# Agenda Item Number 7

CWCB January 26-27, 2010  Denver, Colorado

# 2009-10 Cloud Seeding Programs and Grants

## Joe Busto - CWCB Staff

## Sunset Review Process

## Brian Tobias – Department of Regulatory Agencies

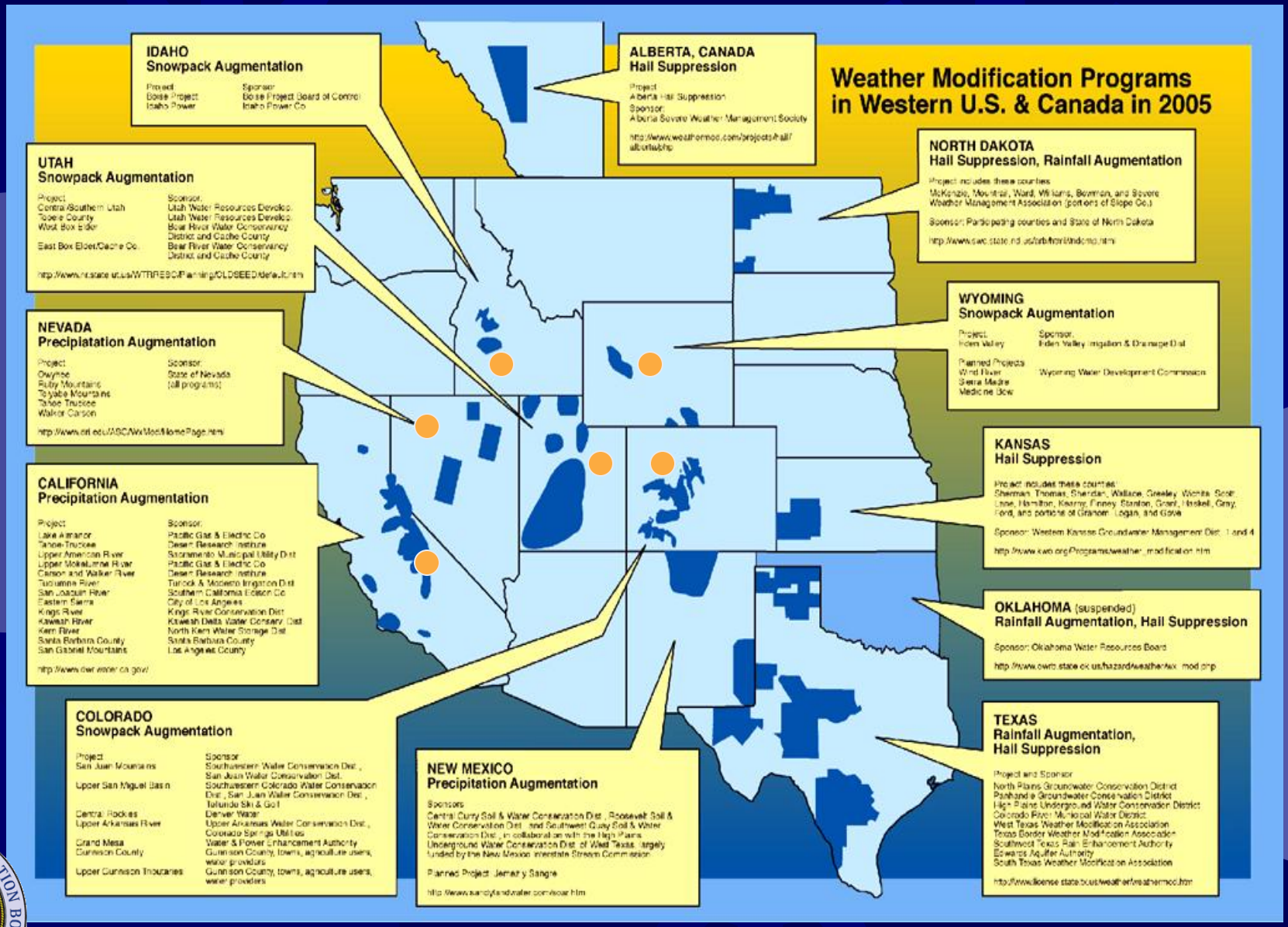
# Weather Modification Methods

Aircraft

Ejectable flares, dry ice and burn in place flares

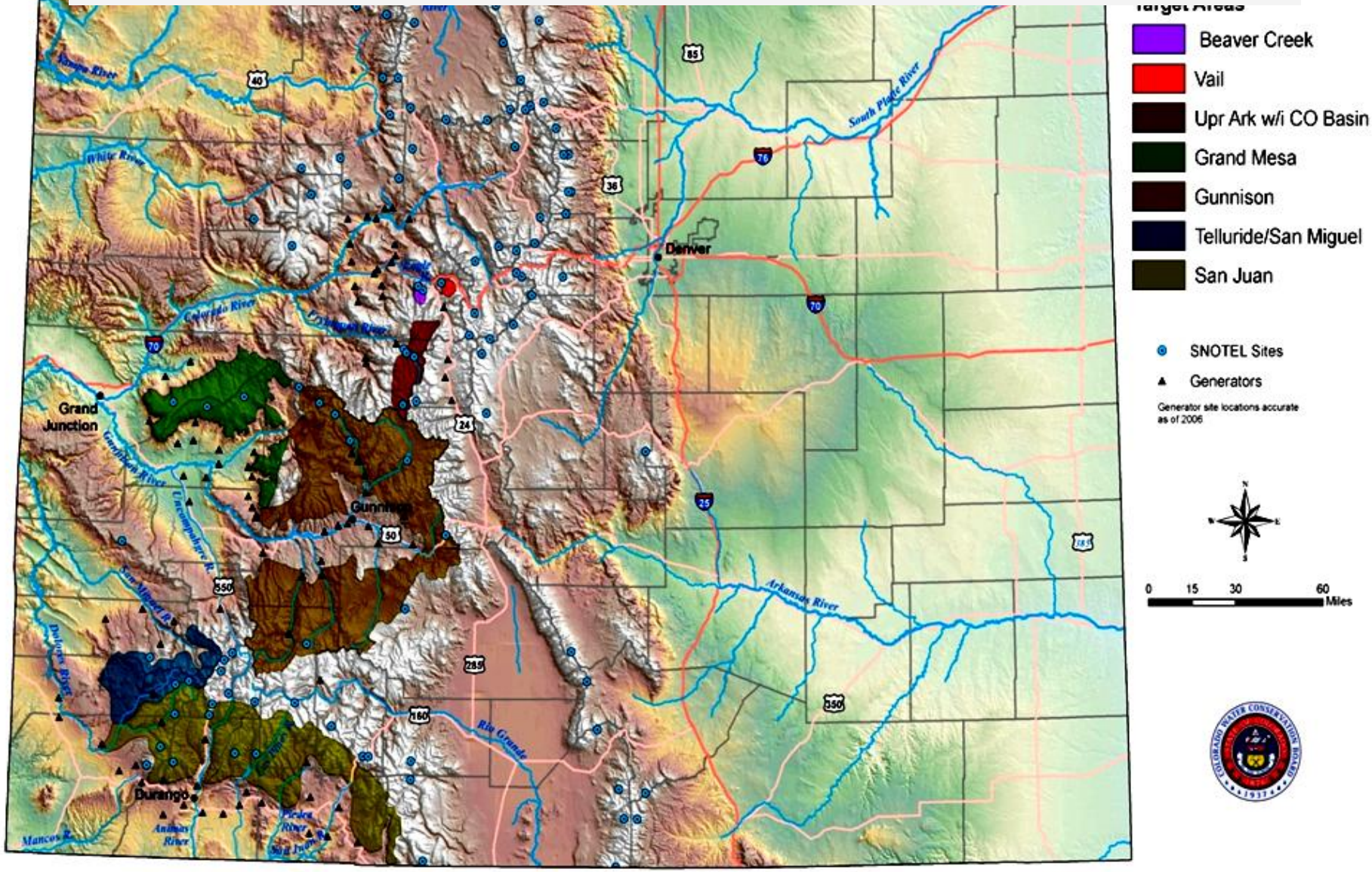
Ground: manual generators, remote gens, propane gens

# 2010 States w/ WxMod Programs

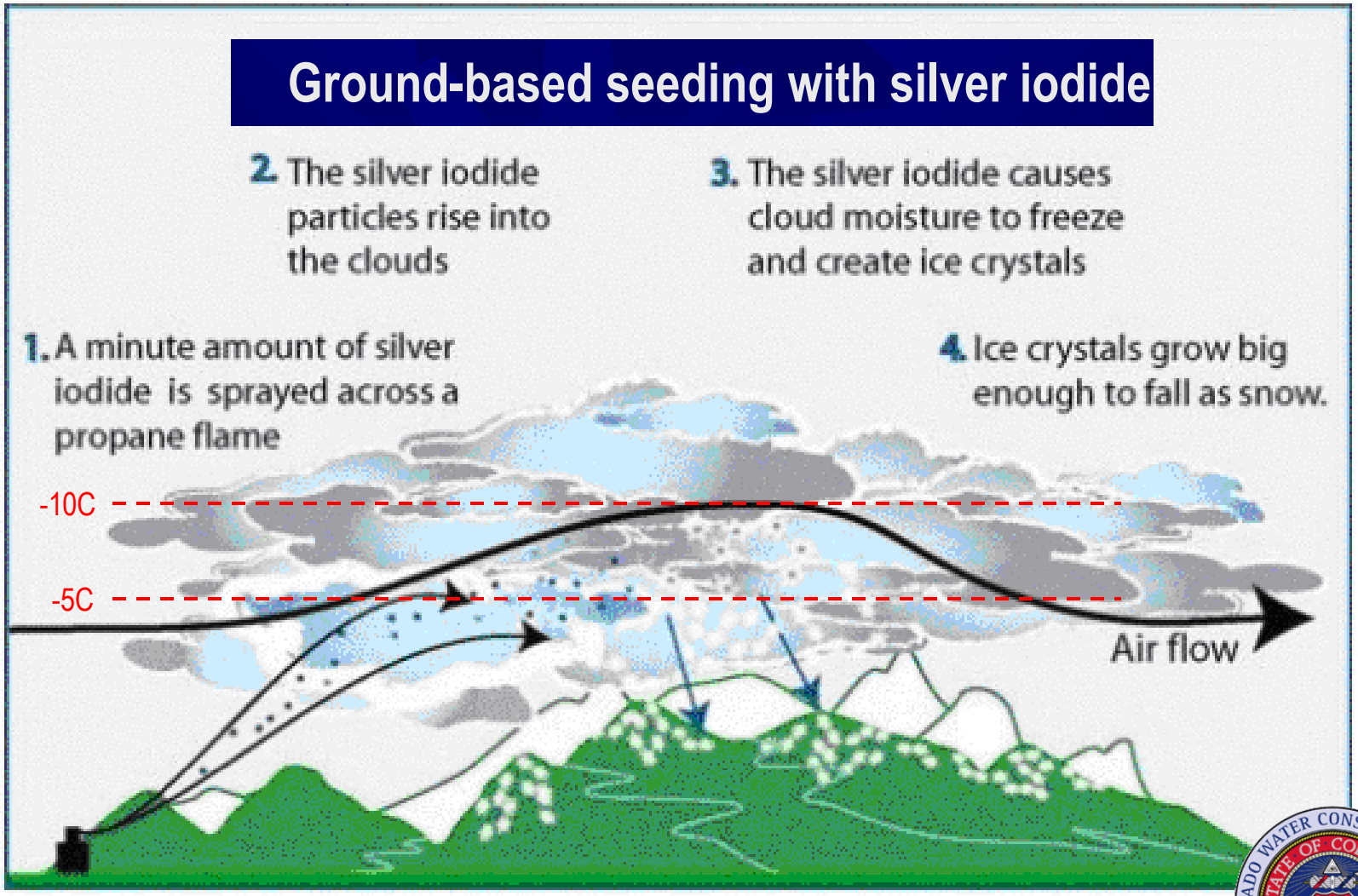



- = Snowpack augmentation states CA, NV, ID, UT, WY, CO

# 107 Generators in Operation



# Conceptual Diagram Winter Cloud Seeding



# CWCB Strategic Plan Elements

- DNR authority is permitting, environmental monitoring, temporary curtailment
  - Recently updated monitoring tools -
- Additional authorities in state-to-state agreements

Six areas of focus in CWCB Strategic Plan

1. Permitting
2. Compliance & Monitoring
3. Grants (NM, AZ, CA, NV, CWCB)
4. Optimization and Modernization
5. Studies & Evaluations
6. Outreach & Public Education

# CWCB Strategic Plan Elements

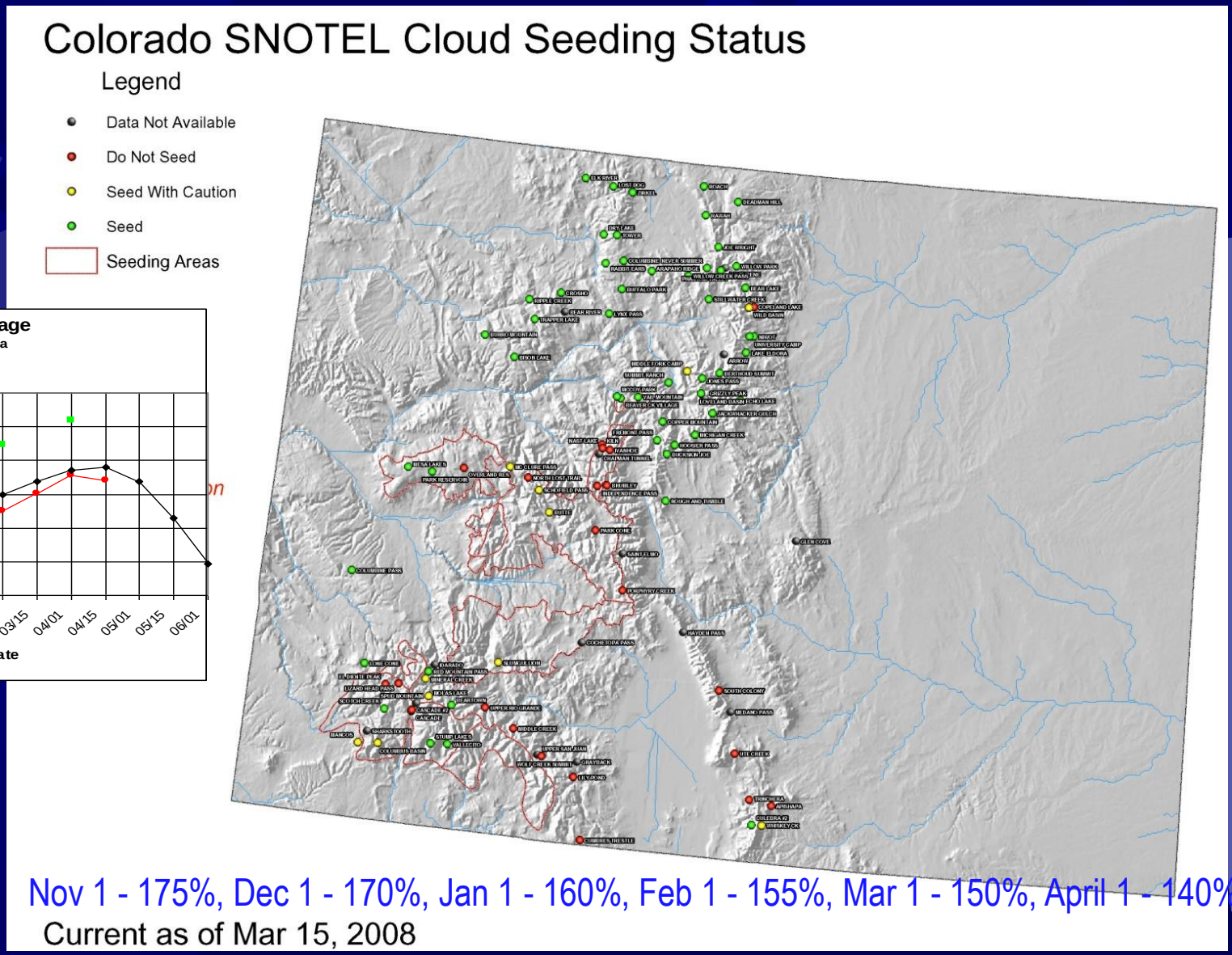
Areas of focus in CWCB Strategic Plan

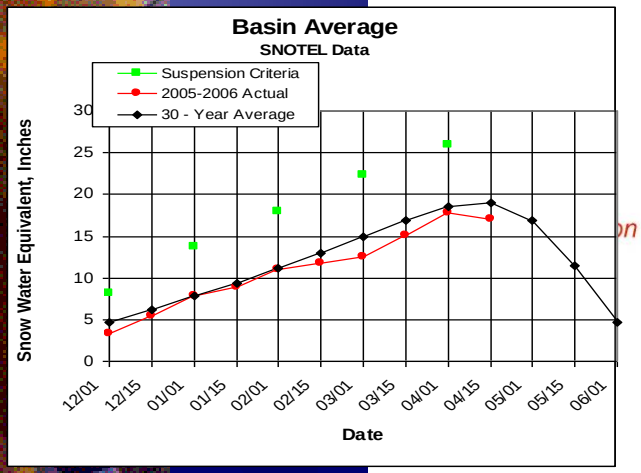
## Compliance & Monitoring

- Tapering snowpack swe thresholds
- Avalanche hazard levels by CAIC (web portal)
- Basin interests notification
- Governor's FTF & WATF provide additional awareness & information
- Bottom line: stop when its really good

# Updated CWCB suspension criteria

## Daily mapping of snowpack SWE thresholds by NRCS



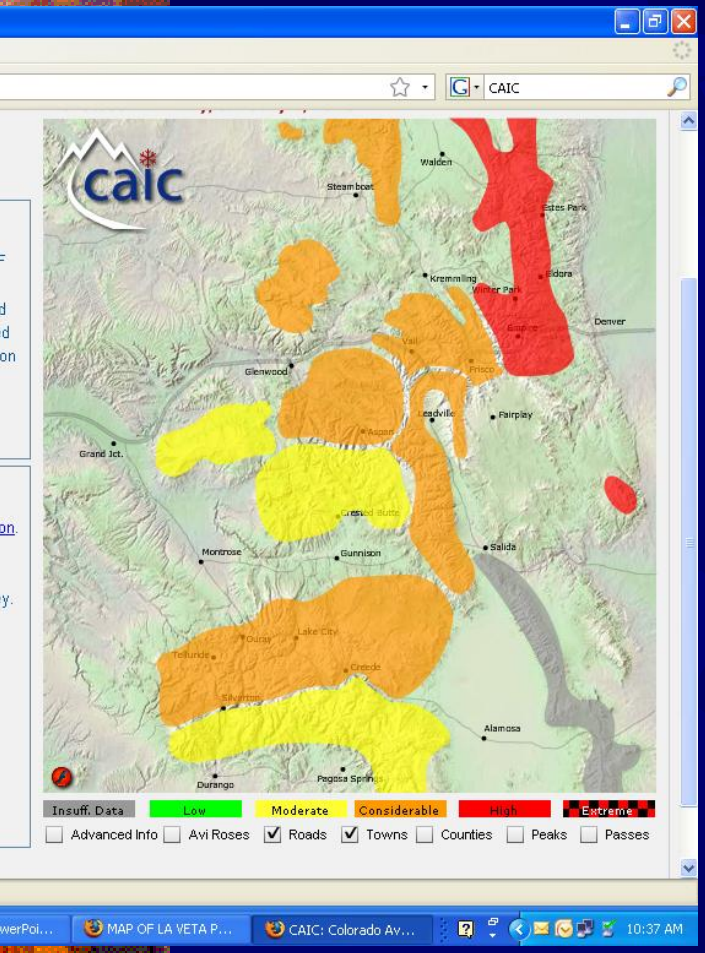



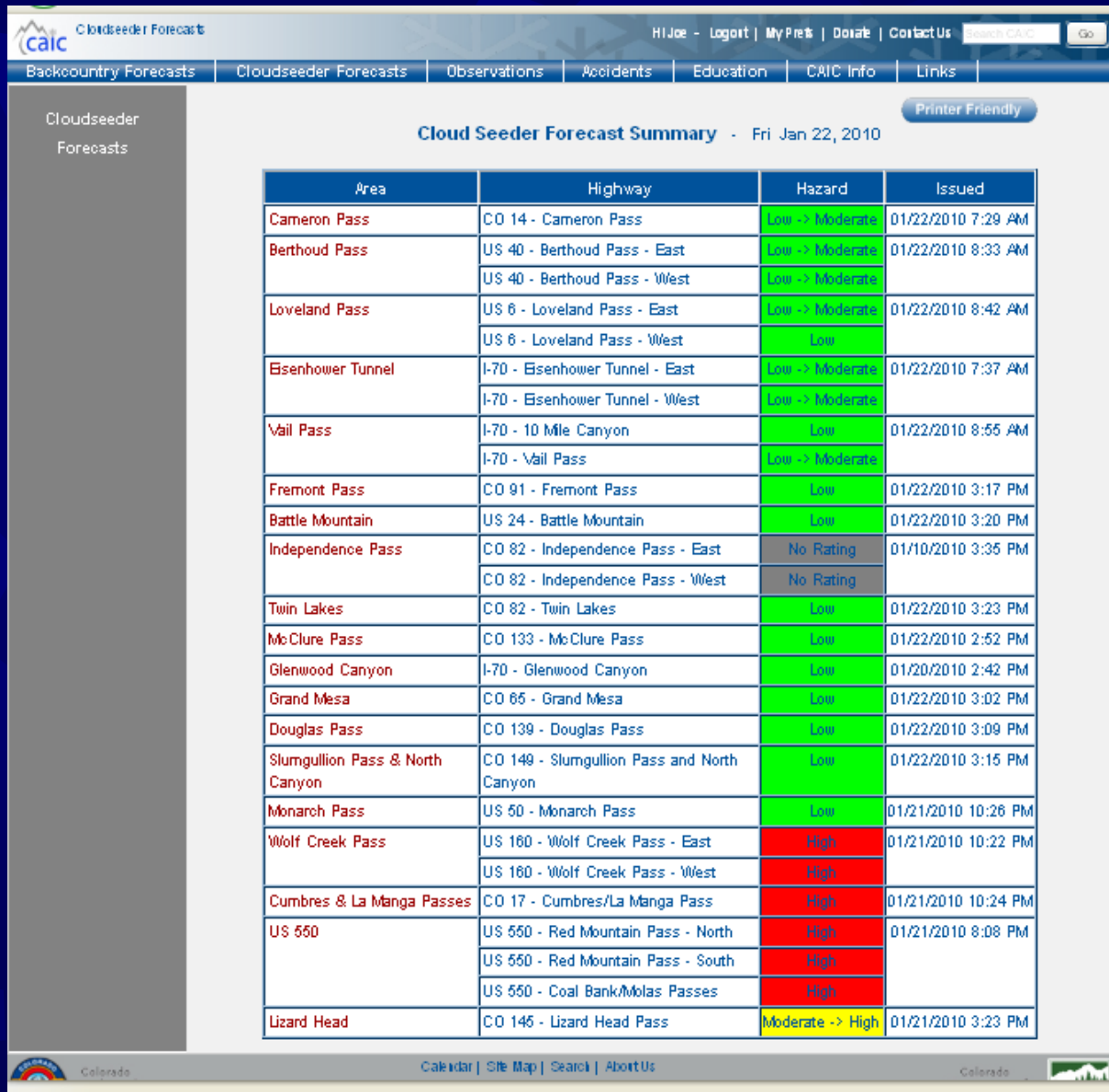

Nov 1 - 175%, Dec 1 - 170%, Jan 1 - 160%, Feb 1 - 155%, Mar 1 - 150%, April 1 - 140%

Current as of Mar 15, 2008

# Updated CWCB suspension criteria

## General Backcountry Warnings Vs. Hazard Levels at Roads and Passes

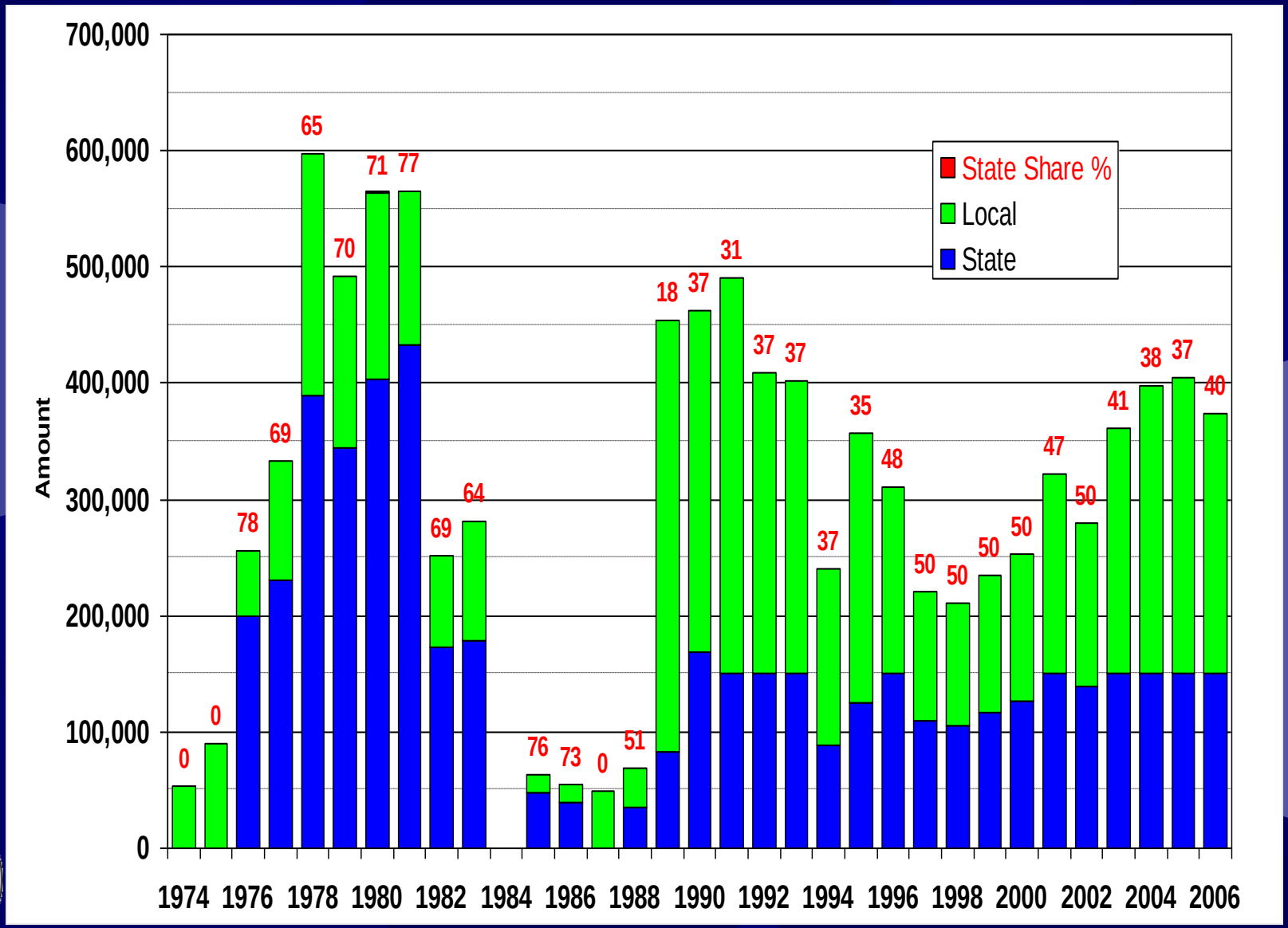



| Area | Highway | Hazard | Issued |
|---|---|---|---|
| Cameron Pass | CO 14 - Cameron Pass | Low -> Moderate | 01/22/2010 7:29 AM |
| Berthoud Pass | US 40 - Berthoud Pass - East | Low -> Moderate | 01/22/2010 8:33 AM |
| | US 40 - Berthoud Pass - West | Low -> Moderate | |
| Loveland Pass | US 6 - Loveland Pass - East | Low -> Moderate | 01/22/2010 8:42 AM |
| | US 6 - Loveland Pass - West | Low | |
| Eisenhower Tunnel | I-70 - Eisenhower Tunnel - East | Low -> Moderate | 01/22/2010 7:37 AM |
| | I-70 - Eisenhower Tunnel - West | Low -> Moderate | |
| Vail Pass | I-70 - 10 Mile Canyon | Low | 01/22/2010 8:55 AM |
| | I-70 - Vail Pass | Low -> Moderate | |
| Fremont Pass | CO 91 - Fremont Pass | Low | 01/22/2010 3:17 PM |
| Battle Mountain | US 24 - Battle Mountain | Low | 01/22/2010 3:20 PM |
| Independence Pass | CO 82 - Independence Pass - East | No Rating | 01/10/2010 3:35 PM |
| | CO 82 - Independence Pass - West | No Rating | |
| Twin Lakes | CO 82 - Twin Lakes | Low | 01/22/2010 3:23 PM |
| McClure Pass | CO 133 - McClure Pass | Low | 01/22/2010 2:52 PM |
| Glenwood Canyon | I-70 - Glenwood Canyon | Low | 01/20/2010 2:42 PM |
| Grand Mesa | CO 65 - Grand Mesa | Low | 01/22/2010 3:02 PM |
| Douglas Pass | CO 139 - Douglas Pass | Low | 01/22/2010 3:09 PM |
| Slumgullion Pass & North Canyon | CO 149 - Slumgullion Pass and North Canyon | Low | 01/22/2010 3:15 PM |
| Monarch Pass | US 50 - Monarch Pass | Low | 01/21/2010 10:26 PM |
| Wolf Creek Pass | US 160 - Wolf Creek Pass - East | High | 01/21/2010 10:22 PM |
| | US 160 - Wolf Creek Pass - West | High | |
| Cumbres & La Manga Passes | CO 17 - Cumbres/La Manga Pass | High | 01/21/2010 10:24 PM |
| US 550 | US 550 - Red Mountain Pass - North | High | 01/21/2010 8:08 PM |
| | US 550 - Red Mountain Pass - South | High | |
| | US 550 - Coal Bank/Molas Passes | High | |
| Lizard Head | CO 145 - Lizard Head Pass | Moderate -> High | 01/21/2010 3:23 PM |

COLORADO WATER CONSERVATION BOARD
STATE OF COLORADO
1876
1937

# Utah funding 32 years



# Funding Winter 2009-10

- CWCB has $175,000, NMISC $25,000, Colorado River $152,300 = $352,000
  - State Controller memo money in COFRS
  - Agreement with San Juan RCDC
- DRI operates 2 remote generators at Winter Park ($62,300)
- DRI deploys & operate Mancos Mtn. & upgrade weather station at Purgatory ($55,100)
- Operational Grants
  - CWCB Only under contract - $40,000 Gunnison, $37,042 to three Southwestern Programs
  - $194,442 under contract by CWCB
  - $177,300 still need to contract

# Funding Winter 2008-09

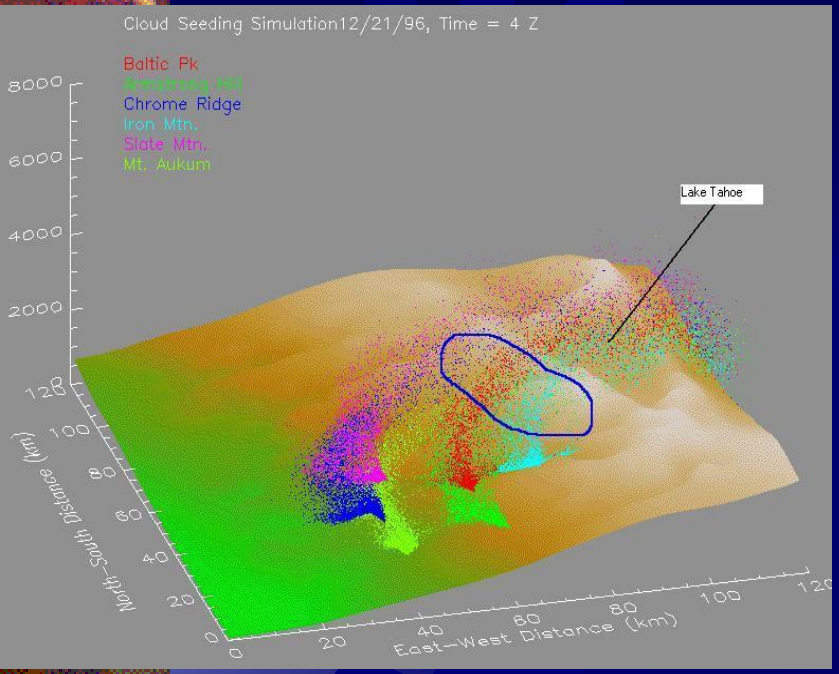
- CWCB had $175K, NMISC $42K, Colorado River $126K = $343,000
- DRI Build a generator for San Juan Mountains ($60,856)
- DRI Build a weather station for Purgatory ($21,689)
- DRI ran two AgI generators at Grand Mesa and one weather station/Liquid Propane Dispenser ($38,000)
- Operational Grants
  - $40,000 to Gunnison County, $90,000 to three southwestern programs, $10,000 to Grand Mesa,
  - $9,500 to Colorado Springs and DW $0 = $149,500

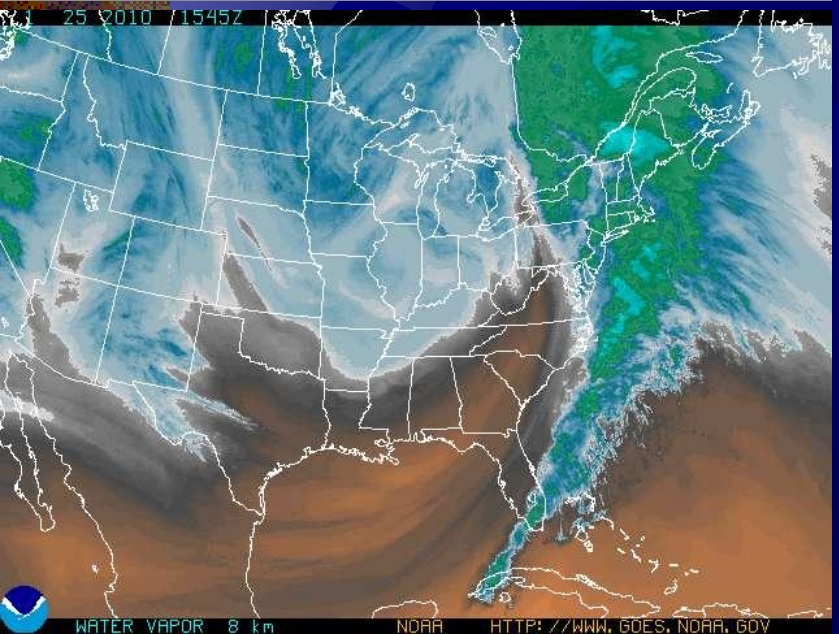
# 5 Years Winter Cloud Seeding

| Winter | Locals | CWCB | Colo. River | NMISC |
|---|---|---|---|---|
| 2005-06 | $455,531 | $60,000 | $45,000 | 0 |
| 2006-07 | $463,396 | $75,000 | $57,000 | 0 |
| 2007-08 | $433,624 | $150,000 | $135,000 | $42,000 |
| 2008-09 | $372,704 | $175,000 | $126,000 | $42,000 |
| 2009-10 | $492,137 | $175,000 | $152,300 | $25,000 |
| **TOTALS** | **$1,827,092** | **$635,000** | **$515,300** | **$109,000** |
| **% of Total** | **59%** | **21%** | **17%** | **3%** |

5 Year Total Combined = $3,086,392

# Downwind Effects Review-2009




27 areas in which these increases were Sufficiently analyzed so as to provide Beyond Target distances.

These distances ranged from about 20 to 250 miles, with most Indications between 50 and 150 miles.

40+ Scientific papers reviewed by Steve Hunter of WET International.

Simulation shows seeding dispersion,

GOES satellite water vapor map

# Do simple things and do them well

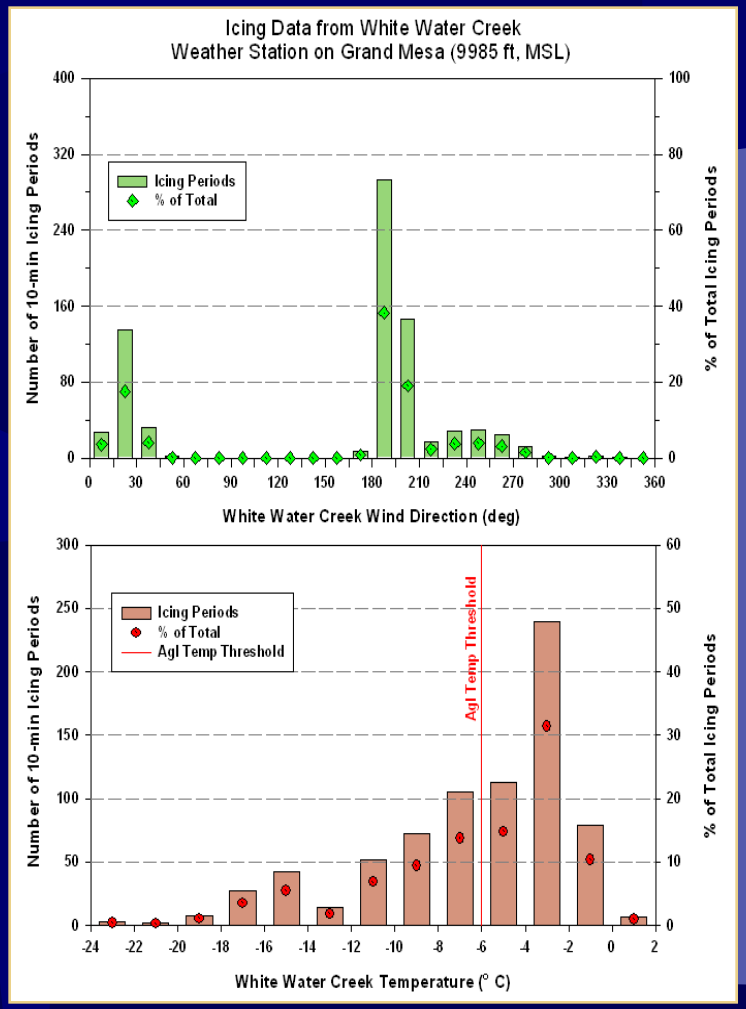
- DRI 25 years R&D (scientifically defensible)
- DRI not a contractor
- DRI equipment dispenses AgI at twice normal rate (19 vs. 8 grams/hour)
- DRI equipment can be located at 10,000 feet with cell comm.
- DRI Weather stations characterize seeding periods for credibility

Figure 1. Top image shows a DRI generator ready for transport to a field site with tower assembly folded down onto the top of the trailer. Bottom image shows typical field installation with tower assembly raised and trailer wheels removed. Solar panel is just visible at the top right edge of the trailer and communications antenna is mounted about halfway up the right side of the tower. Seeding solution tank, nitrogen pressurization tanks, batteries and computer unit are housed inside the trailer.

# Whitewater Creek Weather Station

- Hosted by DRI under contract
- Icing vs Wind Direction & Temp
- Do your own analysis and see the good seeding periods of last winter

Icing rate sensor



# Modernizing Colorado's Ops

## "Remote AgI Generator on Kannah Creek 2007"


**Pros: Science shown generators are more effective at higher elevations, data is logged for easy analysis, twice seeding rate**

**Cons: initial expense, training, communication issues, federal land issues**

# 2004 Utah Liquid Propane Results

- A **25% increase** in snowfall in seeded experimental units over unseeded. Probability that this increase could have occurred by chance was < 5 percent.
- SLW and climatology suggest this increase over a typical **Nov-Mar** period would produce about **8% snow water content increase** in target area
- Because of propane's ability to create ice crystals at -0.5C (vs -4 to -6C with AgI), more clouds can be treated, **extending operations into warmer spring months or warmer climates**

"The experiment needs replication in Utah and other Western states to increase reliability of results and to determine geographic applicability" – Super & Heimbach

# Grand Mesa Liquid Propane Dispenser

"Physical Measurements & liquid propane seeding in one October 2008"

- Copied Utah design
- Deployed Oct.2008 and combined with weather station on the Grand Mesa
- Can be fully automated
- Need precipitation gauges for evaluations

Builds on $383K Utah Liquid Propane R&D Project

# CWCB WM Issues to Consider

- WM Statutes Sunset Review
  - Program and Language changes needed?
    - NMISC 2005 rules allow for state participation in compact issues
    - California has no State WM statutes
    - Input in DORA report not legislative process
- TABOR (budget growth)
  - Equipment ownership & depreciation
- Slow moving agreements (Colo. River, NM)
- CWCB funding priorities
- Technology transfer a success? (it is early)

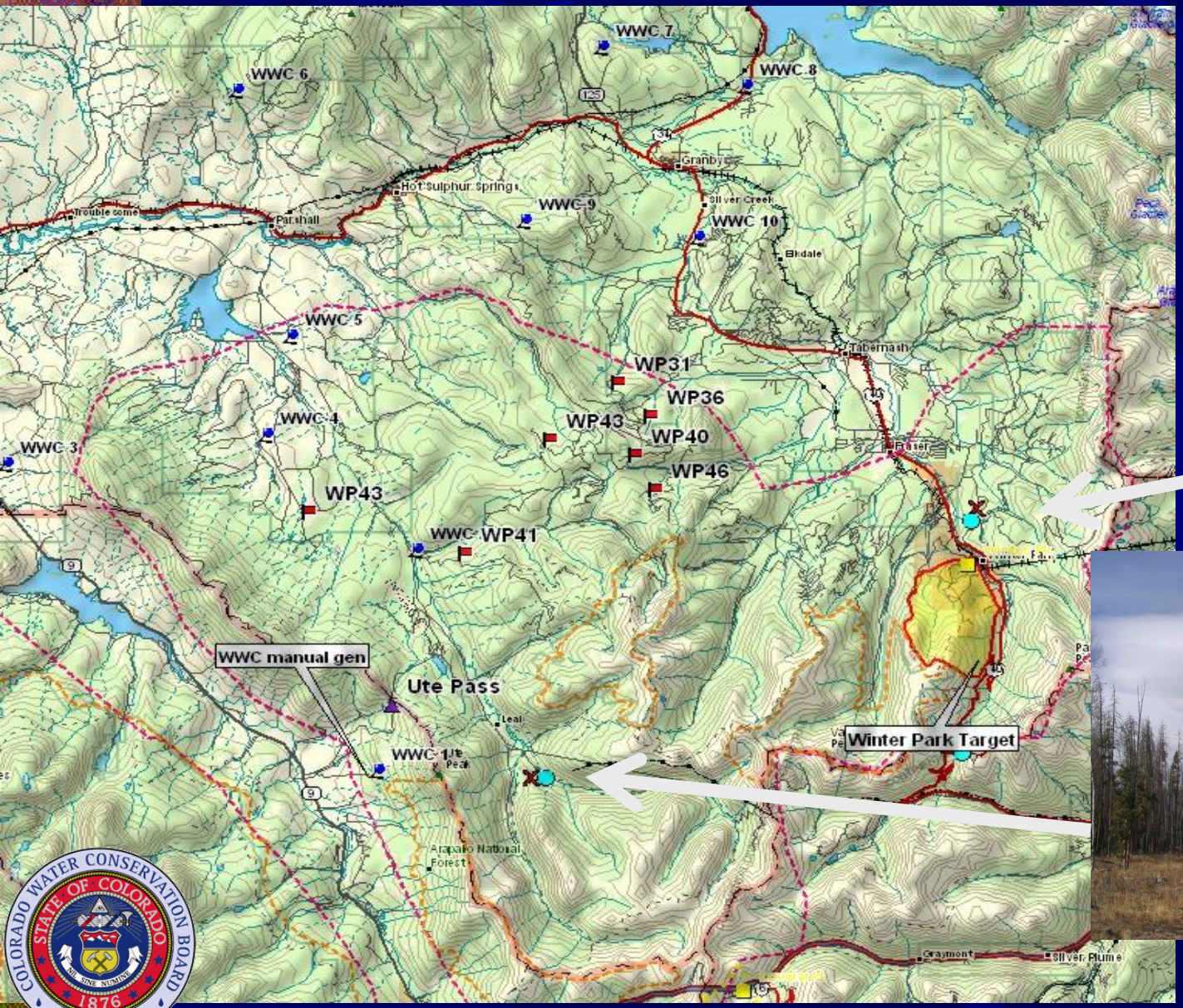
# Recent Staff Accomplishments

- Regional Agreements
- Milk Creek, Mancos Mtn. Winter Park = 4 gens
- Weather stations Grand Mesa, Winter Park & Durango Mtn. Resort = 3 stations
- Propane seeding: new technology imported
- Leveraged $624,000 from downstream since ‘06
- Invited to CRWUA in December 2009
- Interest from Telluride Ski and Golf Co., Intrawest, Denver Water

# Denver Water & Winter Park

- $55K each DW & WP 10 gens 1690 hours
  - 10 Manual Generators at 7487 -8555 msl
- $60K CWCB & Colo. River for two remote gens Nov – March
  - Two Remote gens at 8781 & 9581 msl
- Program is outcome of marketing mission at NSAA (Feb 2009)
  - 28 ski areas in Colorado
  - Honors former member Schwindt's request "seek ski area partnerships"

# DW & WP Generator Locations

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1876
1937

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