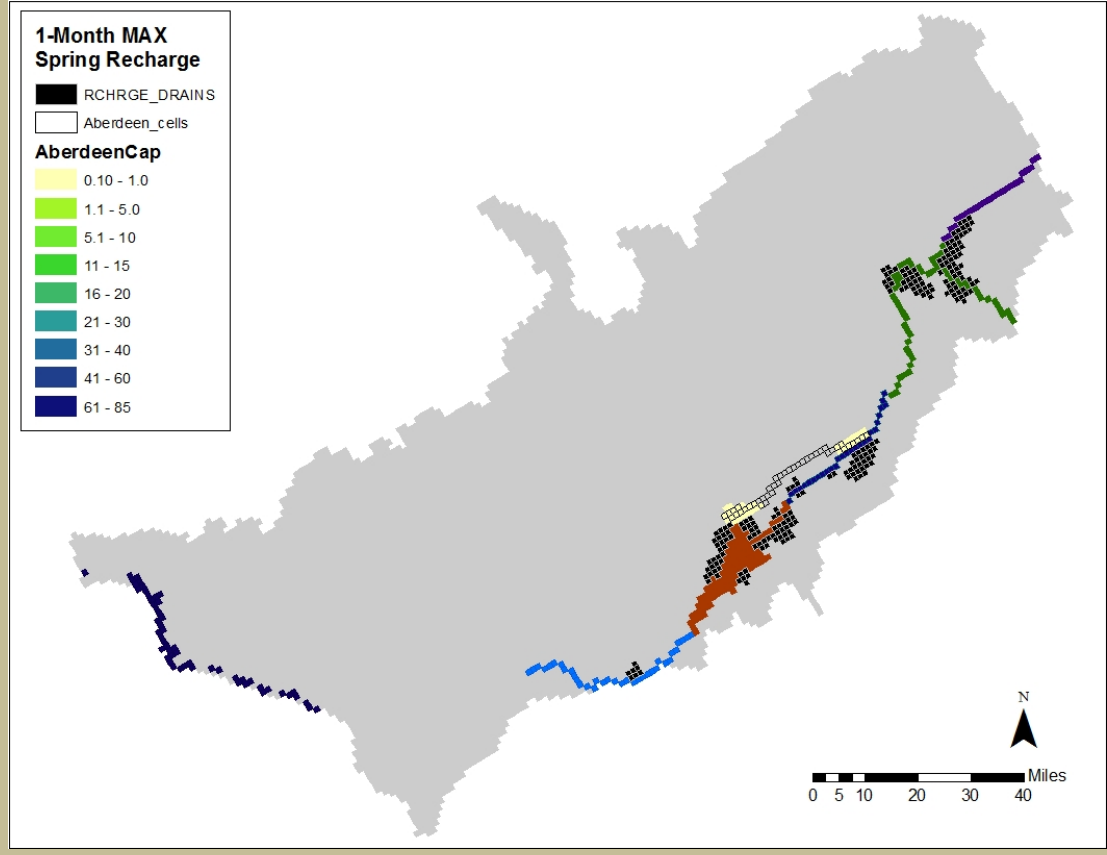
	Rank (of 13)	Retention (%)
SPRING	9	21
FALL	9	21

Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
1,600	300	10
1,600	300	10

Recharge at Aberdeen

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
10,900	6,600	2,250

SPRING 1-month Annual

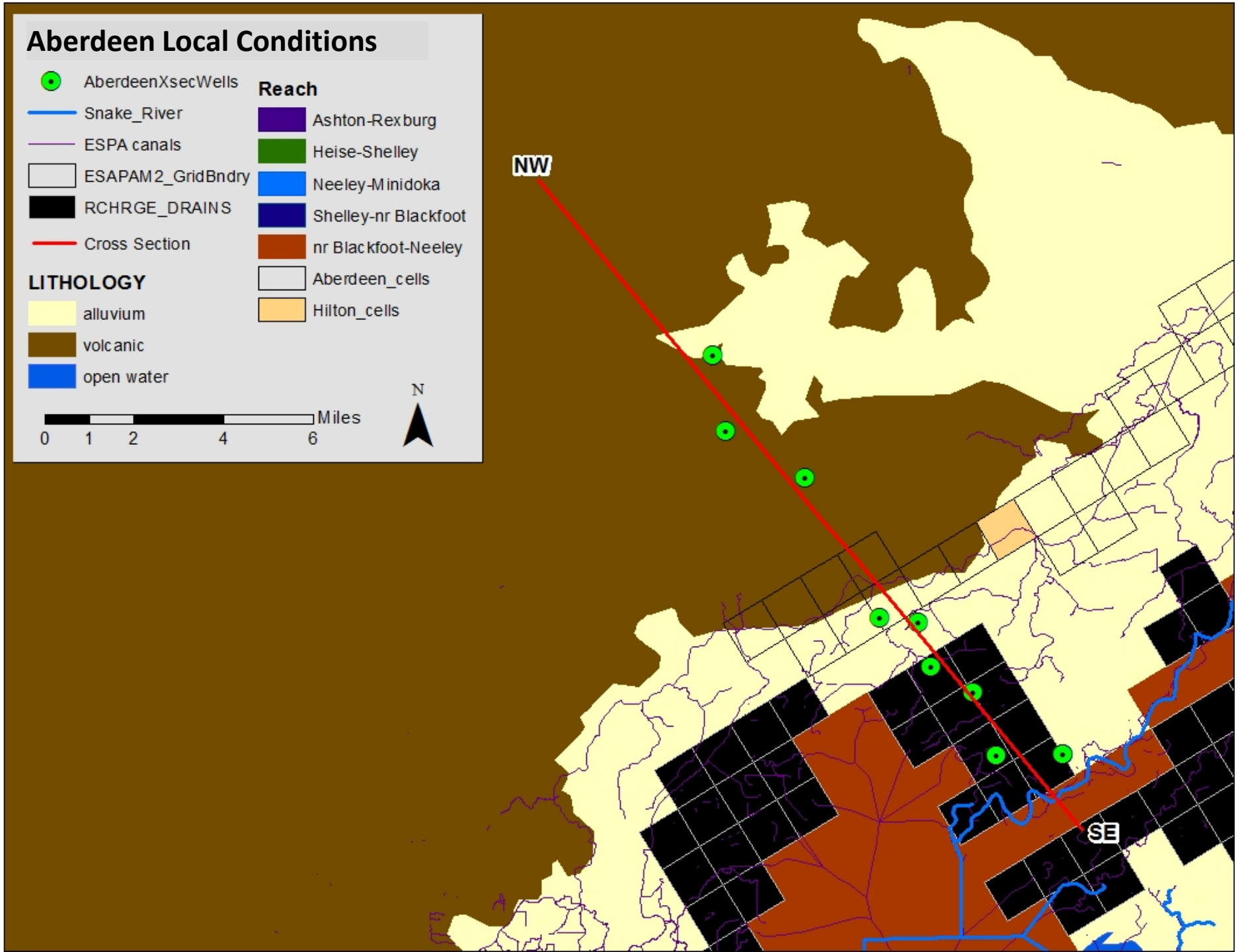
Annual Recharge Limit (AF)	Number of Consecutive Years
2,250	1

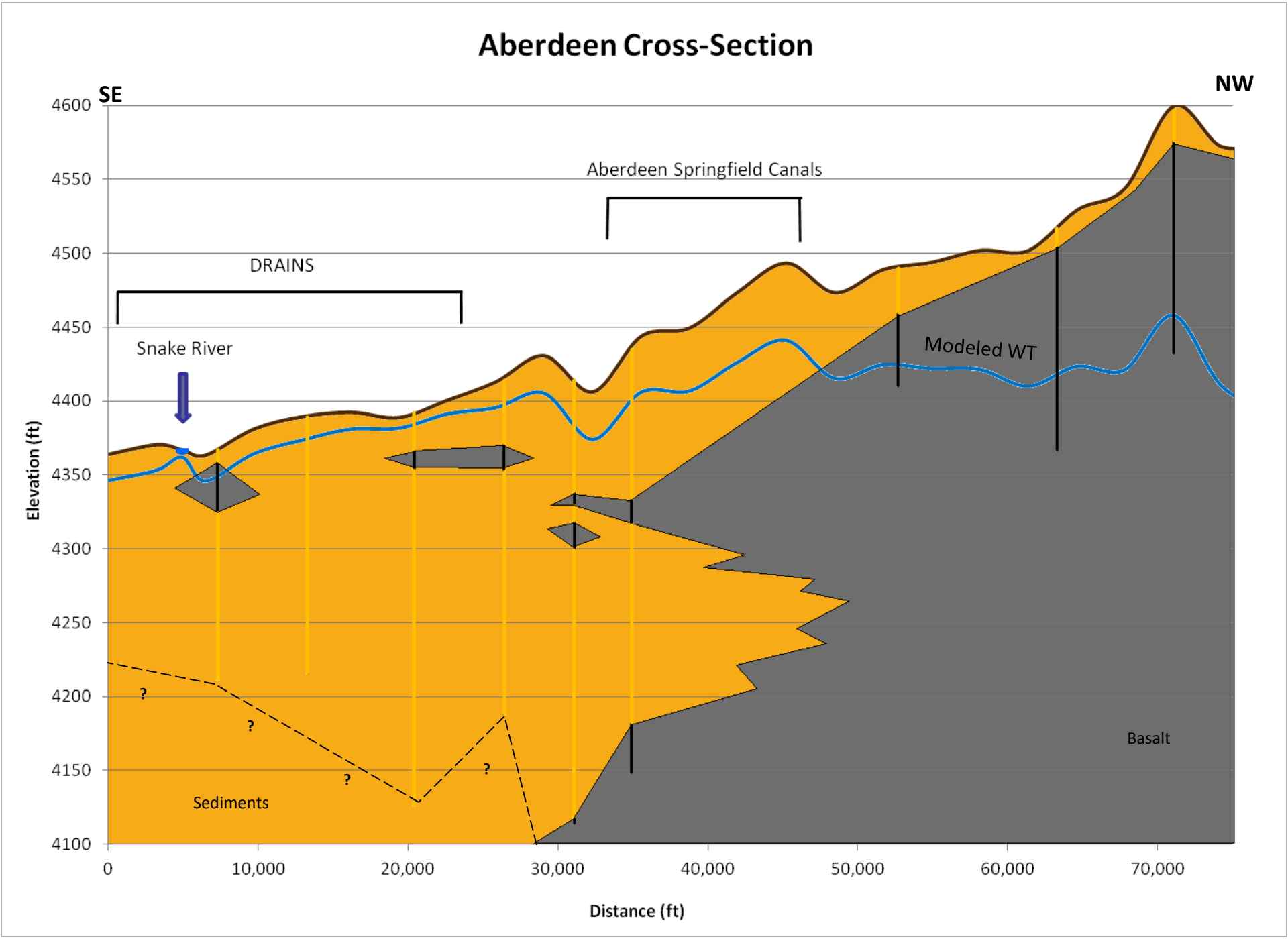
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
10,900	6,600	No Recharge

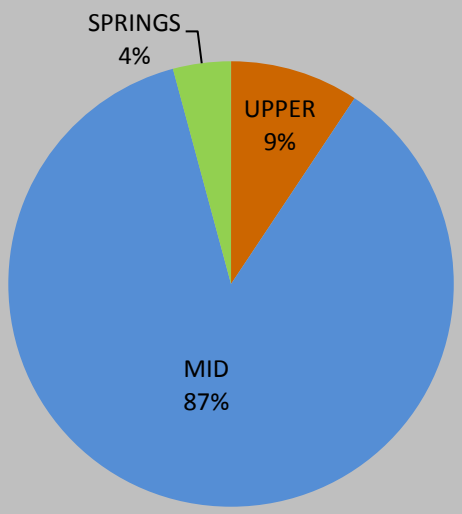
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
No Recharge	0


Aberdeen Local Conditions
AberdeenXsecWells
Snake_River
ESPA canals
ESAPAM2_GridBndry
RCHRGE_DRAINS
Cross Section
LITHOLOGY
alluvium
volcanic
open water
Reach
Ashton-Rexburg
Heise-Shelley
Neeley-Minidoka
Shelley-nr Blackfoot
nr Blackfoot-Neeley
Aberdeen_cells
Hilton_cells
Miles
0 1 2 4 6
N
NW
SE


Aberdeen Cross-Section
SE
NW
Aberdeen Springfield Canals
DRAINS
Snake River
Modeled WT
Basalt
Sediments
?
?
?
?
Elevation (ft)
4600
4550
4500
4450
4400
4350
4300
4250
4200
4150
4100
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
Distance (ft)

Summary of Recharge at Aberdeen



Ultimate Fate of Recharged Water

- Recharge via canal seepage.
- Subsurface is primarily sediments.
- Located in an area of shallow groundwater and groundwater discharge.
- Canal Company is planning a drainage well to remove standing water due to canal seepage.
- Majority of recharge water discharges: Middle Reaches.
- Recharge Limited by: **Shallow Groundwater**.

Aquifer Retention 5 years

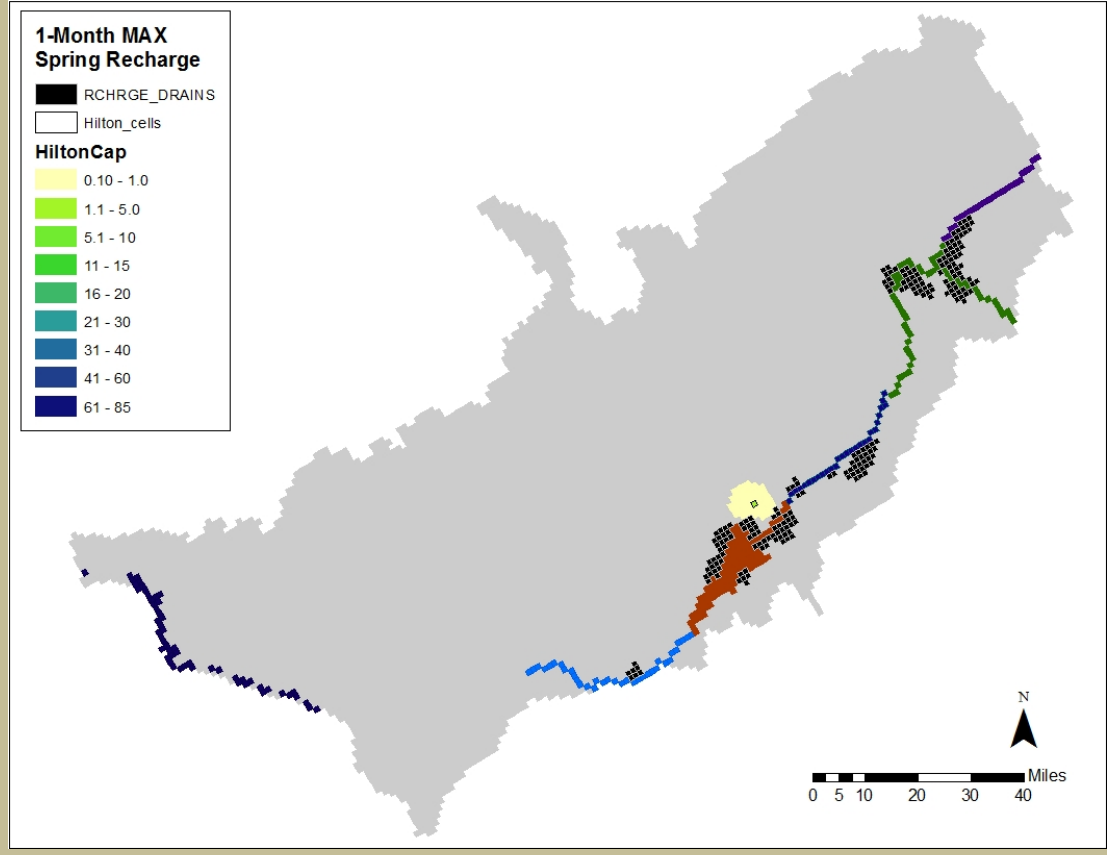
	Rank (of 13)	Retention (%)
SPRING	11	21
FALL	No Recharge	NA

Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
2,300	500	1
No Recharge	NA	No Recharge

Recharge at Hilton

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
7,700	7,600	3,200

SPRING 1-month Annual

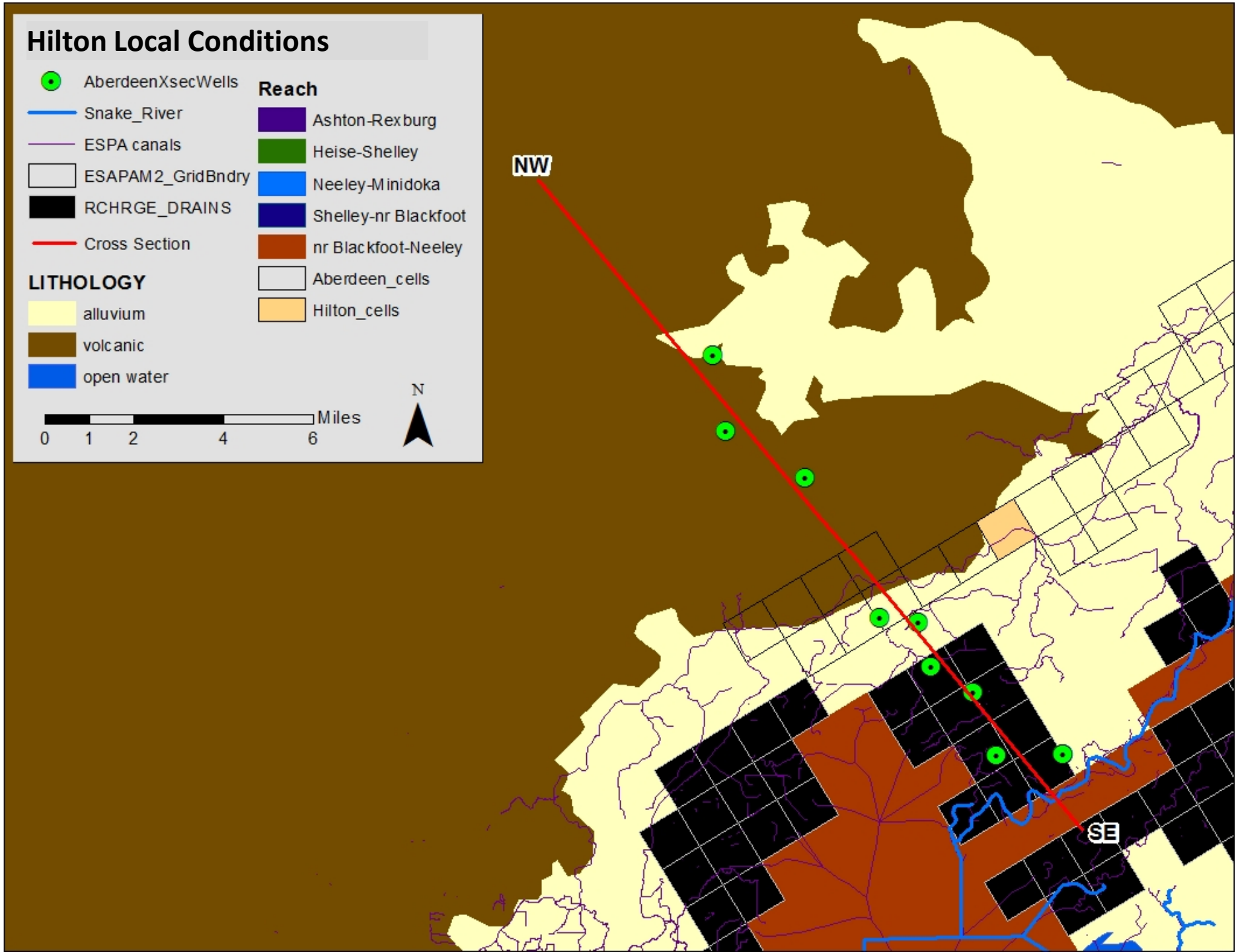
Annual Recharge Limit (AF)	Number of Consecutive Years
3,200	10

FALL 1-month One-Time

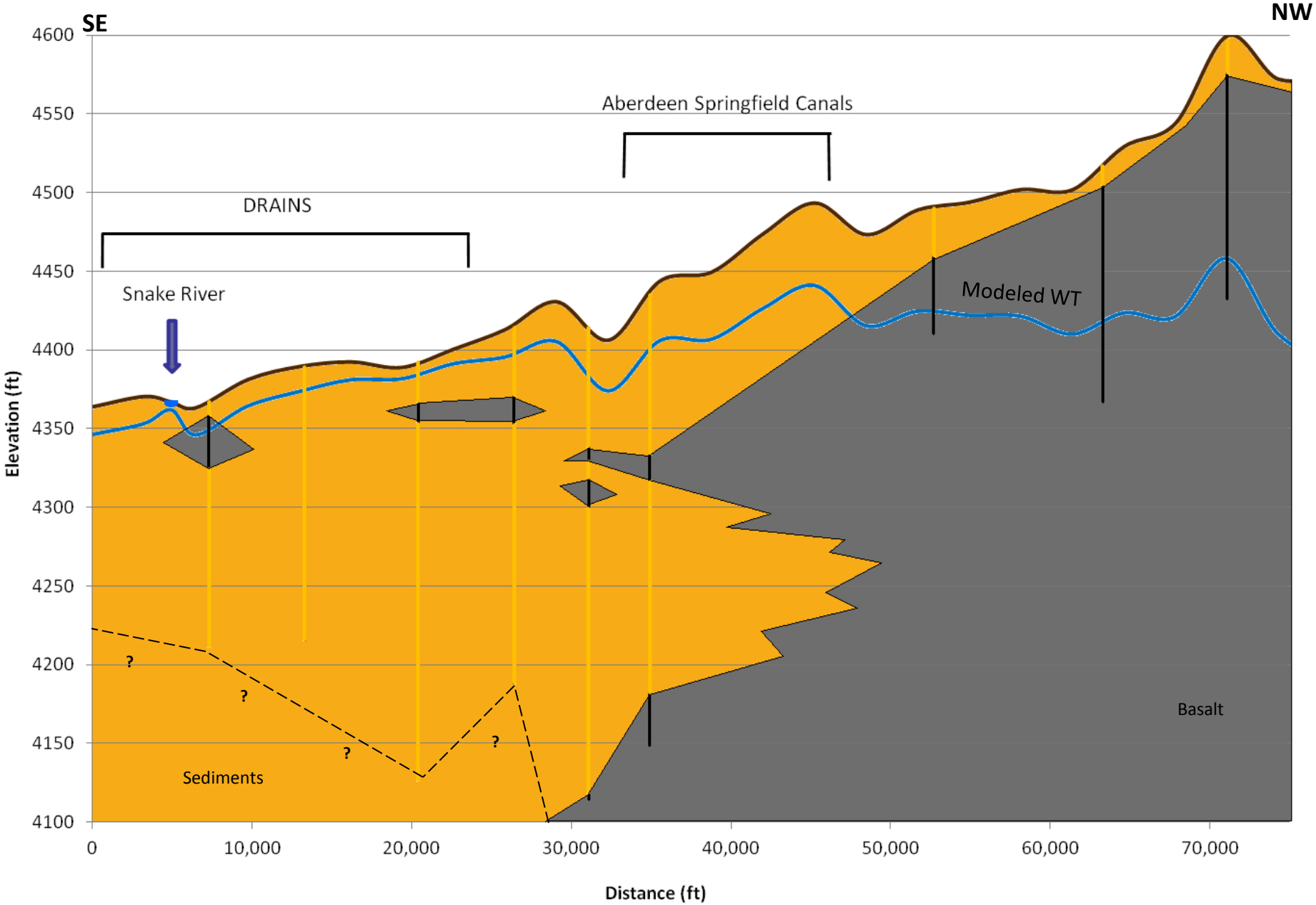
Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
7,700	7,600	2,800

FALL 1-month Annual

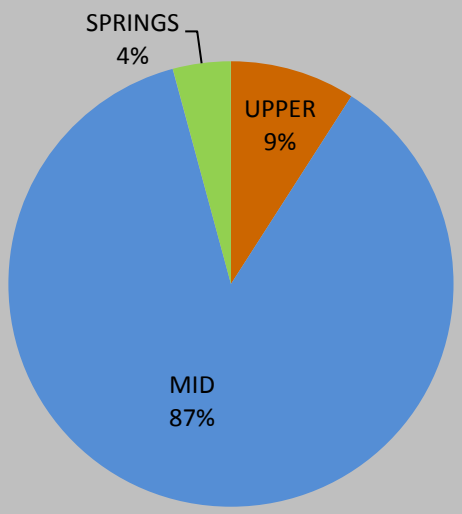
Annual Recharge Limit (AF)	Number of Consecutive Years
2,800	4


Hilton Local Conditions
AberdeenXsecWells
Snake_River
ESPA canals
ESAPAM2_GridBndry
RCHRGE_DRAINS
Cross Section
LITHOLOGY
alluvium
volcanic
open water
Reach
Ashton-Rexburg
Heise-Shelley
Neeley-Minidoka
Shelley-nr Blackfoot
nr Blackfoot-Neeley
Aberdeen_cells
Hilton_cells
Miles
0 1 2 4 6
N
NW
SE

Hilton Cross-Section



Summary of Recharge at Hilton



Ultimate Fate of Recharged Water

- Recharge via off-canal site.
- Subsurface is primarily sediments.
- Located in an area of shallow groundwater.
- Part of Aberdeen system, but discrete location mitigates some shallow GW limitations.
- Majority of recharge water discharges: Nr Blackfoot-Minidoka.
- Recharge Limited by: **Shallow Groundwater**.

Aquifer Retention 5 years

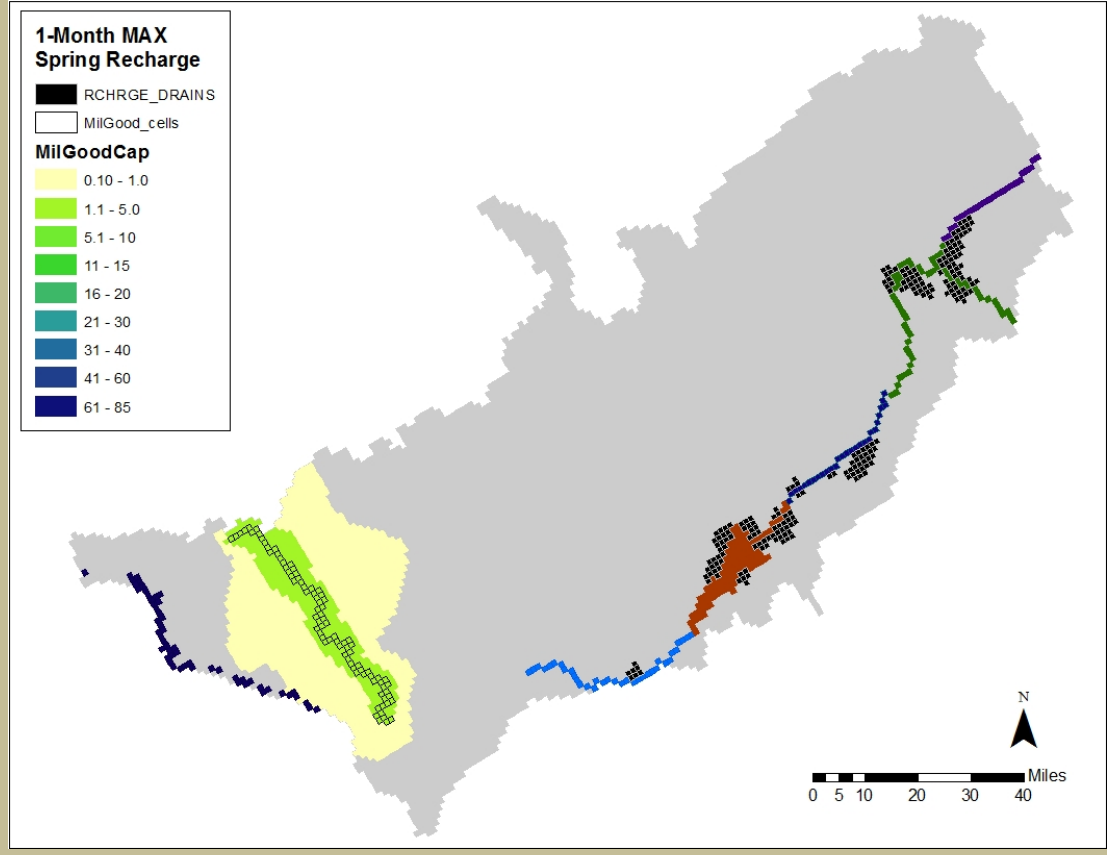
	Rank (of 13)	Retention (%)
SPRING	10	21
FALL	10	21

Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
3,200	700	10
2,800	600	4

Recharge at MilGood

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
46,500	8,200	20,000+

SPRING 1-month Annual

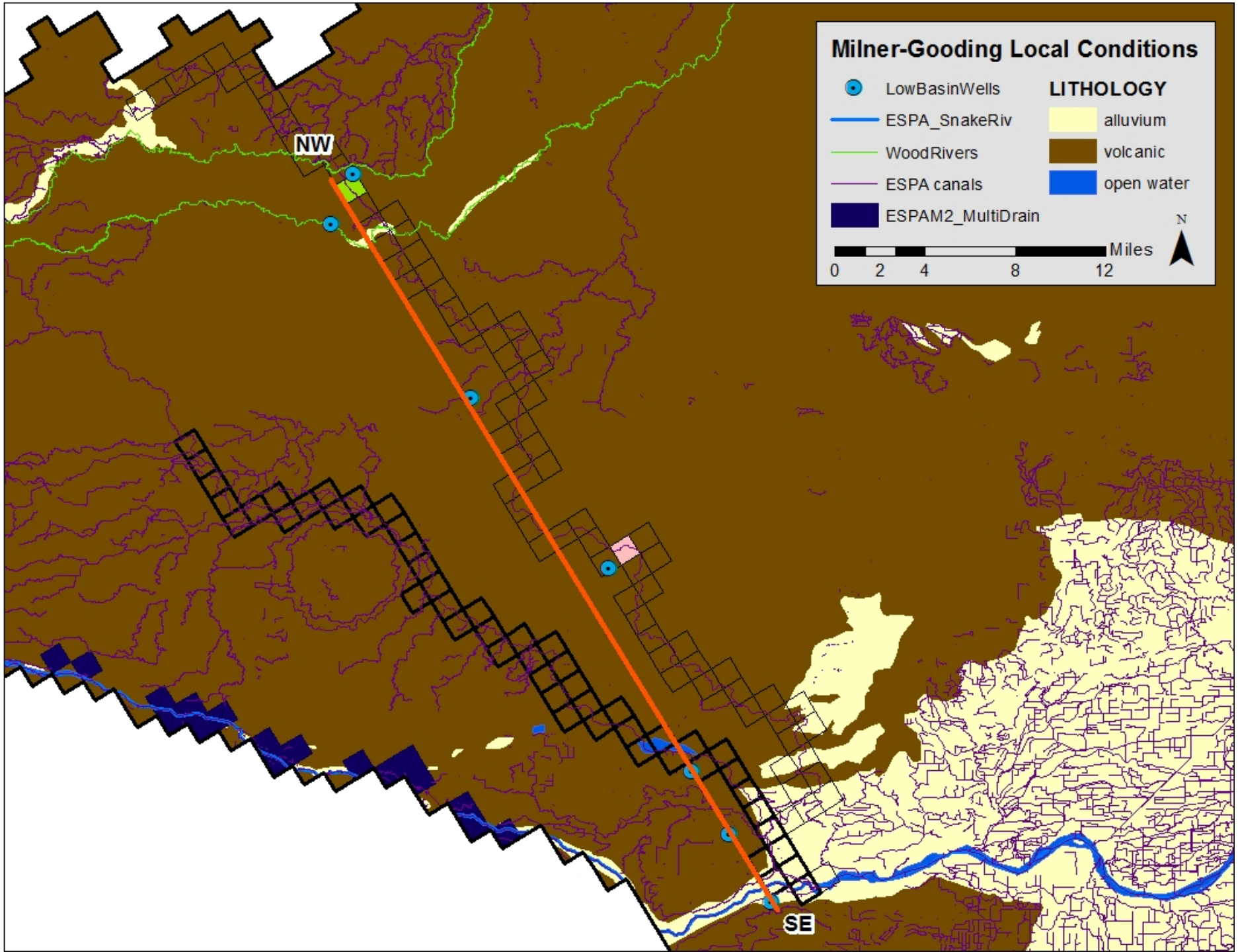
Annual Recharge Limit (AF)	Number of Consecutive Years
8,200	10

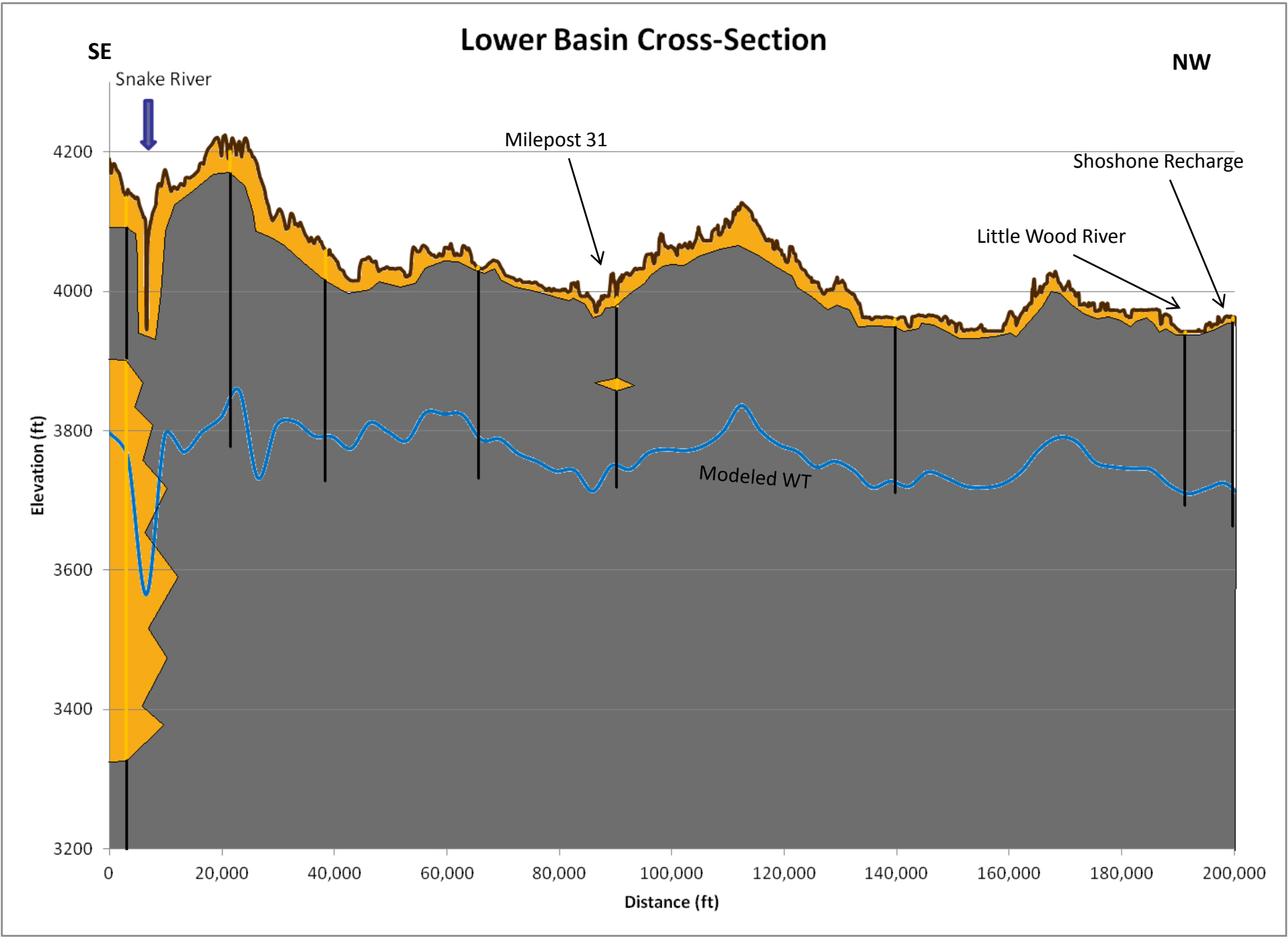
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
46,500	8,200	20,000+

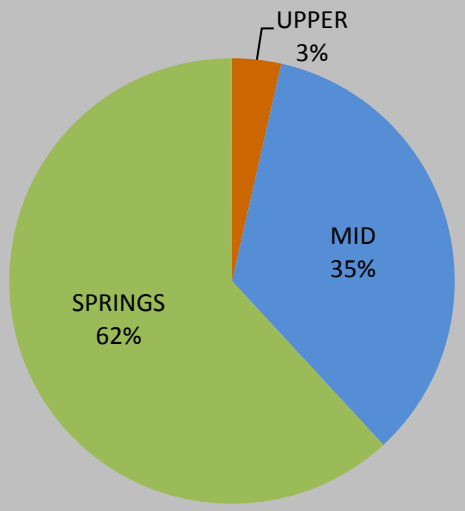
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
8,200	10


Milner-Gooding Local Conditions
LowBasinWells
ESPA_SnakeRiv
WoodRivers
ESPA canals
ESPAM2_MultiDrain
LITHOLOGY
alluvium
volcanic
open water
Miles
0
2
4
8
12
N
NW
SE


Lower Basin Cross-Section
SE
NW
Snake River
Milepost 31
Shoshone Recharge
Little Wood River
Modeled WT
Elevation (ft)
4200
4000
3800
3600
3400
3200
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
Distance (ft)

Summary of Recharge at Milner-Gooding



Ultimate Fate of Recharged Water

- Recharge via canal seepage and off-canal sites.
- Subsurface is primarily basalt.
- Located in an area of deep groundwater.
- Majority of recharge water discharges: Springs.
- Recharge Limited by: **Infiltration Capacity**.

Aquifer Retention 5 years

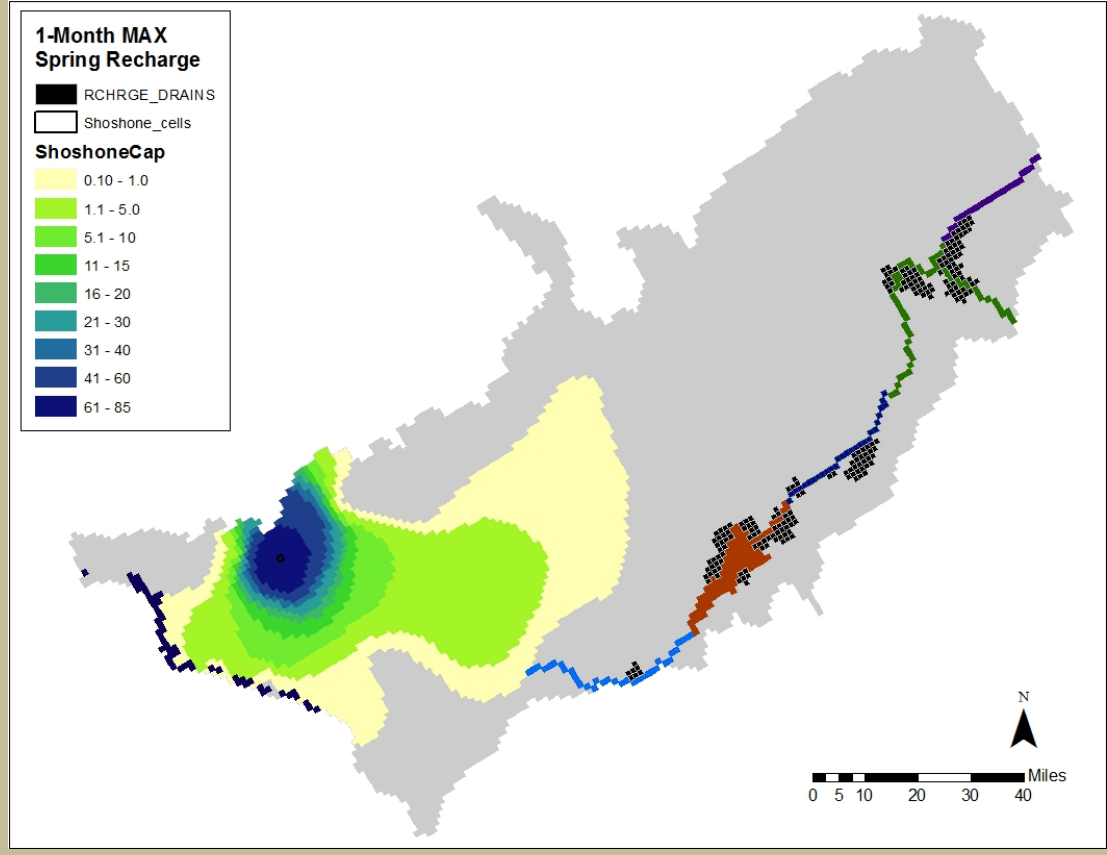
	Rank (of 13)	Retention (%)
SPRING	6	35
FALL	6	35

Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
8,200	2,900	10
8,200	2,900	10

Recharge at Shoshone

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
19,900	21,200	20,000+

SPRING 1-month Annual

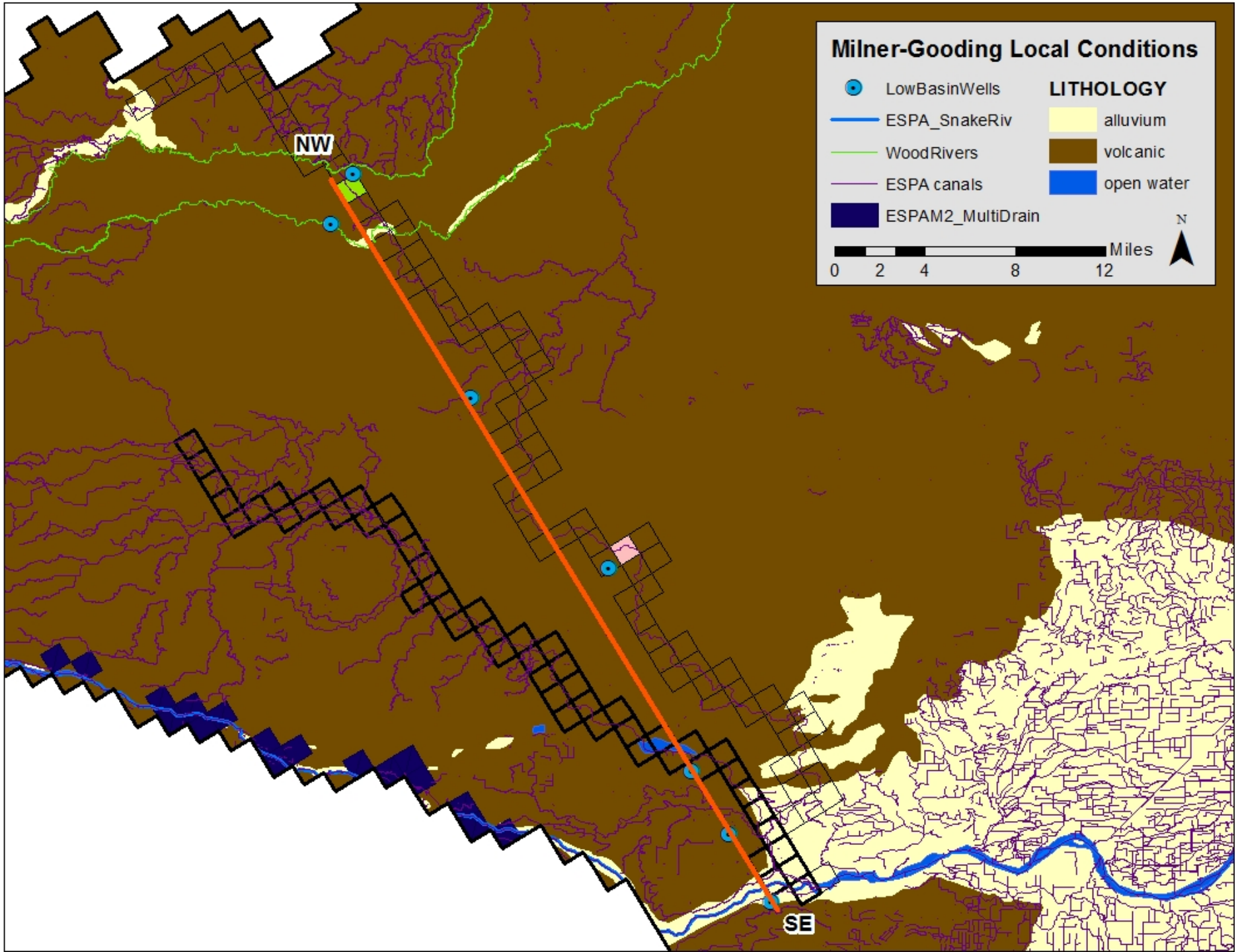
Annual Recharge Limit (AF)	Number of Consecutive Years
19,900	10

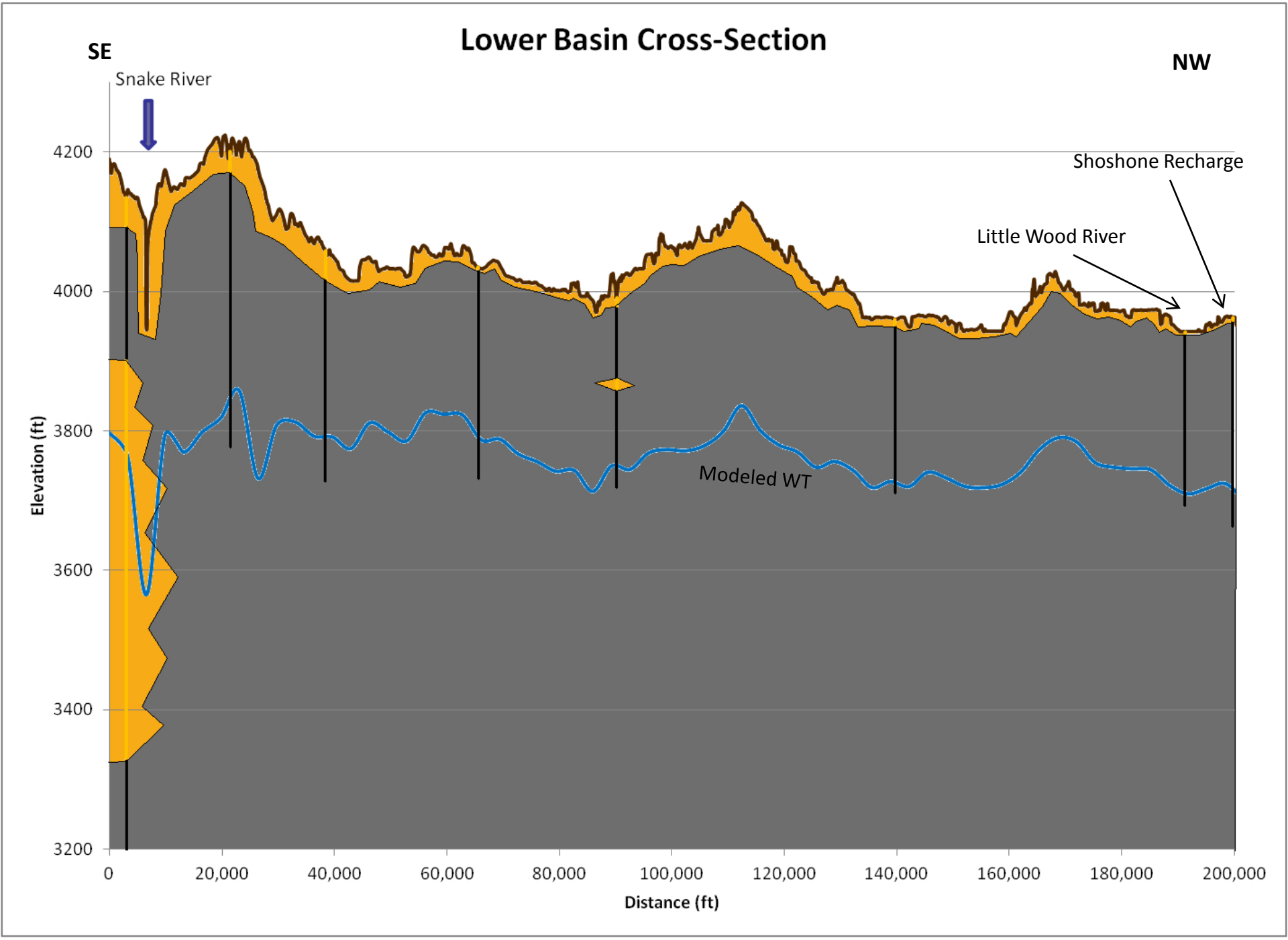
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
19,900	21,200	20,000+

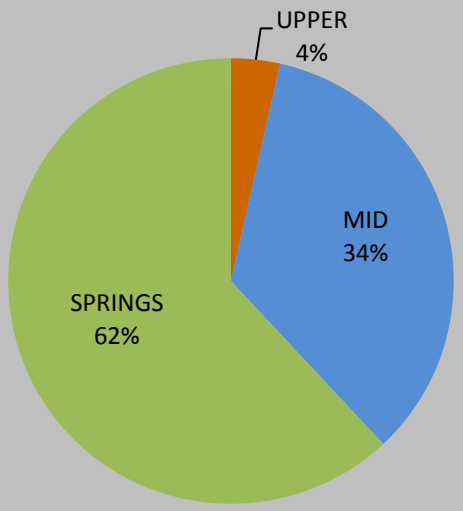
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
19,900	10


Milner-Gooding Local Conditions
LowBasinWells
ESPA_SnakeRiv
WoodRivers
ESPA canals
ESPAM2_MultiDrain
LITHOLOGY
alluvium
volcanic
open water
Miles
0
2
4
8
12
N
NW
SE


Lower Basin Cross-Section
SE
NW
Snake River
Shoshone Recharge
Little Wood River
Modeled WT
Elevation (ft)
4200
4000
3800
3600
3400
3200
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
Distance (ft)

Summary of Recharge at Shoshone



Ultimate Fate of Recharged Water

- Recharge via off-canal site.
- Subsurface is primarily basalt.
- Located in an area of deep groundwater.
- Majority of recharge water discharges: Springs.
- Recharge Limited by: **Diversion Capacity.**

Aquifer Retention 5 years

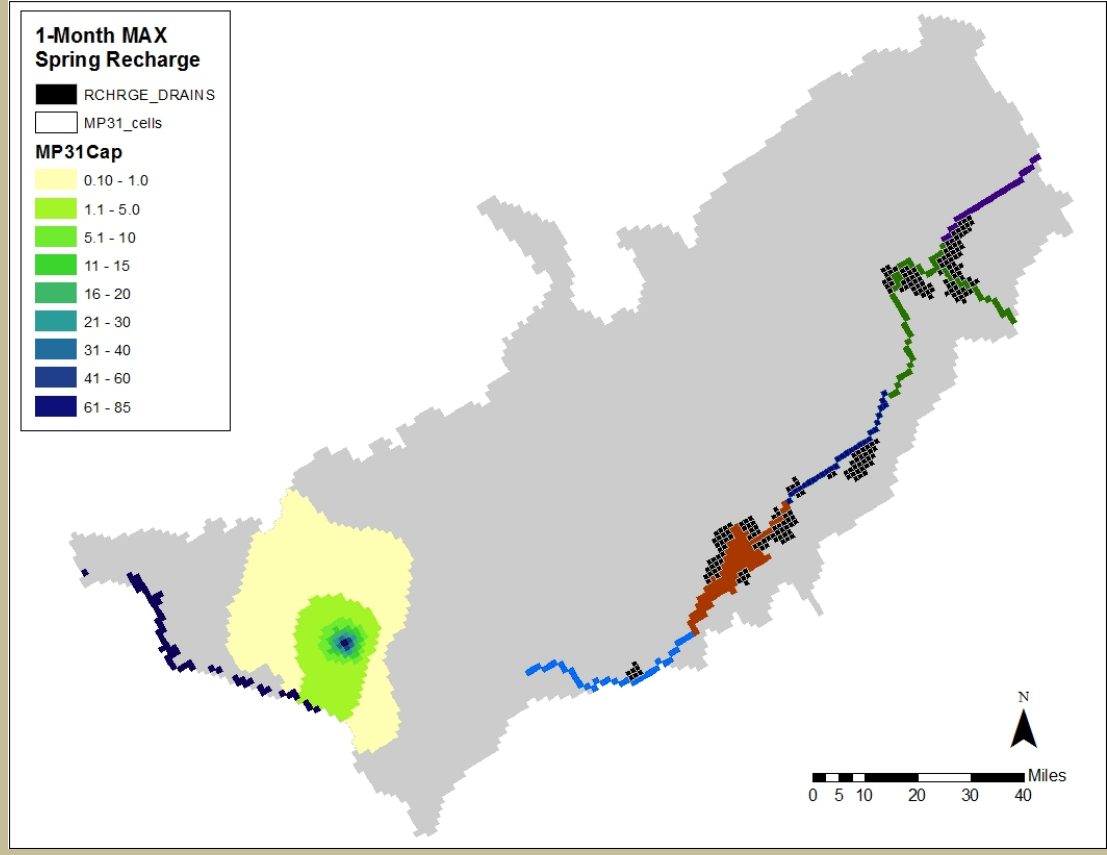
	Rank (of 13)	Retention (%)
SPRING	7	32
FALL	7	32

Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
19,900	6,400	10
19,900	6,400	10

Recharge at MP31

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
18,400	24,200	20,000+

SPRING 1-month Annual

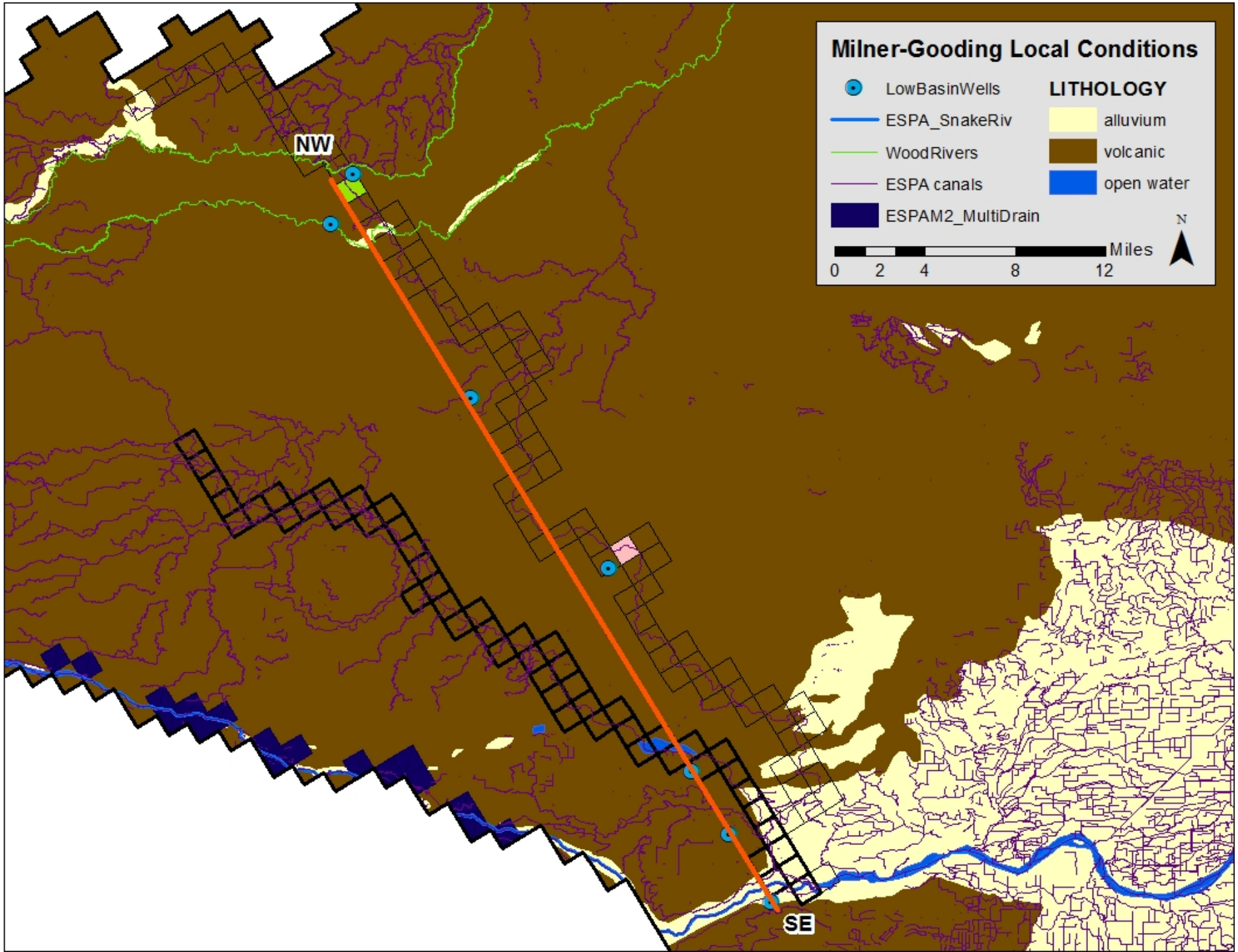
Annual Recharge Limit (AF)	Number of Consecutive Years
18,400	10

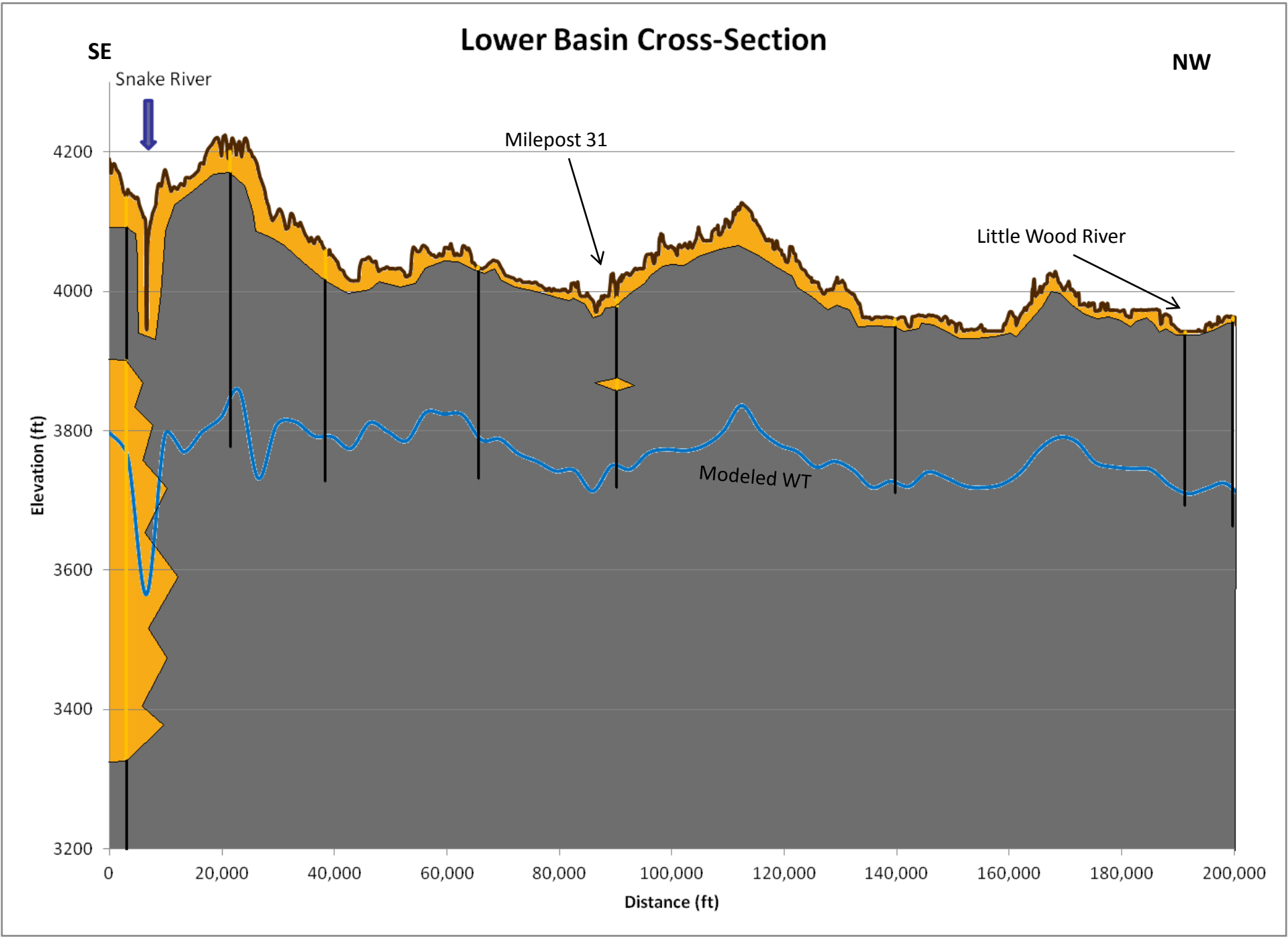
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
18,400	24,200	20,000+

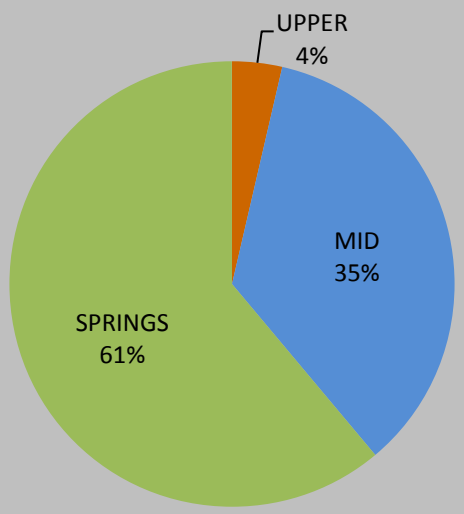
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
18,400	10


Milner-Gooding Local Conditions
LowBasinWells
ESPA_SnakeRiv
WoodRivers
ESPA canals
ESPAM2_MultiDrain
LITHOLOGY
alluvium
volcanic
open water
Miles
0
2
4
8
12
N
NW
SE


Lower Basin Cross-Section
SE
NW
Snake River
Milepost 31
Little Wood River
Modeled WT
Elevation (ft)
4200
4000
3800
3600
3400
3200
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
Distance (ft)

Summary of Recharge at Milepost 31



Ultimate Fate of Recharged Water

- Recharge via off-canal site.
- Subsurface is primarily basalt.
- Located in an area of deep groundwater.
- Majority of recharge water discharges: Springs.
- Recharge Limited by: **Diversion Capacity.**

Aquifer Retention 5 years

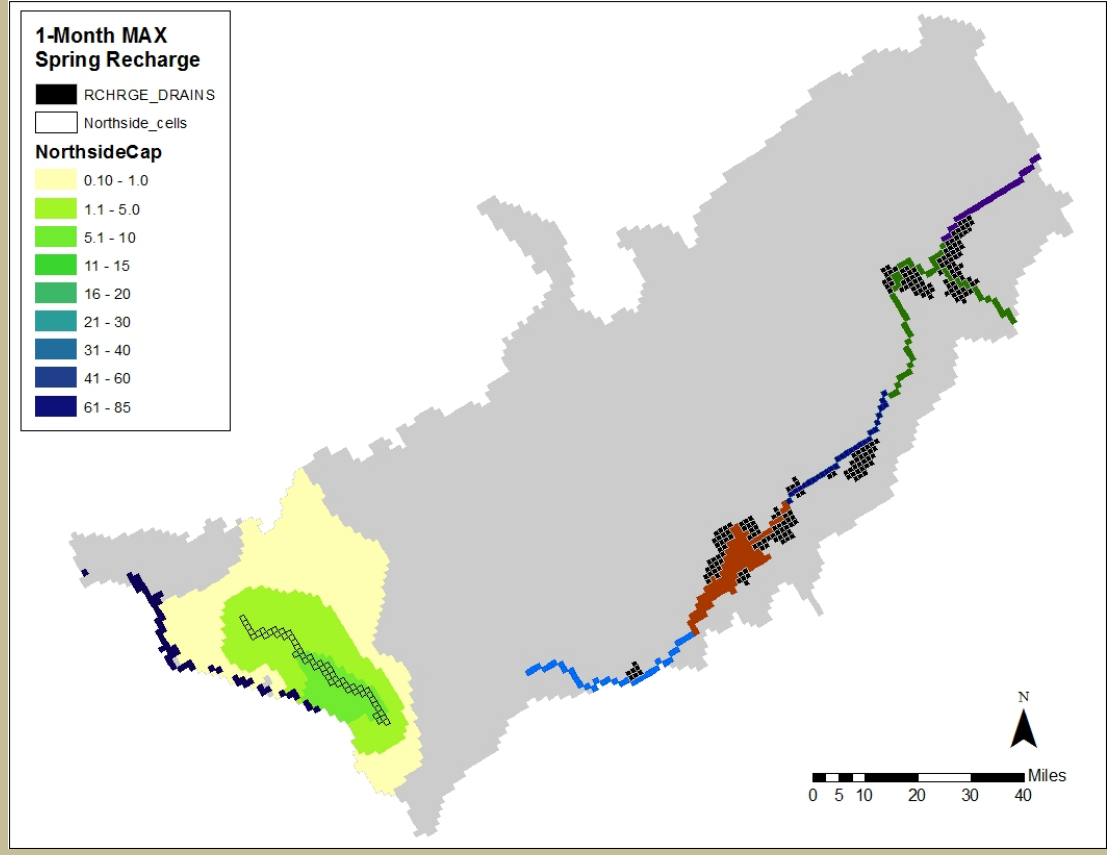
	Rank (of 13)	Retention (%)
SPRING	5	36
FALL	5	36

Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
18,400	6,600	10
18,400	6,600	10

Recharge at Northside

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
30,700	22,200	30,000+

SPRING 1-month Annual

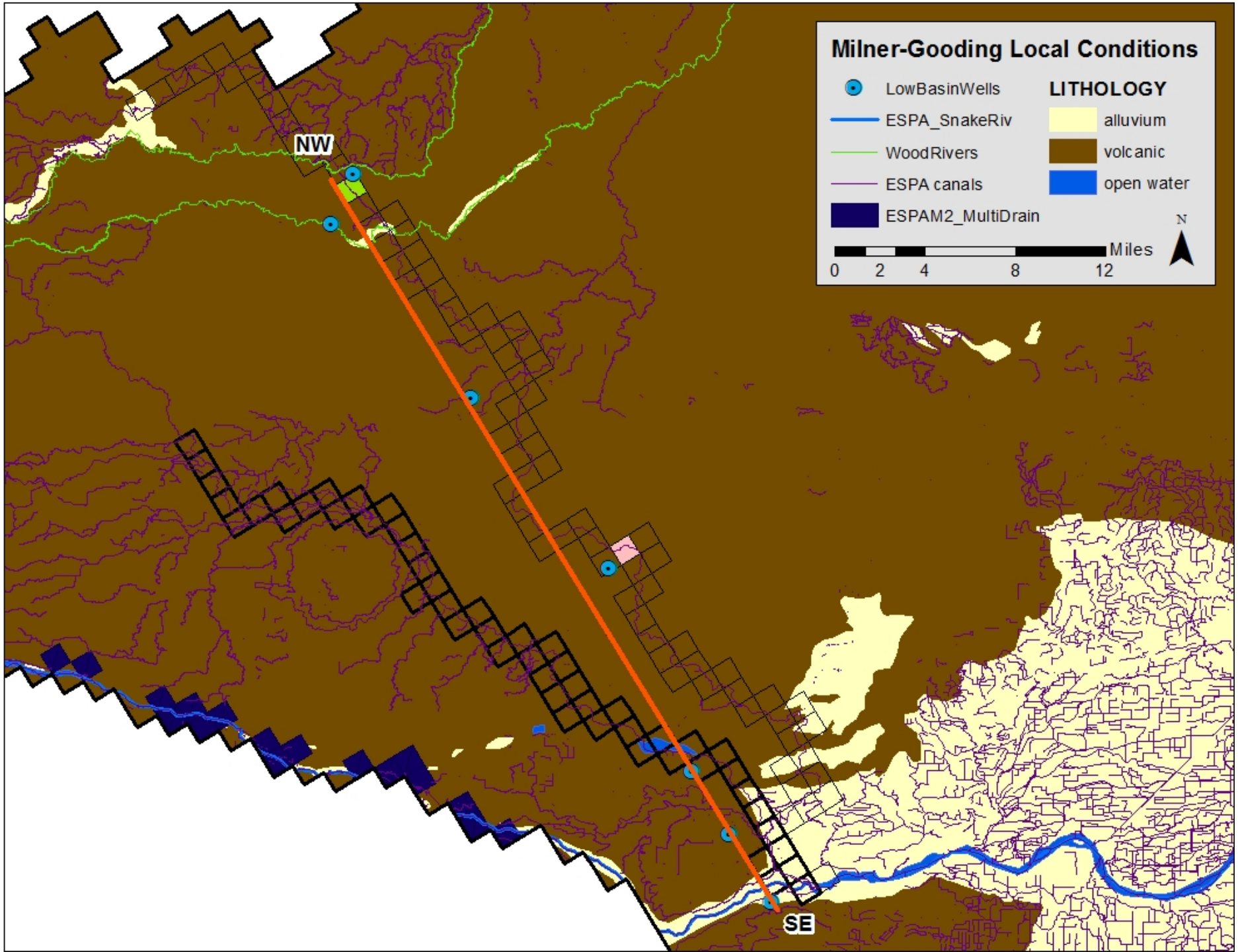
Annual Recharge Limit (AF)	Number of Consecutive Years
22,200	10

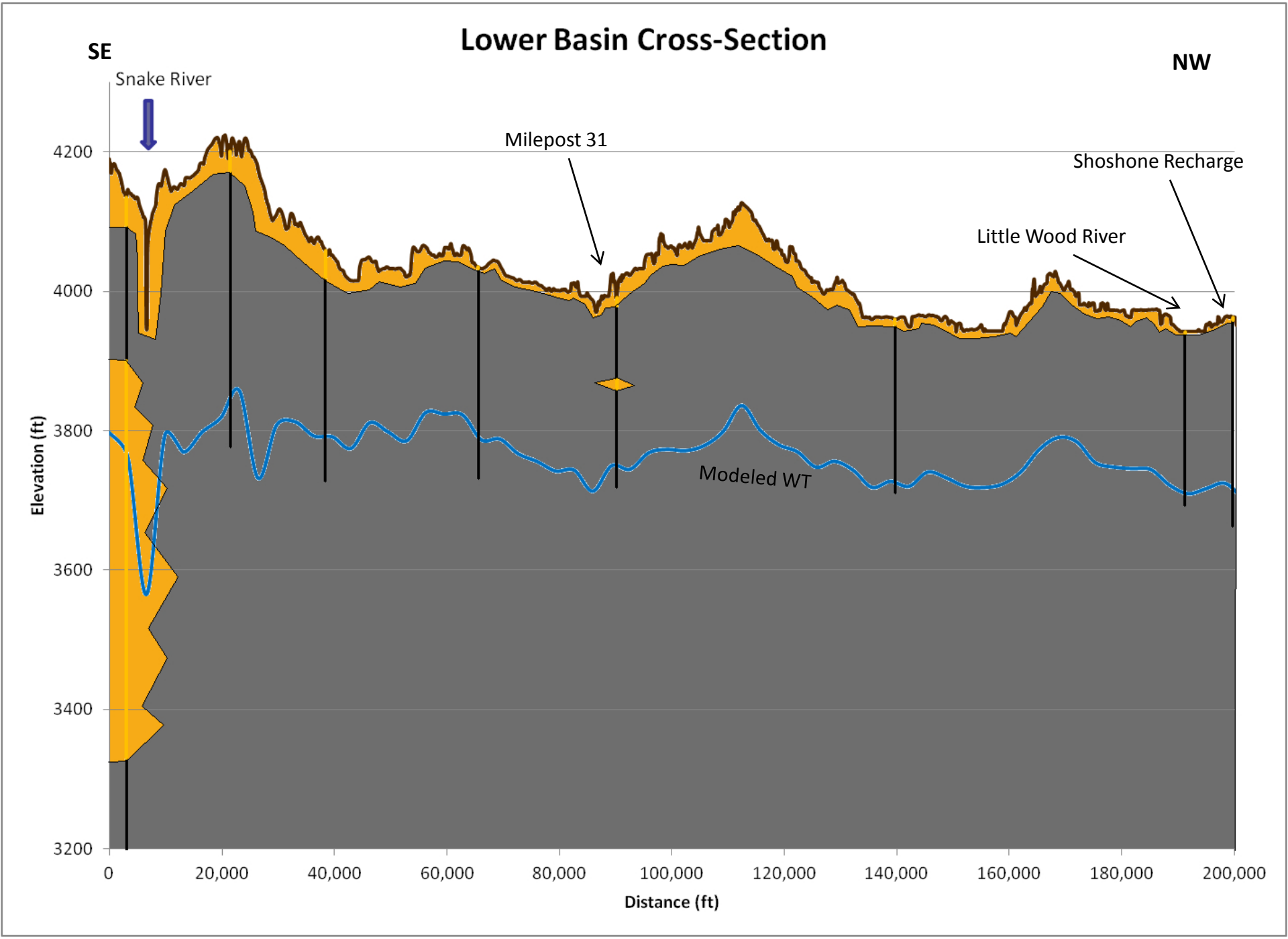
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
30,700	22,200	30,000+

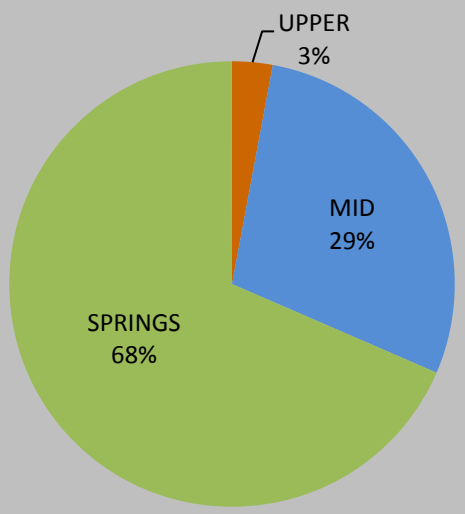
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
22,200	10


Milner-Gooding Local Conditions
LowBasinWells
ESPA_SnakeRiv
WoodRivers
ESPA canals
ESPAM2_MultiDrain
LITHOLOGY
alluvium
volcanic
open water
Miles
0
2
4
8
12
N
NW
SE


Lower Basin Cross-Section
SE
NW
Snake River
Milepost 31
Shoshone Recharge
Little Wood River
Modeled WT
Elevation (ft)
4200
4000
3800
3600
3400
3200
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
Distance (ft)

Summary of Recharge at Northside



Ultimate Fate of Recharged Water

- Recharge via canal seepage and off-canal sites.
- Subsurface is primarily basalt.
- Located in an area of deep groundwater.
- Majority of recharge water discharges: Springs.
- Recharge Limited by: **Infiltration Capacity.**

Aquifer Retention 5 years

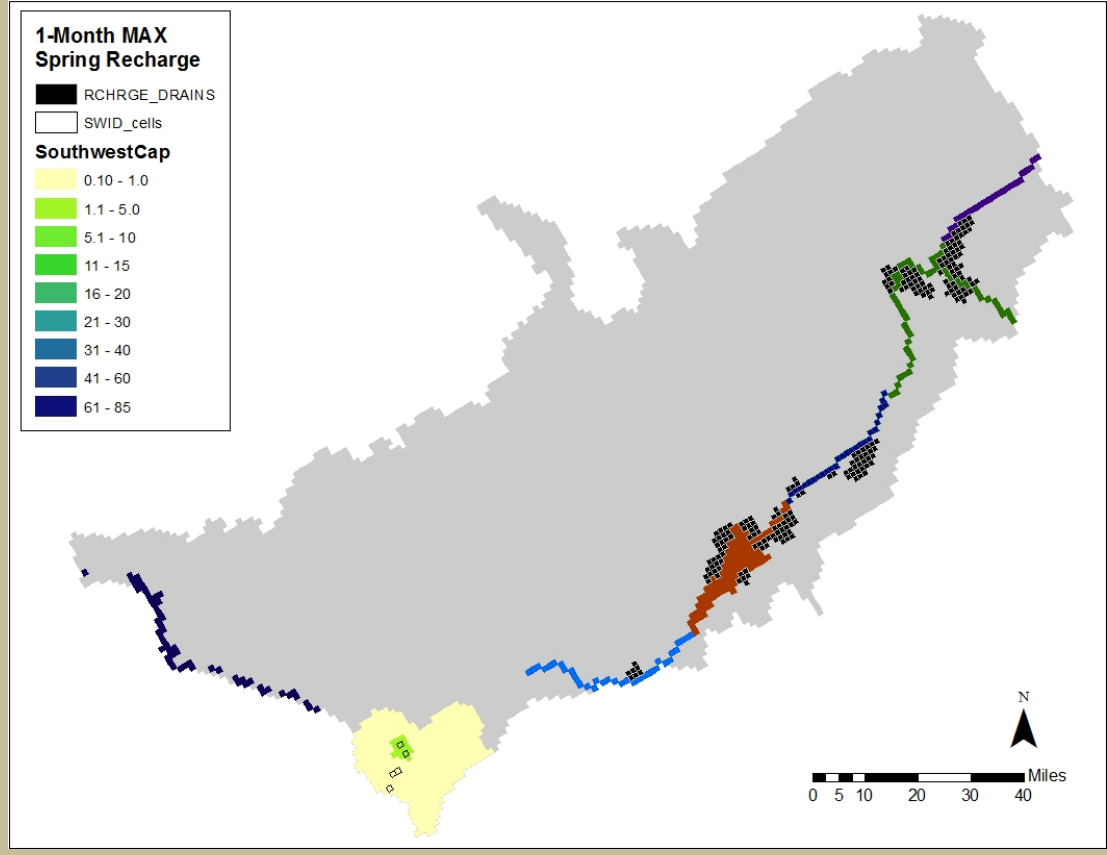
	Rank (of 13)	Retention (%)
SPRING	8	32
FALL	8	32

Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
21,200	7,000	10
21,200	7,000	10

Recharge at Southwest

SPRING and FALL Limitations
for
One-time and Annual Events



SPRING 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
3,600	3,600	20,000+

SPRING 1-month Annual

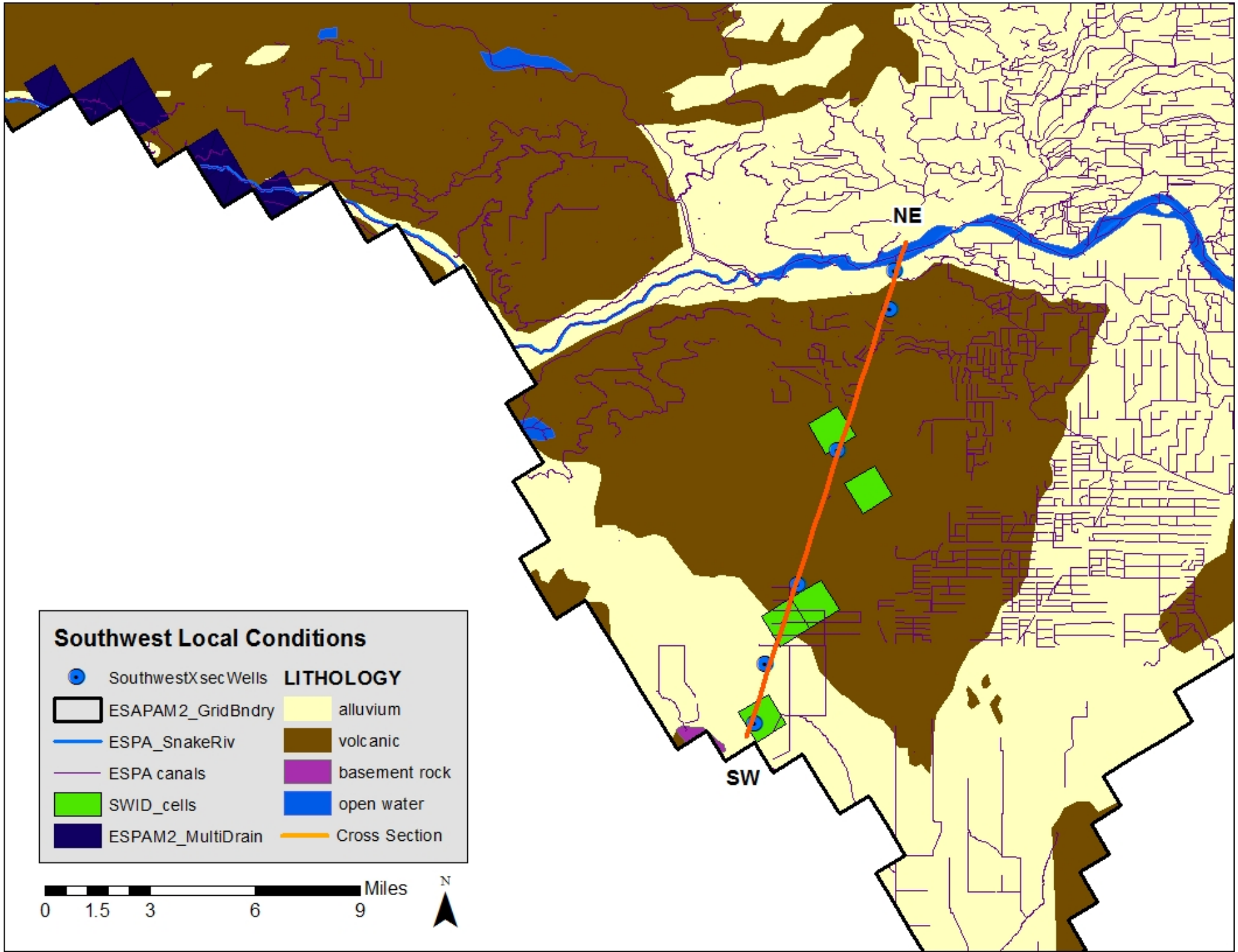
Annual Recharge Limit (AF)	Number of Consecutive Years
3,600	10

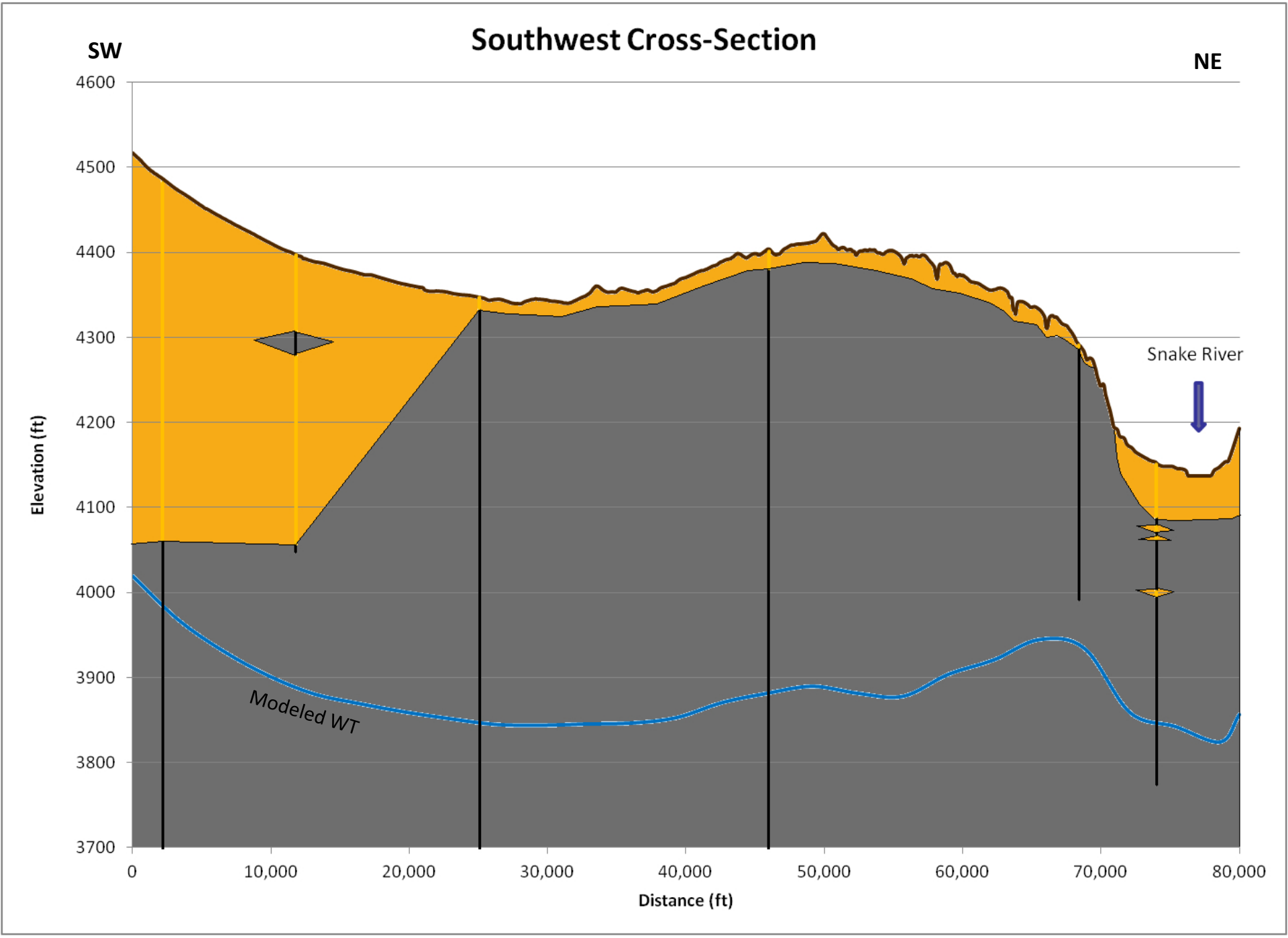
FALL 1-month One-Time

Diversion Capacity Recharge Limit (AF)	Infiltration Capacity Recharge Limit (AF)	Shallow GW Recharge Limit (AF)
3,600	3,600	20,000+

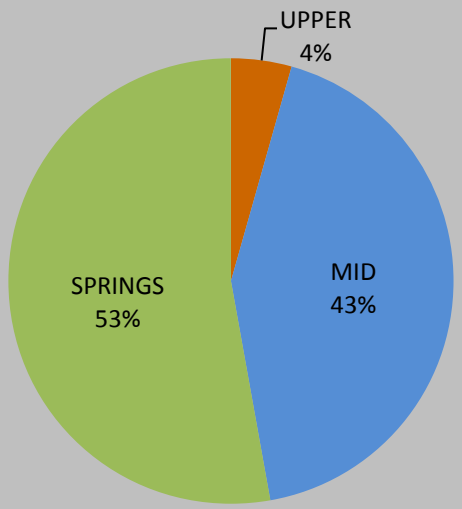
FALL 1-month Annual

Annual Recharge Limit (AF)	Number of Consecutive Years
3,600	10


NE
SW
Southwest Local Conditions
SouthwestXsecWells
ESAPAM2_GridBndry
ESPA_SnakeRiv
ESPA canals
SWID_cells
ESPAM2_MultiDrain
LITHOLOGY
alluvium
volcanic
basement rock
open water
Cross Section
Miles
0
1.5
3
6
9
N


Southwest Cross-Section
SW
NE
4600
4500
4400
4300
4200
4100
4000
3900
3800
3700
Elevation (ft)
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
Distance (ft)
Snake River
Modeled WT

Summary of Recharge at Southwest



Ultimate Fate of Recharged Water

- Recharge via injection at off-canal sites.
- Subsurface is primarily sediment or basalt.
- Located in an area of deep groundwater.
- Majority of recharge water discharges: Springs.
- Recharge Limited by: **Diversion Capacity.**

Aquifer Retention 5 years

	Rank (of 13)	Retention (%)
SPRING	2	54
FALL	2	54

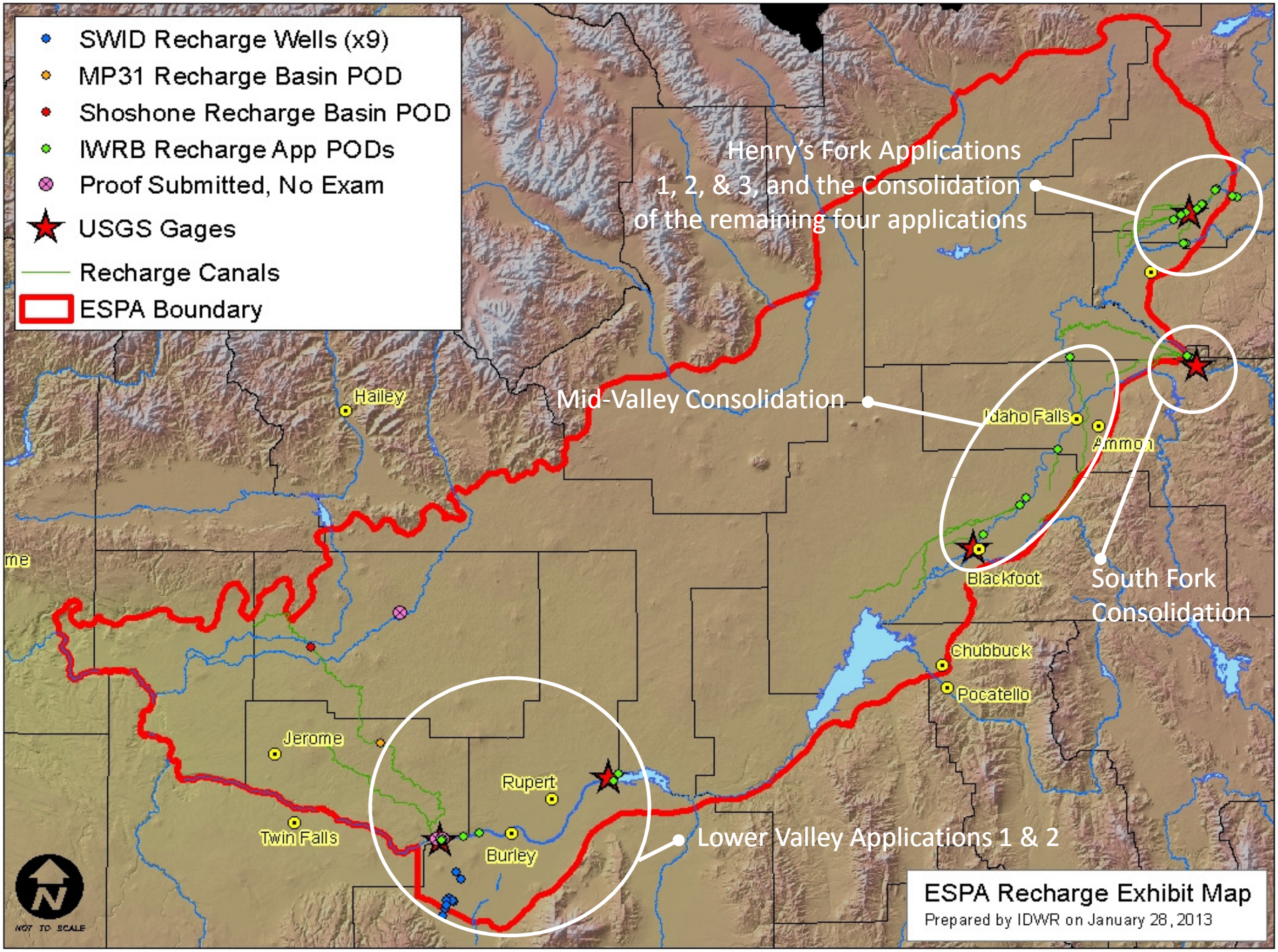
Ability to Benefit Aquifer

Recharge Limit (AF)	Storage at 5 yrs (AF)	Consecutive Years
3,600	2,000	10
3,600	2,000	10

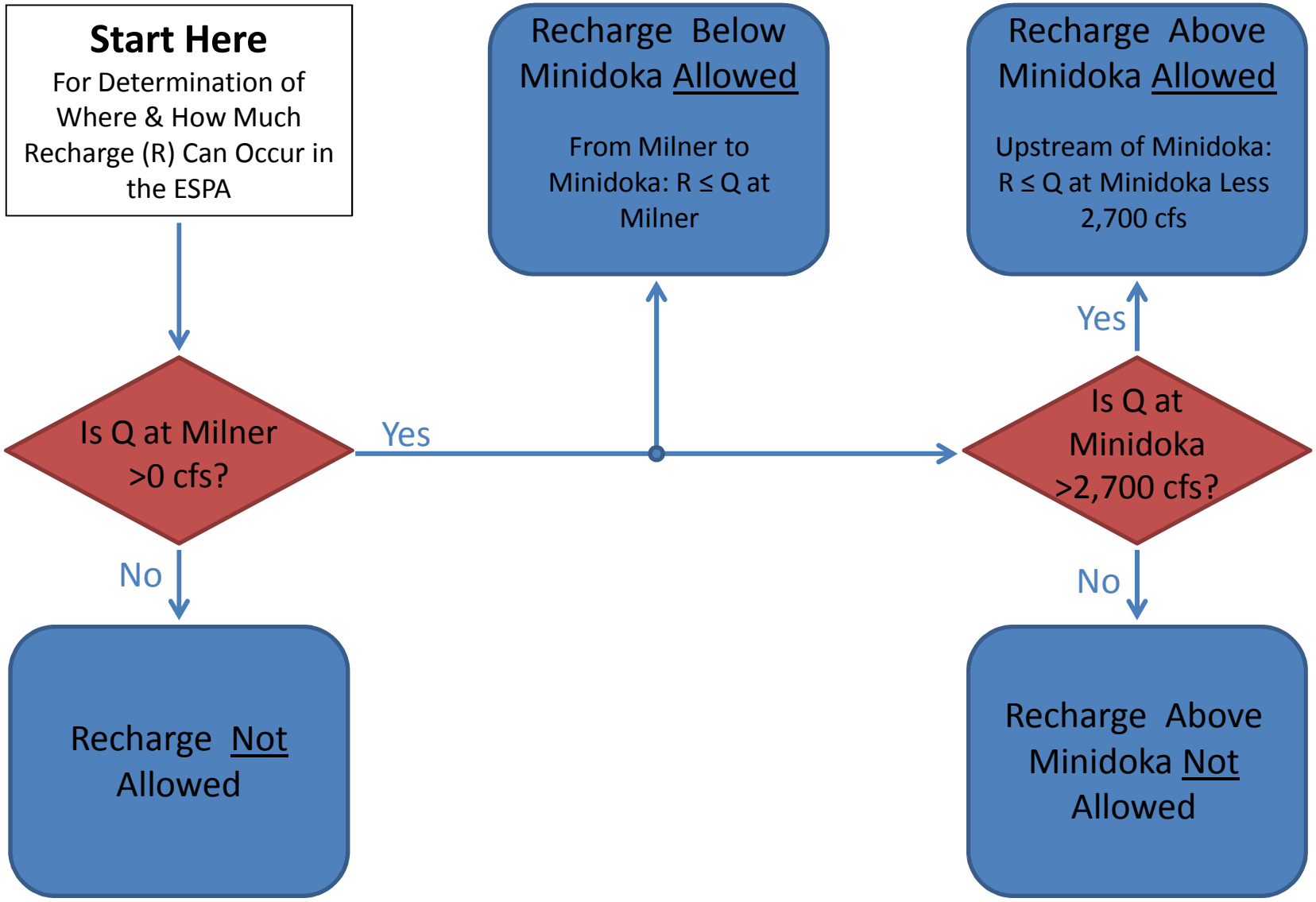
IDAHO
Water Resource Board

IWRB Managed Recharge Program
Overview of Water Availability Analysis for Recharge

Mathew Weaver
November 19, 2013


SWID Recharge Wells (x9)
MP31 Recharge Basin POD
Shoshone Recharge Basin POD
IWRB Recharge App PODs
Proof Submitted, No Exam
USGS Gages
Recharge Canals
ESPA Boundary
Henry's Fork Applications
1, 2, & 3, and the Consolidation
of the remaining four applications
Mid-Valley Consolidation
South Fork
Consolidation
Lower Valley Applications 1 & 2
Hailey
Idaho Falls
Ammon
Blackfoot
Chubbuck
Pocatello
Jerome
Rupert
Twin Falls
Burley
NOT TO SCALE
ESPA Recharge Exhibit Map
Prepared by IDWR on January 28, 2013

ESPA Recharge Flow Chart



Water Supply Analysis Assumes the Following:

1. Period of Record: Water Years 2000 – 2012

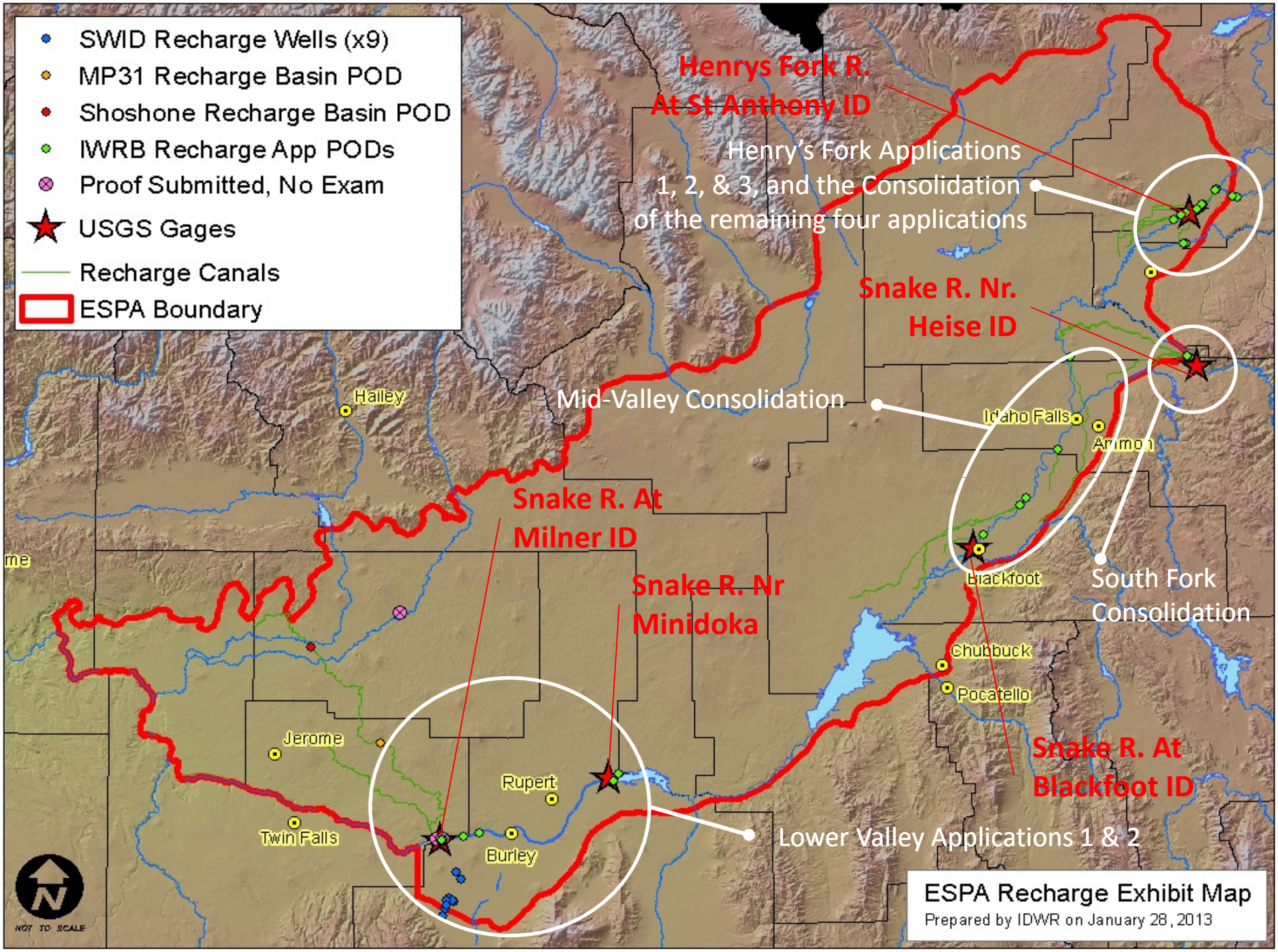
2. Water right is in priority at the point of diversion

3. USBR unsubordinated hydropower WRs at Minidoka Dam are fully satisfied

4. Volume of water available for recharge is limited to either spills past Milner, or water at the recharge POD less an assumed minimum streamflow, whichever is smaller

    a. Spills past Milner are corrected for storage releases and reach gains downstream of Minidoka Dam

    b. Minimum stream flows were assumed as follows: Milner 0 cfs, Minidoka 500 cfs, Blackfoot 200 cfs, South Fork 900 cfs, and Henrys Fork 200 cfs.


SWID Recharge Wells (x9)
MP31 Recharge Basin POD
Shoshone Recharge Basin POD
IWRB Recharge App PODs
Proof Submitted, No Exam
USGS Gages
Recharge Canals
ESPA Boundary
Henrys Fork R.
At St Anthony ID
Henry's Fork Applications
1, 2, & 3, and the Consolidation
of the remaining four applications
Snake R. Nr.
Heise ID
Mid-Valley Consolidation
Hailey
Idaho Falls
Ammon
Snake R. At
Milner ID
Snake R. Nr
Minidoka
Blackfoot
South Fork
Consolidation
Chubbuck
Pocatello
Jerome
Rupert
Twin Falls
Burley
Snake R. At
Blackfoot ID
Lower Valley Applications 1 & 2
NOT TO SCALE
ESPA Recharge Exhibit Map
Prepared by IDWR on January 28, 2013

IDAHO Water Resource Board

Annual Volume

Summary of Annual Vol. of Water Available for Recharge (acre-feet)					
Year	@ Milner	@ MINI	@ Blckft	@ Heise	@ St. Anthony
2000	1,171,023	650,148	354,321	337,023	166,842
2001	191,514	22,104	0	0	0
2002	197,804	21,268	0	0	0
2003	175,628	13,510	0	0	0
2004	192,315	8,289	0	0	0
2005	202,231	3,033	0	0	0
2006	1,459,490	967,934	550,562	396,452	149,498
2007	423,345	136,715	13,321	0	12,446
2008	210,218	27,966	0	0	0
2009	1,742,561	1,454,256	704,037	595,757	290,729
2010	552,379	211,047	7,509	7,509	7,509
2011	4,724,650	3,543,703	1,722,875	1,622,313	744,860
2012	1,065,751	592,660	338,409	330,530	155,209
Sum	**12,308,909**	**7,652,633**	**3,691,034**	**3,289,585**	**1,527,094**
Avg.	946,839	588,664	283,926	253,045	117,469
St.Dev.	1,260,112	997,660	496,605	459,572	211,037
Min. (<>0)	175,628	3,033	7,509	7,509	7,509
Max.	4,724,650	3,543,703	1,722,875	1,622,313	744,860

Note, values as calc. for USGS River Gage Stations: Milner (13088000); MINI (13081500); Blckft (13062500); Heise (13037500); and St. Anthony (13050500).

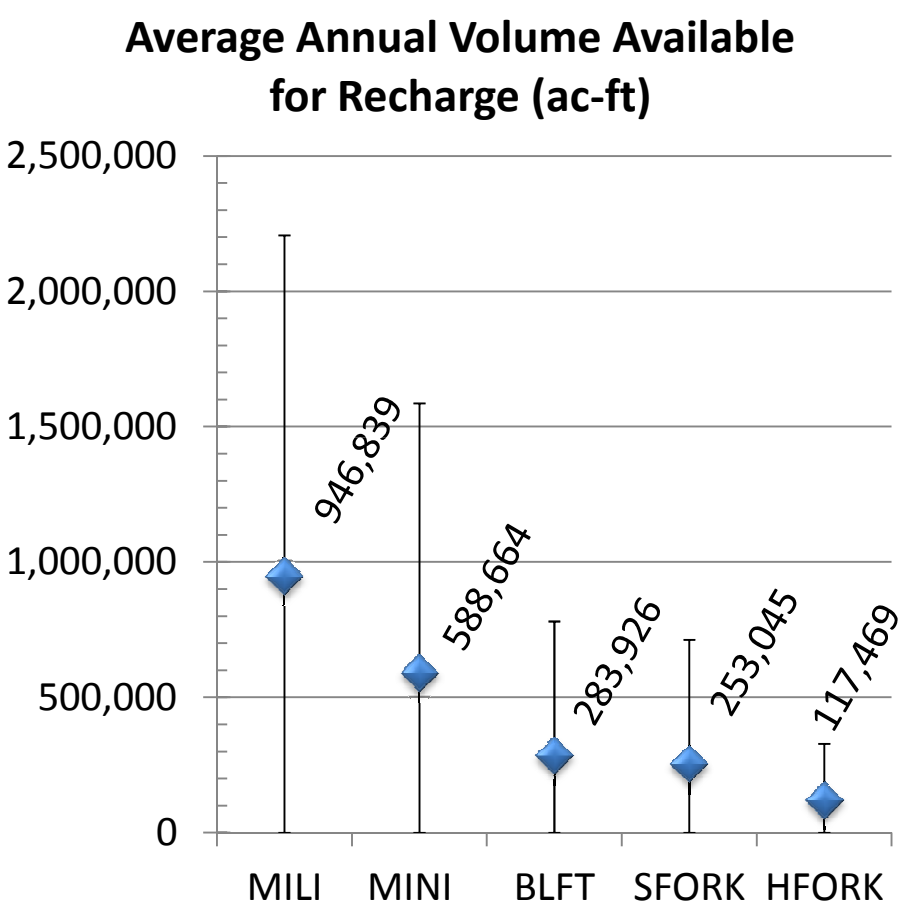
IDAHO Water Resource Board

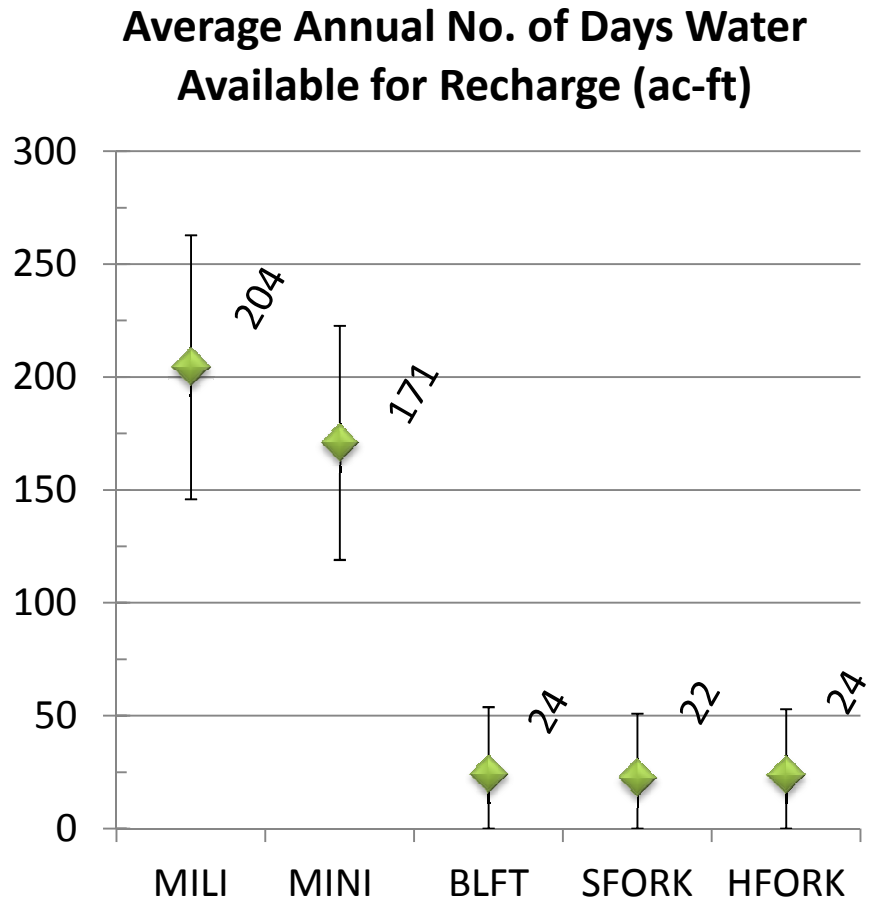
Annual No. of Days

Summary of Annual No. of Days Recharge Can Occur					
Year	@ Milner	@ MINI	@ Blckft	@ Heise	@ St. Anthony
2000	197	120	44	42	44
2001	161	120	0	0	0
2002	253	246	0	0	0
2003	159	220	0	0	0
2004	192	204	0	0	0
2005	161	99	0	0	0
2006	239	129	50	46	50
2007	177	138	4	0	4
2008	161	131	0	0	0
2009	295	250	60	53	55
2010	221	165	16	16	16
2011	320	213	82	79	82
2012	121	186	56	56	56
Avg.	**204**	**171**	**24**	**22**	**24**
Sum	2,657	2,221	312	292	307
St. Dev.	58	52	30	29	29
Min. (<>0)	121	99	4	16	4
Max.	320	250	82	79	82

Note, values as calc. for USGS River Gage Stations: Milner (13088000); MINI (13081500); Blckft (13062500); Heise (13037500); and St. Anthony (13050500).

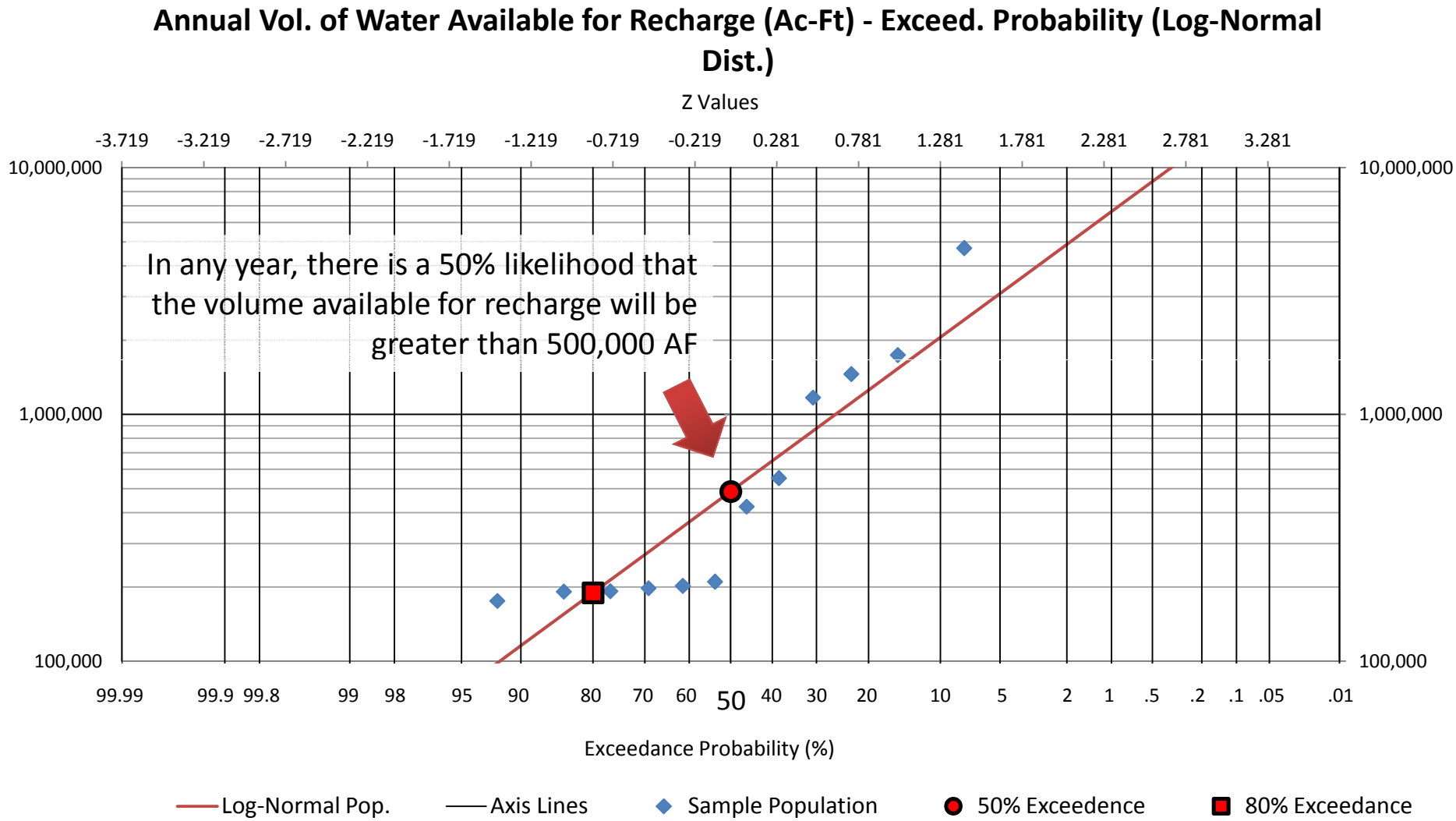
Variation in the Data





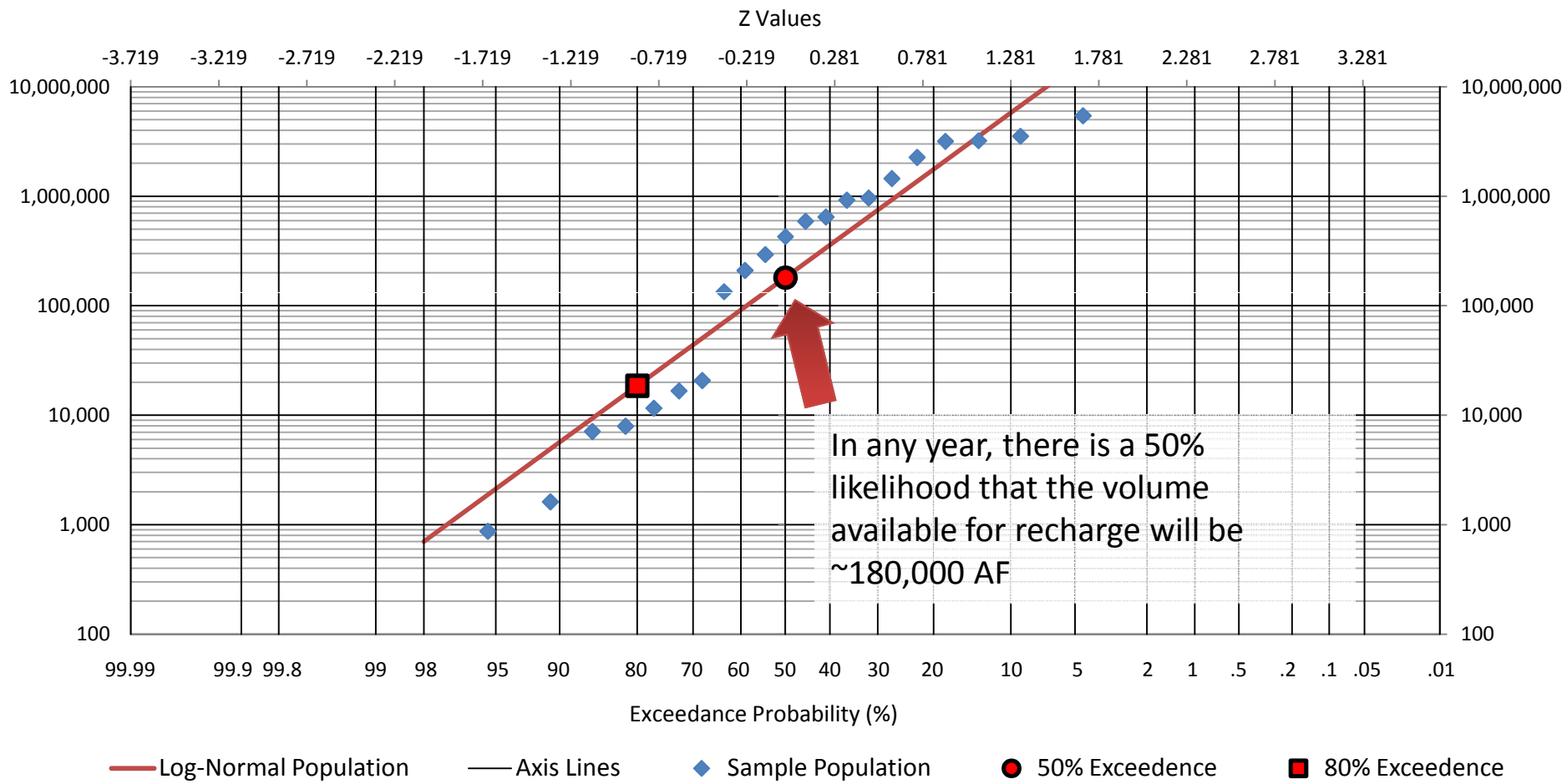
Notes, values as calculated for USGS River Gage Stations: MILI (13088000); MINI (13081500); BLFT (13062500); SFORK (13037500); and HFORK (13050500). Error bars represent +/- 1 standard deviation.

Frequency Analysis: Milner

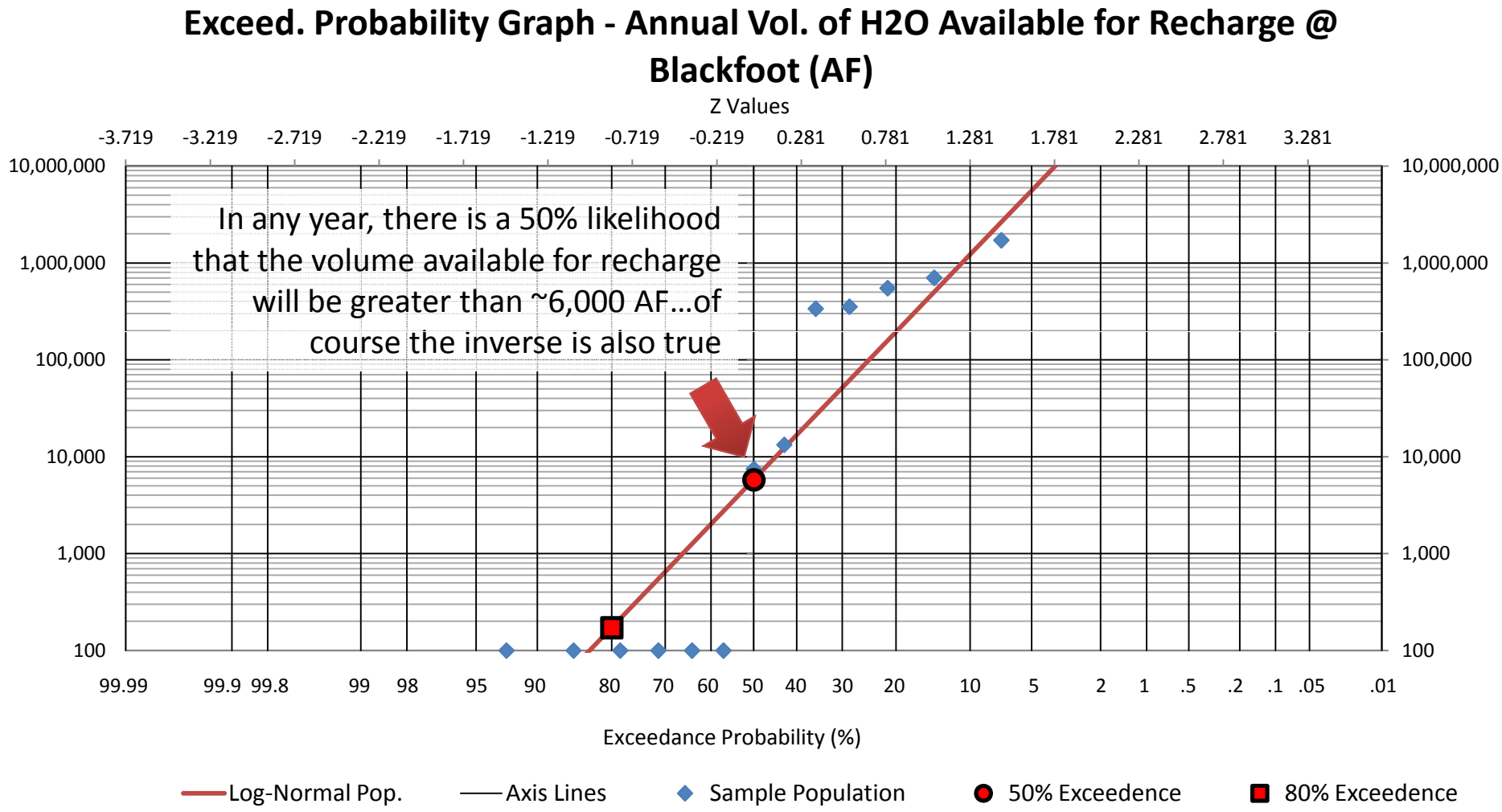


Frequency Analysis: Minidoka

Exceed. Probability Graph - Annual Vol. of H2O Available for Recharge At and Above Minidoka Dam (AF)

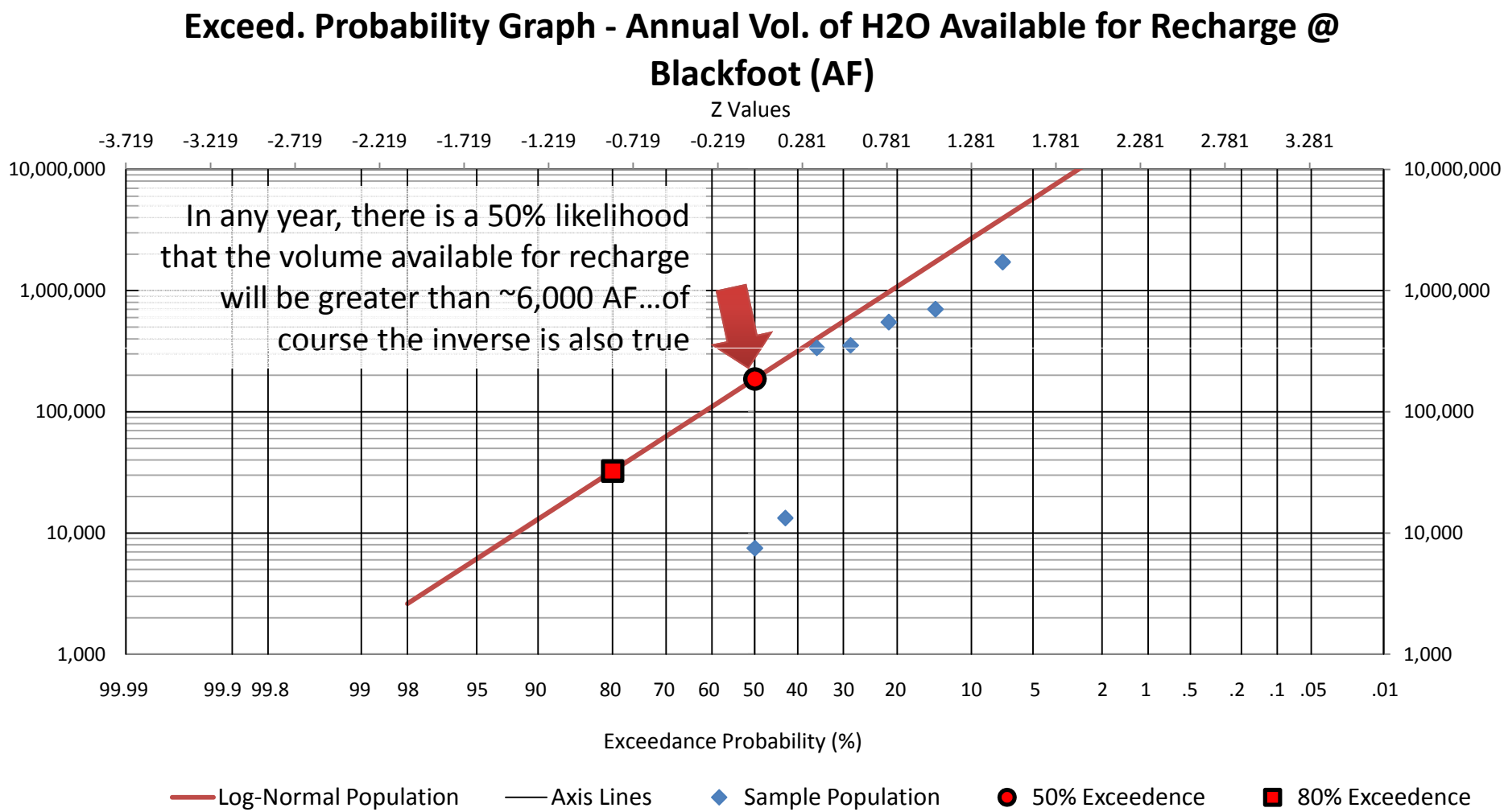


Frequency Analysis: Main Snake



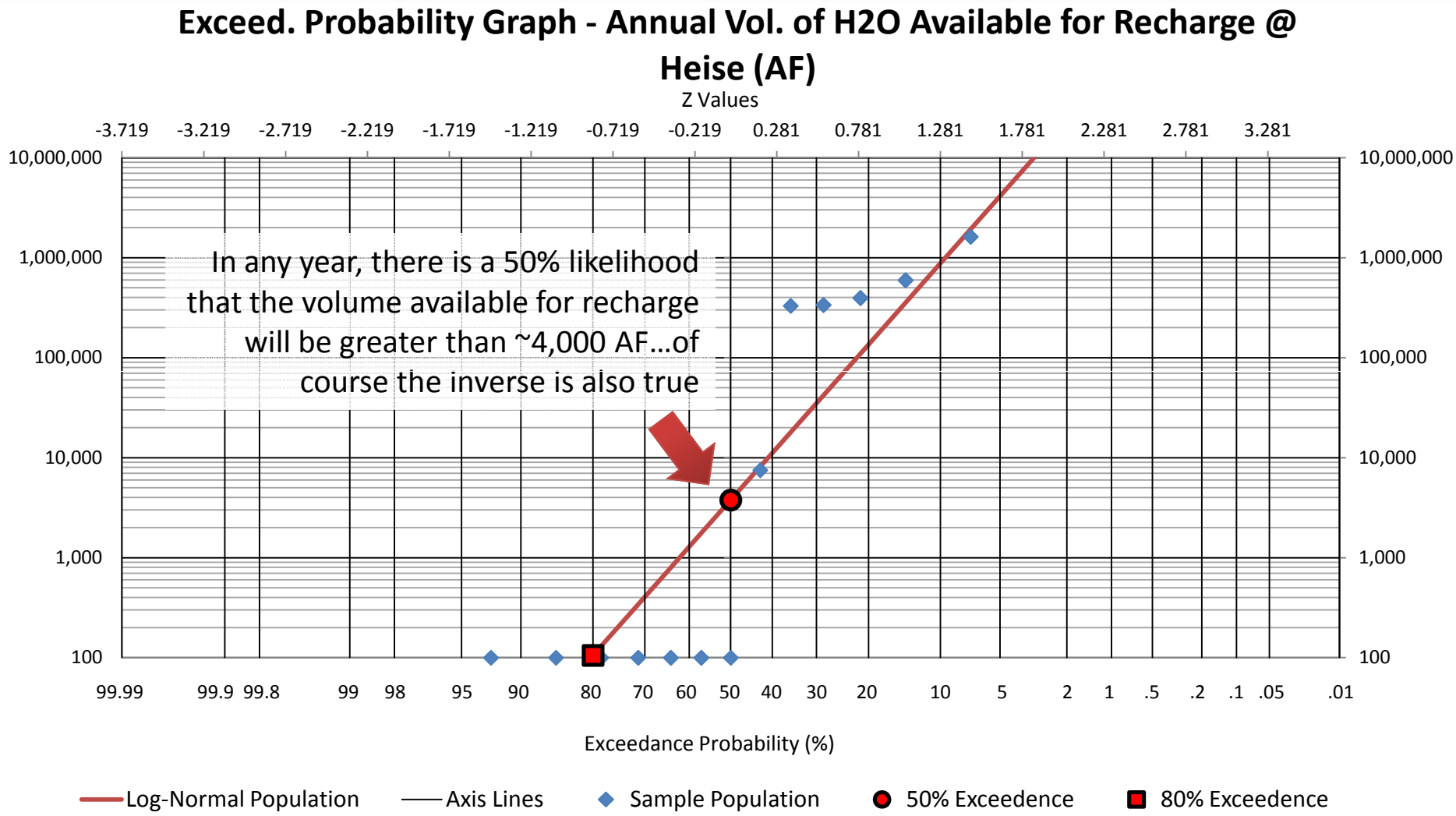
Note, Priority Date as established for the Snake R. at Blackfoot Gage

Frequency Analysis: Main Snake



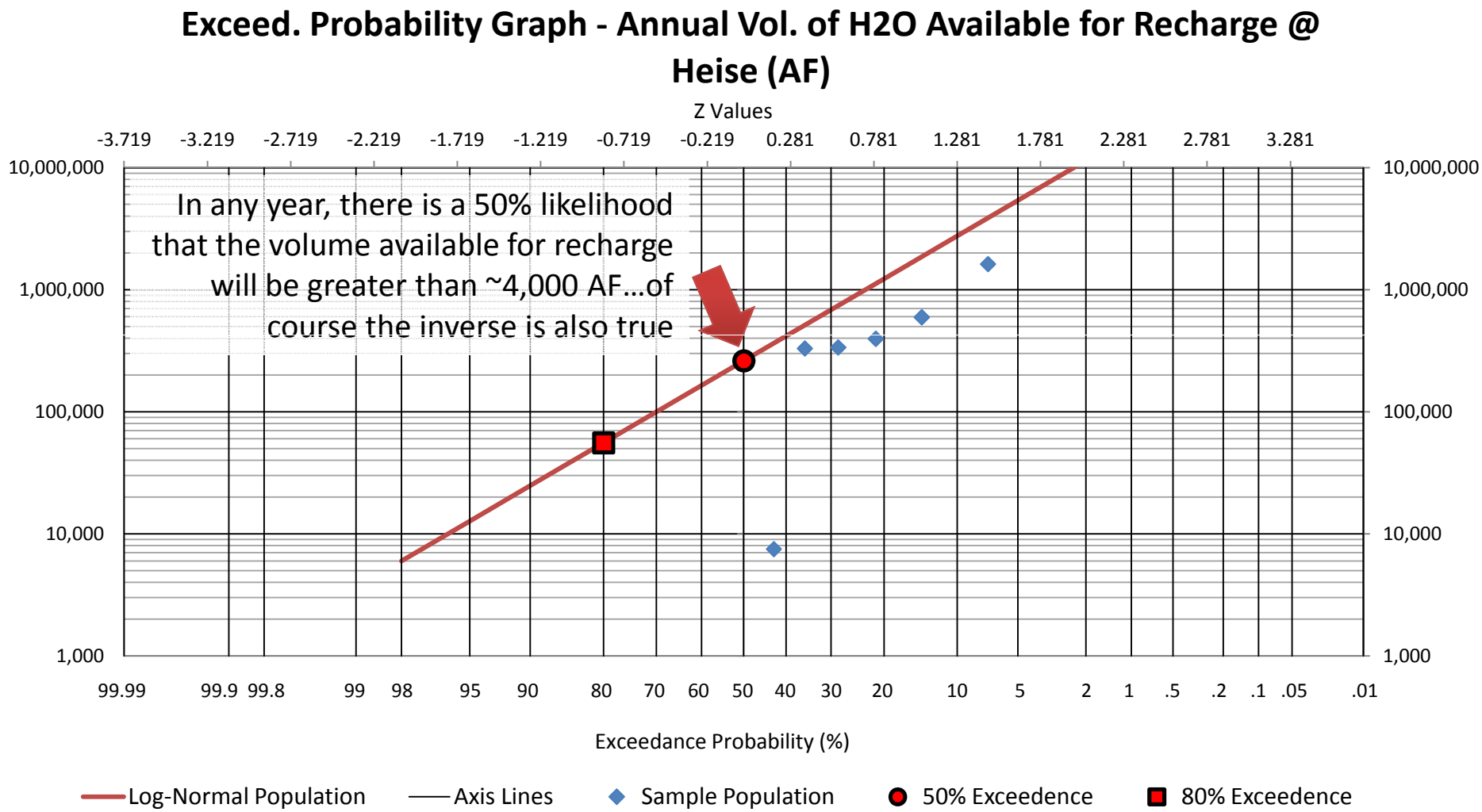
Note, Priority Date as established for the Snake R. at Blackfoot Gage

Frequency Analysis: South Fork



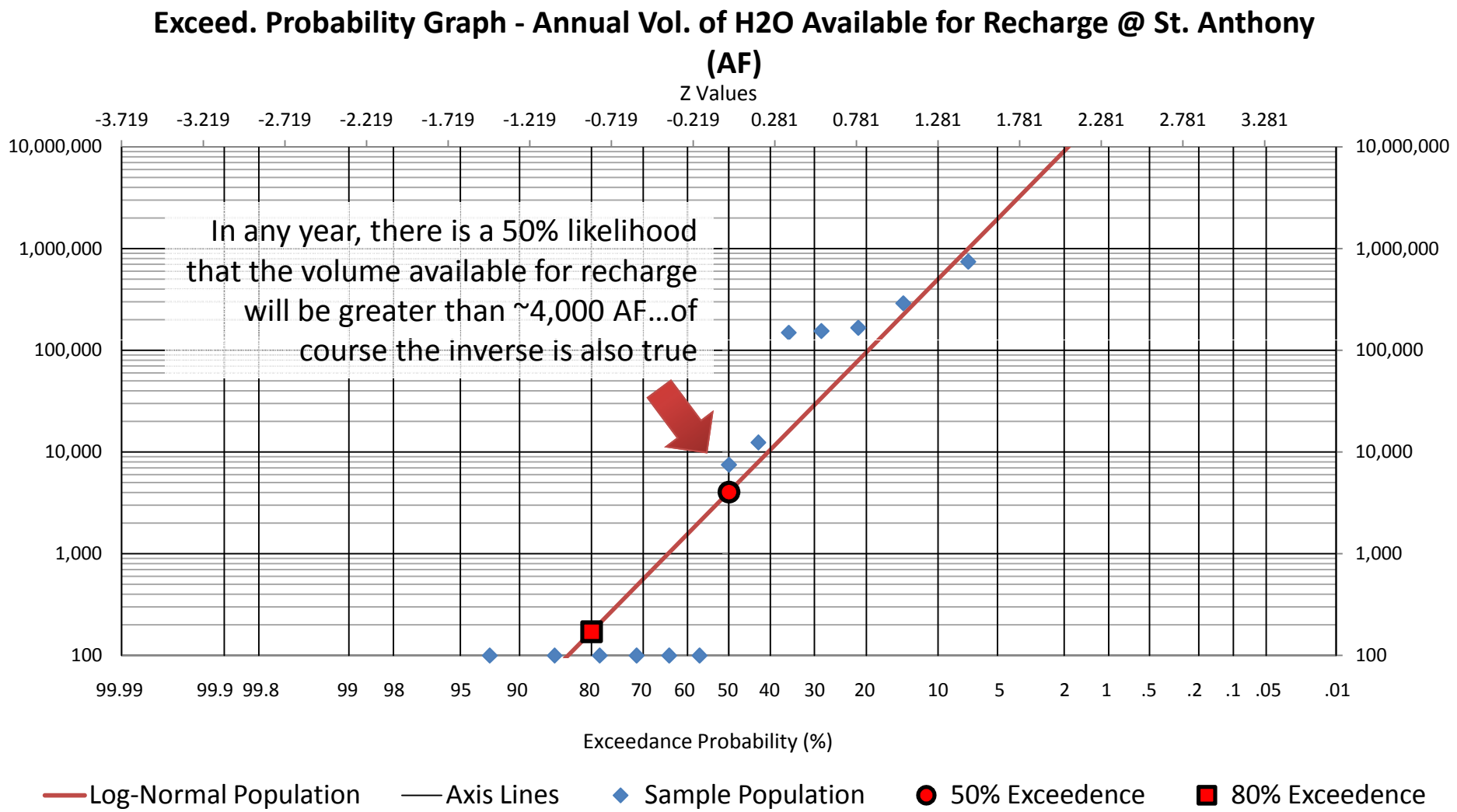
Note, Priority Date as established for the Snake R. NR Heise Gage

Frequency Analysis: South Fork



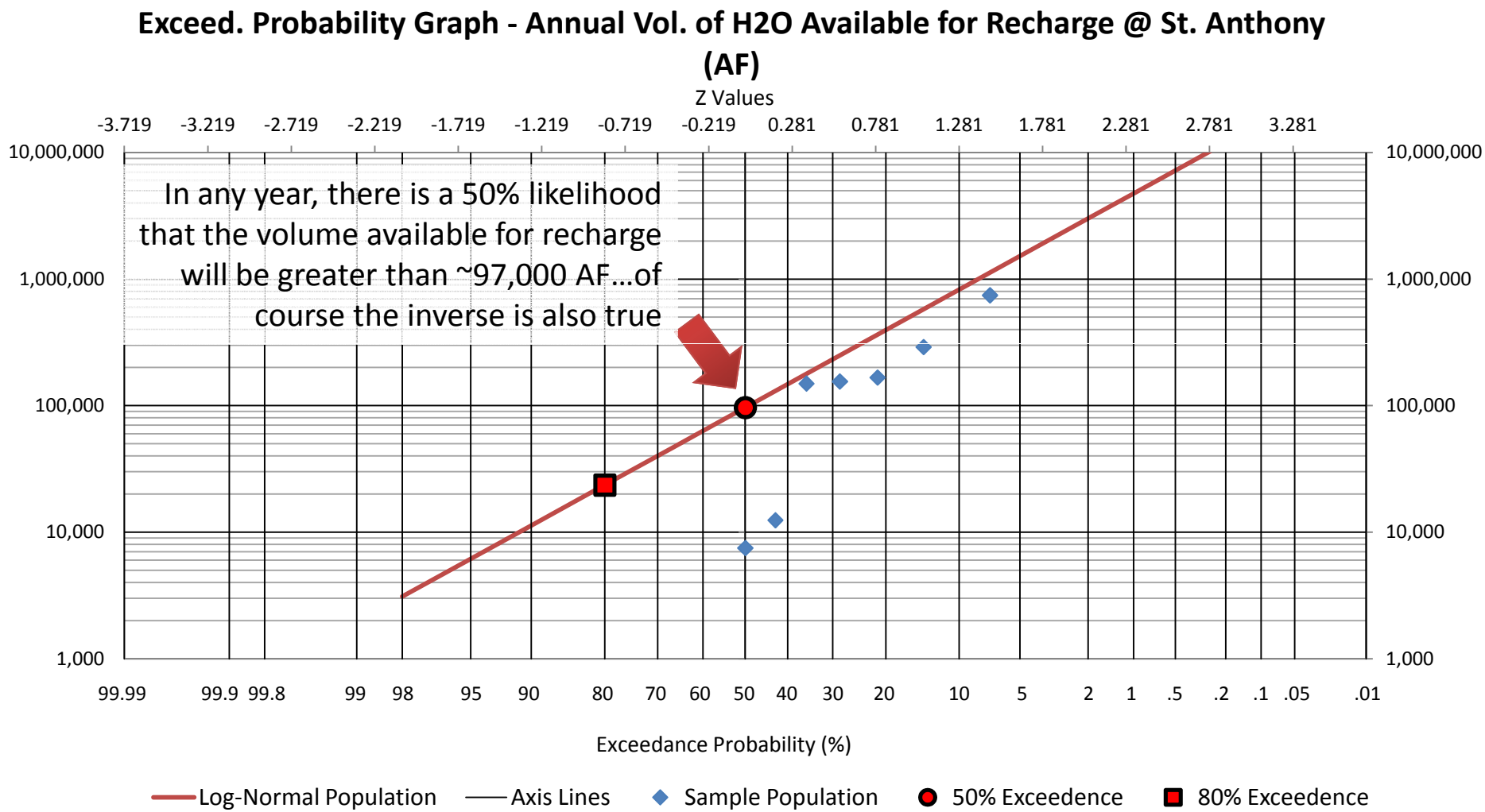
Note, Priority Date as established for the Snake R. NR Heise Gage

Frequency Analysis: Henrys Fork



Note, Priority Date as established for the Henry's For at St. Anthony Gage

Frequency Analysis: Henrys Fork



Note, Priority Date as established for the Henry's For at St. Anthony Gage

IDAHO Water Resource Board

50% & 80% Exceedance

Summary: 50% & 80% Exceedance Annual Vol. Available for Recharge (AF)					
Year	@ Milner	@ MINI	@ Blckft	@ Heise	@ St. Anthony
50% Exceedance	487,231	181,082	5,779	3,779	4,048
80% Exceedance	189,411	18,621	172	105	171

Summary is for entire population, including years of zero available water for recharge.

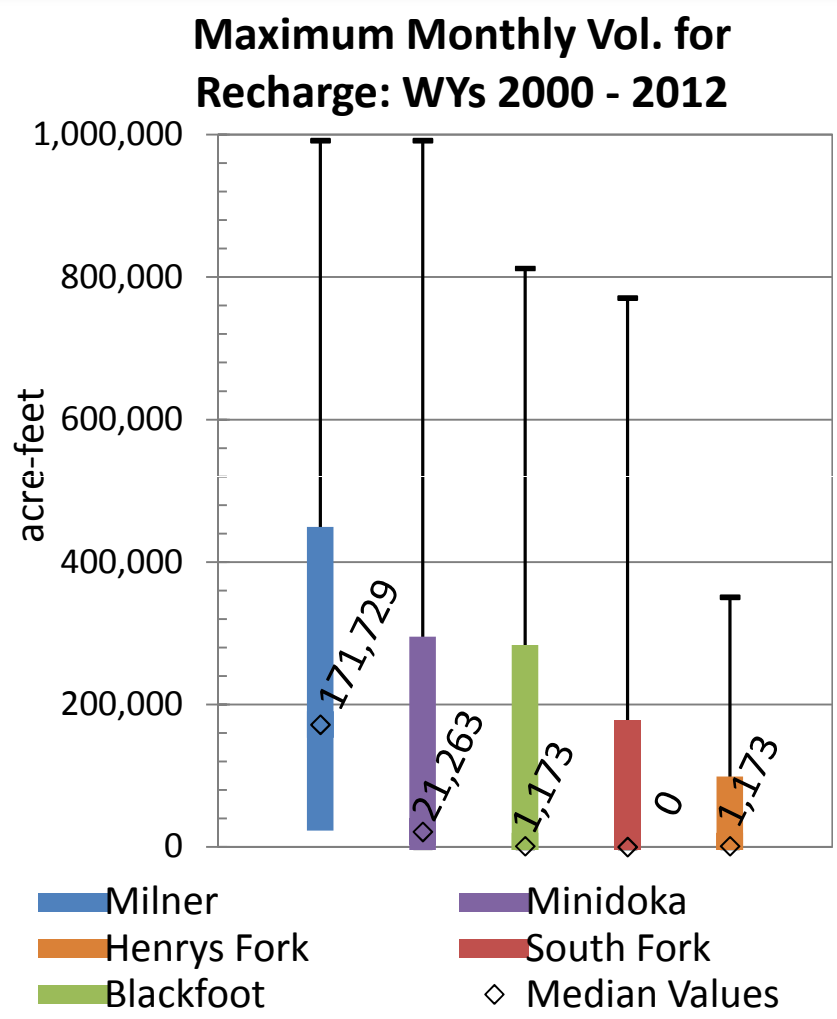
Summary: 50% & 80% Exceedance Annual Vol. Available for Recharge (AF)					
Year	@ Milner	@ MINI	@ Blckft	@ Heise	@ St. Anthony
50% Exceedance	487,231	181,082	187,045	261,605	96,575
80% Exceedance	189,411	18,621	32,516	55,659	23,594

Summary only includes non-zero years from the sample population.

Note, values as calculated for USGS River Gage Stations: Milner (13088000); MINI (13081500); Blckft (13062500); Heise (13037500); and St. Anthony (13050500).

Max. Monthly Volume

Summary of Water Supply Availability by Recharge Site			
Rank	Site	Gage	Median Max. Monthly Vol. (AF)
1	Milner-Gooding Canal	MILI	171,729
2	MP31 (Milner-Gooding)	MILI	171,729
3	North Side	MILI	171,729
4	Shoshone (Milner-Gooding)	MILI	171,729
5	Southwest Irr. District	MILI	171,729
6	Minidoka (i.e. L. Walcott)	MINI	21,263
7	ASCC Canal	BLFT	1,173
8	Egin Lakes	HFORK	1,173
9	Fremont-Madison East	BLFT	1,173
10	Hilton Spill (ASCC)	BLFT	1,173
11	Idaho Canal	BLFT	1,173
12	New Sweeden	BLFT	1,173
13	Great Feeder Canal	SFORK	0



Notes, values as calculated for USGS River Gage Stations: MILI (13088000); MINI (13081500); BLFT (13062500); SFORK (13037500); and HFORK (13050500). Error bars represent +/- 1 standard deviation.

Any Questions?

Hilton Spill Recharge Basin, June 2011.

IDAHO
Water Resource Board

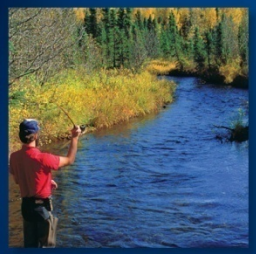
ESPA Managed Recharge Analysis Wrap-Up

Idaho Water Resource Board

November 19, 2013

Brian Patton

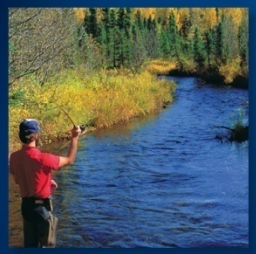
IDAHO
Water Resource Board



Recharge Analysis Summary

- Recharge Goal: Stabilize ESPA
  - ✓CAMP – Phase 1 water budget change 200-300KAF (100KAF from recharge)
  - ✓Average annual loss from aquifer storage of ≈200KAF (1952-2008)
  - ✓CAMP Phase 2 goal – work toward recovery of ESPA (250KAF from recharge)

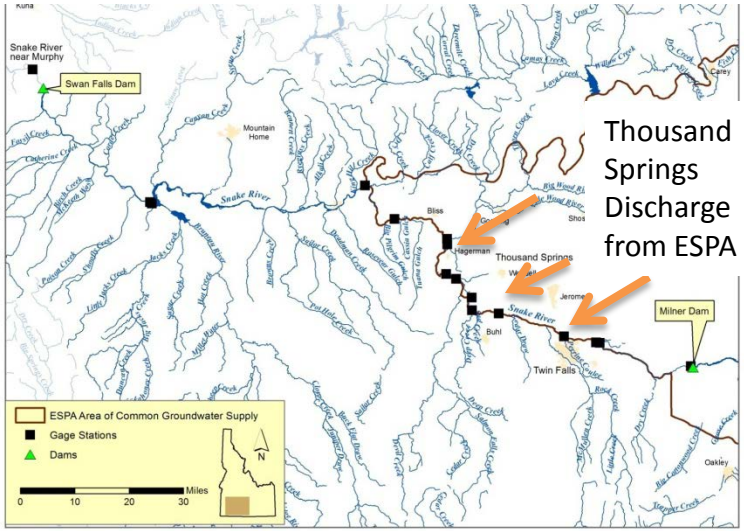
IDAHO
Water Resource Board



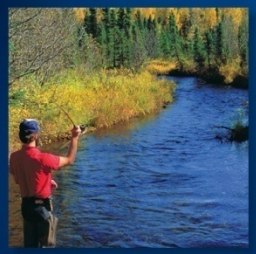
Recharge Analysis Summary

- Stabilization of ESPA is essential to:
  - ✓Prevent further GW vs. SW user conflicts on Eastern Snake Plain
  - ✓Meet State's Swan Falls Agreement obligations to maintain minimum flows at Murphy Gage

When flow is zero at Milner, flow at Swan Falls Dam is made up almost entirely of spring flows from the ESPA



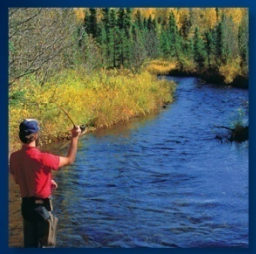
IDAHO
Water Resource Board



Recharge Analysis Summary

- Water supplies and dollars for recharge are limited
  - ✓Recharge limited by Swan Falls Re-Affirmation Agreement to average of 175KAF/yr through 2017 and 250KAF after 2018
- ESPA stabilization requires recharge of large water volumes in areas with good aquifer retention
- Analysis was done to determine how best to use limited water supplies and dollars to achieve aquifer stabilization most effectively

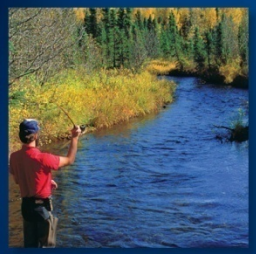
IDAHO
Water Resource Board



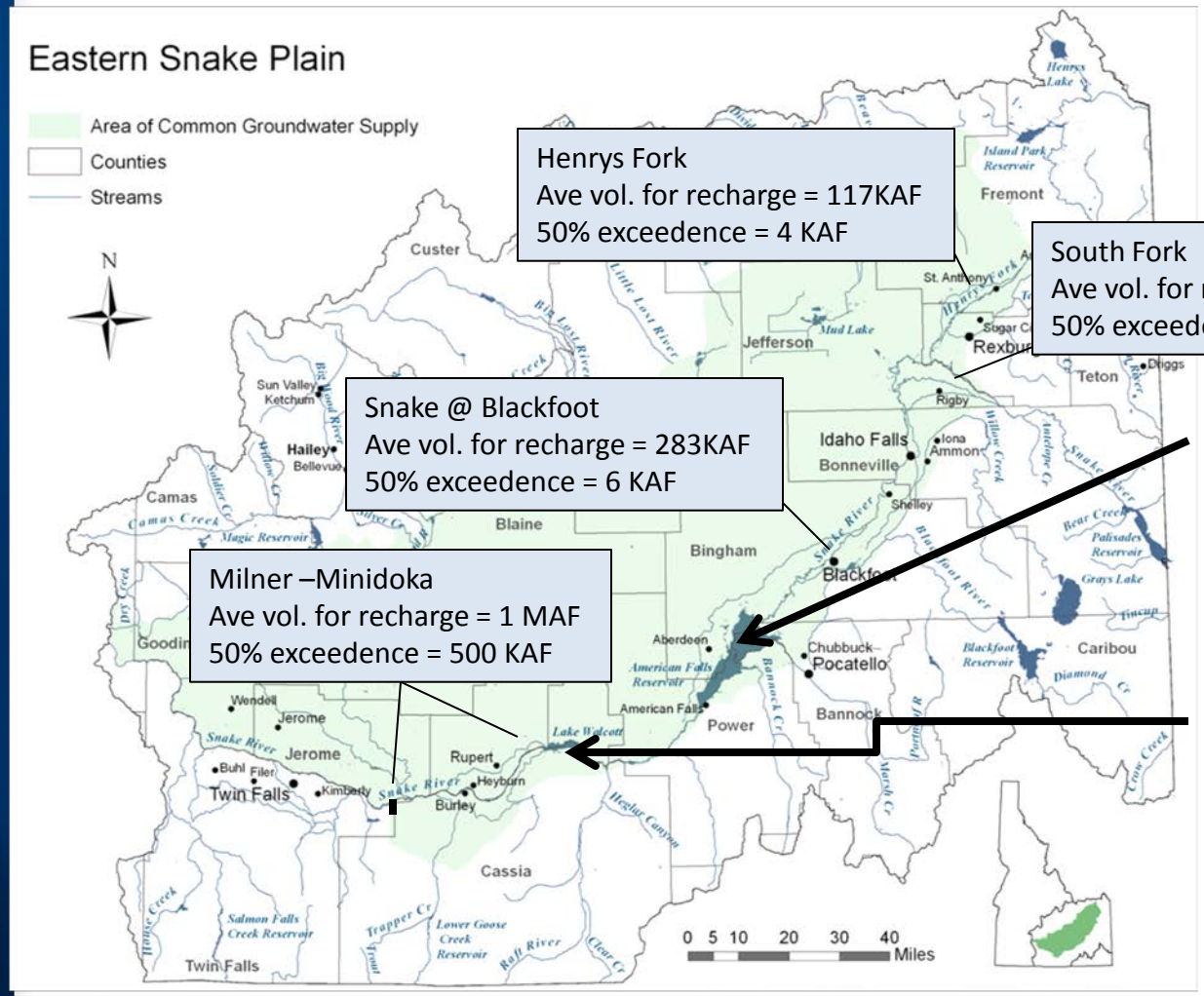
Recharge Analysis Summary

- Recharge is "surplus" water operation
  - ✓Late priority water right(s)
  - ✓Inconsistent and erratic water supply
- Recharge needs to operated so not to interfere with optimal reservoir fill
- Unsubordinated hydropower rights of 2,700 cfs at Minidoka Dam and storage right of 1.6 MAF at American Falls Reservoir create a "break point" with recharge water availability

IDAHO
Water Resource Board



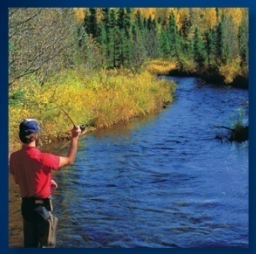
Location Matters for Recharge Water Availability



- American Falls Reservoir:
  1.6 million AF
  1921 priority

- Unsubordinated hydropower rights at Minidoka Dam:
  2,700 cfs
  1909/1912 priority

IDAHO
Water Resource Board



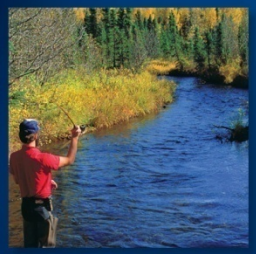
What happens if we filter Recharge Site Rankings through water availability?

Recharge Site Rankings: Efficiency and Limitations		Water Supply 50% exceedence
Rank	Site	
1	North Side	500 KAF
2	MP31 (Mil Good Canal)	500 KAF
3	Shoshone (Mil Good Canal)	500 KAF
4	Minidoka	100 KAF
5	Mil Good Canal	500 KAF
6	FM East	4 KAF
7	Southwest	500 KAF
8	Egin	4 KAF
9	G Feeder	4 KAF
10	Hilton (Aberdeen Canal)	6 KAF
11	Aberdeen Canal	6 KAF
12	New Sweeden	6 KAF
13	Idaho Canal	6 KAF

Best recharge site rankings match up well with best water availability

Areas with lower water availability are lower in recharge site rankings

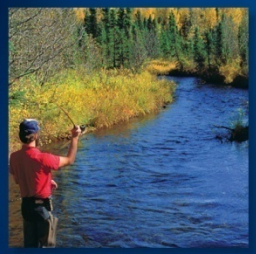
IDAHO
Water Resource Board



Conclusions for ESPA Recharge

- Water rights and non-interference with reservoir fill drives water supply availability by location
- Best site rankings and water availability in Minidoka-to-Milner reach
  - ✓ This reach only has 3 diversion points for recharge: Northside Canal, Milner-Gooding Canal & SWID Pipeline
  - ✓ Need additional capacity (diversion & infiltration) in this reach to take advantage of water supply and good aquifer retention
  - ✓ MP31 and Walcott Projects – others?

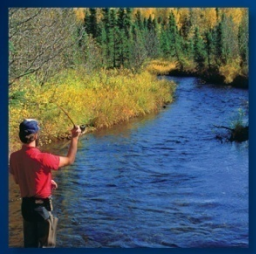
IDAHO
Water Resource Board



Conclusions for ESPA Recharge

- Recharge above American Falls (AMF) has value
  - ✓ Water supply more limited – about 50% of years no recharge water available
  - ✓ Sites generally rank lower
  - ✓ In above-average water years, however, sites above AMF are needed to utilize available water for recharge
  - ✓ Given existing large canal capacities above AMF, minimal infrastructure investment needed
  - ✓ Exception may be enlarging conveyance capacity to Egin Site

IDAHO
Water Resource Board



Questions & Discussion