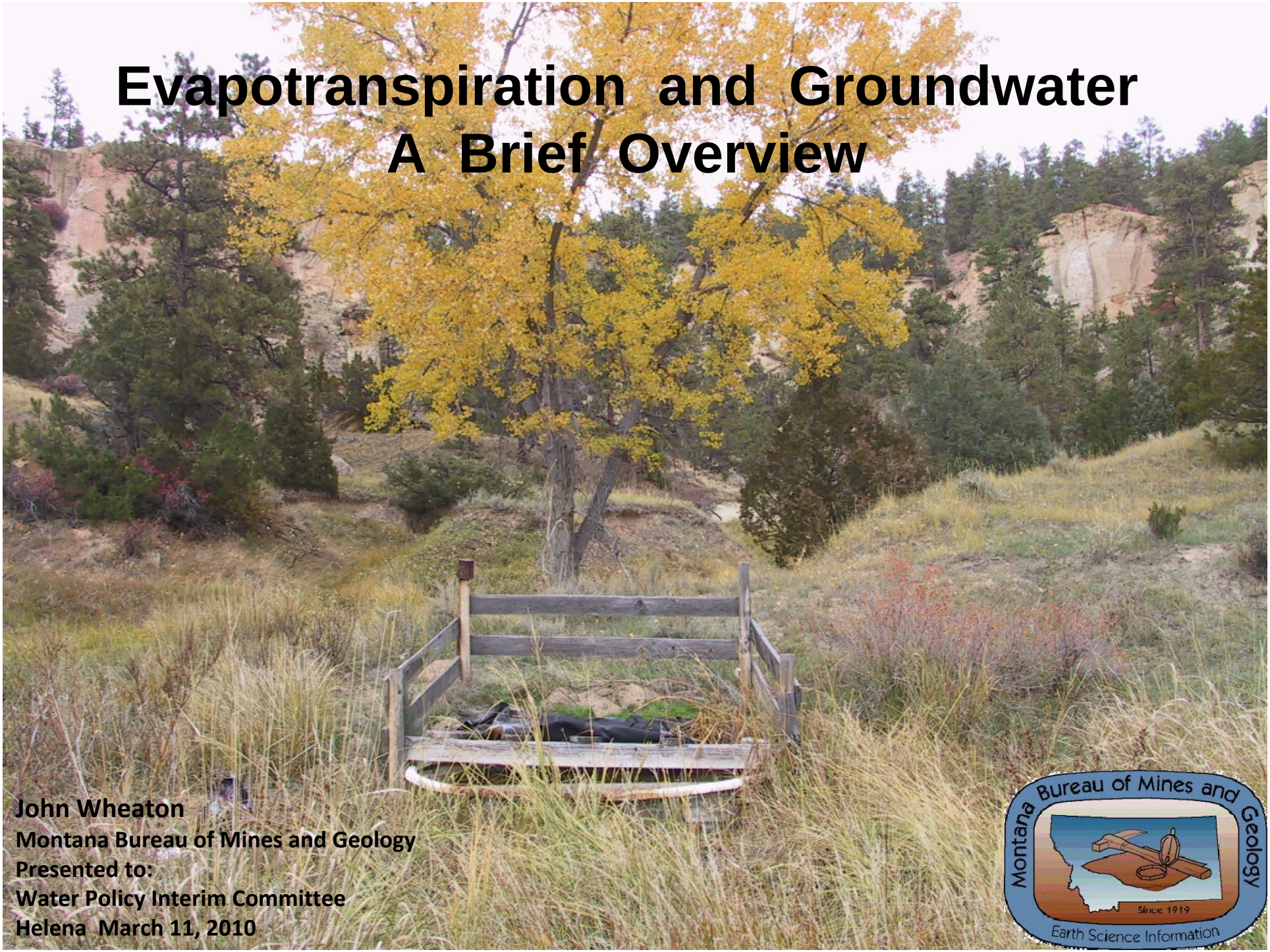
Evapotranspiration and Groundwater
A Brief Overview



John Wheaton
Montana Bureau of Mines and Geology
Presented to:
Water Policy Interim Committee
Helena March 11, 2010


Some People we are working with:
MBMG – Elizabeth Meredith
Gary Icopini
MSU – Clayton Marlow
Monitoring Well
In Salt Cedar stand

Evaporation : Process of water going from a liquid to gas state

Transpiration : Water moving through plants and evaporating

Both Energy and Mass are removed to the atmosphere

Evapotranspiration affects groundwater by
intercepting potential recharge
and by removing water directly from aquifer

In Montana, the Potential Evapotranspiration far exceeds Precipitation.

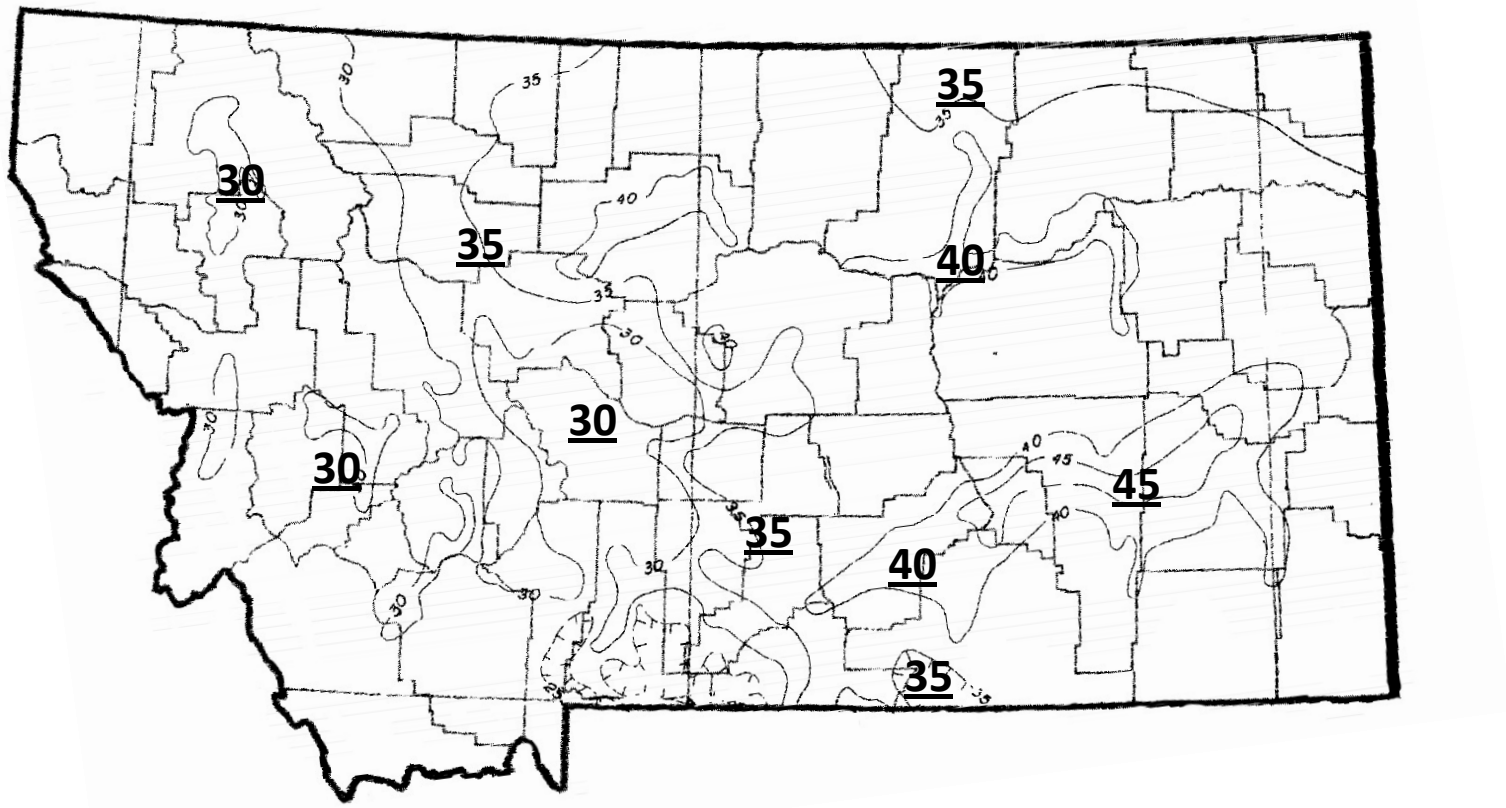
ANNUAL

FREE WATER SURFACE EVAPORATION

(SHALLOW LAKE)

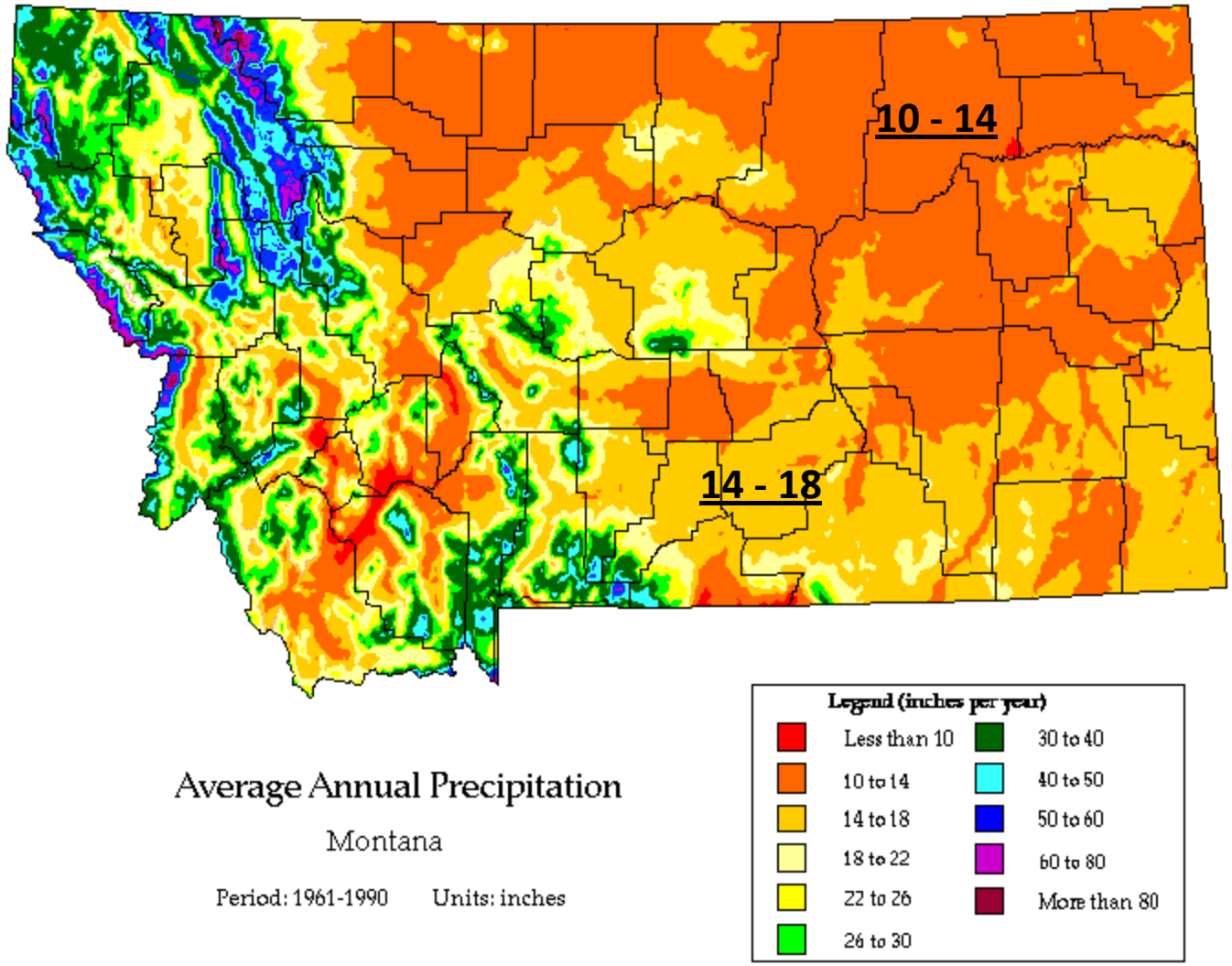
1956-1970

INCHES



Source: NOAA Technical Bulletin 33

NATIONAL WEATHER SERVICE OFFICE OF HYDROLOGY
HYDROLOGIC RESEARCH LABORATORY



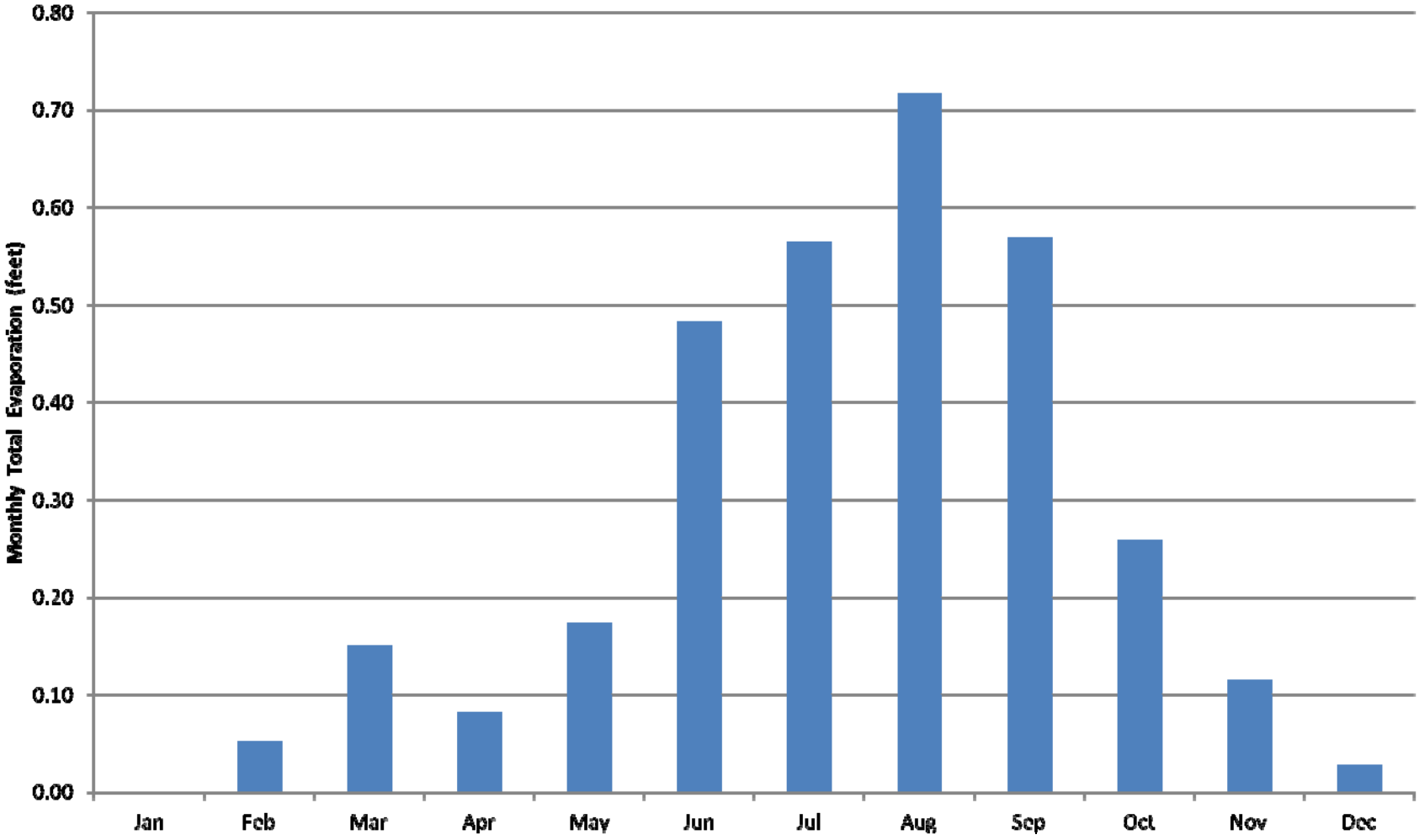
Source: Western Regional Climate Center

http://www.wrcc.dri.edu/pcpn/mt.gif

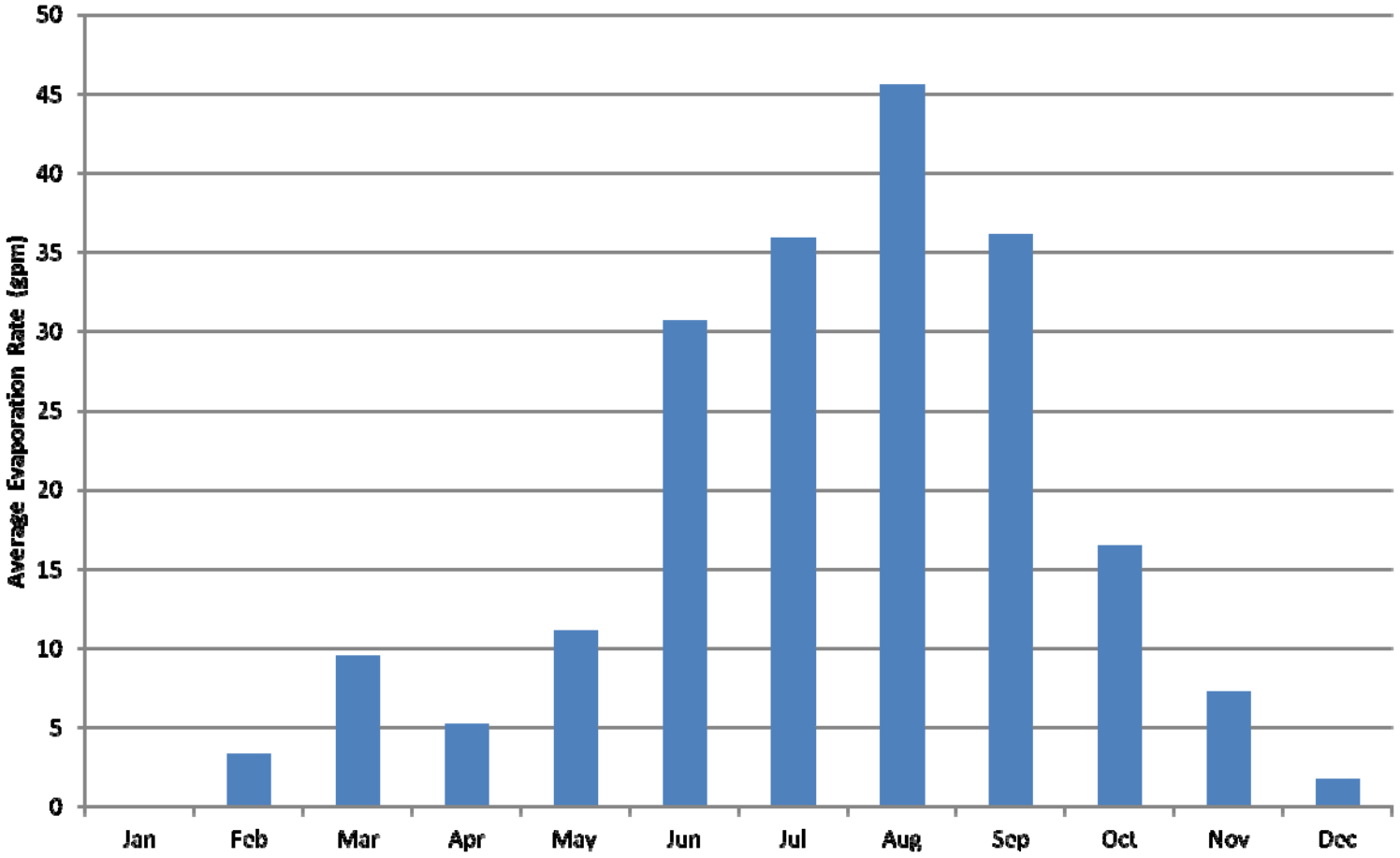
Floating Class A pan

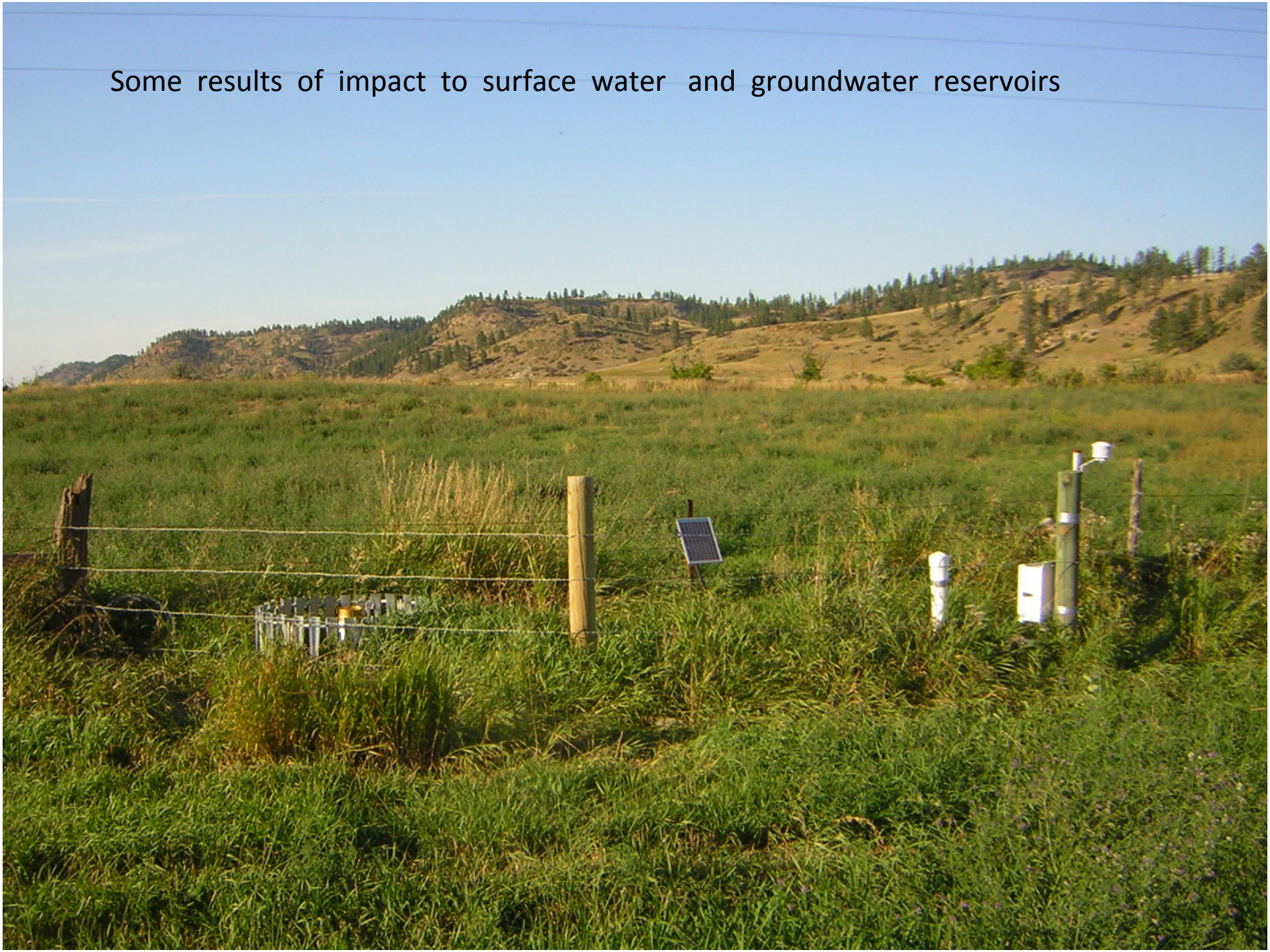
Measuring Free – Water Surface Evaporation

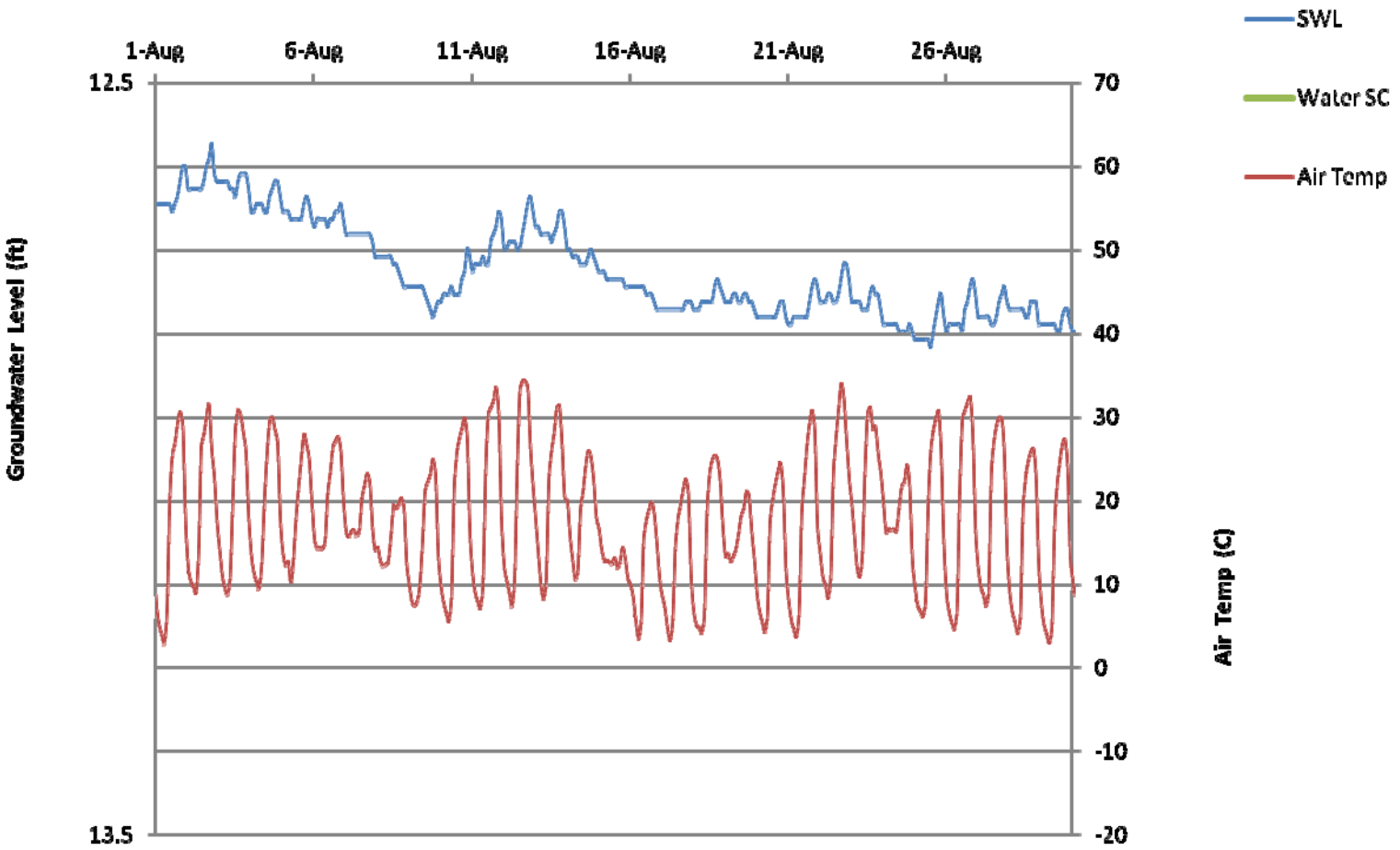
Free Water Surface Evaporation Example
Mine Pit Impoundment in eastern Montana
Measured with floating pan
Annual Total : 3.19 ft

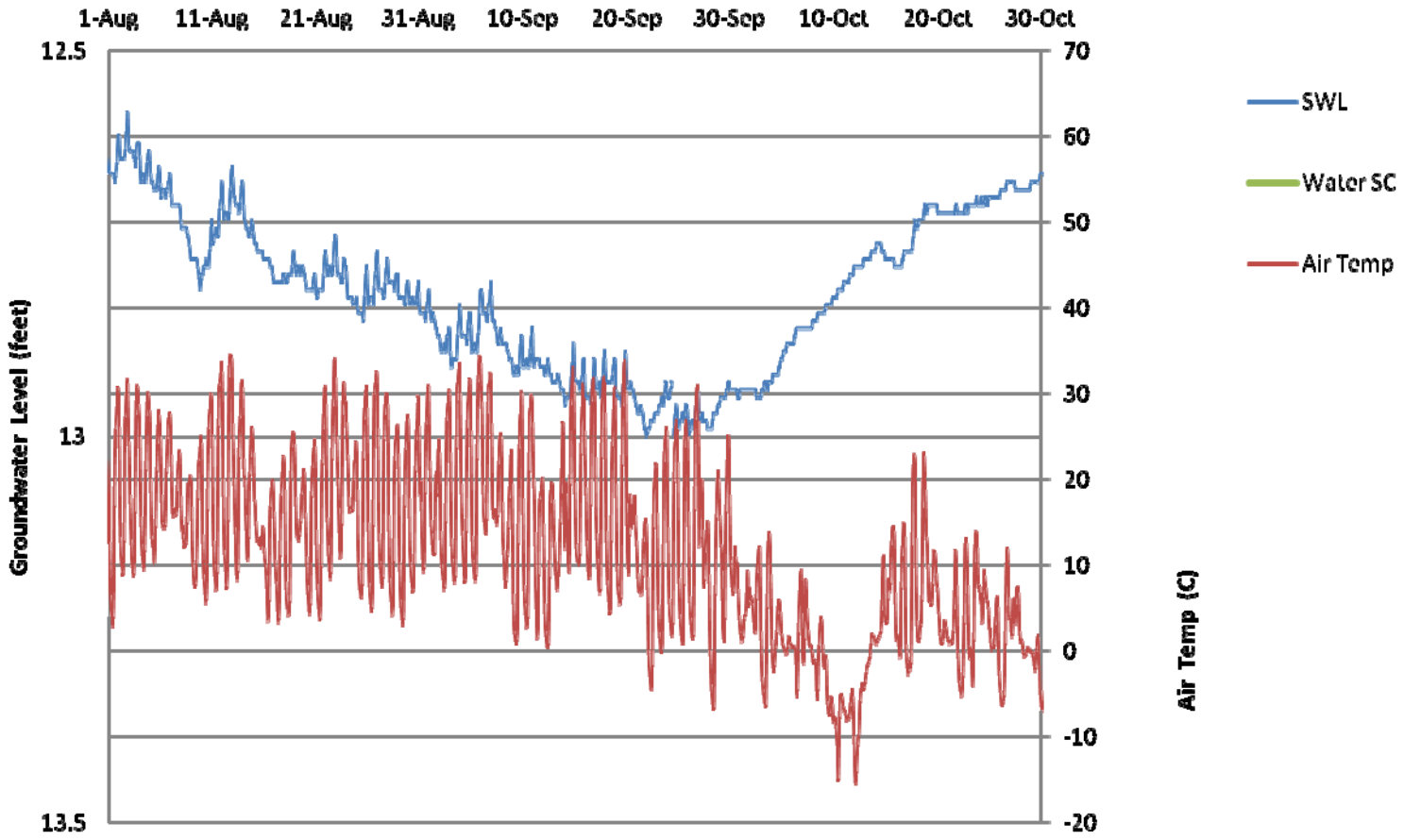


Free Water Surface Evaporation Example
Mine Pit Impoundment in eastern Montana
Surface area = 4.2 acres
Evaporation rates shown are monthly averages :
12 hours per day during evaporating months

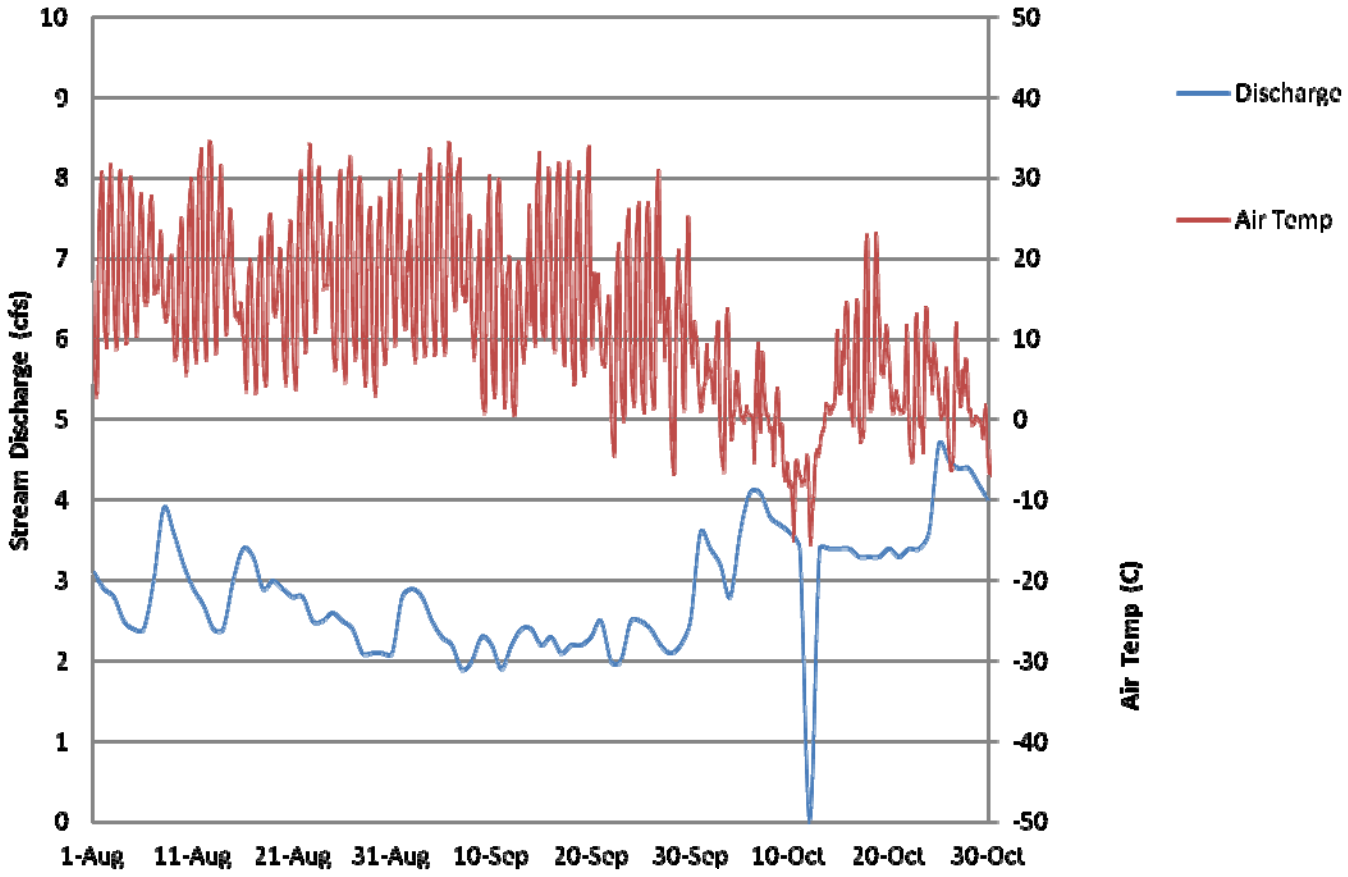



Some results of impact to surface water and groundwater reservoirs

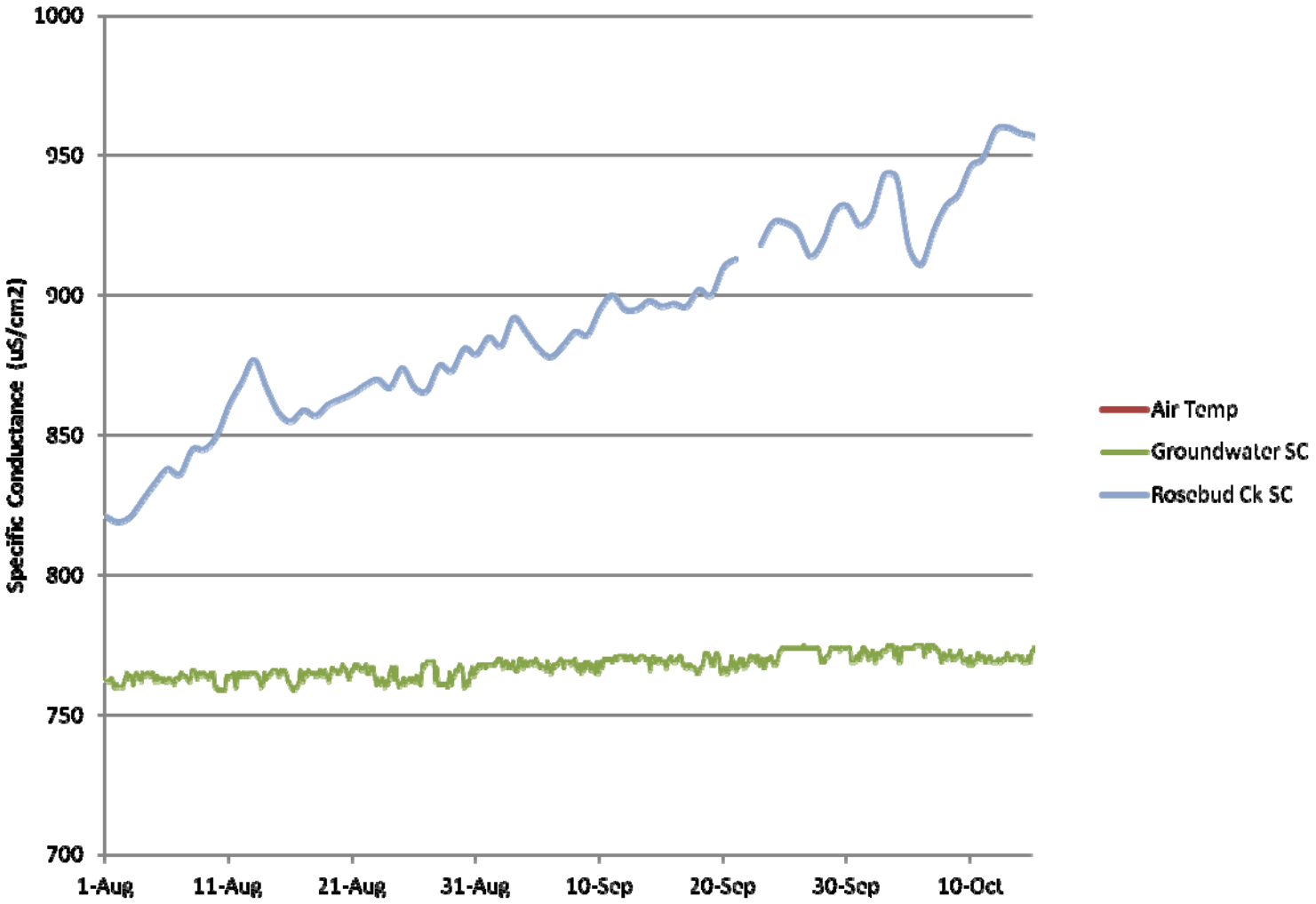

1-Aug
6-Aug
11-Aug
16-Aug
21-Aug
26-Aug
12.5
13.5
70
60
50
40
30
20
10
0
-10
-20
Groundwater Level (ft)
Air Temp (C)
SWL
Water SC
Air Temp


1-Aug
11-Aug
21-Aug
31-Aug
10-Sep
20-Sep
30-Sep
10-Oct
20-Oct
30-Oct
12.5
13
13.5
Groundwater Level (feet)
70
60
50
40
30
20
10
0
-10
-20
Air Temp (C)
SWL
Water SC
Air Temp

Stream flow: Rosebud Creek near Kirby, MT



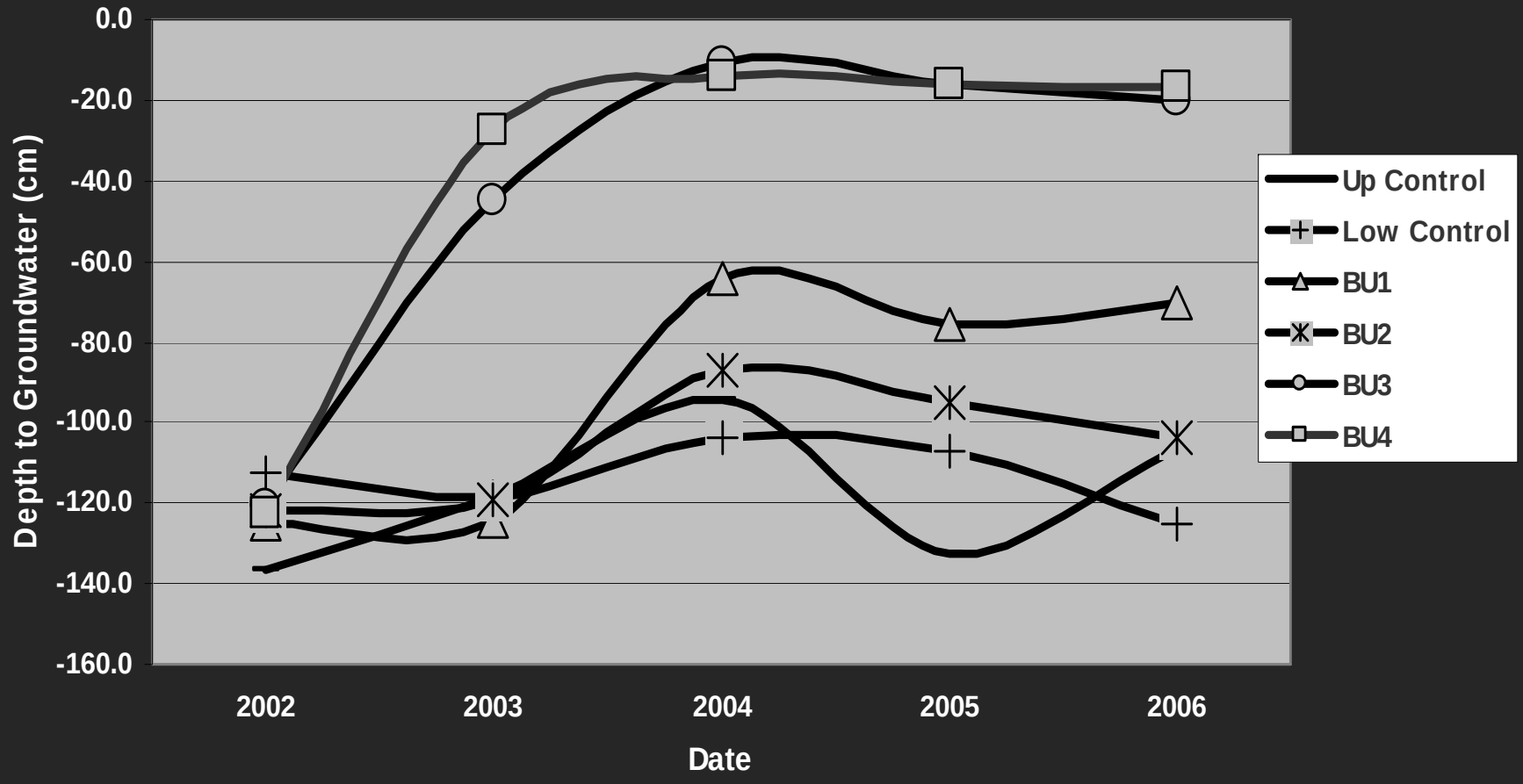
Specific conductivity of groundwater



Missouri Breaks (Roy)

Clayton Marlow (MSU)

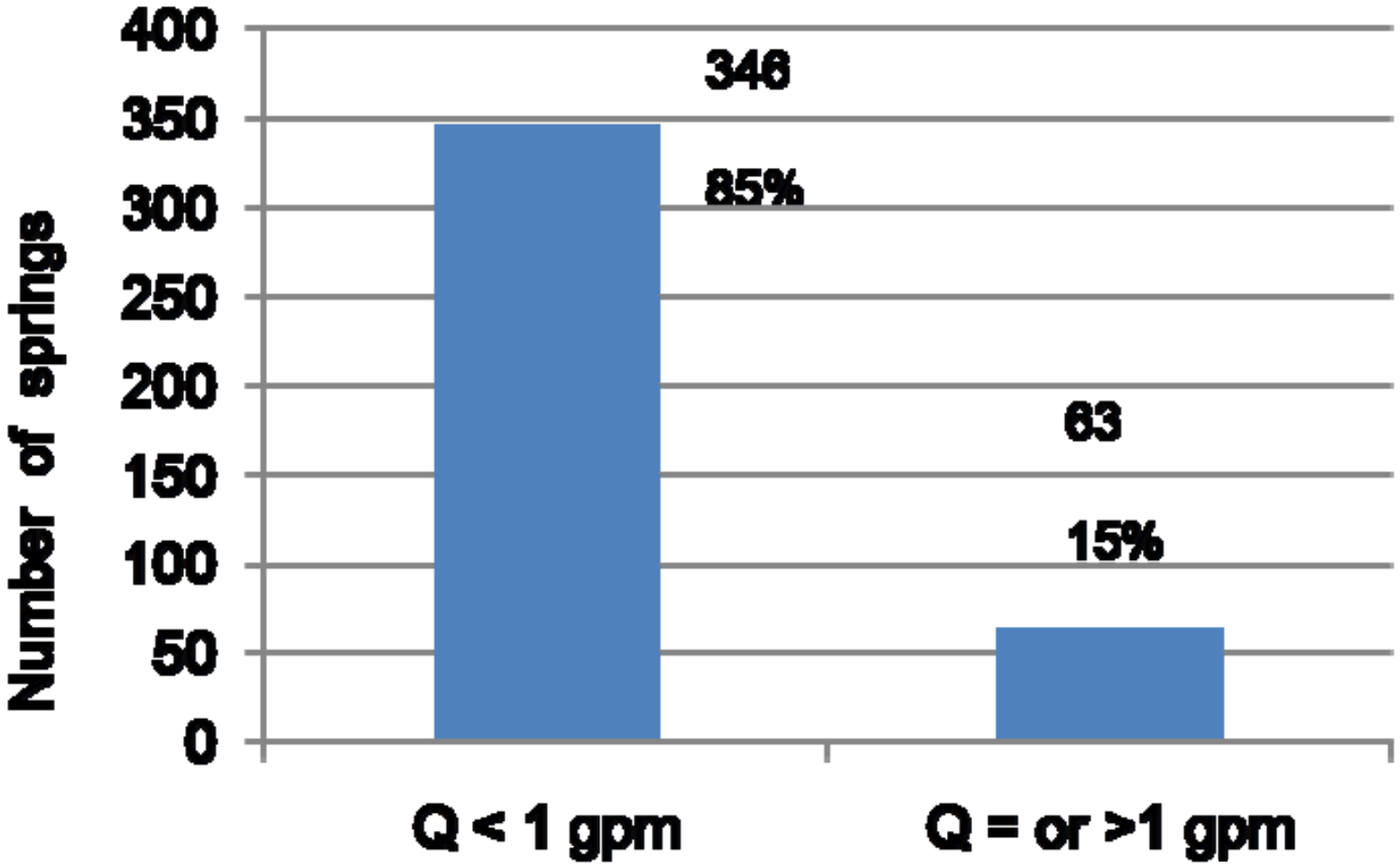
Average Seasonal Groundwater Response to Prescribed Fire




Ashland Ranger District
Spring Inventory : 2002 & 2003
435,000 acres
Precipitation : 16 inches per year
Potential Evaporation : 40 inches per year
Livestock : 20,500

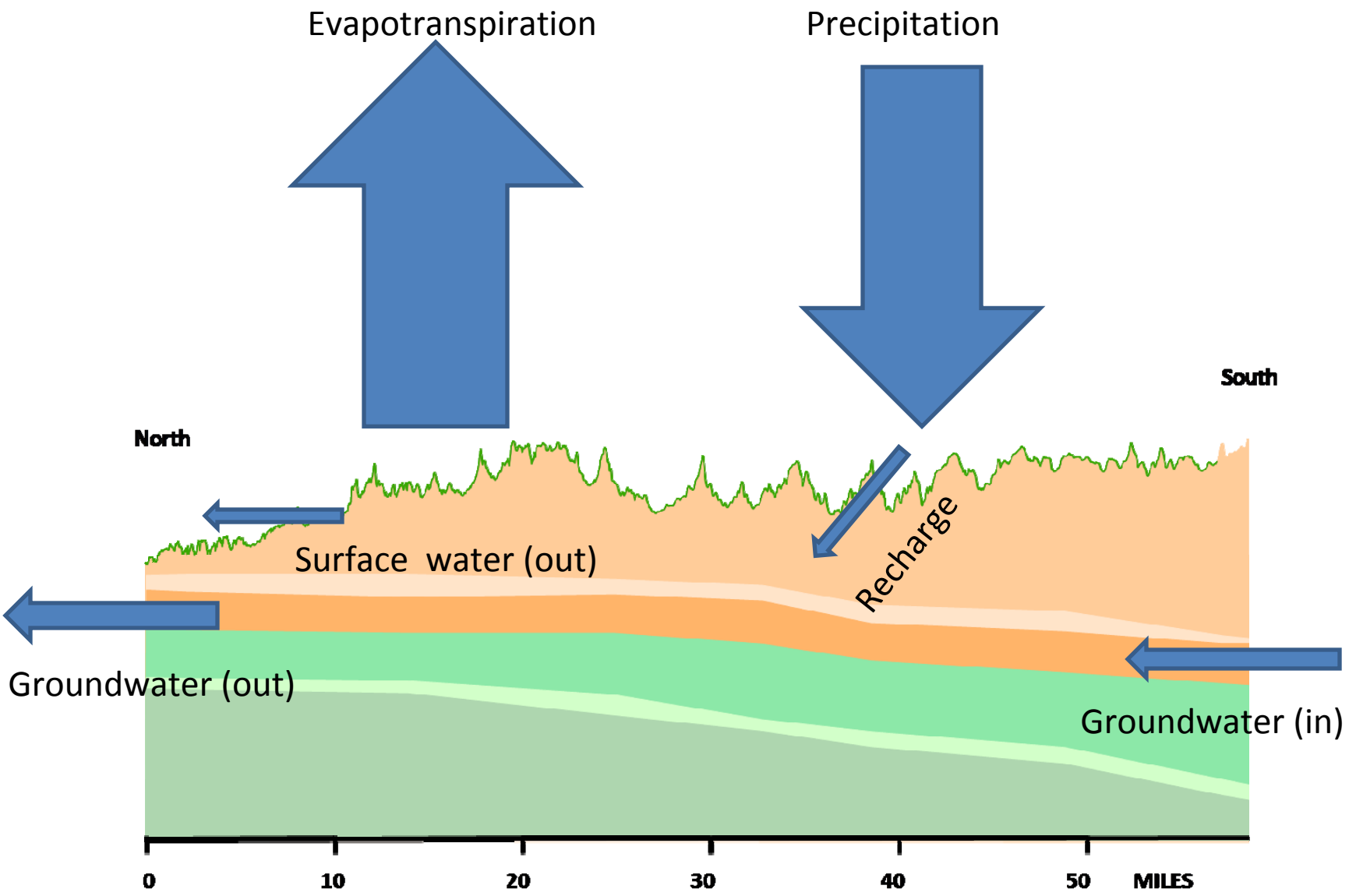

SOFTWATER
SPR.
USFS 263
1145 / 40CT

Spring Discharge Count, Ashland Ranger District : 409

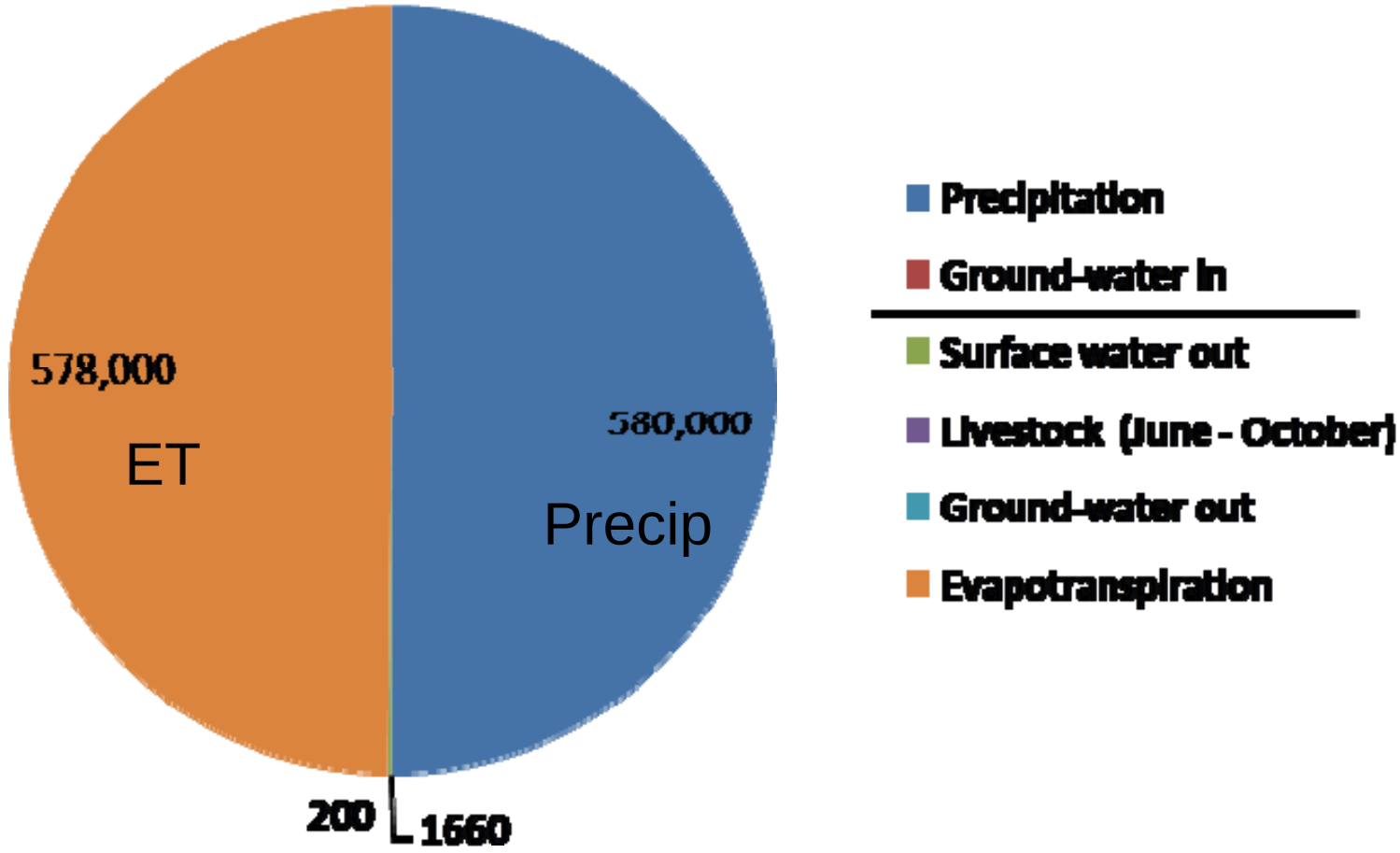


125 Or 31 % Q = 0 gpm

Ashland Ranger District Water



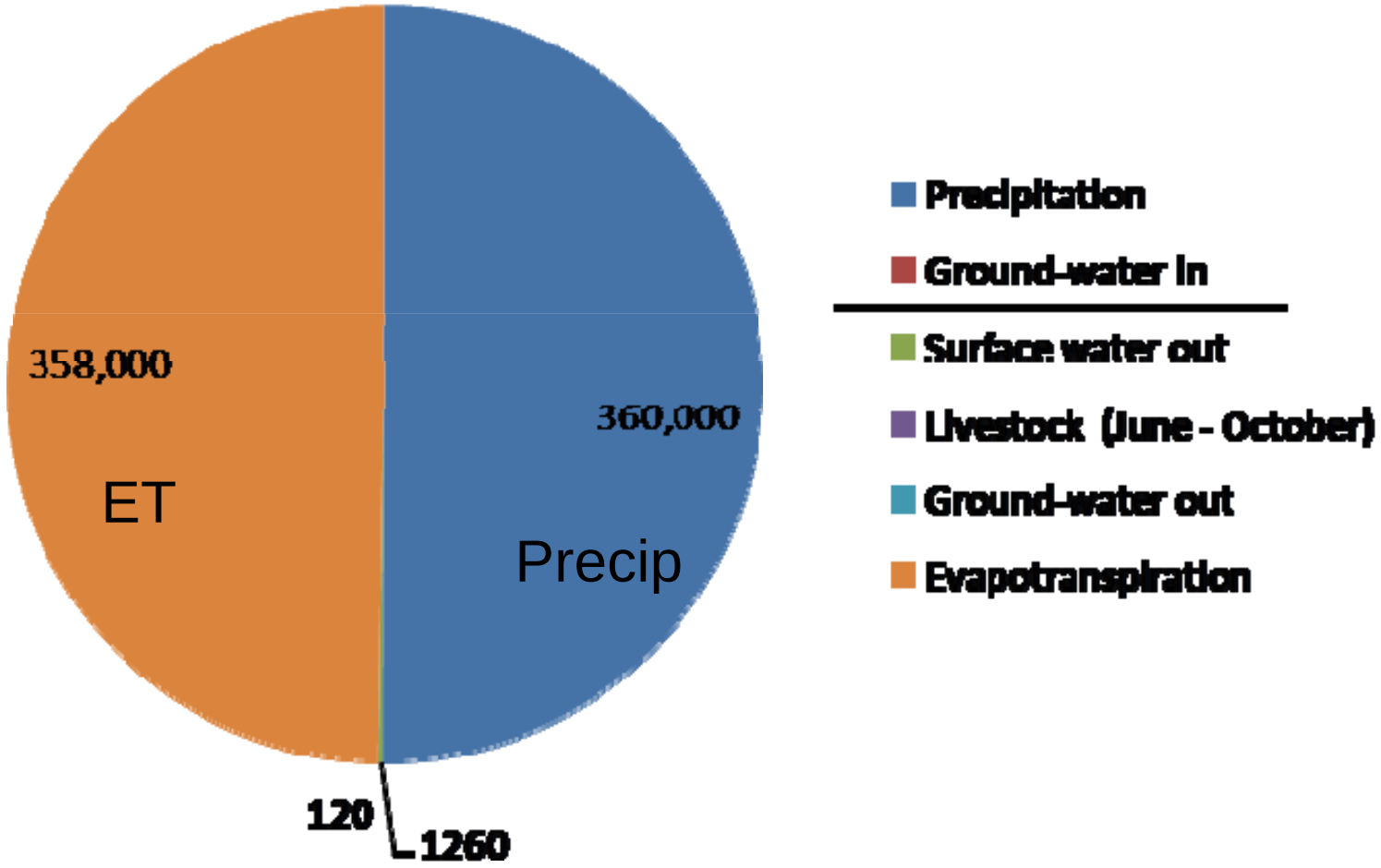
Estimated Water Budget (acre-feet per year)
Ashland Ranger District



Livestock

Streams and springs

Estimated Water Budget (annual gallons per minute)
Ashland Ranger District



Livestock

Streams and springs

Conclusion:

We need to recognize the role of transpiration in:

Stream flow

Spring flow

Aquifer recharge

Aquifer depletion