

# **APPENDIX A**

## **Details of Texas Cloud Seeding Operations**

# Texas Department of Licensing and Regulation

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## WEATHER MODIFICATION

The Weather Modification program assists with the implementation of rain enhancement programs designed to increase rainfall over targeted watersheds. The TDLR assists political subdivisions, other organizations and individuals in the design and implementation of weather modification for rain-enhancement (cloud-seeding) programs.

The department processes applications and other forms for Texas weather-modification licenses and permits. It also sponsors and oversees the weather-modification research activities in Texas and provides information. TDLR licenses the companies and individuals who offer these services, grants permits for the actual program implementation, and ensures compliance with relevant state laws, and Senate Bill 1175, as adopted by the 77th Texas Legislature, transferred the regulation of weather modification and the funding for cloud seeding projects to other state agencies:

**Weather Modification Program** - On September 1, 2001, the regulation of weather modification activities was transferred to the Texas Department of Licensing and Regulation (TDLR). George Bomar (512/936-4313, [george.bomar@license.state.tx.us](mailto:george.bomar@license.state.tx.us)) remains the contact person.

### Cloud-Seeding Projects

Funding for cloud-seeding projects is available from the Texas Department of Agriculture (TDA). For questions about funding for proposed projects as well as current contracts, contact Jane Lee (512/475-3641, [jane.lee@agr.state.tx.us](mailto:jane.lee@agr.state.tx.us)) or Carol Funderburgh (512/463-8536, [carol.funderburgh@agr.state.tx.us](mailto:carol.funderburgh@agr.state.tx.us)) at the TDA.

### Cloud Seeding for Enhancing Rainfall in Texas

The patriot Benjamin Franklin was correct in observing: "Everybody talks about the weather, but nobody does anything about it." For generations, people have talked about the weather but, until recently, no one has attempted any corrective measures to the adverse hand Mother Nature tends to deal.

Recent droughts in Texas have sharpened the focus of many on the potential of weather modification, or cloud seeding, to help alleviate the effects of drought. To be sure, the technology of seeding clouds to induce more rainfall works optimally in drought-free seasons when there is an abundance of suitable ("seedable") clouds to treat with agents like silver iodide. Drought periods tend to produce too much cloud-free weather, thereby limiting the good that can be accomplished through cloud-seeding technology.

Thus, cloud seeding is being embraced on a widespread basis in Texas, not nearly so much as a drought breaking measure but, rather, as a long-term water-management strategy. The State of

Texas has given its support to the application of cloud-seeding technology by helping to fund, through the Texas Department of Agriculture (TDA), an array of rain-enhancement projects covering nearly a third of the land area of the state of Texas.

At the conclusion of the 2001 growing season in the Lone Star State, seeding convective clouds to induce additional rain from them was being done on nearly 52 million acres of Texas, from the northern reaches of the Texas Panhandle region to the Rio Grande Valley and the coastal bend portion of South Texas.

### **Summary of Ongoing Cloud-Seeding Projects in Texas**

Texas has a lengthy history of efforts to ameliorate the impact of periodic, severe droughts through the use of cloud-seeding technologies. Numerous rain making endeavours sprouted during the epic drought of the 1950s, eventually prompting the Texas Legislature to enact a law governing the use of weather-modification technology. That measure was followed by an effort, using Federal research money, to assess the utility of rain enhancement technology through a series of comprehensive, though at times spasmodic, cloud-seeding experiments in the 1970s and 1980s.

It was only after this protracted spell of intensive research yielded substantial and rather compelling evidence that cloud seeding could promote more rainfall from convective clouds that a coordinated, State-funded rain-enhancement program began to evolve in the late 1990s. Today, with a severe to extreme drought ravaging large sectors of the Lone Star State, more land area is engaged in rain-enhancement activities than at any other point in Texas history.

Yet, the eleven rain-enhancement projects now in operation in Texas (and a further project proposed) are much more than well-considered responses to the dire drought situation.

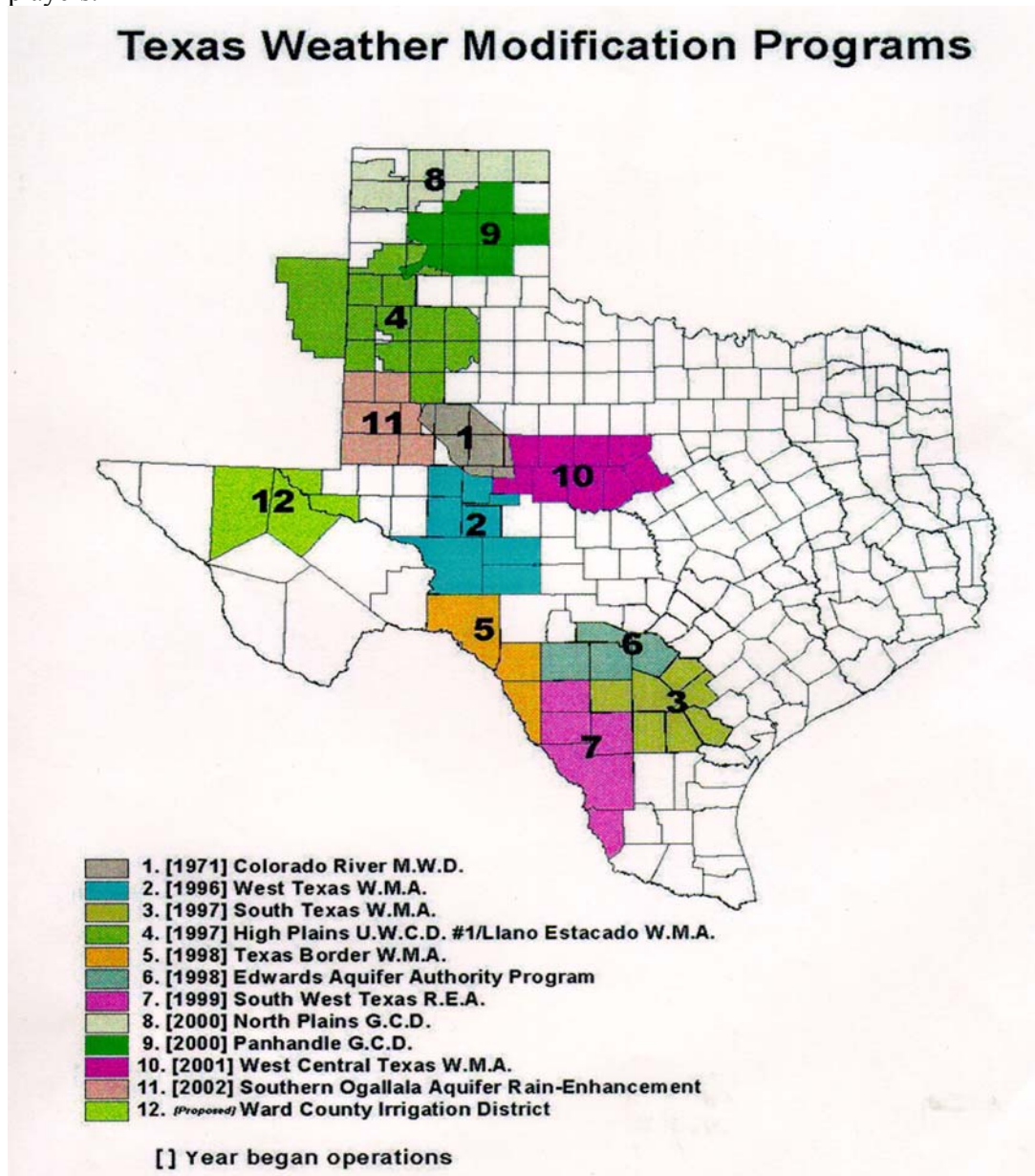
These projects, covering some 52 million acres from the Caprock in the Texas High Plains to the coastal prairies south of San Antonio and the lower Rio Grande basin, are designed to be integral parts of a long-term, water-management strategy by water conservation districts and other water-management authorities to replenish fresh-water supplies in aquifers and reservoirs as well as to help meet the water needs of agriculture, industry, and municipalities.

Each of the projects uses specially equipped aircraft designed to place seeding material (pyrotechnic flares containing silver iodide or other specially-designed nucleating materials) into convective cloud towers to induce those clouds to produce more rainwater. The seeding is achieved by burning either ejectable flares dropped from near cloud top or wing-mounted flares (borne on the aircraft's wings) at just below cloud base. Some "base" seeding is also accomplished by operating generators that are wing-mounted on the aircraft, which fly below cloud base in the updraft region of these growing convective clouds. The pilots in the aircraft are directed to appropriate clouds by a licensed meteorologist, who, from ground level, uses weather radar to recognize which clouds need a "nudge" from the seeding effort.

### **Projects in Progress**

All of the cloud seeding projects, in progress and proposed, benefit from a substantial amount of State funding made available by the Texas Legislature. The funds, available through the TDA, help those political subdivisions (water districts, water authorities, county commission, municipalities) sponsoring the cloud seeding to pay for their projects. In fiscal year 2002, over 2 million dollars in

TDA funds have been obligated to help pay for the rain-enhancement projects currently permitted for operation in Texas and shown on the attached map and these funds are matched by the local players.



1. Colorado River Municipal Water District
2. West Texas Weather Modification Association
3. South Texas Weather Modification Association
4. High Plains Underground Water Conservation District
5. Texas Border Weather Modification Association
6. Edwards Aquifer Authority
7. South West Texas
8. North Plains Groundwater Conservation District
9. Panhandle Groundwater Conservation District
10. West Central Texas Weather Modification and Colorado Municipal Water District
11. Southern Olgallala Aquifer Rain Enhancement (SOAR)
12. Proposed Ward County Irrigation District

## **1. Colorado River Municipal Water District**

The cloud-seeding project of the based in Big Spring, is distinguished as one of the oldest rain-enhancement projects anywhere in the world. The District, with a full-time meteorologist and pilot, has sponsored a rain-enhancement program for 30 years. It has owned its cloudseeding aircraft (a twin-engine Piper Aztec) for much of that time and uses the aircraft to seed growing thunderstorms from below cloud base.

The District owns a weather-radar system, which is used by its meteorologist to identify seedable clouds with the latest and best weather-diagnostic technology, and then to direct its pilot and aircraft to those growing convective clouds for treatment. The meteorologist, Ray Jones, is now operating out of a new facility, especially equipped for cloud seeding, just north of Big Spring.

The seeding of clouds is intended to augment rainwater over the watersheds of two reservoirs (Thomas and Spence) located on the upper Colorado River of Texas. Its target area, totaling some 2.24 million acres, is bounded by the cities of Lamesa, Big Spring, Snyder, and Sweetwater. Seeding missions are due to continue through October of this year. More information about this project is available from the CRMWD in Big Spring (915/267-6341; <http://www.crmwd.org/>).

## **2. West Texas Weather Modification Association**

The rain-enhancement program run by the West Texas Weather Modification Association is in its seventh year of operation. This project, headquartered in San Angelo, embraces seven counties (6.43 million acres) in west central Texas between Midland and San Angelo. Like the CRMWD, the WTWMA employs full-time meteorologists (Arquimedes Ruiz and Jim Boyd) who use the Association's own C-band weather radar system to deploy aircraft when seedable cloud conditions warrant. After relying in 1996-97 on a contractor for most, if not all, of its cloud-seeding services, the Association began building its own facilities and staff to run its own program.

With the move away from contracted services and the procurement of its own aircraft, radar facilities and project personnel, the WTWMA became the prototype for other budding rain-enhancement programs to emulate. The staff of the WTWMA can provide more information on this project (915/949-1950).

## **3. South Texas Weather Modification Association**

The rain-enhancement project run by the South Texas Weather Modification Association is into its sixth year of operation, covering 7 counties and some 4.4 million acres in the region between San Antonio and Corpus Christi.

The Association is an alliance of two water districts (Evergreen Underground Water Conservation District and the Live Oak Underground Water Conservation District) and a county commissioners court. The operation is now conducted out of Pleasanton, where the Association has erected its own facility to house and operate a C-band weather radar acquired from the National Weather Service.

The Association owns both aircraft used in its seeding operations. Because the STWMA has ownership of all of the resources (technical and human) needed to execute a rain enhancement program, that weather-modification effort now runs on a year-round basis. More information on this project can be obtained by contacting the STWMA's Tommy Shearrer or Mike Mahoney (830/569-4186; <http://www.karnesec.net/>).

#### **4. High Plains Underground Water Conservation District**

The High Plains Underground Water Conservation District, based in Lubbock, first launched its cloud-seeding program in the spring of 1997. This year, the District is sponsoring cloud seeding through the spring and summer over its 15-county area, which embraces some 6.9 million acres along and above the Caprock on the Texas High Plains. The District's target area is the largest of the eleven operational cloud-seeding programs in Texas.

The District now owns three cloud-seeding aircraft and has invested in a state of the art weather radar facility. Radar surveillance of cloud and storm development is maintained at Lamb County Airport, in Littlefield, while the three aircraft are stationed at airports in and near Lubbock. The District intends for seeding operations to augment rainwater over the watershed of the Ogallala Aquifer. For more information about the HPUWCD's program, contact Jim Conkwright or Scott Orr in Lubbock (806/762-0181; <http://www.hpwd.com/>).

#### **5. Texas Border Weather Modification Association**

The cloud-seeding project run by the Texas Border Weather Modification Association (TBWMA) stretches along the Rio Grande, from below the Big Bend down the Rio Grande to beyond Eagle Pass. The Association, consisting of three member counties (Kinney, Maverick, Val Verde) and some 3.8 million acres in its target area, has been seeding thunderstorms since 1998. For the past three years, the program has been self-run, utilizing its own radar, aircraft, and support services.

The number of aircraft being deployed on cloud-seeding missions has been increased to two, both of which operate at cloud base. Radar surveillance is based at new Association headquarters in Del Rio at the International Airport. S. W. "Bill" Cauthorn, Chairman of the TBWMA (830/768-4001) or Dale Reed, Project Meteorologist (830)778-5954, can provide more information about this project.

#### **6. Edwards Aquifer Authority**

The cloud-seeding project sponsored by the Edwards Aquifer Authority (EAA), is designed to put additional water on the ground, and into the aquifer that is the sole source of water for several million people living in South Central Texas, including the metropolis of San Antonio. The "target area" in 2002 includes four counties (Uvalde, Bandera, Medina, Bexar) which cover some 3.1 million acres along and above the Balcones Escarpment, which runs from near Uvalde to San Antonio.

In the past four years, the Authority used an out-of-state contractor for cloud-seeding services. For the first time, in 2002, the Authority is securing cloud-seeding services from the two weather-modification projects based in Pleasanton and Cotulla. The aircraft to be used for both cloud-base and cloud-top seeding are based in Pleasanton and Cotulla, where the weather radar systems providing surveillance are also located. Rick Illgner of EAA's Hondo office (830/741-8665) can supply more information about this project.

## **7. South West Texas Rainfall Enhancement Association**

The project, began in 1999 and is run by the Southwest Texas Rain-Enhancement Association (SWTREA), is the first of its kind to become dual-purpose: for both rain enhancement and hail suppression. The Association is an alliance of five counties (Dimmit, LaSalle, Webb, Zapata, Zavala), three of which are served by the Wintergarden Groundwater Conservation District. The SWTREA project first became a multi-purpose weather-modification program in the spring of 2000, seeding convective clouds to enhance the production of rainfall from those clouds but also to mitigate the formation of hail in those clouds.

It is the first hail-suppression program using aircraft to be established in Texas since 1977. The SWTREA, based in Carrizo Springs and representing about 5.5 million acres, owns its own aircraft, radar, and technical personnel required to operate on a year-round basis. Aircraft to be used in the seeding operation are based in Laredo and Cotulla. Ed Walker of the SWTREA (830/876-3801) is the contact for more information on this project.

## **8. North Plains Groundwater Conservation District**

The program of the North Plains Groundwater Conservation District (NPGWCD) became operational in May 2000, upon the completion of a new weather radar facility at the airport in Dumas. The NPGCD also secured its own cloud-seeding aircraft and has in its employ a meteorologist to conduct its seeding operations.

The District's target area, of some 4 million acres, includes virtually all of the northernmost tier of Panhandle counties, as well as parts of Hartley, Moore, and Hutchinson Counties. Richard Bowers of the NPGCD (806/935-6401; [bowers@npgd.org](mailto:bowers@npgd.org)) can be reached for more information about this project.

## **9. Panhandle Groundwater Conservation District**

A second large water district in the Panhandle region, the Panhandle Groundwater Conservation District (PGCD), is also conducting cloud-seeding operations to enhance rainfall, and thus augment groundwater recharge, over the Ogallala in the northern extremity of Texas.

The PGCD's program, which began in 2000, was run by Weather Modification Incorporated of Fargo North Dakota. However, in 2001, the PGWCD program followed the path that most other weather-modification projects have taken: Self-sufficiency, utilizing their own aircraft, radar facility, and personnel. The PGCD's target area consists of nearly 3.5 million acres in the eastern portion of the Panhandle.

C. E. Williams of the PGCD (806/883-2501; <http://www.panhandlegroundwater.org/>) can provide additional information about this project.

## **10. West Central Texas Weather Modification Association**

Texas' newest weather-modification program is run by the West Central Texas Weather Modification Association (WCTWMA), which began in the early summer of 2001. The target area of the project covers nearly 4.5 million acres, which include the following counties: Nolan, Taylor, Callahan, Eastland Coke, Runnels, Coleman, Brown and Comanche. The contractor, Weather

Modification Inc. of Fargo, North Dakota, in 2002 is again furnishing aircraft, weather radar system and personnel to the project.

Cloud-seeding activities are based in Abilene, at Elmdale Airport, where the weather radar system is also located. Tom Mann of WCTWMA's (915/672-8544) can supply more information about this project.

#### **11. Southern Ogallala Aquifer Rain Enhancement (SOAR)**

This project has its central operation out of Plains in far west Texas and, like the Panhandle Groundwater Conservation District, its target area is the Ogallala Aquifer. It has a co-operative seeding operation with the neighbouring State of New Mexico where a lot of the source clouds are seeded.

The SOAR project is chaired by Gary Walker, who is also a Member of the State Legislature for District 80 based in Plains.

**Source:** Texas Department of Licensing and Regulation  
Map provided during consultations with TDLR

<http://www.license.state.tx.us/weather/weathermod.htm>

<http://www.license.state.tx.us/weather/summary.htm>