## 1.0 INTRODUCTION

It is apparent that the southern region of the Australian continent is experiencing significant changes to rainfall patterns. This has been a long-term trend of the last 15 years and several explanations are offered from the scientific community ranging from global climate change, El Nino, and local air born pollutants reducing the capacity of clouds to deliver rain.

In the period from 1950 to 1970, the Australian scientific community, and, in particular the CSIRO, led the world in the investigation of the potential for rainfall enhancement by weather modification with cloud seeding. However, whilst cloud seeding continues in Tasmania, with the occasional experiment on the mainland, it no longer enjoys enthusiastic support by the scientific community in Australia. The CSIRO, in particular, maintains a very strong stance that this form of weather modification simply does not work for the Australian continent. Doubts about available moisture content, and, based on the experience of the 1970's, weather modification has not been regarded as a suitable subject for the investment of valuable research dollars.

The United States encountered similar problems in demonstrating the efficacy of cloud seeding but continued to invest in research throughout the 1970's, and Texas, in particular, has maintained an extensive cloud seeding operation across the western half of that State which has expanded rapidly since 1995.

This report summarizes the findings of a study tour conducted by the author to investigate the activities of the Texas Weather Modification Association in July 2002 and is presented in the background of the water shortage situation in Australia. This shortage drives the imperative to consider all forms of potential ameliorative measures including weather modification and any new advances, which could be reconsidered in the Australian context. Considerable information is provided in this report for comprehensive follow up by others, in particular by the CSIRO, who have thus far been very unsupportive of the likely success of cloud seeding in Australia.

Weather modification for rain enhancement by cloud seeding is simply the introduction of forms of salt to the cloud to encourage the formation of ice, which is the essential ingredient in forming rain. Silver iodide is the most common ingredient introduced to clouds, which has a similar crystal structure to ice when burnt. It can be introduced to the cloud by ground based or aeroplane-mounted generators. Wing mounted pyrotechnic flares (as shown of the cover page) is a very convenient technique for distribution of the seeding material and is the most common method used in the US.

## 2.0 AUSTRALIAN CLIMATIC CONDITIONS

Rainfall activity in Australia has undergone considerable change in the past 20 years. Scientific discussion continues as to the fundamental causes including global climate change, El Nino, and the impacts of localised cloud pollution from industry and cities. Whichever the causes, the impacts on agriculture and domestic water storages are becoming quite dire for the southern regions of the continent of Australia.

Some climate scientists maintain that Australia's aggregate annual rainfall is actually increasing, but, clearly, the depleted situation of water storages in the southern half of the continent speaks for itself. Dr Bryson Bates of the CSIRO was warning publicly in March 2002 that the dry spell in the south west would spread across the Nation. In an ABC interview of 14 March, he said that low rainfall in the past 27 years could be the result of changes in pressure patterns off the Antarctic, rather than the Indian Ocean. He also said that rain is missing the Australian continent due to changes in pressure cells in the south. He said that the dry spell being experienced followed a natural shift in the 1970's and is not the result of the greenhouse effect.

While the scientific community struggles to find explanations for the reasons, communities around the south of the continent are already enduring water shortages and worse are foreshadowed. Any possible opportunities to counteract this should be pursued.

## 3.0 REDUCED WATER STORAGE YIELD

Dramatic changes have been occurring for water storage yields across the southern regions of the Australian continent since 1975. There are countless examples to demonstrate this trend and three are presented in this report. None of the following information is neither new nor attributable to the author and is freely available on the public internet. The author is grateful to Ian Searle of the Tasmanian Hydro Corporation for his advice in respect to the following details.

### 3.1 Perth Water Storage Inflows

Figure 1 presents the 90-year record of storage yield for the Perth (WA) storages, which clearly shows there has been a distinct 50% reduction in average annual inflows in the period from 1975 to 2001.

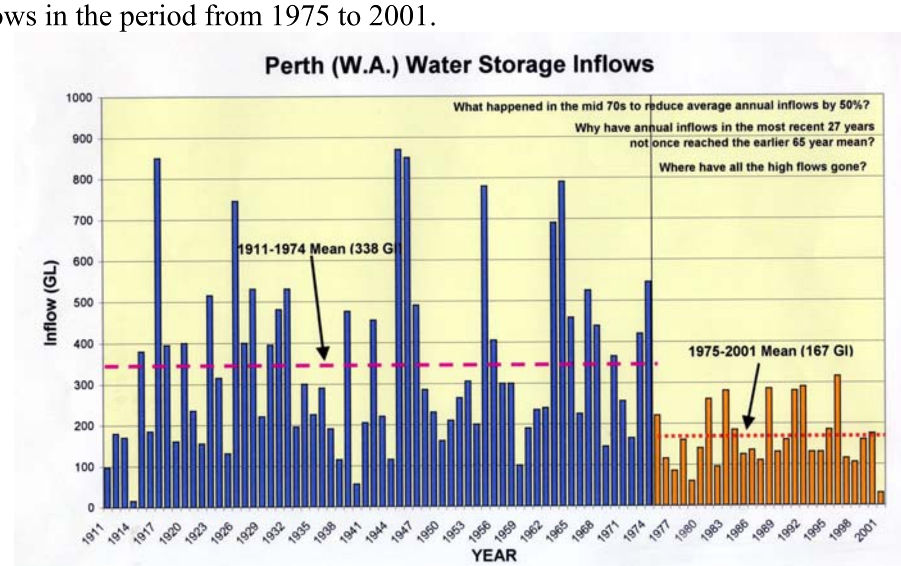


**FIGURE 1**

The average annual inflow for the period 1911 to 1975 was 338 Gigalitres (GL) whilst the average for the period 1975 to 2001 was 167 GL. It is also worthy of note that not one of the individual 27 years in the period 1975 to 2001 even reached the mean of the previous 65 years. Even worse, the mean inflow for 2001 was as little as 23 GL.

Some further explanation for this very worrying trend is offered by observing the behaviour of El Nino as can be seen from Figure 2.

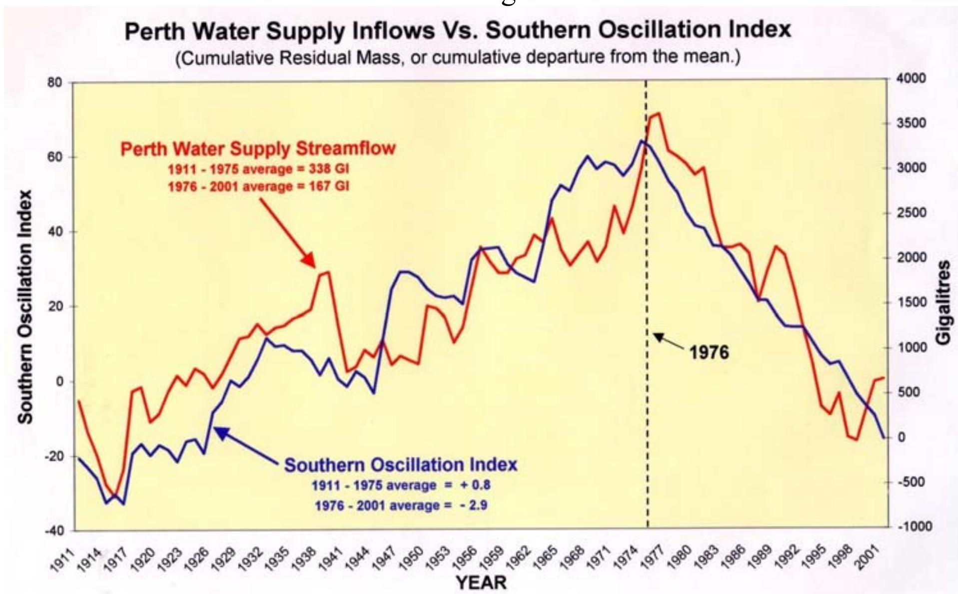


**FIGURE 2**

This chart shows the statistical storage yield index (red line) has the same trend as the Southern Oscillation Index (SOI) (blue line). A distinct change in the SOI in 1976 from an average of +0.8 to an average of –2.9 is clearly evident.

This situation can be repeated for storages all across the southern half of the Australian continent. The situation in Tasmania is similar by way of further example.

### 3.2 Tasmanian Hydro Electric System Yields

Figure 3 shows the 80 years of net inflow yield for the Tasmanian Hydro storages. The chart demonstrates the same deterioration in yield from the mid 1970's, which also follows the same trend as the SOI.

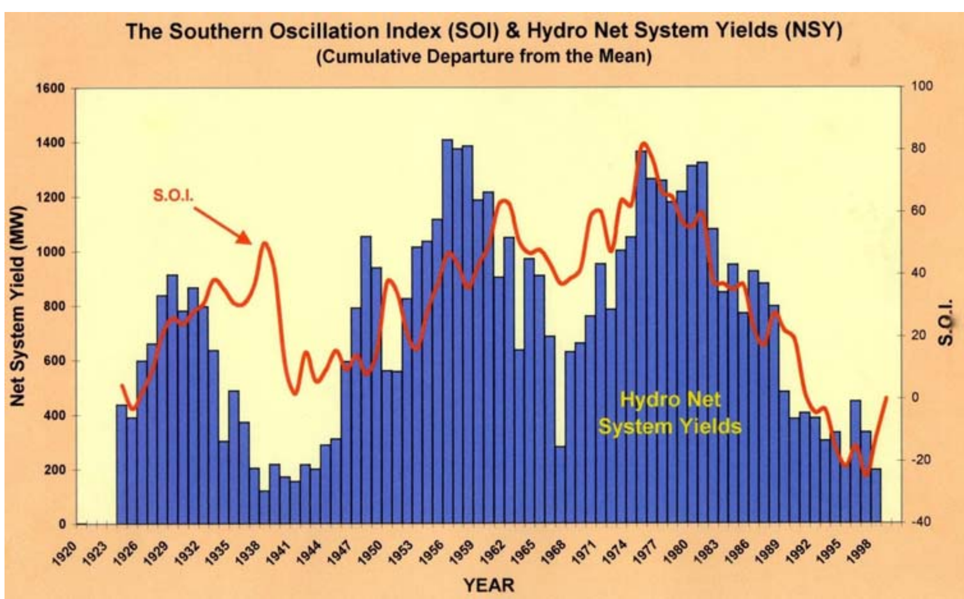


**FIGURE 3**

This is particularly interesting since cloud seeding has been undertaken periodically in Tasmania since the 1970's in at least 50% of the years. It could either suggest that cloud seeding is having little positive impact in improving yield or that the methods of cloud seeding need further refinement. It could also mean that the situation could have been dramatically worse if cloud seeding had not been conducted.

There are questions here that the current *Parliamentary Inquiry into future water supplies for Australia's rural industries and communities* being conducted by the Standing Committee on Agriculture, Fisheries and Forestry should explore.

Rainfall decline is also being experienced in the Southern Midlands of Tasmania outside the hydro storages. Figure 4 shows the statistical presentation of rainfall associated with the Oatlands, York Plains, and Bothwell sites. The average rainfall in the period 1976 to 1999 has fallen by 11.8%. This represents an average annual rainfall of 511 mm compared to an average 579 mm in the 1920 to 1975 period.

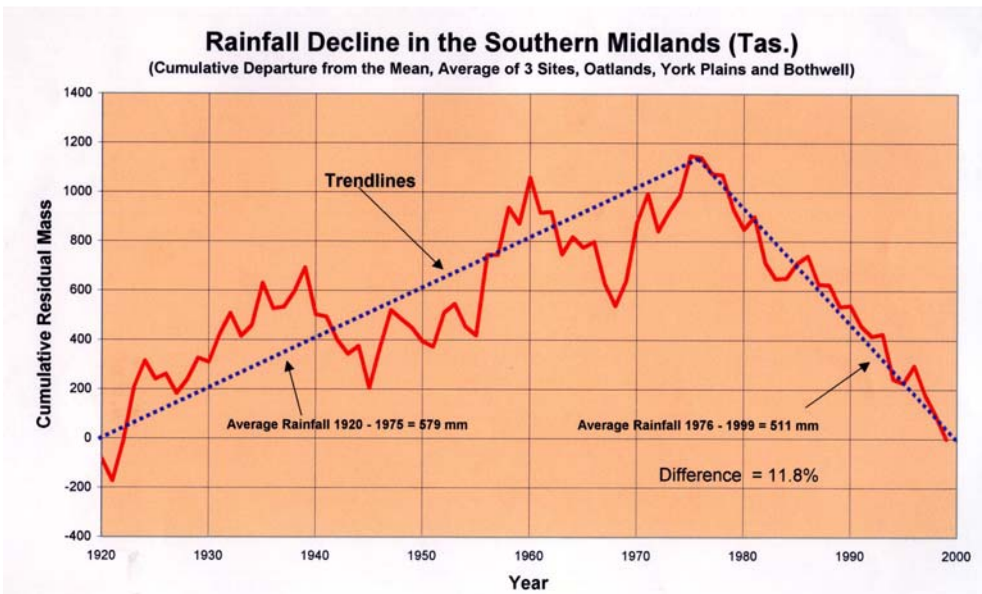


**FIGURE 4**

Only sporadic seeding has been undertaken for these storages. There seem to be more questions here than answers but the future picture does not look good for ongoing sustainable storage yield and all options to overcome this situation should be considered including ongoing analysis as to the effectiveness of weather modification, and, in particular, cloud seeding.

### 3.3 Wimmera Mallee Stock and Domestic Storages in Victoria

The last example to provide is the extremely dire situation in which the water users of north west Victoria find themselves.

The Wimmera Mallee Stock and Domestic Supply System is the largest open channel water supply scheme in the world. For the 100 odd years of it's existence, there has been a very active debate about the amount of water wasted in this system due to seepage and evaporation. Thankfully, since 1993, the scheme is progressively being piped and it is now becoming a matter of absolute urgency to complete the piping of all of it.

In total, this is about a $350 million project of which about $50 million has already been expended. The funding for this has been achieved in a partnership between the State of Victoria, the Commonwealth, and water users. So far, about 50,000 megalitres (ML) of water is being saved every year by the completed works, and a further 100,000 ML can be saved every year with its completion.

The storages for this scheme are located in the Grampian Mountains in the catchments of the Wimmera and Glenelg Rivers. Similar storage yield deterioration has been occurring since 1975. The past three years has seen water consumers on the system endure the worst water restrictions seen in 100 years. The last occasion that cloud-seeding operations were conducted in the region was in 1972 after which the cloud seeding Division of the CSIRO was closed down. Seeding operations ceased owing to the lack of efficacy in demonstrating the benefits of weather modification.

Figure 5 shows the 95-year yield record for these storages as a five-year rolling average. This style of presentation tends to reduce the variation of the graph for unusual years.

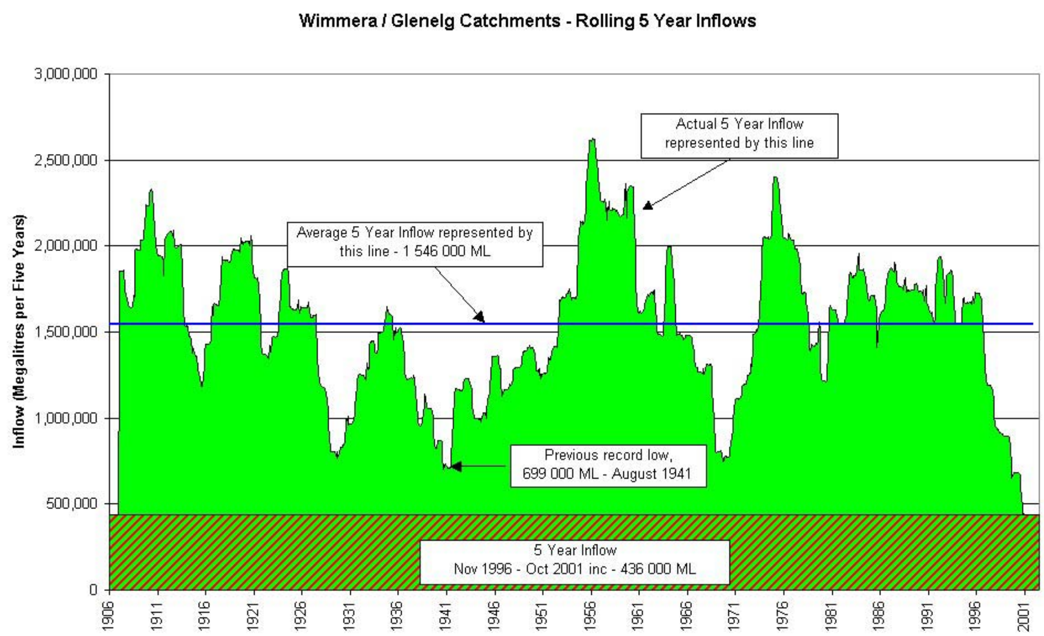


**FIGURE 5**

This chart demonstrates the same trend of storage yield reductions since 1975. Although the five-year rolling average reduces the dramatic presentation of the decline, it needs to be noted that the average for the period from 1996 to 2001 was 436,000 ML compared to the average for the whole period of 1,546,000 ML

The current storage of the entire Wimmera Mallee system is currently only 11% of capacity. It is clear that water restrictions will continue on an even more stringent basis for water users. This is a grim picture given the economic dependence of the whole region of northwest Victoria on this water supply system. Such a desperate picture has driven the author to not only champion the cause for the piping of the entire system but to seek out all possible options to enhance the yield situation, and, in particular, whether cloud seeding should be reconsidered on the basis of new experience internationally.

Weather modification research and development has continued in many locations around the world in Israel, Asia, and North America. In particular, in Texas, great success has been lauded since 1995 with the use of pyrotechnic flares and hi-tech interpretive radar with cloud seeding specifically for rain enhancement. The author sought to investigate this work during a study tour in July, 2002.

## 4.0 WEATHER MODIFICATION IN NORTH AMERICA

Extensive weather modification programs are conducted across the central and western States of the USA and Canada. The extent of these programs is shown in Figure 6 sourced from the special edition, Atmospheric Water, published by the North Dakota Water Education Foundation, October 2000 and endorsed by the North American Interstate Weather Modification Council, chaired by Mr George Bomar of the Texas Department of Licensing and Regulation.

Some programs use it for snow pack augmentation, and some use it for hail suppression, but the great bulk of the programs are for precipitation enhancement. A very impressive networking occurs between various State based weather modification Associations. Rainfall enhancement programs are conducted in North Dakota, Kansas, Oklahoma, Nevada, California, and New Mexico and, in particular, the State of Texas is well advanced with its activities in rain augmentation.

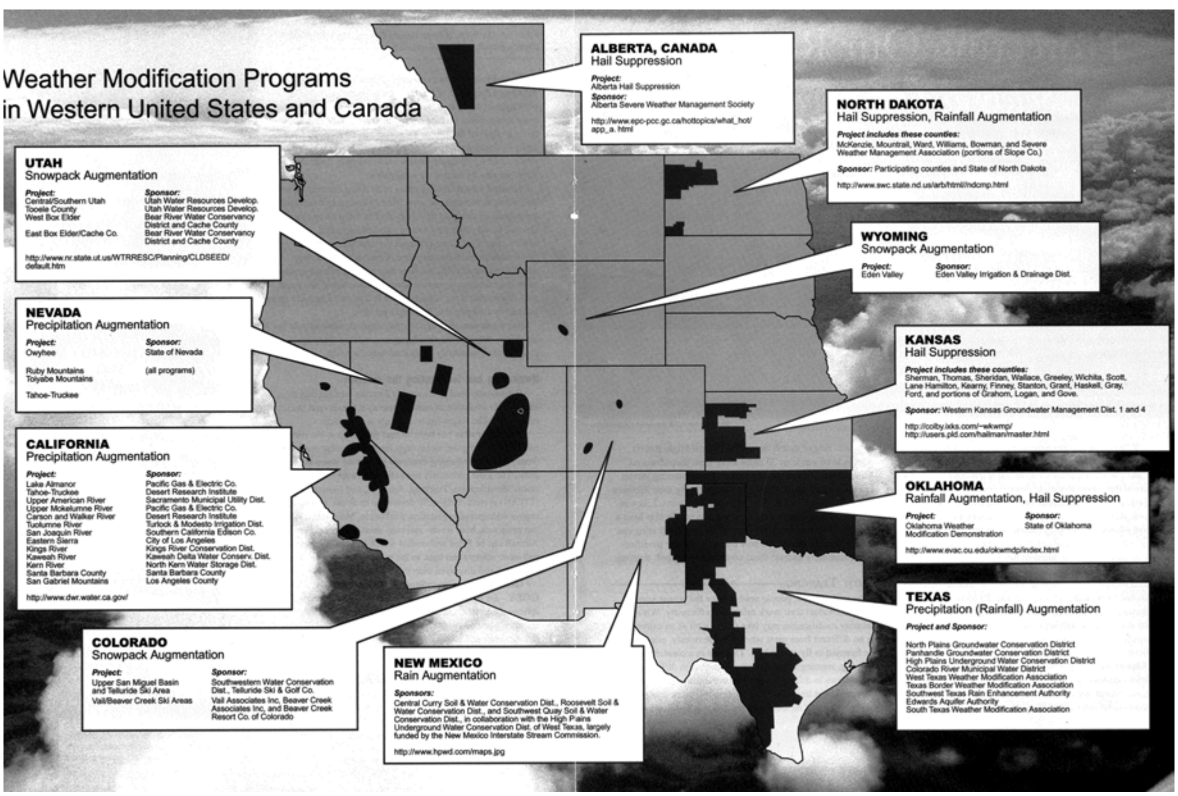


**FIGURE 6**

## 5.0 WEATHER MODIFICATION PROGRAMS IN TEXAS

Texas has by far the most sophisticated and well-regulated activities in the US and was a natural choice for the subject of a detailed study tour. It also has similar geographic and climatic conditions to that of Australia. If the Texans can make it work, and, demonstrate its effectiveness, Australia needs to know why and how and whether there is potential application in Australia.

All weather modification activity is extensively regulated and controlled by the Texas Department of Licensing and Regulation (TDLR) in co-operation with the Texas Department of Agriculture (TDA). A complete summary of all the programs has been presented in Appendix A of this report sourced from the web site of the TDLR and edited in conjunction with notes collected during the study tour. These notes of meetings are also included as Appendix B.

Mr George Bomar who is the chief meteorologist for the TDLR has provided Figure 7 showing the location of programs in Texas. He is responsible for the licensing of all programs, in conjunction with Ms Jane Lee of the TDA.

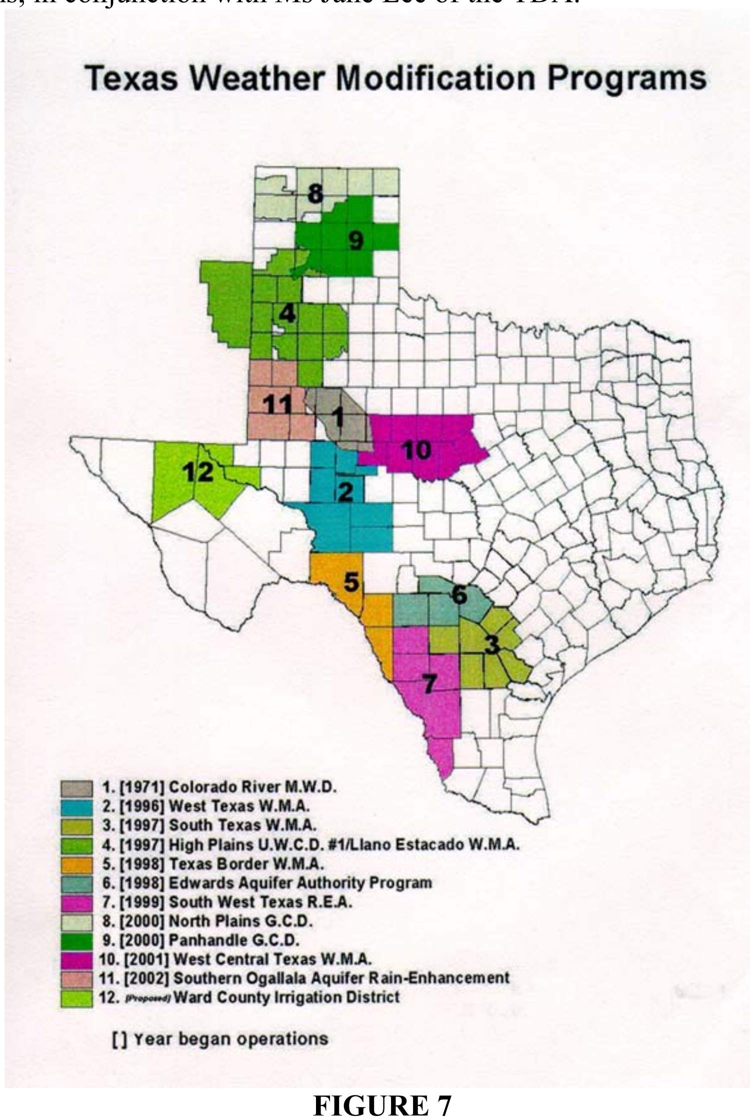


**FIGURE 7**

Each program has a formal management association of Local Government, Water District representatives, and others with community and agricultural interests. The grass roots nature of the management of the programs is very impressive. Each Association engages it's own meteorologist and, in most cases owns and operates it's own aeroplanes and engages it's own pilots. Contractors are avoided so that the focus is always on results and not flying time.

Each Association is issued a permit to operate for 3 years by the TDLR and the meteorologist is issued a license for one year. This permit and license system is reviewed by a statutory Texas Weather Modification Advisory Committee, which meets quarterly for review of the activities of each group. The author was able to attend one of these quarterly meetings in San Angelo on 18 July and observe the review process. Evidence given to the Committee is sworn and the author was even required to complete a witness affidavit just to address and bring a greeting to the meeting *(refer page 20 – 29 of Appendix B)*. This level of regulation is very impressive and sets a very strict legal framework for weather modification to occur.

The State Legislature provides funding, which is required to be matched by the Associations. With the State providing US$2.94 Million per year, this means that Texas is spending US$5.88 Million in total on weather modification. Matching funds are provided through the rating structures of Local Government Counties and Water Districts, and, in some cases by Farming Associations *(refer page 2 and 3 of Appendix B)*.

Each Association is required to provide the full details of each cloud seeding operation to a central processing facility in San Angelo where the state-wide Texas Weather Modification Association (TWMA) has it's own meteorologists to assess each operation in detail for it's effectiveness *(refer page 12 of Appendix B)*. This is a very effective and comprehensive analysis and has allowed a vast database of successive cloud seeding events to be analysed for the overall effectiveness of the total activities. It is very impressive and hard to argue against such a large database of information, which also includes comparison with unseeded control clouds.

There is a very well co-ordinated public relations effort in Texas because, like anywhere, weather modification is a controversial issue. Two public relations videos were provided to the author and are enclosed in the CD ROM attached in Appendix D. The author's visit was used very constructively by the TWMA as demonstrated in the news clip on the CD and the print media as shown in Appendix C.

Each Association has its distinct target area, and some have been operating for 30 years. Of the total 170 Million acres for the whole of Texas, 52 Million acres are thus targeted for rain enhancement *(refer page 16 of Appendix B)*. All of the programs are for the seeding of summer convective clouds between June and November. Cloud seeding is avoided in the US winter to avoid exacerbation of already severe weather conditions. This is the opposite of the requirement for Australian conditions where the demand is for winter rainfall. This difference could be the source of contention in Australia but is discussed further in section 6 of this report.

All of the twelve programs described in Appendix A are for rainfall augmentation, either for agricultural benefits, or for water storage yield enhancement. It was not possible to visit all twelve programs but a very extensive program was organised by George Bomar of those that have relevance in relation to the Australian climate.

## 5.1 South Texas Weather Modification Association (STWMA)

The location of this group is shown as Nos 3 & 6 on Figure 7. This Association is an alliance of several groups in the region between San Antonio and Corpus Christi for rain enhancement for water supply. In particular, this program serves to recharge the Edwards aquifer, which is the sole water supply for many communities including the provincial city of San Antonio. This program is managed by Tommy Shearer, with Mike Mahoney as the meteorologist and is based in Pleasanton.

The region is 100 – 150 Km from the coast of the Gulf of Mexico and has maritime clouds with climatic conditions similar to southeast Queensland.

All of the programs in Texas use a sophisticated interpretive radar system referred to as TITAN and SSS. With software provided from South Africa, the radar reflectivity of the cloud can provide a four dimensional picture of any cloud (the fourth dimension being time). Precise information on a range of parameters is provided at computer console for the controlling meteorologist to direct the pilot to exactly the right place, at the right time, and what proportion of silver iodine to release by instructing the burning of a directed number of flares.

A typical TITAN image is presented as Figure 8 which shows the reflectivity (dBZ) shown at various intensities. It also shows the tracking of the aircraft and where flares were electronically ignited.

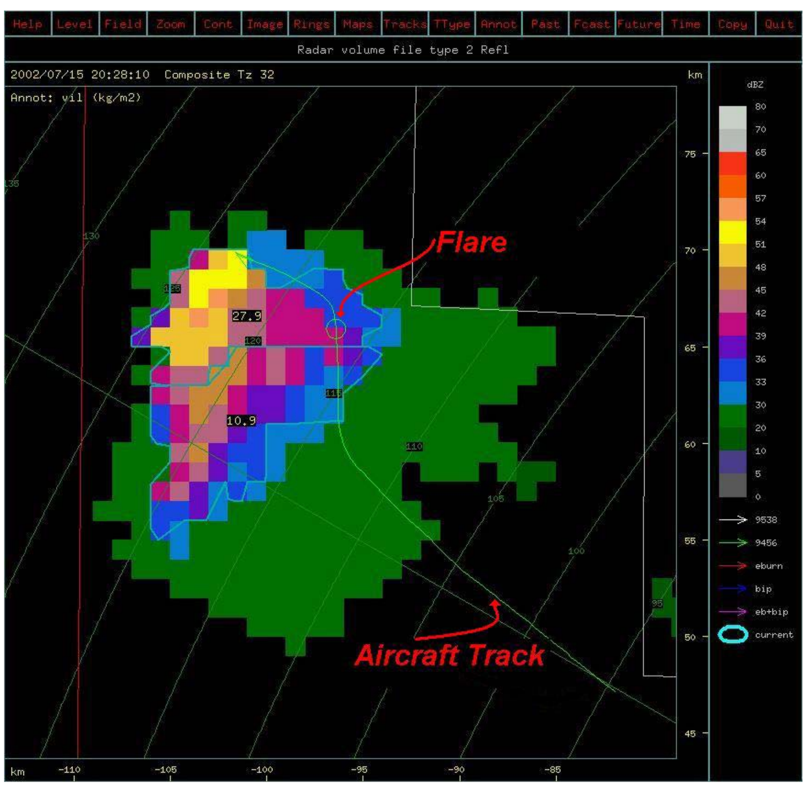


**FIGURE 8**

The use of these images is explained further in this report but their power is in the four dimensional dissection which can occur in real time to decide precisely where to distribute the seeding material and what dose to provide. This level of resource is not yet available in Australia owing to the absence of a comprehensive radar network on the scale required. Each of the Associations maintains and pays for its own radar. An additional use of this information is the ability to analyse each individual operation afterwards to see if it could have been undertaken better and also to compare it with comparable unseeded clouds.

The STWMA use 80 gm pyrotechnic flares, which are twice the size used in other projects in Texas as shown here fitted to the wing of a Piper Comanche. Because only bottom seeding occurs in this project, only small aircraft are required, so, for better aerodynamics, wing tip flares are avoided.

Wing generators are no longer used in any of the Texas operations. The Texans have realised that precise doses of seeding agent are required and the intermittent switching off of generators proved to be a problem with freezing up and blockage. Time and time again, the author saw discarded wing generators in hangers across Texas like these in Pleasanton.

The question of the use of wing generators in Australia needs to be reviewed in the light of the need for accurate and precision dosing *(refer page 43 Appendix B)*.

The STWMA is the only project which engages in cloud modification on a full year round basis owing to the greater presence of maritime clouds and lesser opportunity for hail.

## 5.2 Southern Ogallala Aquifer Rain-Enhancement (SOAR)

The location of this group is shown as No 11 on Figure 7 and based in the township of Plains. It's principal objective is to enhance precipitation for recharge to the agallala aquifer. This is a huge continental limestone aquifer providing water supply to much of central United States which is a similar situation for water supply in eastern South Australia, and western Victoria. The geology and topography is virtually identical to the Mallee region of South Australia and Victoria with continental cloud formation.

Mr Gary Walker, who, in addition to being the Manager of the Plains Water District, is also a Member of the Texas Legislature for District 80 based in Plains. He manages the SOAR program. The licensed meteorologist is Mr Duncan Axisa.

An excellent power point presentation to the author during an inspection of this operation explained the TITAN procedure. Page 31 – 40 of Appendix B refers. The PowerPoint file is enclosed on CD as file TITAN.PPT. It is very worthwhile following this presentation from the notes in Appendix B. This presentation is important in understanding how TITAN is used. Figure 9 shows the arrangement of the various components.

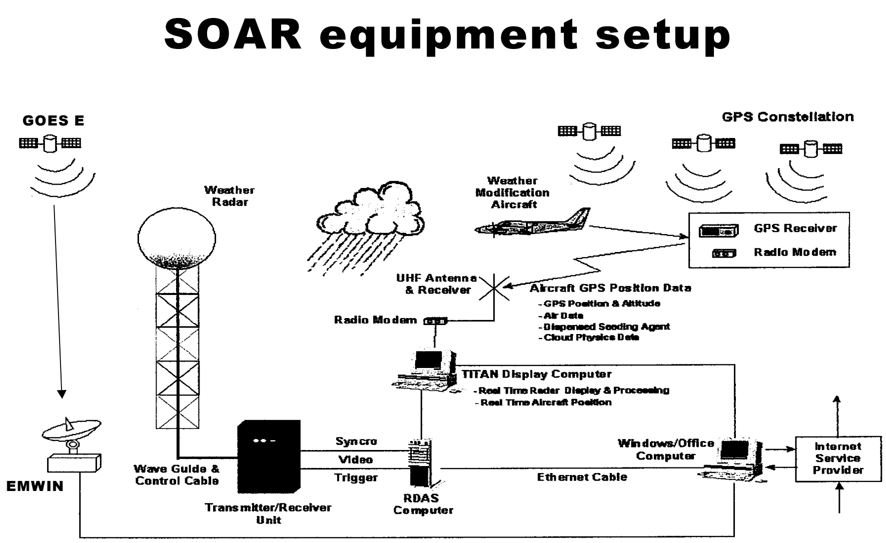


**FIGURE 9**

This arrangement is similar for each of the projects across Texas. The geostationary satellite (GOES) provides continental weather information for overall weather warnings. This check is conducted to ensure impending adverse events are not exacerbated. The controlling meteorologist compiles this information on the office PCs' whilst at the same time analysing the radar signals being interpreted by the TITAN program. Once a disaster clearance is received when a potential cloud appears, the meteorologist then sets about analysing the potential cloud by making 'slices' using the mouse on the screen image to analyse the reflectivity information. A sample slice is shown as Figure 10, which also compares comparable information of a seeded cloud to a cloud which was unseedable.

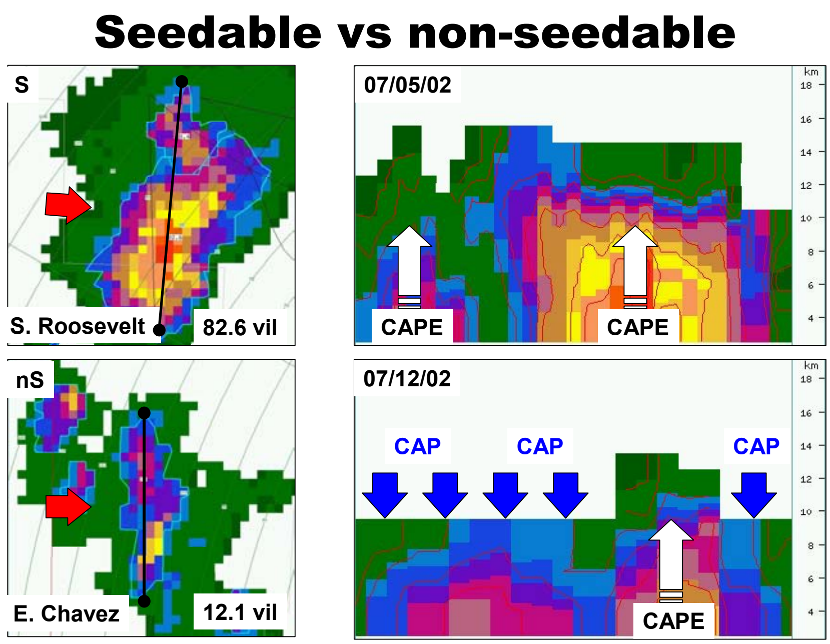


**FIGURE 10**

All clouds are named (alphabetically or numerically) with forename and surname to assist tracking in the database. Sometimes clouds bifurcate requiring a new forename but retaining its surname. The left image of Figure 10 shows the location of the 'slice' and the right image provides information on the location of the convective available potential energy (CAPE) (in another words updraft) and concentrations of moisture.

The CAP is important because it will prevent the cloud rising and is the reason why the E.Chavez cloud was not seeded. The vertical integrated liquid (VIL) is also an important criteria to determine the cloud "seed-ability" *(refer page 36 – 37 of Appendix B)*.

The two aircraft at SOAR are pressurized Cessna 340's because of the predominance of top seeding over base seeding, requiring high altitudes. This was the major difference between this program and the STWMA. The author encountered considerable debate on this question of top seeding or bottom seeding, which is obviously not yet settled in Texas. *(Refer to page 41 and page 51 of Appendix B for discussion on this matter.)*

The author's observation is that top seeding is preferred in the continental clouds and bottom seeding in maritime clouds. The timing of seeding in the life of the cloud is critical. It seems that the key to success is timing and precision dosing.

This can be a factor in whether to top seed or bottom seed. Table 1 (page 13) is a summary of the information in slide 10 of the TITAN PowerPoint presentation. There is a distinct difference discovered by the Texans in when to seed certain clouds and that precision timing is critical in relation to the total life of the cloud.

## When, where, how much & with what?

| On top seeding | Base seeding |
|---|---|
| First third of cloud life time | First half of cloud life time |
| Updraft or turrets:<br>• Cloud top temps between –5°C and -15°C<br>• High concentration of supercooled water droplets<br>• Vertical velocity > 200ft/min | The inflow of the convective cell:<br>• TITAN SSS field identifies weak top structure development within a cell<br>• Pilot helps meteorologist "see" |
| 1 flare per updraft or turret | 1 flare per 5km$^3$ of supercooled volume |
| Ejectable:<br>• 20 gram flare silver iodate | Burn in place:<br>• 40 gram flare silver iodate |

**TABLE 1**

For top seeding it is critical to get to the right place to seed within the first third of the cloud's life and, for top seeding within the first half life. Bottom seeding can therefore provide more time. The dosage is also different for each method and finding the updraft is critical for bottom seeding.

### 5.3 West Texas Weather Modification Association

The location for this group is shown as No 2 on Figure 7 and is based in San Angelo. This Association is Chaired by Mr Dale Bates with Arquimedes (Archie) Ruiz and Jim Boyd as the licensed meteorologists. This group also acts as the processing facility for the central Texas Weather Modification Association for all the operations across Texas.

The region is a semi-arid and not unlike western NSW and northwest Victoria where cloud formations are predominantly continental.

Dale Bates is a retired rancher, with some 30 years of interest in cloud seeding and has been a driving force in the success of the Texas cloud seeding program. Archie is an interesting character whose meteorological training was obtained in Russia and is a refugee from Cuba. His knowledge of weather modification has also been an essential part of the successful Texas story in the past 5 years.

Their presentation on the efficacy of the database was very convincing *(refer page 42 to 55 of Appendix B).* This presentation resulted in a good explanation as to the efficacy of the results of the cloud seeding operations in Texas. The summary details of a full comparison with control clouds are shown in Table 2.

# TWMA research

## (courtesy of TWMA San Angelo)

### Comparison between Seeded and Control clouds for small cells
### Sample size: 731 seeded & 731 control clouds

| VARIABLE | SEEDED | CONTROL | INCREASE (%) |
|---|---|---|---|
| Lifetime (min) | 83 | 56 | 48 |
| Area (km sq.) | 54.5 | 44.6 | 22 |
| Volume (km cu.) | 175.3 | 143.2 | 22 |
| Top height (km) | 8.1 | 7.9 | 3 |
| Max dBz | 48.7 | 48.3 | 1 |
| Top height of max dBz (km) | 4.4 | 4.4 | 0 |
| Volume above 6km (km cu.) | 54.1 | 43.1 | 26 |
| Precip. Flux (m cu./s) | 375.8 | 300.5 | 25 |
| Precip. Mass (kton) | 1731 | 969.7 | 79 |

**TABLE 2**

Of the many thousands of seeded clouds, 731 samples are compared with comparable control clouds in accordance with 9 established criteria. Control clouds are established by the firing of blank flares of which only one responsible person is aware. Neither the pilot, nor the controlling meteorologist, is aware that they are firing blank flares. This means that a particular operation will be conducted with all the same human variables and judgements to so establish a more genuine control cloud.

In all of the 9 criteria shown in Table 2, significant improvements can be seen in terms of precipitation outcomes, and those criteria, which could exacerbate severe storm events, have not increased. These are top height and maximum dBz, which is a factor in hail generation.

The most significant positive outcome is the precipitation mass at a staggering 79%.

These numbers are very convincing at it is very difficult to argue that cloud seeding in Texas is not producing worthwhile results. What remains is whether these techniques can be employed in the Australian context.

## 6.0 APPLICATION IN AUSTRALIA

The need for improved precipitation outcomes in Australia occurs during the Australian winter. Cloud seeding in Texas occurs during the US summer. Some argue this is therefore one reason why the Texas experience will not apply in Australia. However, winter cloud seeding is conducted in Israel using similar techniques and this is not a reason to discard the possibility for Australia.

The pollution of clouds from industrial and natural dust and smoke particles is now an established cause of rainfall depletion in many parts of the world. This is recognised by the CSIRO. Winter clouds in Australia are the worst polluted. If cloud seeding can improve the capacity of the cloud to overcome this pollution then seeding winter clouds in the correct manner offers great opportunity for improved precipitation outcomes.

The Texan experience demonstrates the critical nature of timing, location, and precision dosing. Clearly, the absence of a comprehensive radar network in Australia, on the scale necessary for success, is a limiting factor to any application in Australia. This should not detract however, from at least some experimentation with existing radar in Australia.

However, the role that the TITAN radar and software package plays is also critical. The ability for detailed analysis of potential clouds, prior to launching a seeding operation, is the key to success. For any further research in Australia, procurement of this package would be essential. Successful cloud seeding operations in Tasmania have been conducted without this additional resource but the author wonders how even more successful the Tasmanian operation would be if it had access to the power of the TITAN system.

The CSIRO maintain that the success in Tasmania does not have application on the mainland because there is plenty of existing moisture over the Tasmanian island and that the absence of moisture over the mainland means cloud seeding is a waste of time. However, this assertion does not take due regard for the fact that the Texans are not seeding directly over their target area. Sometimes they are seeding hundreds of kms away. For example in the SOAR operation, seeding is undertaken as far away as New Mexico *(refer page 40 Appendix B).*

This could mean that to target a rainfall outcome over the Grampian Mountains in western Victoria, could require seeding over Bass Strait, or the Southern Ocean, or over the great Australian Bight where there is consistently plenty of moisture.

In discussion with the Texas Weather Modification Association (TWMA), the author was presented with an analysis of the potential for cloud seeding in Australia *(refer page 42 – 43 of Appendix B)*. Their advice was that there were at least 15 seedable events in the Murray Valley region of South Australia and Victoria in the past year. They seemed convinced that Australia was missing a great opportunity to use the resource that TITAN provides.

## 7.0 CONCLUSIONS

The depleted water storage situation in Australia drives an imperative that all possible ameliorative possibilities should be considered.

Significant investment is being made in Texas for cloud seeding supported by the State Legislature with a total of nearly US$6 million being spent each year.

A very comprehensive legal framework has been established with regulation provided through the Texas Department of Licensing and Regulation through a well-reviewed permit and licensing system with funding appropriations being delivered by the Texas Department of Agriculture. Such a framework would not necessarily be needed for research activity but ultimately would have to be considered for a full operational implementation of cloud seeding.

Considerable effort is being expended in the demonstration of the efficacy of rainfall outcomes with precipitation mass improvements lauded as high as 79% and a comprehensive public relations effort is extended to overcome much of the cynicism which exists about the impacts of cloud seeding.

The geographical and climatic conditions across Texas are very similar to those of the Australian continent and location in the southern hemisphere is not a prohibiting factor in engaging the Texas experience in Australia.

If cloud seeding is to be revisited in Australia, it will require investment in the integrated interpretive radar system employed in Texas referred to as TITAN.

The CSIRO in particular should be exhorted to reconsider renewing its interest in cloud seeding based on the example provided in Texas.

This interest should commence with a visit of CSIRO meteorologists to Texas as a matter of urgency to review what the author has prepared in this report.