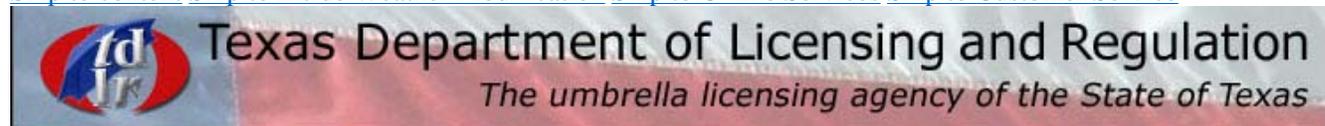


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HARVESTING THE TEXAS SKIES IN 2006 - A Summary of Rain Enhancement (Cloud Seeding) Operations in Texas

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Texas has a lengthy history of using cloud seeding to lessen the impact of periodic, often severe, droughts. Numerous “rainmaking” efforts sprouted during the epic drought of the 1950s, and some continued into the 1960s, giving impetus to the Texas Legislature to adopt a law, in 1967, governing the use of weather modification technologies. In ensuing years, both the State and federal governments provided funds for both cloud seeding research and assessing the impact of commercial weather modification projects.

With more substantive evidence that cloud seeding, when performed in timely and appropriate ways, could invigorate convective clouds, promoting their growth and capacity to produce rainwater, a coordinated, State-funded program began in earnest in the latter half of the 1990s. Today, with drought a pending, if not everpresent, threat to the economy and well-being of Texans, rain enhancement projects flourish within large areas of Northwest, West, and South Texas. In fact, the nine cloud seeding projects today cover about 37 million acres (or about 20 percent of the land area of the state). When drought was a greater threat a few years ago, as many as 51 million acres were included in cloud seeding “target” areas.

Texas' present-day cloud seeding efforts are much more than well-considered responses to drought, however. They are also concerted efforts, using the latest technological tools and understanding, to replenish fresh-water supplies in aquifers and reservoirs as well as to help meet the growing needs of agriculture, industry, and municipalities for fresh water. Political subdivisions like water conservation districts and county commissions have embraced the technology of rain enhancement as one element of a long-term, water-management strategy designed to ensure a growing population has enough water to meet its future needs.

Each of the cloud seeding projects uses specially-equipped aircraft designed to place seeding materials (in the form of pyrotechnic devices, or flares, containing silver iodide and other compounds) into convective towers (turrets of growing thunderstorms) to induce them to expand and process more atmospheric water. The seeding is achieved by burning flares either mounted on the wings of single and twin-engine aircraft or held in racks, and dropped (ejected), from the underside of the aircraft fuselage. Pilots in the aircraft are directed to convective clouds believed by the meteorologist to be treatable with the seeding agent. Timing and targeting are the two critical factors in successful seeding of young thunderstorms. The concerted efforts of both pilot(s) and meteorologist are designed to give the

growing cloud a “nudge” to enable it to be more efficient in the way it uses available cloud droplets to grow raindrops.

Projects in Texas

As each of the rain enhancement projects became established in recent years, State matching funds were allocated to the sponsoring groups to enable them to procure needed hardware such as specially-equipped aircraft and ground-based radar systems. Each project initially constructed its program, either leasing or purchasing aircraft, at a cost of 8 to 9 cents per acre, with the State assuming up to 4.5 cents of that cost. Eventually, the State share of the cost was reduced to zero. From the time the State began paying in part for the programs (1997) until State funds were exhausted (2004), the State contributed about \$11.7 million. An additional \$1.5 million in State funds was spent during that time to assess the projects' performance.

No State funds are available now, for the remainder of the current biennium (which ends on August 31, 2007) for any cloud seeding operations in Texas.

The following is a description, by project, of rain enhancement operations anticipated during 2006 in Texas.

Colorado River Municipal Water District (CRMWD)

The rain enhancement project based in Big Spring and maintained by the CRMWD is distinguished as one of the oldest weather modification operations in the world. The District has been seeding clouds within a 2.45 million acre area, almost uninterruptedly, since 1970. The District owns its own aircraft, and its meteorologist uses a C-band weather radar system to direct its pilots to appropriate convective towers when the potential for cloud, and rain, enhancement is deemed feasible. All of the seeding done by this organization is from below cloud base.

Seeding by the District is designed to augment rainfall from thunderstorms roaming within the watersheds of two reservoirs on the upper Colorado River of Texas (J. B. Thomas and E. V. Spence). The target area, where the effects of seeding are intended to occur, is bounded by the cities of Lamesa, Big Spring, Snyder, and Sweetwater. More information about this project is available from the CRMWD in Big Spring (325-267-6341; www.crmwd.org/wxmod.htm).

West Texas Weather Modification Association (WTWMA)

This project, based in San Angelo, is in its ninth consecutive year of operation. Its target is the third largest in the state---some 6.4 million acres in west central Texas between Midland and San Angelo. Like the CRMWD, the WTWMA employs a full-time meteorologist and pilots using Doppler weather radar data produced by the National Weather Service. The meteorologist is based at Mathis Field, while aircraft are located at the San Angelo airport as well as several other locations within the target area.

The project is one of two in the state with a dual purpose: Permits are held by the WTWMA for both rain enhancement and hail suppression operations. The way in which the Association obtained its aircraft and radar, and hired its permanent staff, in 1997-98, to become self-contained as a project served as a prototype for other rain enhancement programs that materialized in Texas later on. The staff of the WTWMA can provide more information about this project (325-949-1950; www.wtwma.com).

South Texas Weather Modification Association (STWMA)

The project with its base of operations in Pleasanton (south of San Antonio) is in its eighth year of operation, having been established in 1997 to seed clouds over a *target* area extending from the base of the Edwards Plateau to near the coastal bend area of Texas. The STWMA is an alliance of two water districts (Evergreen Underground Water Conservation District and the Live Oak Underground Water Conservation District) and a county commission. Seeding activities are directed by a staff meteorologist working with National Weather Service Doppler weather radar data from the airport in Pleasanton. Because the STWMA has ownership of all of the resources (technical and human) needed to execute rain enhancement operations at any time, the weather modification project runs on a year-round basis.

In 2002 the STWMA expanded its target area to absorb three of the counties previously in the cloud seeding target area of the rain enhancement program of the Edwards Aquifer Authority (EAA). The EAA reduced the size of its target area (now the primary drainage area for the Edwards Aquifer) and enlisted existing rain enhancement projects based in Pleasanton and Carrizo Springs to provide aerial and technical coverage for its newly-redefined target. As a result, the target area of the STWMA expanded by some 2.2 million acres, to the current 6.6 million, making it the state's largest weather modification target. The EAA contracts with the STWMA for cloud seeding services in Bandera, Bexar, and Medina counties. More information on this project can be obtained by contacting the STWMA staff (830/569-4186; <http://www.southtexasweathermodification.com>).

Seeding Operations and Atmospheric Research (SOAR) Program

The only rain enhancement project to have direct interface with interests in New Mexico is the SOAR project, based in Plains and operated by the Sandy Land Underground Water Conservation District (SLUWCD). Gaines, Terry, and Yoakum counties make up the Texas portion of the bi-state project, which encompasses some 2 million acres in eastern New Mexico as well as 3.8 million in Texas. Two of the counties (Terry and Yoakum) have had cloud seeding since the establishment of a program, in 1997, by the High Plains Underground Water Conservation District No. 1. Terry and Yoakum counties were a part of the 15-county HPUWCD weather modification project for five years until they formed the nucleus of the SOAR project in 2002.

Seeding activities for both areas of Texas and New Mexico are directed by a SOAR meteorologist based in Plains, where the aircraft are also headquartered. More information about the SOAR Program can be obtained by contacting the SLUWCD staff (806/456-2155; www.sandylandwater.com/soar.htm).

Edwards Aquifer Authority (EAA)

The EAA first initiated its own rain enhancement effort in 1998, using an out-of-state contractor for seeding operations based in Hondo. Since its inception, the aim of the project has been 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. After four years of contracted services, the EAA in 2003 assigned portions of its "old" target area to two well-established and independently-run cloud seeding projects nearby. Since then, three of the counties in its redefined target have been served by the South Texas Weather Modification Association, while a fourth county (Uvalde) has been included in the target of the Southwest Texas Rain Enhancement Association (based in Carrizo Springs). The EAA office in San Antonio (800/292-1047; www.edwardsaquifer.org) can supply more information about its rain enhancement effort.

Southwest Texas Rain Enhancement Association (SWTREA)

The project begun in 1999 and run by the Wintergarden Groundwater Conservation District, based in Carrizo Springs, was the first of the nine existing weather modification projects to diversify into the suppression of hail. The SWTREA is an association of counties (Dimmit, LaSalle, Uvalde, Webb) which was expanded in 2002 to absorb Uvalde County, previously in the EAA target area. Today, its target area is the second largest of all of the Texas projects---some 6.5 million acres. It is the first hail suppression project in Texas to use aircraft for seeding thunderstorms since hail suppression activities in the Texas South Plains ended in 1977. The SWTREA maintains a staff operating out of the Pleasanton airport, where its meteorologist directs seeding operations using National Weather Service Doppler radar data and aircraft based out of Carrizo Springs. The SWTREA staff (830/281-3888; www.swtrea.org) is the contact for more information on this project.

North Plains Groundwater Conservation District (NPGWCD)

The program of this northernmost water district in the Texas Panhandle became operational in May 2000, with the completion of new radar and aircraft facilities in Dumas. It was the first rain enhancement project to be constructed at the outset, using aircraft, equipment, and personnel obtained and owned by the sponsoring entity. (All other projects in Texas used contractor services in the initial years to establish their rain enhancement programs.)

The District's target area, of some 4.2 million acres, includes virtually all of the northernmost tier of Panhandle counties, as well as parts of Hartley, Moore, and Hutchinson counties. Through the TDLR, arrangements are in place to allow the NPGWCD aircraft to conduct seeding operations over the Oklahoma Panhandle, in order to treat

promising rain systems moving out of Oklahoma into Texas. (In the same way, the State of Oklahoma is entitled to seed cloud systems in Texas that are deemed to be moving into Oklahoma.) The staff of the NPGWCD (806/935-6401; www.npgd.org) can provide more information about this 6-year-old project.

Panhandle Groundwater Conservation District (PGWCD)

A second large water district in the Panhandle region also conducts cloud seeding operations to enhance rainfall and, thus, augment groundwater recharge over the Ogallala Aquifer in the state's northern extremity. This project, after being served in its initial year by a contractor, followed the path taken by earlier projects in Texas and in 2001 procured its own aircraft, radar, office facility, and support personnel. Like its companion project to the west, the PGWCD project has access to cloud systems moving out of Oklahoma into its target area, which currently consists of nearly 4.1 million acres in the eastern sector of the Texas Panhandle. The staff of the PGWCD (806/883-2501; www.panhandlegroundwater.org/precipitationenhancementprogram.htm) can provide additional information about this project.

Trans Pecos Weather Modification Association (TPWMA)

Texas' newest rain enhancement project made its inaugural seeding flights in May 2003. The Association consists of the Ward County Irrigation District and other political subdivisions within Culberson, Loving, Reeves, and Ward counties. Its target area in that part of Texas along and west of the Pecos River consists of 5.1 million acres. TPWMA aircraft are based at the airport in Pecos, where a C-band radar is also situated. Seeding missions are directed by a staff meteorologist working from an office at Mathis Field in San Angelo. Additional information is available about this project through the Ward County Irrigation District in Barstow (432/445-6834; www.transpecosweathermodification.com).

Contact Information

Individuals, or organizations, representing areas of the state not now engaged in cloud seeding but with an interest in doing so should contact George Bomar (512/936-4313; e-mail: gbomar@license.state.tx.us) of the TDLR about any, and all, weather modification permitting and licensing matters or for general information about cloud seeding technology.

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