

# Weather Modification Air and Water Quality

Idaho DEQ

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# Silver

## Drinking Water Standard

### ➤ Drinking Water – Silver (Ag)

- 58.01.08.400.03 – Secondary MCLs
- 40 CFR Part 143.3 Ag 0.10 mg/L
- Cosmetic Effects
  - *Skin discoloration* is a cosmetic effect related to silver ingestion.
  - Graying of the white part of the eye



# Silver

## Ground Water Quality Standard

- Ground Water – Silver (Ag)
  - 58.01.11.200.01.b
  - Secondary Standard
  - 0.10 mg/L (ppm)



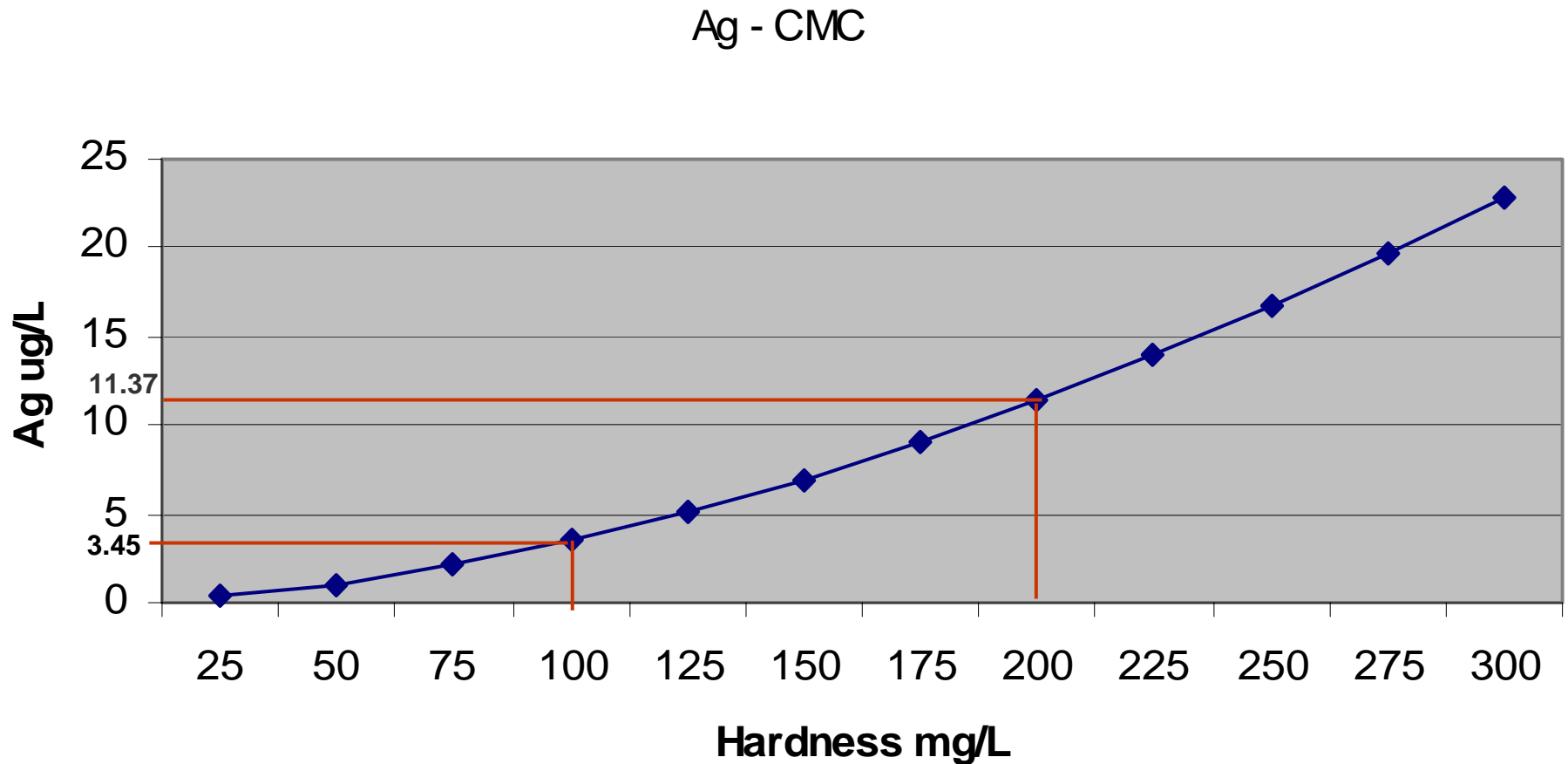
# Silver

## Surface Water Quality Standards

- **Surface Water – Silver (Ag)**
  - **58.01.02.210.01**
  - **Aquatic life – Acute Toxicity Standard**
  - **Hardness Dependant Metal**
  - **At 50 ppm Hardness 1.05 ug/L (ppb)**
  - **At 100 ppm Hardness 3.45 ug/L (ppb)**
  - **At 200 ppm Hardness 11.37 ug/L (ppb)**



# Surface Water – Silver (Ag)



# Conclusions, Stone et.al. 2006

High resolution analysis of water, sediment and biological samples from areas subjected to long-term, 50 year+, cloud seeding programs, specifically PG&E's Mokelumne and Lake Almanor cloud seeding projects, support the following:

- The amount of silver iodide released to the atmosphere in cloud seeding is small, and even after many years of cloud seeding operations the resulting environmental concentrations very small to non-detectable.
- Given the stability of silver iodide compounds, extreme insolubility of silver iodide in water and the absorptions of ionic silver by colloids found in the sediments and aquatic vegetation, silver concentrations in the Mokelumne and Lake Almanor Basin from cloud seeding are expected to be minimal.

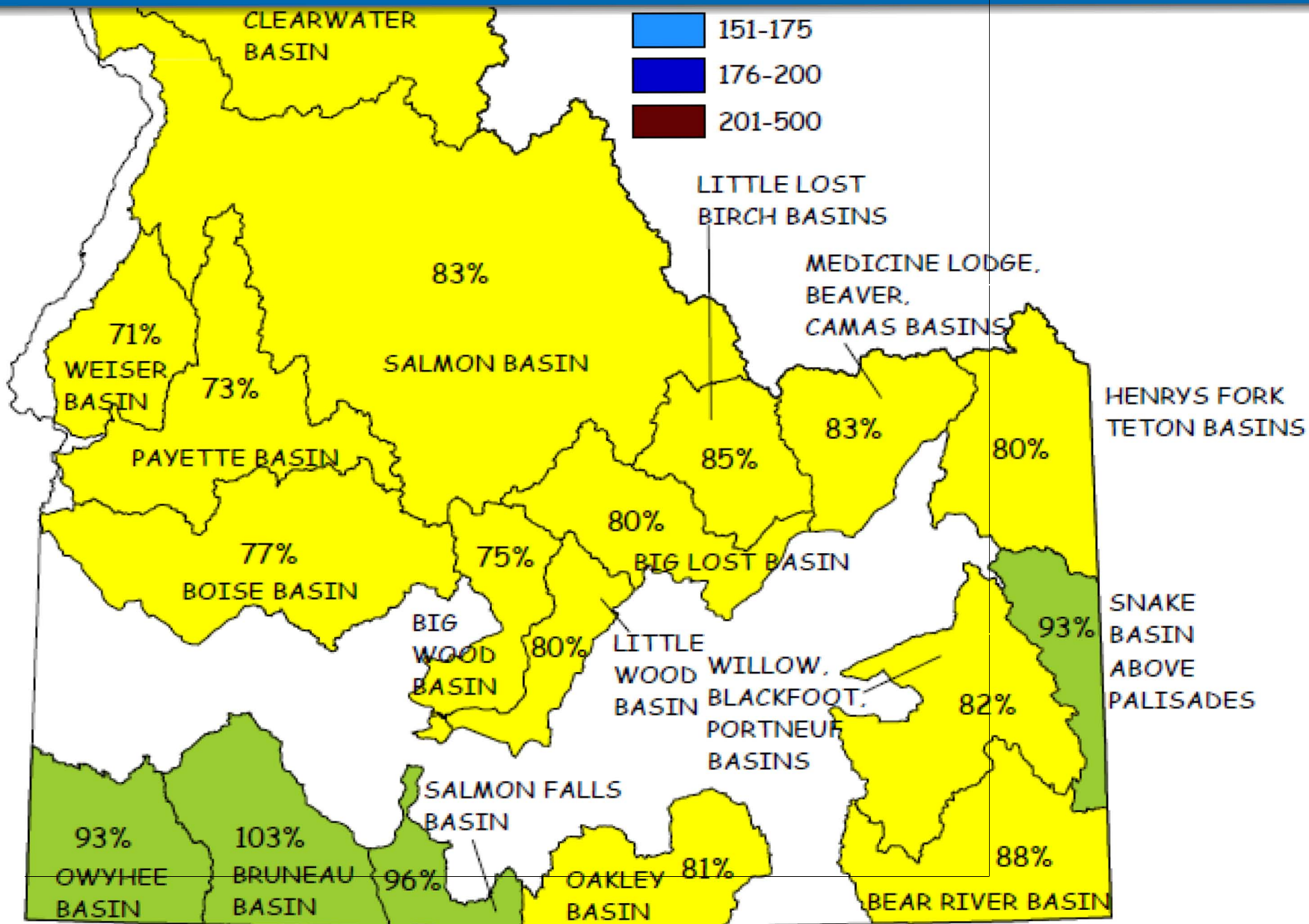
# Conclusions, Stone et.al. 2006

- • Since the monitored levels are low, usually below the detection limit in the target watershed, it is unlikely that continued cloud seeding operations would result in any significant increase in silver concentrations in the target watersheds.
- • Silver concentrations were below regulatory standards. Therefore, continued operations should not result in any significant chronic effect to sensitive aquatic organisms.
- • There is little to suggest the silver from cloud seeding gets into the system and bio-accumulates in organisms.

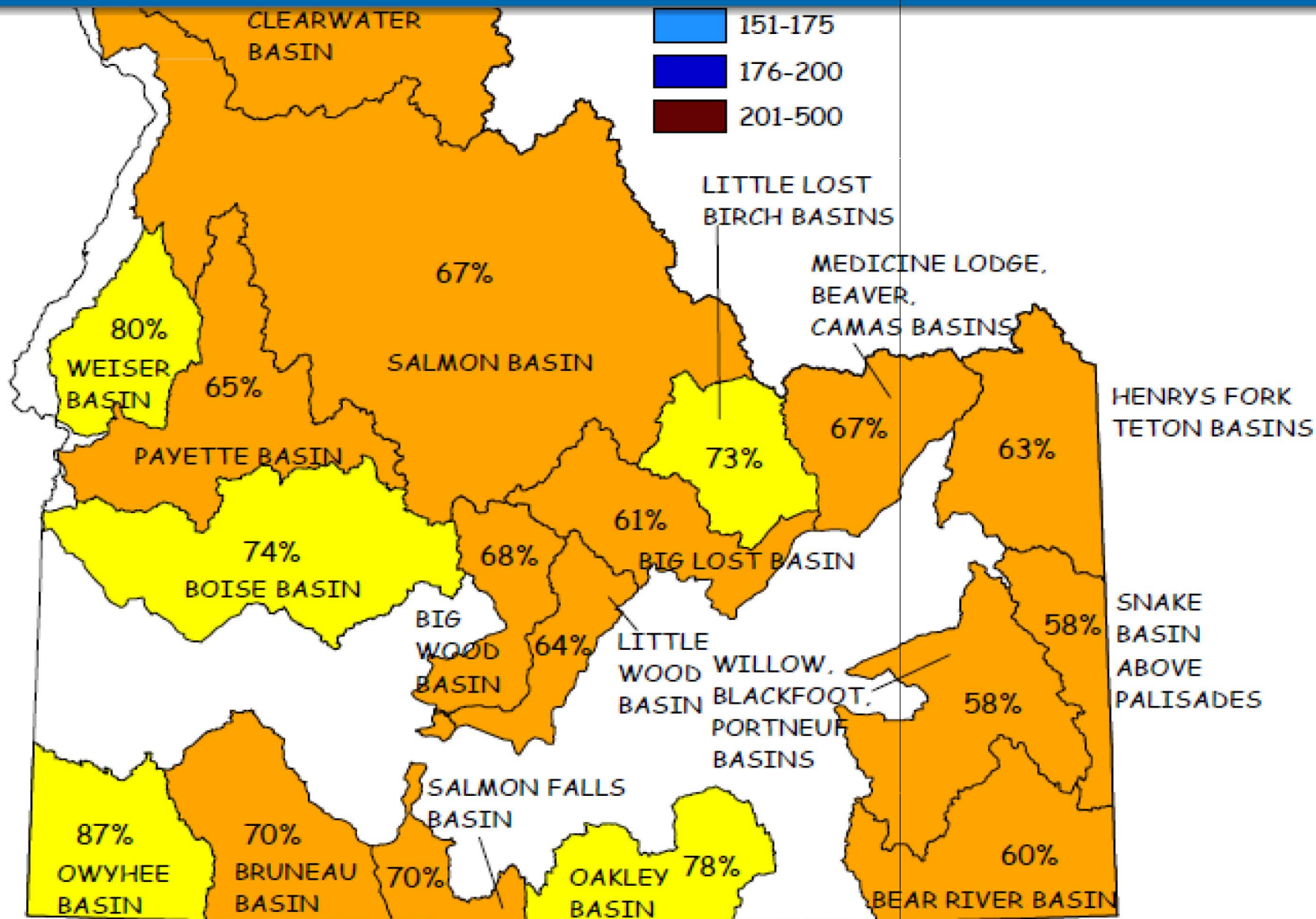
# Chemistry and Studies -Silver Iodide and Silver Chloro-iodide compounds

- Background Ag concentrations in Sierra snow
  - < 2.0 ppt (ppt= g Ag/ml x 10<sup>-12</sup>) (ppt = ng/L)
- [Ag] in seeded snow typically range 40 – 60 ppt in layers sandwiched between unseeded snow
- Total snowpack profile mean Ag concentrations average 5 - 20 ppt in highly effective seeding programs
- <10 ng/L Ag in Snow, or Rain, (WMA, 2009)
- WQ STD = 1050 ng/L at 50 mg/L hardness
- Byron Marler\*, Charles White\*, Ed McCarthy\* and Richard Stone\*\*  
April 19, 2007 \*Pacific Gas & Electric Company \*\*RHS Consulting  
[http://www.weathermodification.org/Annual\\_Meeting\\_2007/marler\\_WMA07.pdf](http://www.weathermodification.org/Annual_Meeting_2007/marler_WMA07.pdf)





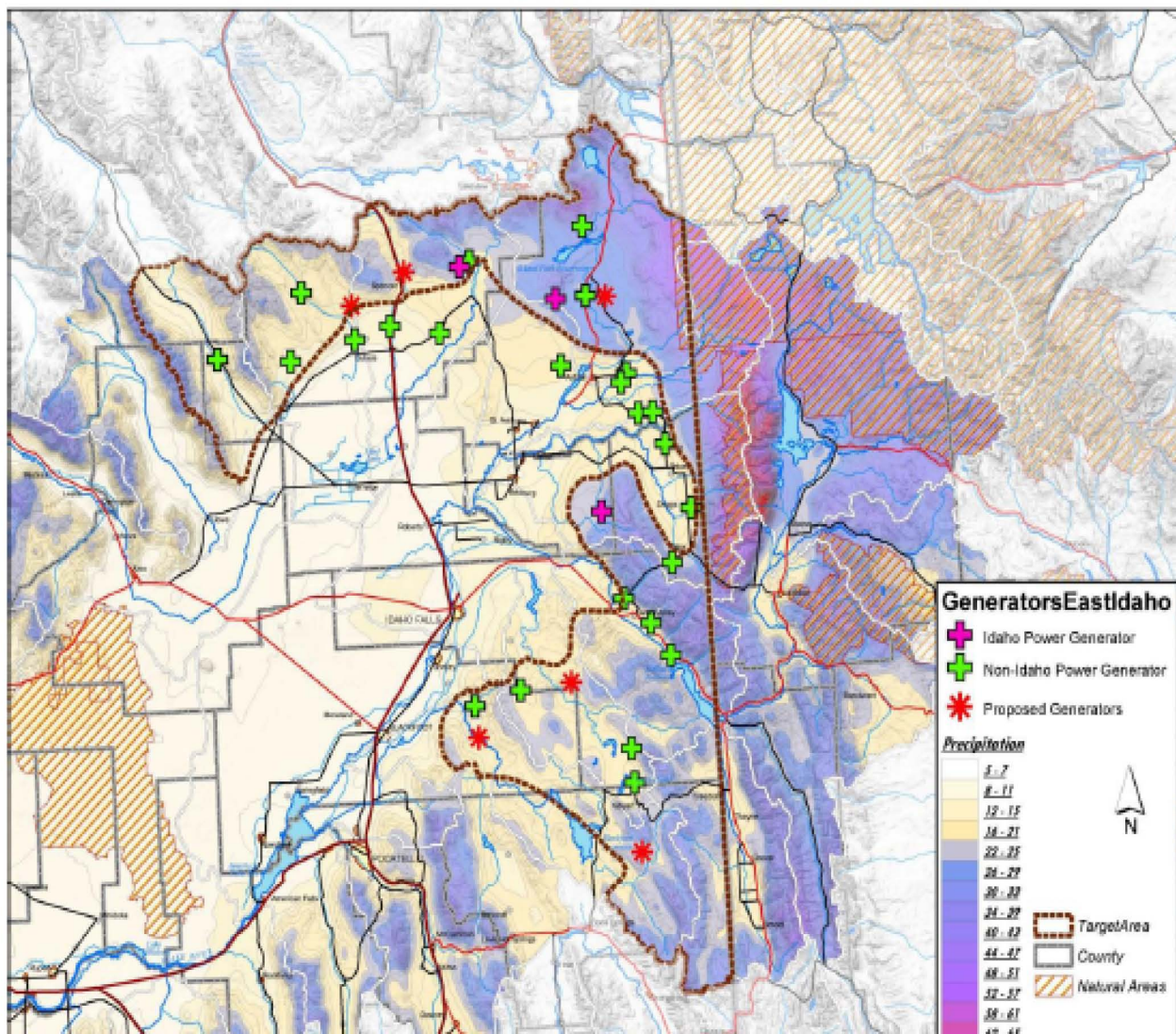
**Mountain Snow Water Equivalent**  
**February 10, 2009 Idaho Snow Survey SNOTEL Data**



Mountain Snow Water Equivalent  
February 8, 2010 Idaho Snow Survey SNOTEL Data



# Upper Snake Planned '09-'10 Operations



# Air Quality

- Emits, or uses, less than 0.333 lb/hr of silver iodide; and
- Emits, or uses, less than 119 lb/hr of acetone; and
- Uses a propane combustor less than one million Btu/hr (1 MBtu/hr)
- An Air Quality Permit would not be required
- These values are screening values

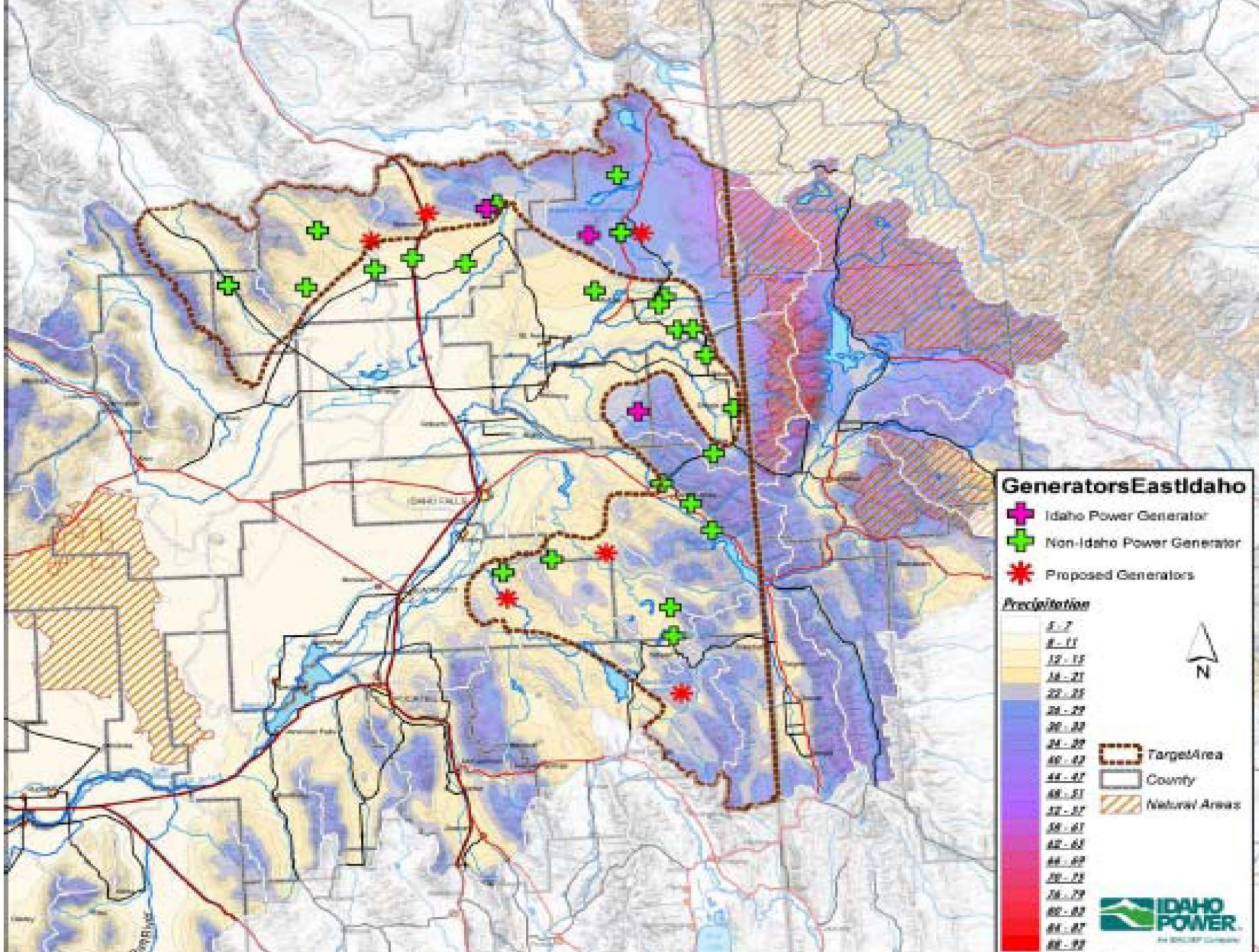


# Air Quality

- Silver Iodide Particle Generation Rate:
  - 12 grams per hour (0.0264 lb/hr)
  - 13 in one spot > 0.333 lb/hr = permit eval?
- Acetone Silver Iodide Solution usage Rate:
  - 0.12 gallons per hour
- Acetone usage Rate:
  - 0.78 lb/hr
  - >153 generators in one location = unlikely
- Propane Combustion Rate:
  - 0.5 gallons per hour (45,750 Btu/hr)
  - 22 Generators >1 MBtu = permit eval?







### GeneratorsEastIdaho

- Idaho Power Generator
- Non-Idaho Power Generator
- Proposed Generators

### Precipitation

- 8 - 11
- 12 - 15
- 16 - 21
- 22 - 25
- 26 - 29
- 30 - 33
- 34 - 37
- 38 - 42
- 43 - 47
- 48 - 51
- 52 - 57
- 58 - 61
- 62 - 65
- 66 - 69
- 70 - 75
- 76 - 79
- 80 - 83
- 84 - 87
- 88 - 92

- Target Area
- County
- Natural Areas



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