

July 2020

Water Policy Interim Committee
Jason Mohr

FINAL REPORT TO THE 67TH MONTANA LEGISLATURE

HJ40: SEEDING CLOUDS

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Before the close of each legislative session, the House and Senate leadership appoint lawmakers to interim committees. The members of the Water Policy Interim Committee, like most other interim committees, serve one 20-month term. Members who are reelected to the Legislature, subject to overall term limits and if appointed, may serve again on an interim committee. This information is included in order to comply with 2-15-155, MCA.

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This report is a summary of the work of the Water Policy Interim

Committee, specific to the Water Policy Interim Committee’s 2019-20 study as outlined in the Water Policy Interim Committee’s 2019-20 work plan and House Joint Resolution 40 (2019). Members received additional information and public testimony on the subject, and this report is an effort to highlight key information and the processes followed by the Water Policy Interim Committee in reaching its conclusions. To review additional information, including audio minutes, and exhibits, visit the Water Policy Interim Committee website: www.leg.mt.gov/water.

A full report including links to the documents referenced in this print report is available at the Water Policy Interim Committee website: www.leg.mt.gov/water.

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HJ40: SEEDING CLOUDS

HJ40: A STUDY OF WEATHER MODIFICATION

HJ40 is a study of weather modification, also known as “cloud seeding.” The process involves introduction of substances into the air to cause condensation in clouds and to precipitate rain or snowfall. Weather modification techniques may also be used to reduce the size and severity of hailstones or the effects of fog.

Although "centuries of rainmakers" employing "a healthy dose of guesswork, quackery, and fraud" attempted to modify the weather, modern cloud seeding is generally attributed to three General Electric scientists working in the company's Schenectady, New York, labs in 1946.¹

The effectiveness of weather modification has been widely debated—indeed some refer to it as "cloud rustling"—but according to the North American Weather Modification Council:

Numerous evaluations have indicated that cloud seeding, when properly applied, can produce precipitation increases up to 10 percent or greater. Studies of hail suppression seeding indicate hail damage reductions up to 45 percent. Agricultural wheat production in seeded areas has increased by 5.9 percent in North Dakota.²

Montana state laws regulating weather modification date to 1967 with the passage of the Weather Modification and Control Act. Soon after the passage of the act, Montana State University researchers launched an "experimental winter orographic cloud seeding program" in the Bridger Range.³ The project was part of the U.S. Bureau of Reclamation's Project Skywater, which tested the technology in Western drainages “to explore, develop and determine the feasibility of applying the technology of weather modification to meet the nation’s increasing demand for clean water.”⁴



MODIFIED AIRCRAFT FOR CLOUD SEEDING. (IDAHO POWER CO.)

¹ Jedediah S. Brown, Bureau of Reclamation, *Project Skywater* (2009).

² <http://www.nawmc.org/faq/>

³ Arlin B. Super and James A. Heimbach, Jr., "Evaluation of the Bridger Range Winter Cloud Seeding Experiment Using Control Gauges," *Journal of Climate and Applied Methodology* (1990).

⁴ Jedediah S. Brown, Bureau of Reclamation, *Project Skywater* (2009), 2. Brown adds for Project Skywater: "Reclamation concentrated studies and testing in the western states, principally in the upper Colorado River basin and along the Sierra Nevada in California, for the purposes of managing and mining water resources, as well as for national defense, public health, and technological development. Never well-funded, the program had a decidedly mixed cost-benefit, environmental, and operational record that never convincingly supported a sound basis for a national, extensively funded weather modification program."

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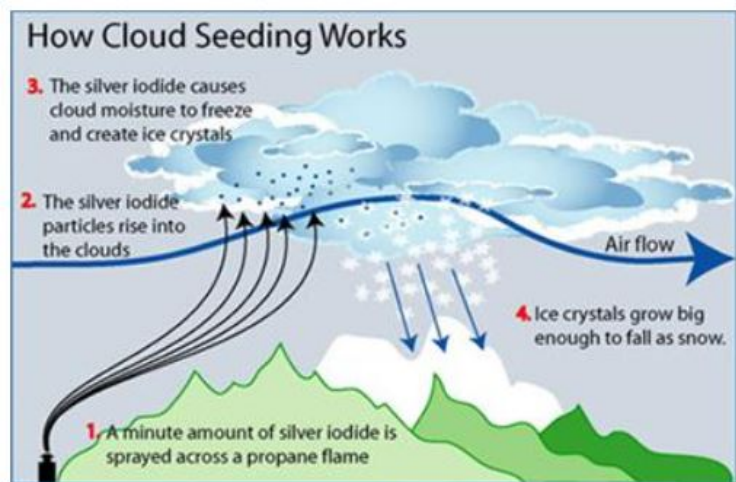
While not scientifically conclusive, researchers of the Bridger Range cloud seeding experiment later concluded "the statistical analysis suggests that seeding increased snowfall in the intended target area and sometimes further downwind as well, when the temperature near the top of the Main Ridge was colder than about minus 9 degrees Centigrade."

It was the Legislature's action in 1993 that clearly defined the regulatory landscape for weather modification in Montana. This legislation was passed due to concerns about the weather modification activities in Montana's atmosphere by a North Dakota agency. As a result, no weather modifications activities have occurred in the state for nearly three decades.

THE TECHNIQUE

Weather modification can generally be divided into cold- and warm-weather cloud seeding. Cold-weather seeding aids in snowmaking; warm-weather seeding increases rainfall or tempers hailstorms.

The focus of cold-weather seeding "aids precipitation formation by enhancing ice crystal production in clouds. When the ice crystals grow sufficiently, they become snowflakes and fall to the ground."⁵ Silver iodide is typically used to "seed" the clouds, due to its "environmental safety and superior efficiency."⁶ An Idaho Power Company scientist told the WPIC the company's weather modification efforts are primarily to increase snowpack, estimating runoff increases of 80,000–270,000 acre feet a year.⁷



WATER INFORMATION PROGRAM, SOUTHWESTERN WATER CONSERVATION DISTRICT (COLO.)

There are two ways to seed a cloud: either through a ground-based generator or a fixed-wing aircraft. Burn-in-place flares are mounted on a modified aircraft to seed a cloud; propane-fired burn heads cast the silver iodide into the air. In either instance, atmospheric conditions must be right for a weather modification activity to work.

Warm-weather seeding focuses on increasing rain precipitation and reducing hailstorms and fog. Warm-weather seeding also uses dry ice (solid carbon dioxide) in addition to silver iodide. The warm-weather

⁵ North American Weather Modification Council brochure, "Understanding Cold Season Cloud Seeding (2019)."

⁶ Kevin Smith, Engineering Bureau chief, Water Quality Division (Department of Environmental Quality) testified to the WPIC on March 9, 2020, that silver iodide is stable in water, and that a review of cloud seeding operations found low levels of silver iodide. Smith said the DEQ would monitor for silver iodide for authorized weather modification activities.

⁷ Testimony of Derek Blestrud, senior atmospheric scientist, Idaho Power Co., to the WPIC, Sept. 10, 2019.

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seeding technique is principally the same as the cold-weather: Silver iodide or dry ice particles help convert supercooled water droplets to ice crystals and eventually snowflakes that melt and become rain.⁸ Other salt compounds enhance the ability of the cloud to produce raindrops large enough to fall to the ground. For hail, "cloud seeding is used to increase competition for cloud water through the addition of more, efficient ice nuclei, and to spread the energy released by the storm over a larger area."⁹

A LICENSE AND A PERMIT

To conduct a weather modification operation, an applicant must acquire a license and a permit. The Department of Natural Resources and Conservation issues both. (Certain research, development, and experiments conducted by qualified agencies and organizations are exempt from licensing and permitting.)

Weather modification licenses are straightforward: an applicant must "demonstrate competence in the field of meteorology to the satisfaction of the department"¹⁰ and pay \$100.¹¹ These licenses must be renewed annually.¹²

Permits, which a licensed applicant must receive annually for each operation covering one geographic area, are more rigorous.¹³ Permit requirements include:

- A fee of 1 percent of estimated operation costs
- \$10 million proof of financial responsibility¹⁴ to meet "the applicant's ability to respond in damages for liability that might reasonably be attached to or result from the applicants' weather modification and control activities"¹⁵
- An environmental impact statement prepared by the DNRC
- A public meeting
- Publication of notice of intention to conduct weather modification operation

A regulatory scheme that appears to prohibit the activity may seem incongruous to some; the events that led to the passage of Senate Bill 72 in 1993 are at the root cause.

⁸ North American Weather Modification Council brochure, "Understanding Warm Season Cloud Seeding (2018)."

⁹ Ibid.

¹⁰ Section 85-3-203, MCA.

¹¹ Section 85-3-205, MCA.

¹² Section 85-3-204, MCA.

¹³ Section 85-3-206, MCA.

¹⁴ Section 36.20.303, ARM.

¹⁵ Section 85-3-211, MCA.

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SB72: "SHOOTING AT AIRPLANES"

Senate Bill 72 (1993) added the defining characteristics to Montana's weather modification policy. Signed into law by Gov. Marc Racicot, it dramatically toughened requirements first passed in 1967.

One of two bills proposed by Sen. Gerry Devlin of Terry, SB72 was in direct response to an application by the North Dakota Atmospheric Resources Board. A Montana board initially denied the application, but a judge ordered it to be issued.

Devlin said the reason for the bill was a lack of public input on the North Dakota application, which proposed to cloud seed in eastern Montana for the benefit of western North Dakota. Devlin said he feared "people might start shooting at airplanes" unless his bill passed.¹⁶ Most notably, the bill added "proof of financial responsibility," an environmental impact statement,¹⁷ and a public meeting requirement.

Since the passage of SB72, the DNRC has issued annual licenses, but no permits.

REGIONAL WEATHER MODIFICATION LAWS

A WPIC-requested survey of the laws and policies in Montana's neighboring states suggests these states have less-restrictive laws, allowing for various weather modification projects.¹⁸ Programs in these states appear to encourage research and use of weather modification.¹⁹ Some state-supported projects cover large areas of these states. In others, weather modification projects are conducted by locally created districts or private companies.

Less-restrictive laws in five nearby states appear to have encouraged more weather modification projects. How each state constructs its regulatory scheme varies.²⁰



NORTH AMERICAN WEATHER MODIFICATION COUNCIL (NAWMC.ORG)

¹⁶ Testimony of Sen. Devlin to Senate Natural Resources Committee, Jan. 15, 1993. See Appendix B.

¹⁷ Section 85-3-202, MCA. An environmental impact statement is the most rigorous environmental assessment provided by the Montana Environmental Policy Act.

¹⁸ Legislative Environmental Policy Office memo to WPIC, "Regional Weather Modification Laws," Feb. 28, 2020. See Appendix C.

¹⁹ The states surveyed are: Montana, Colorado, Idaho, North Dakota, Utah, and Wyoming. The review also looked at federal laws related to weather modification and at the major, privately funded, cloud-seeding project in Alberta.

²⁰ See more details in the Legislative Environmental Policy Office memo to WPIC, "Regional Weather Modification Laws," Feb. 28, 2020. See Appendix C.

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Some states have few regulations. For example, in Idaho there is no permitting requirement. Operators must file a log of activities.²¹ Operators range from small water districts to larger projects like Idaho Power Company, which has an annual budget of \$4.2 million, three aircraft, and 55 remote cloud-seeding units.²²

Other states rely on a centralized authority. In Colorado, the state Department of Natural Resources administers eight projects to benefit mostly irrigators and ski areas. The North Dakota Atmospheric Resource Board administers projects in that state, include the North Dakota Cloud Modification Project, which benefits six western counties.

Portions of central Alberta are known as "Hailstorm Alley." After repeated hailstorms caused millions in damages, 20 insurance companies formed the Alberta Severe Weather Management Society in 1996. The society contracts with a North Dakota firm to conduct the aerial-based project, which reportedly costs \$5 million annually.²³

The impacts of the Alberta project are not clear, according to company that statistically models risk for insurance companies and other organizations.²⁴ Further research appears to be necessary to determine advantages and liabilities of cloud seeding.

FINDINGS, RECOMMENDATIONS, LEGISLATION

As of Sept. 15, 2020, this section is pending committee action.

LIST OF APPENDICES

Appendix A	Summary of Licensing and Permitting for Weather Modification in Montana
B	Legislative Services Division memo to WPIC, "Legislative History for SB72," December 2019.
C	Legislative Environmental Policy Office memo to WPIC, "Regional Weather Modification Laws," Feb. 28, 2020
D	Written public comments on HJ40 draft report received Sept. 10, 2020

²¹ The federal government required reporting to the National Oceanic and Atmospheric Administration. This report must include the date of the activity, purpose, modification agents used, and method employed. National Oceanic and Atmospheric Administration, <https://library.noaa.gov/Collections/Digital-Collections/Weather-Modification-Project-Reports>.

²² Testimony of Derek Blestrud, senior atmospheric scientist, Idaho Power Co., to the WPIC, Sept. 10, 2019.

²³ Globalnews.ca, *Everything You Need to Know About Thunderstorm Alley in Alberta*, May 2018.

²⁴ Email from Matthew Nielsen, government and regulatory affairs senior director, RMS, Inc. to WPIC staff, Aug. 31, 2020.