

# Santa Ana River Watershed Weather Modification Pilot Program

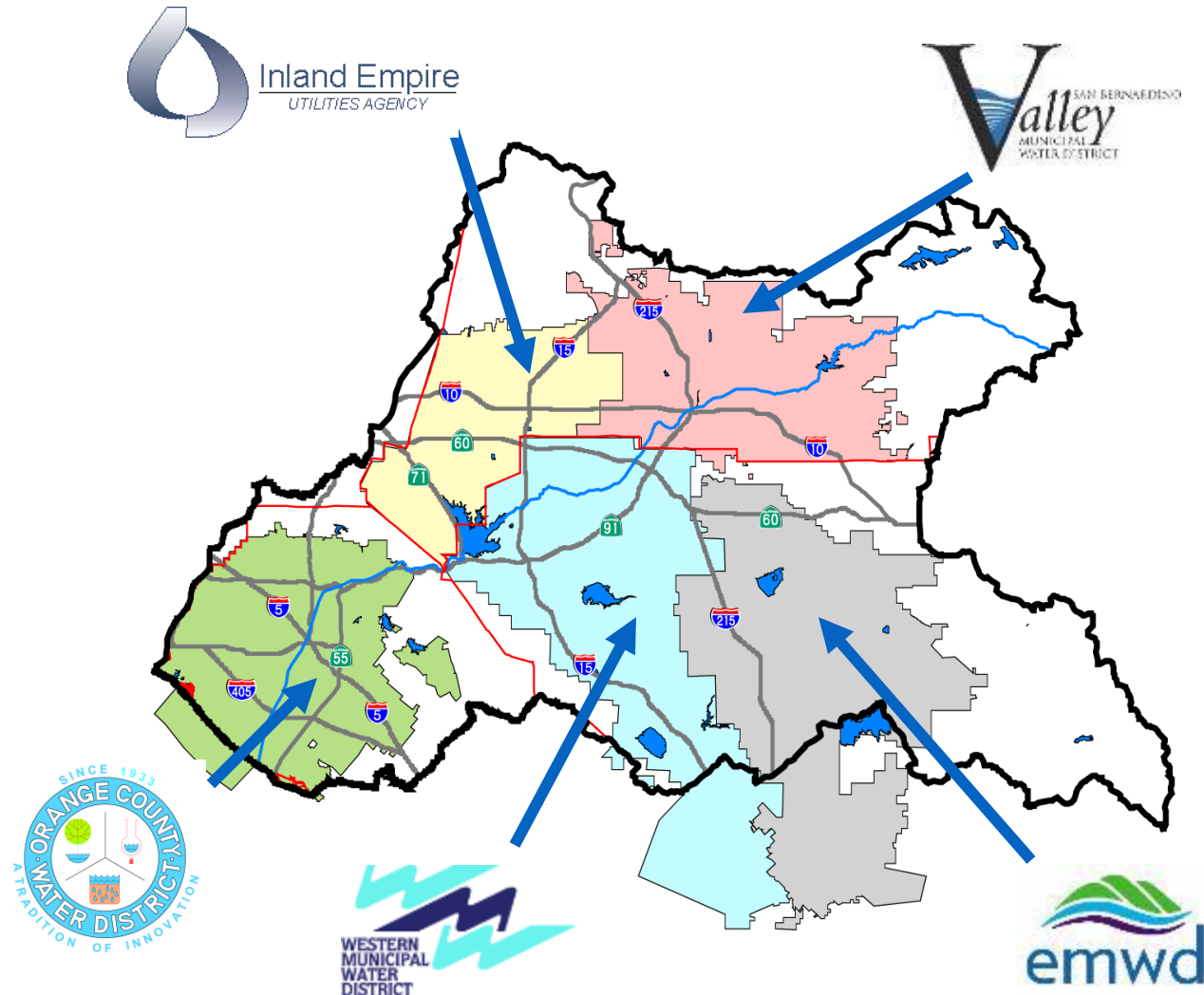
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Water Resources & Planning Manager  
Santa Ana Watershed Project Authority

Source: CBS News



# SAWPA: Joint Powers Authority with five Member Agencies



## Stakeholders:

- 97 Water-related Agencies
- 4 Counties
- 63 Cities
- State, environmental, and regulatory agencies
- Federal agencies
- Other special districts
- Special interest groups

# How cloud seeding works

**1**

Silver iodide mixed with acetone is vaporized, releasing particles into the atmosphere.

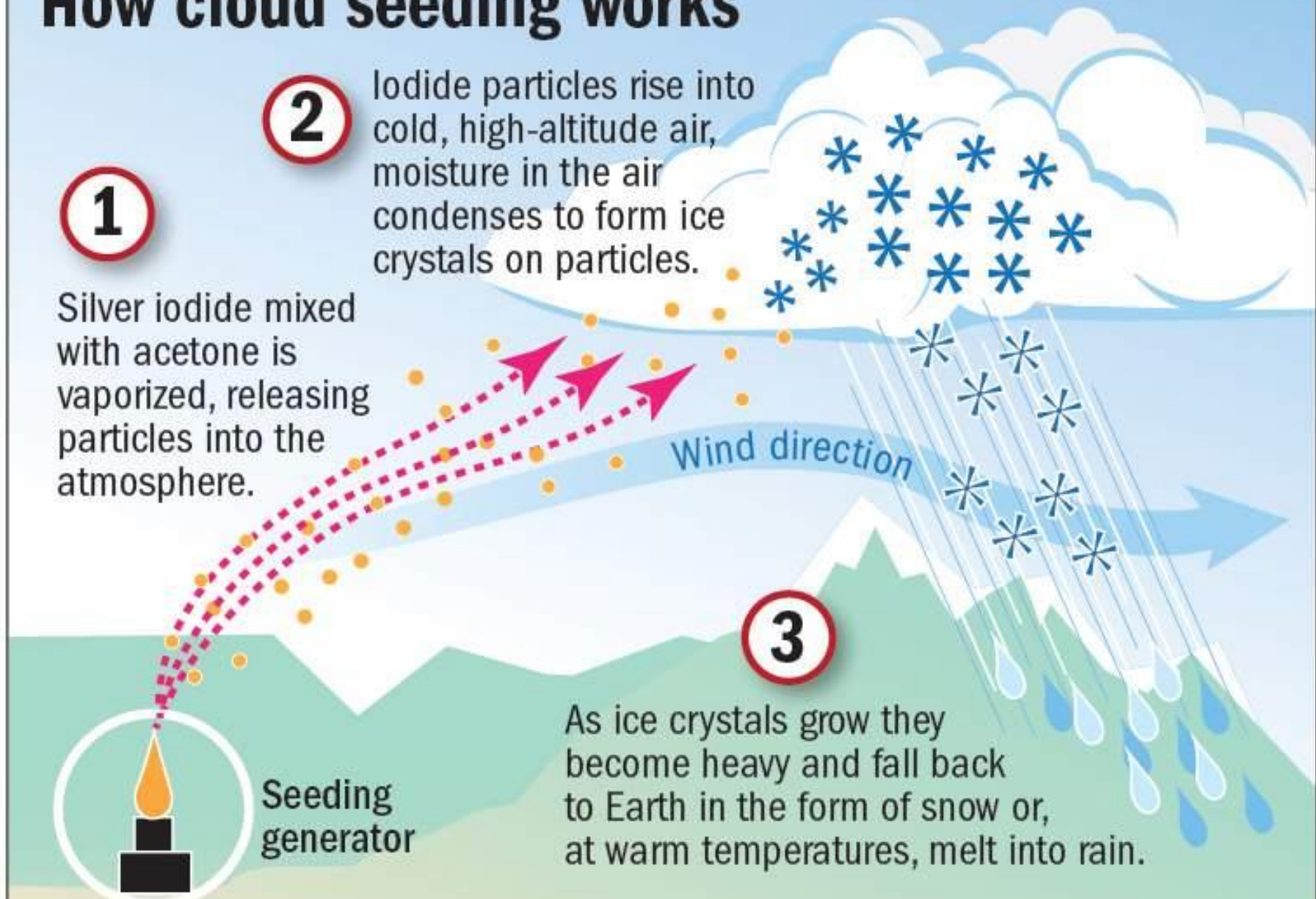


**2**

Iodide particles rise into cold, high-altitude air, moisture in the air condenses to form ice crystals on particles.

**3**

As ice crystals grow they become heavy and fall back to Earth in the form of snow or, at warm temperatures, melt into rain.



Source: The Fact Site

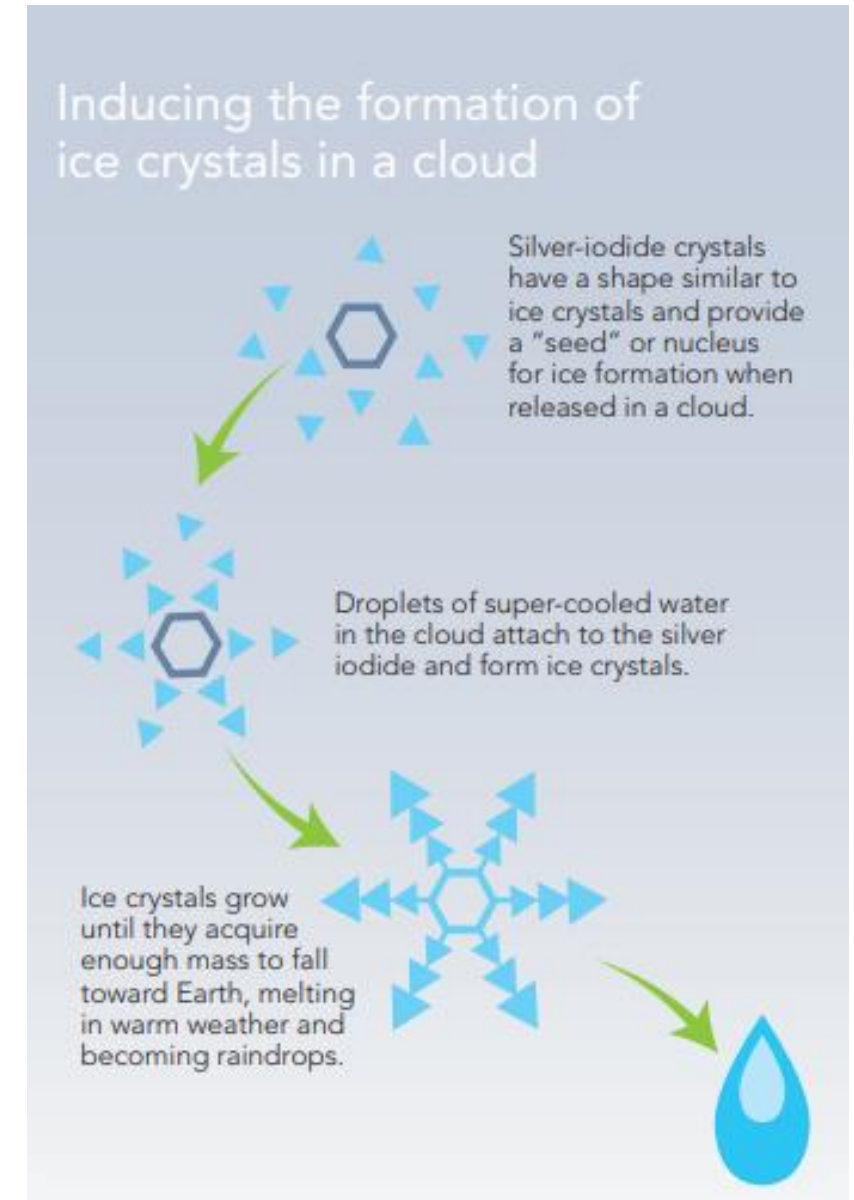
# Cloud Seeding History

## Background

- Physics is well known
- Started in the U.S. in the 1940s
- Challenges: Overselling, limited science
- Misconceptions remain

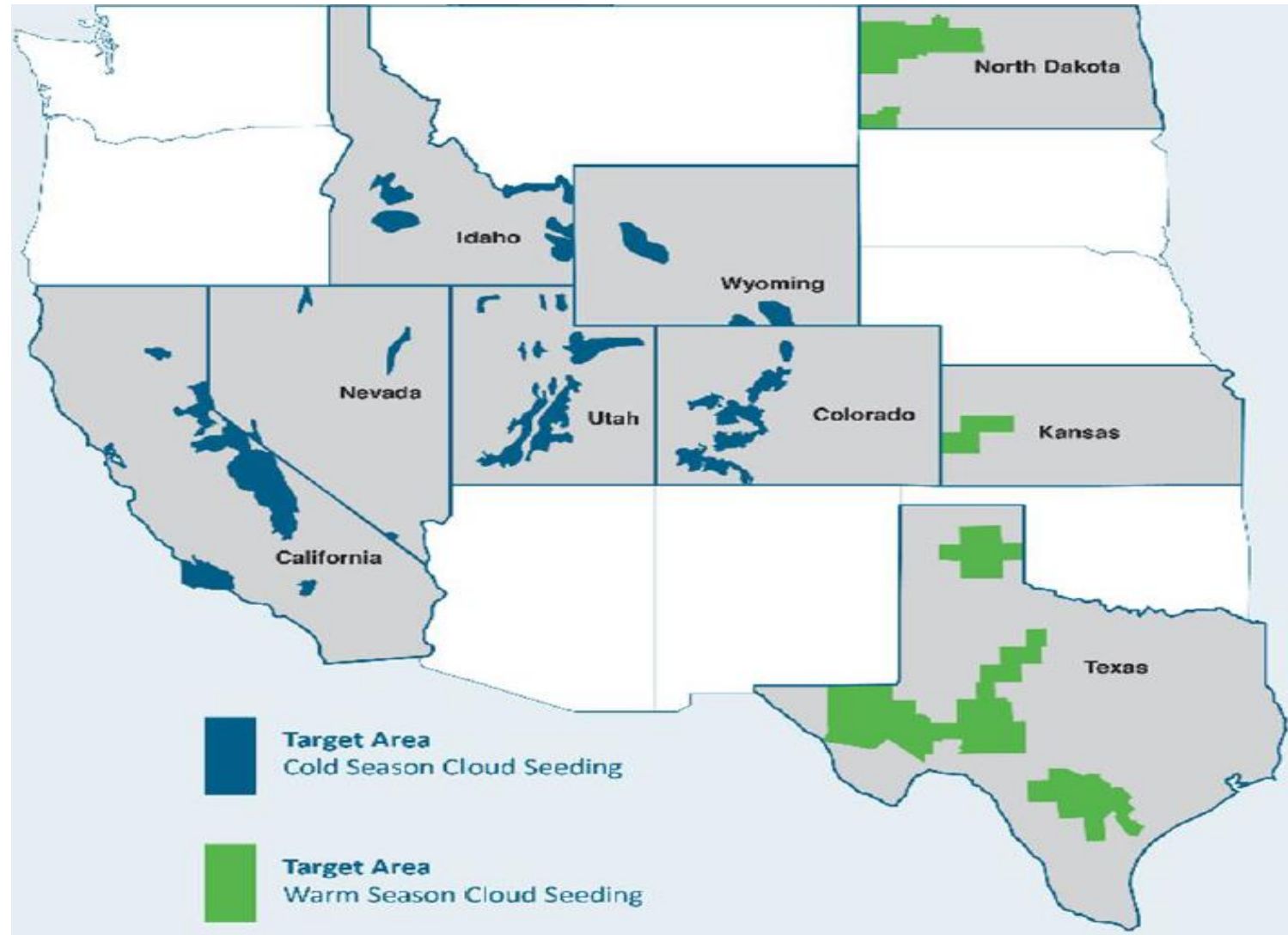
## Recent Advances

- Weather forecasting
- Computing / Modeling
- Seeding methods
- Scientific validation studies



# U.S. Projects

- ◆ Cold Season Cloud Seeding Leaders
  - CA, CO, ID, UT, WY, NV
- ◆ Applications
  - Power Utilities (hydropower)
  - Ski areas
  - Water Resource Agencies
  - Irrigation Districts
- ◆ California Projects
  - Santa Barbara County
  - San Luis Obispo
  - Sacramento Municipal Water District
- ◆ CA DWR
  - Cloud seeding is a “safe and effective means of augmenting local water supplies.”



Source: North American Weather Modification Council

# Ground Based Seeding Methods

## CNG's (Cloud Nuclei Generators)



- Ideal for orographic lift (winds caused by land barriers)
- Create a continuous plume
- Inexpensive to install and operate

## AHOGS (Automated High Output Ground Seeding) Systems



- Ideal for strong convective storm attributes (turbulence)
- Delivers higher concentration of silver iodide
- Operated remotely – rapid release

# Licensing and Permitting

- Operators are licensed and carry liability insurance
- Suspension criteria turns off program during high precip/flood conditions
- Though no CA state permit required, CEQA mitigated negative declaration will be conducted
- There have been no successful legal challenges to any operation in US for over 50 years



# Potential Environmental Effects

- Silver iodide is not soluble or biologically available
- 50 years of physical, biological, aquatic, soils and vegetation studies found:
  - Subtle or indiscernible effects
  - Potentially beneficial (more runoff)
- Strong studies with credible results and regulations reflect recent research





# Potential Health Effects

- Silver Iodide (AgI)
  - Not been measured above background
- Human effects
  - No effects found in 50 years
  - More silver exposure in tooth fillings
  - More iodine in table salt on food
- Concentrations
  - EPA drinking water quality 0.1 mg/L
  - U.S. Public Health Service level 0.05 mg/L
  - Seeded rainfall is 0.1 mcg/L or 1000 times less than EPA standard



# Why consider cloud seeding in the Santa Ana River Watershed?

## Precipitation – and flows in the Santa Ana River – have been trending down

- Cloud seeding increases precipitation (with an emphasis as snow in upper elevations)
- Produces a local supply
- Potential to reduce the use of imported water

## Dry years and droughts occur

- Cloud seeding works in both dry and wet years

## Cost effective

- Costs for 8%-11% increase in streamflow is a fraction of the cost of imported water

## Supports local water storage

- Natural infiltration
- Takes advantage of existing stormwater capture infrastructure

# Santa Ana River Watershed Weather Modification Pilot Program

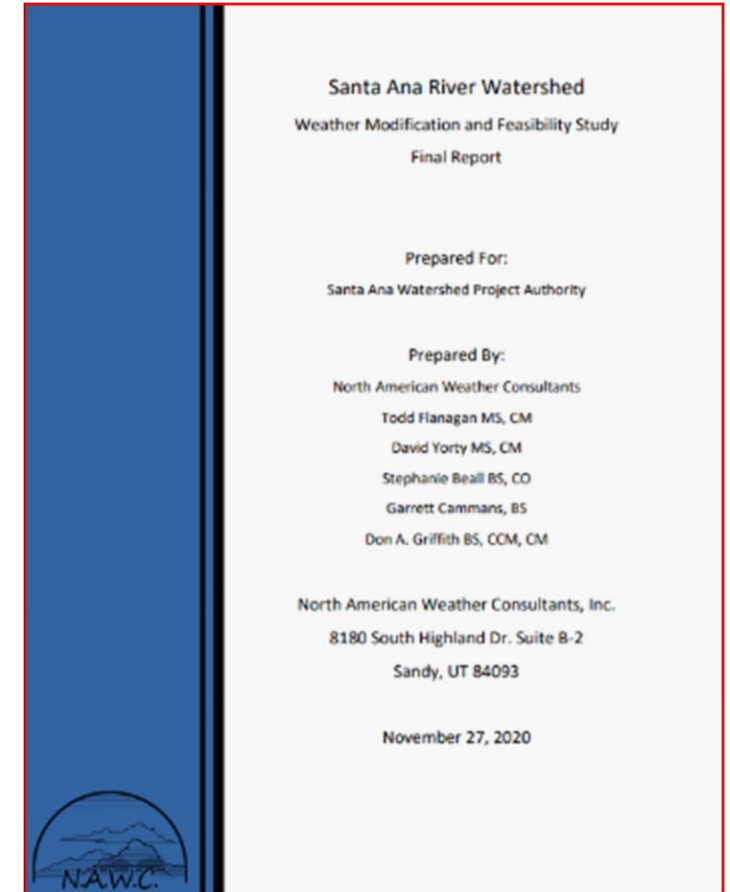
Feasibility Study (2020)

CEQA and Ground Seeding  
Siting (2021-2022)

Outreach and Public  
Engagement (2021-2025)

Prop 1 Round 2 Grant  
Application (2022)

4-Year Pilot Study (2022-  
2025)



Feasibility Study (2020)

<https://sawpa.org/latest-info/watershed-cloud-seeding-feasibility-study/>

# Feasibility Study Outcomes

## Ground Based Seeding Dispersion Model

4 seeding areas:

- NW
- NE
- SW
- SE

Included a number of ground sites in each area



# Projected Increases in Precipitation and Streamflow (annual averages)

## Ground Only Seeding:

Target Area	Seasonal Precip. Increase (inches)	Percent Increase	Avg. Natural Streamflow (AF)	Streamflow Increase (AF)	Percent Increase
NW	0.41	3.5%	25,000	2,043	8.2%
NE	0.49	4.1%	65,000	4,330	6.7%
SW	0.59	3.7%	5,000	447	9.0%
SE	0.49	4.5%	10,000	1,373	13.7%
<b>TOTAL w/ Ground Only</b>			<b>105,000</b>	<b>8,193</b>	<b>7.8%</b>



Remember this number.

# “Annual” Cost Estimates for Pilot – Ground Based Seeding

	Rate	Frequency	
<b>Annual Operations</b>			
Set Up	\$ 33,500	1	\$ 33,500
Take Down	\$ 24,000	1	\$ 24,000
Reporting	\$ 10,000	1	\$ 10,000
<b>Monthly Operations</b>			
Fixed Services	\$ 24,500	5	\$ 122,500
<b>Variable Items (timed expenses are billed on a per hour basis)</b>			
Ground Flares	\$ 110	60	\$ 6,600
Generator Run Time	\$ 19.50	600	\$ 11,700
Flight Time	\$ 375	N/A	-
Aerial Flares	\$ 110	N/A	-
<b>TOTAL</b>			<b>\$ 208,300</b>
<b>COST PER ACRE-FOOT</b>			<b>\$ 25.42</b>
<b>Benefit to Cost</b>			<b>10.03</b>

**Cost per acre-foot (AF) =**  
 Total Program Cost / Estimated AF produced

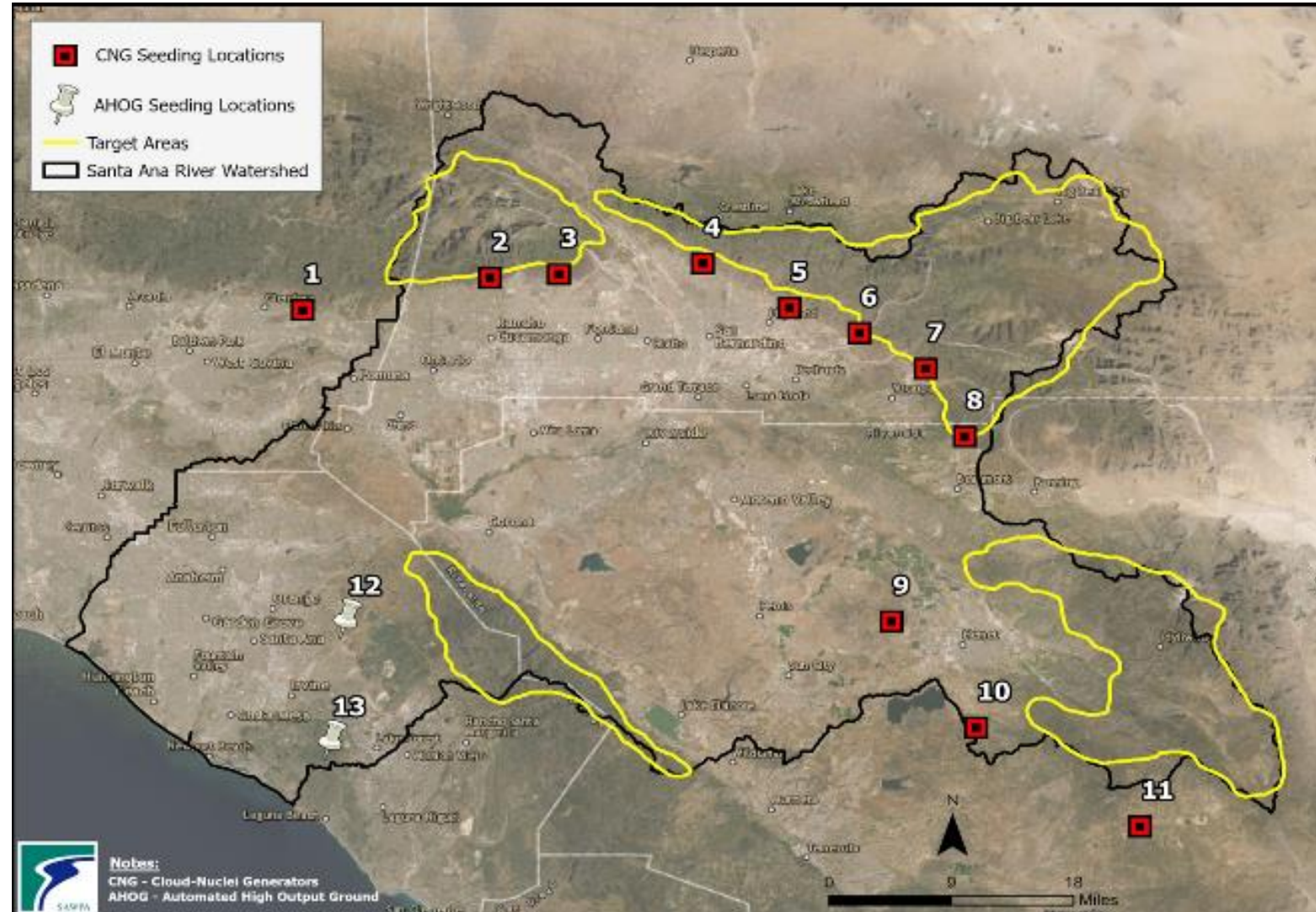
$$\$208,300 / 8,193 \text{ AF} = \mathbf{\$25.42 \text{ per AF}}$$

**Benefit to Cost Ratio =**  
 Cost of Untreated Imported Water per AF / Cost of Cloud Seeding per AF

$$\$255 \text{ per AF} / \$25.42 = \mathbf{10.03}$$

# Purpose of Weather Modification Pilot Program

- Verify increases in precipitation
  - Compare Target areas to Control areas
  - 3-4 years needed
- Evaluate increases by areas in watershed
- Benefit/Cost evaluation
- Review of operations
- Review of suspension criteria
- Address permitting



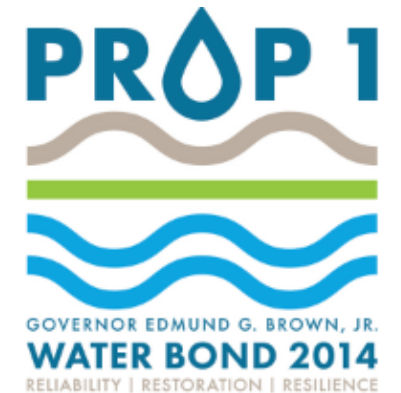
# Pilot Program Schedule

Program Element	2020	2021	2022	2023	2024	2025	2026
Feasibility Study	Active						
Outreach: Local Cost Share for Prop 1 Round 2 Grant		Active	Active				
Ground Seeding Site Analysis		Active					
CEQA			Active				
Prop 1 Round 2 Grant Application			Active				
Pilot Program				Active	Active	Active	
Outreach/Public Engagement		Active	Active	Active	Active	Active	



# Pilot Program – Next Steps

- SAWPA Commission has authorized:
  - Study of Ground Based Seeding Unit Sites and Access
  - CEQA Mitigated Negative Declaration
- Prepare proposal for Prop 1 Round 2 Grant (IRWM)
  - DWR grant to cover 50% of pilot program
- Outreach is essential
  - Briefings to agencies and the public in the watershed
  - CEQA public meetings
- Cost share for Grant
  - Opportunities for support from interested agencies



# Thank You!

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