

MINUTES - NORTH DAKOTA ATMOSPHERIC RESOURCE BOARD

NOVEMBER 16, 2017

Chairman Henry Bodmer called a meeting of the Atmospheric Resource Board to order at 1:31 p.m., November 16, 2017.

ROLL CALL

Roll call was taken. Members present were Henry Bodmer, Monte Hininger, Casey Veil, Tom Tupa, Garland Erbele, Kyle Wanner, and Rob White.

Others present were Darin Langerud, Director; Kelli Schroeder, Business Manager; Mark Schneider, Chief Meteorologist; Daniel Brothers, Meteorologist; Jody Fischer, Weather Modification International (WMI); Jeff Diemert, ND Water Users Association and John Paczkowski, State Water Commission (SWC).

MINUTES

IT WAS MOVED BY MR. WANNER, SECONDED BY MR. HININGER, AND CARRIED ON A VOICE VOTE TO APPROVE THE MINUTES OF THE APRIL 12, 2017 MEETING AS DISTRIBUTED.

David Monson arrived at 1:33pm.

FINANCIAL STATUS REPORT

Ms. Schroeder reviewed the financial status report for the period ending September 30, 2017.

REVIEW OF THE 2017 NORTH DAKOTA CLOUD MODIFICATION PROJECT (NDCMP)

Project overview

Mr. Langerud provided the board with a handout containing information relating to the 2017 NDCMP and reviewed the information.

Mr. Bodmer also reported that the Ward County Commission (Commission) appointed Roger Neshem to the Ward County Weather Modification Authority (Authority). This summer, there seven people in Ward County complaining to the Commission that our operations were chasing the rain away and not worth the money. The previous Authority chair resigned and Mr. Bodmer was elected the chair. The next day, he was informed by Mr. Neshem that the Commission voted 4-0 to suspend the NDCMP in Ward County. Mr. Bodmer has never been contacted by the Commission about this request. He has not received calls from anyone that doesn't like the program and has had three to four calls saying keep up the good work.

The Commission has since cut the 2018 budget for the cloud seeding program in half. Mr. Bodmer indicated that the group that is against this program want to end cloud seeding in all of North Dakota, not just Ward County.

Mr. Bodmer has recommended to many people to call the Atmospheric Department at the University of North Dakota to get information about the effectiveness of the program, but it seems no one has according to Dr. David Delene from the University of North Dakota (UND). Mr. Bodmer noted that there is no scientific evidence that cloud seeding chases rain away.

Mr. Bodmer used the Freedom of Information Act to get all emails to the Ward County Commissioners about this subject before they voted. There were seven individuals, including Mr. Neshem, who coordinated an email campaign to the Commission. Mr. Neshem also contacted the Grain Growers Association (Association) at their meeting in December 2016 and another seed agent to support his viewpoint. The Association passed a resolution against weather modification and forwarded it to the Commission. The seed agent also sent an email to the Commission against the program.

In response to a question from Mr. Wanner, Mr. Bodmer noted that there were a couple of positive emails to the Commission as well. He feels that the problem is that there was never a public hearing in the county about whether this program is supported or not before the Commission cut the budget. There is no evidence that this program stops the rain. Yet that's what some of the locals were saying.

In response to a question from Mr. Wanner, Mr. Langerud noted that we've had discussions with the Governor about this issue. One of his issues is that some of the studies on this program are old. But just because something is old doesn't mean it is not still relevant. One of the ideas that the Governor floated is to do a randomized experiment that would essentially confirm the 4-year randomized study that was done in the late 1960s and early 1970s. This study found more average rainfall per rain event, a larger area of rain, on average, on the seeded days versus non-seeded days. But these studies don't happen quickly and without a significant amount funding.

Mr. Monson discussed information that was provided at a legislative hearing from a man from southwestern North Dakota. He had data that appeared very compelling according to some of the committee members. Representative Schatz from Dickinson area setup this person to come in and present outside of the scheduled public hearings.

Mr. Bodmer indicated that one of the guys from Ward County that was always saying we were chasing the rain away showed a map of District 2, pointed to northern portion and said there is less rainfall in this area than other parts of the state over the last 20 years and that weather modification is chasing the rain away. Mr. Bodmer noted that in that area he mentioned, Burke County was included and they just joined the program 4 years before. So that shows this man's premise is false. But no one seems to check those facts. Another person said they could see the aircraft chasing the rain away.

However, the aircraft this person photographed was a Mooney, not anything WMI operates.

Mr. Monson said the man from southwestern North Dakota had data from all the rain that had fallen on his farm, his neighbors and it was kind of a band that went around. He showed it was raining more in other areas but his area is shorted. He is convinced it was related to this project.

Mr. Langerud indicated that he would like to see this man's data. He said the Board has had a cooperative rain gauge network since 1977, with observer numbers ranging from 500 to 800 statewide. A student at UND in 2005 did his thesis looking at 27 years of that data and rainfall in the seeded versus downwind and upwind areas. He found that there is more rainfall in the seeded areas and downwind of the seeded areas than the upwind control areas during that time. Looking at 3 to 4 different rain gauge sites when you have a bias going into it is not helpful and not scientific.

Mr. Bodmer discussed a letter to the editor that was printed across the state from a man in Enderlin. This man felt that the project was drying out the crops and it was time to stop weather modification. He said the last 15 to 20 years in North Dakota has been extremely dry. Mr. Bodmer said that in his part of the state, the problem in the last 20 years has been too much water, not drought. The writer also indicated that the program is being voted in by urban voters, not farmers. The vote in Bowman County was definitely not an urban vote. But none of the editors verified that information.

Mr. Bodmer noted that Mr. Neshem is always talking about the hail insurance rates in relation to this program as well. Mr. Bodmer acquired the rates for every township in the northwest. You can see that Mr. Neshem's premise that hail rates are higher where there is weather modification is not true. When that was pointed out, then Mr. Neshem's story changed -- that's an average or it's the cost that's too high. They only want the program gone.

In response to a question from Mr. Wanner, Mr. Langerud noted that the board could consider recommending certain actions at the next legislative session. The most recent study that was done was in Wyoming for wintertime seeding. They had two mountain range target areas, randomized over a 10-year period to get enough data. They still came up short for the amount of data that they really needed. It cost \$14 million. From that, they are doing feasibility studies in three different mountain ranges to determine whether or not those ranges are feasible for doing wintertime cloud seeding to increase snowfall. Hail and rainfall from convective clouds is more complicated than snowfall. So for what we would be looking at, it would be a significant program in duration and resources to do something of that nature here.

Mr. Tupa recommended we take a pro-active approach to this and in the next budgeting process, suggested the board submit a one-time funding request to do a study sponsored by the board to put this to rest. If it's a proactive option on the part of the

board, he thinks the opposition would have to accept the results. Granted, it will be a fairly costly endeavor but it's something that could be looked at.

Mr. Bodmer noted that one of the county commissioners had done some research and found rates for hail insurance for home roofs. In Minot, Williston and those areas, the difference in hail insurance rates for the roof is enough to pay for the program.

Mr. Langerud reported that when the Ward County Commission contacted him to suspend the program, he explained to the county that we need to review our legal obligations because our contract is with the Ward County Weather Modification Authority, not with the Commission. The Commission creates and appoints the members of the Authority. Upon talking to our legal counsel, we reported to the Commission that only Ward County Weather Modification Authority has the legal right to suspend operations or change the program. He recommended the Commission work with the Authority if they would like to change the program. Mr. Bodmer never received a request or any other communication from the Commission.

Mr. Monson has concerns with requesting the legislature fund a research program for around \$14 million when that could pay for the program for 14 years operationally. He feels you have to be careful about what we want, do we want to study this or do the operate the program.

ARB RESEARCH & EVALUATION PROGRAM

Development of a polarimetric radar hail detection algorithm

Mr. Langerud reported that we have a study ongoing with a scientist from the National Center for Atmospheric Research (NCAR). He is looking at the radar data from the Minot NEXRAD radar. It is a dual-polarization radar that is able to discern to a degree the types of particles in clouds – be it rain drops, drizzle drops, snowflakes or hail. He is designing a software tool that will be an algorithm that will detect hail and the location of the hail in the clouds. Also, there was a new algorithm that was just developed last year that has some success in defining size categories of the hail in the clouds. We will get a tool that we can run every year after our season is over on the Minot raw data. It will give graphical information on where the hail occurred and what the size of the hail was that occurred in those locations. The nice thing about the Minot radar is that it's right on the corner of the district so we're going to have part of the area where the clouds have been seeded in our project area and another area where the clouds have not been seeded outside of the project. So, over a period of time, we'll be able to get a significant number of seeded cases and non-seeded cases and we can compare the statistics for the two areas to see if there is a difference in the amount and size of hail that has fallen from seeded and unseeded clouds.

REVIEW OF THE 2017 NORTH DAKOTA CLOUD MODIFICATION PROJECT

Project overview (*Continued*)

Mr. Langerud referred back to the thesis from the UND graduate student which was in 2005. He has talked with one of the professors at UND, Dr. David Delene to see if they have a graduate student who is looking for a project. Mr. Langerud suggested that since thesis done in 2005, there's another 12-13 years of data in the rain gauge network that could be applied to this type of analysis. This has not yet started but we've already identified a student who wants to do that study. Hopefully we can have this completed in time for the next legislative session.

Mr. Tupa recommended putting a line item in the budget request to cover studies like this. Mr. Wanner recommended the board have a position on whether we support a large study or some like these just mentioned.

Mr. Monson felt that Mr. Langerud should bring the data into the legislative hearings about the Wyoming project. If it works there, it should work here and that's no cost to show the work that Wyoming did.

Mr. Hininger thought we should just do what we can to educate the public on the reality of what this project accomplishes. When Williams County opted into the program, the vote was 80% in favor of the program. It appears there is no one standing up to refute the misinformation being put out there. If we brought people up to speed on the positive end of the program, that misinformation would go away.

ELECTION OF OFFICERS

The current officers include Mr. Bodmer as Chair, Mr. Brewer as Vice Chair and the Secretary position is vacant. Mr. Bodmer indicated that he would like to step down as chair and called for nominations for offices.

Mr. Hininger nominated Mr. Tupa for chair. Mr. Bodmer seconded the nomination.

In response to a question from Mr. Tupa, Mr. Langerud indicated that everyone on the board is eligible to be chair, regardless of being appointed or ex-officio.

Mr. Tupa nominated Mr. Wanner. He declined due to his position.

Mr. Monson argued that Mr. Tupa would be a good candidate due to his experience testifying before the legislature.

IT WAS MOVED BY MR. MONSON AND SECONDED BY MR. BODMER TO CEASE NOMINATIONS AND CAST A UNANIMOUS BALLOT FOR MR. TUPA AS CHAIR. THE MOTION CARRIED UNANIMOUSLY WITH MR. TUPA ABSTAINING.

Mr. Bodmer called for nominations for Vice Chair.

IT WAS MOVED BY MR. WANNER AND SECONDED BY MR. HININGER TO NOMINATE MR. VEIL AS VICE CHAIR. THE MOTION CARRIED UNANIMOUSLY.

Mr. Bodmer called for nominations for Secretary.

IT WAS MOVED BY MR. BODMER AND SECONDED BY MR. TUPA TO NOMINATE MR. HININGER AS SECRETARY. THE MOTION CARRIED UNANIMOUSLY.

Mr. Tupa left the meeting at 2:40 p.m. Mr. Bodmer continued running the meeting with his absence.

REVIEW OF THE 2017 NORTH DAKOTA CLOUD MODIFICATION PROJECT (Continued)

Cost Summary

Ms. Schroeder reviewed the cost report for the 2017 NDCMP. Both districts were under budget due to the low number of flight hours this year related to the drought. Travel, delivery & freight was also significantly low also due to the slow season and less acetone shipped to the field.

In response to a question from Mr. Monson, Mr. Langerud indicated that shelf-life of chemical from year to year isn't a problem. We adjust our purchases the following year to accommodate the additional carryover of chemical.

Seeding Agent Usage / Inventory

Mr. Schneider reviewed the ending chemical inventory and usage for the 2017 NDCMP.

Generator Performance

Mr. Schneider reviewed generator performance. In 2017, generator performance came in at a record low of 1.46%. There is a graph on page 24 of the contractor's final report provided by WMI.

In response to a question from Mr. Erbele, Mr. Schneider indicated that the pilots do a generator test immediately upon takeoff. If both burners don't light, they land and troubleshoot the problems. If they test good on takeoff but fail when needed, this is when the failures are tracked. When there haven't been flights, WMI has their pilots do a maintenance flight to check burners once per week. In addition to that, WMI encourages pilots to clean the burner plates often to keep them in good working condition.

Intern Programs

Ms. Schroeder reviewed the internship final report and activities for the 2017 NDCMP. As of the end of the 2017 project, we have trained 370 intern co-pilots and 56 intern meteorologists.

Mr. Langerud noted that our staff participate at fly-ins at their airport locations. We have a booth at the county fair in Bowman and staff participate. We also participate in Water Day at the State Fair most years. We also go to the Ag Expo and water festivals.

UND Weather Research and Forecasting (WRF) Numerical Modeling

Mr. Langerud reviewed the Weather Research and Forecasting numerical modeling project we are working on with the UND. UND is running 3 instances of the mesoscale numerical weather forecast model on the domain in western North Dakota, specifically focused on forecasting for the operational summer cloud seeding project. There have been improvements of the modeling over this time.

Aircraft Operations & Contractor's Final Report

Mr. Langerud reviewed his memo to the Board regarding liquidated damages recommendations.

IT WAS MOVED BY MR. WANNER AND SECONDED BY MR. MONSON TO APPROVE THE DIRECTOR'S RECOMMENDATION TO NOT APPLY PENALTIES TO THE FINAL CONTRACT PAYMENT AND APPROVE THE FINAL CONTRACT PAYMENT. THE MOTION CARRIED UNANIMOUSLY.

Mr. Langerud introduced Jody Fischer, Director of Flight Operations, Weather Modification International. Mr. Fischer reviewed the project from the contractor's perspective.

ISSUES FOR NDCMP 2018

Project planning and funding changes

Mr. Langerud updated the board regarding planning for the 2018 NDCMP. Ward County has cut funding, so the authority will be discussing options. Mr. Langerud feels that with the funding cuts, it will require the reduction of 1 aircraft from Ward County. However, budgeting and planning will happen in the next few months.

Radar technician services

Mr. Langerud discussed our newly contracted radar technicians. Our contract was for 2017 with the ability to do 2 one-year extensions. They are interested in continuing.

ARB RESEARCH & EVALUATION PROGRAM

Polarimetric Cloud Analysis and Seeding Test (POLCAST)

Mr. Langerud reported on the POLCAST project and reports. Final evaluation work is just being wrapped up. A UND student has done a thesis on one component of this study – looking at the rainfall effects from the radar of the seeded and unseeded clouds. There were 37 randomized cases where an airplane was launched to the cloud, determined if it was suitable, and the radar meteorologist would open a random, unmarked envelope which had instructions to seed or not seed. Analysis of the rainfall data from the radar found that, at every instance from seeding initiation up to 60 minutes in 10 minute increments, the seeded cloud had a higher rainfall rate in every instance of each of those 10 minute increments than the unseeded clouds. The statistical significance of the data is .06, not quite to the statisticians' holy grail of .05, but very close. They also found that the seeded clouds tended to last longer, which is consistent with other hygroscopic seeding research around the world. In the seeded cases at 40 minutes, 82% were still precipitating. In the non-seeded cases only 56% of them were raining. At 60 minutes, 41% of seeded clouds were still raining while only 25% of the non-seeded clouds were still raining.

A lot of the rainfall that comes from hygroscopic seeding appears to be lengthening the duration of the cloud, how long it lasts and how long it produces rainfall. This is consistent with what has been found in an experiment that was done in the late 90's in Mexico and also in Thailand.

In response to a question from Mr. Bodmer, Mr. Langerud explained that hygroscopic seeding is different from glaciogenic seeding. Glaciogenic seeding is done to produce ice in clouds. Hygroscopic seeding is done to produce larger rain drops that grow by collision and coalescence with other droplets, making larger drops without producing ice in clouds. This study was done because other research around the world indicated that this was potentially useful for summertime clouds. But you cannot apply a result in Thailand and Mexico directly to North Dakota because this type of seeding is much more dependent on the aerosols and types of aerosols in the air that help to make the condensation nuclei in the clouds. Glaciogenic seeding is more applicable from place to place.

In this evaluation, we used UND's radar to see if we can see the onset of drizzle droplets in the cloud sooner than the unseeded clouds. We have indications that the seeded clouds start to make drizzle, which is the first indication of rainfall growth, earlier than the non-seeded clouds. This study looks further into the precipitation rates of those clouds after they've been seeded. And it follows along that we're getting more rainfall out of it. Ultimately what this might mean is we could incorporate hygroscopic seeding into our operational program. But we weren't going to just say let's just start seeding clouds with hygroscopic flares and just hope it works. We've been working towards this goal and we're getting closer to the point where we can make a determination if we want to do this operationally or not.

One of the things we haven't been able to do – no one has done – is try to determine what effects hygroscopic seeding might have on hail formation, hail development and hail suppression. If you're making more rain drops – bigger rain drops preferentially freeze over small rain drops – you can make the argument that making bigger rain drops with hygroscopic seeding is going to increase beneficial competition and you might actually make more smaller hailstones that can fall and melt more completely before they hit the ground and you reduce hail damage. But if you're not able to do that effectively enough, you just might be making more hail. This is an area where numerical modeling would be useful. But modeling of something this chaotic is not far enough along right now to be able to give us any decent results. We're making incremental progress toward understanding how well this might work and if we're going to, at some point, implement it. But the indications we have are in the direction that we want to continue to evaluate it. From what we've seen so far, none of it says that we're wasting our time.

We signed a no-cost extension on this project, so we should have results of the initial cases next spring. It won't be a lot of cases. However, we'll have a software tool to start running on a yearly basis to continue research.

Mr. White left the meeting at approximately 3:55 p.m.

BOWMAN RADAR OPERATIONS

Mr. Langerud briefed the Board on radar operations in Bowman. Eight counties in southwestern North Dakota, eastern Montana and northwest South Dakota are sponsoring running the radar outside of NDCMP months. The counties are splitting the cost to run the radar for 8 months. The data displays on our web site and updates every 5 minutes. It is shared with the National Weather Service. The data is being evaluated to be included in NOAA's regional radar mosaics.

2017 ARB COOPERATIVE OBSERVER NETWORK REPORT

Status Report and Growing Season Rainfall Totals and Grid Maps

Mr. Brothers reported on our volunteer precipitation reporting network. We have 503 rainfall observers and 210 snow observers. Online reporting increased by 5, now at 163. He reported that the network has existed for 41 years with 40 observers who have reported all 41 years. Certificates of appreciation are sent at 10 years, 20 years, 30 years and 40 years. Anyone who has reported at least 30 years is recognized on our web site in our observer Hall of Fame and also are sent a Hall of Fame certificate. Currently, the total number of observers who are still active and have reported at least 30 years is 142.

Mr. Brothers provided the Board with the seasonal percent of normal map for the growing season. He reminded the Board that all precipitation maps are available on our web site. Mr. Langerud reminded the Board of all of the additional ways of getting precipitation data from the State Water Commission web site.

In response to a question from Mr. Erbele, Mr. Brothers responded that there is a map of observers on our web site. Spacing is fairly uniform now. It's definitely a lot better than when Mr. Brothers started working on it 14 years ago. There are a few spots that could use more coverage, such as Sioux County, part of Cass County, and then the national parks out west.

In response to a question from Mr. Bodmer, Mr. Erbele stated that the State Water Commission does not monitor soil moisture at this time.

In response to a question from Mr. Wanner, Mr. Langerud noted that some of the NDAWN sites measure soil moisture.

GPS-Based Snow Reporting

Mr. Langerud reported on work that has been done with a scientist from the University of Colorado who has been doing measurements of snowpack using GPS base stations and taking the reflected signal to determine the depth of snow. We did a trial with her at 2 sites in eastern North Dakota – Absaraka and Casselton. She has now retired. However, the Jet Propulsion Lab (JPL) is going to continue to operate the network she designed. Mr. Langerud reached out to JPL to see if this is something they want to continue with us. Mr. Langerud would like to see it continue. We're using two of the approximately 120 RDO's Precision Ag towers. If we can prove that this works accurately enough, all you need is a communications mechanism on each tower. She offered to give us the algorithm so that we could run it here.

On soil moisture, the SWC Water Appropriations Division is going to start instrumenting some of their test wells next summer with a remote instrument package that will allow them to read water levels and other things. The computer board and communication device that they are using is scalable – it can incorporate a bunch of other probes and data. We're looking at the possibility of testing one of these that has soil moisture, soil temperature and getting some other atmospheric data to help augment the precipitation data that we are collecting. It also might be useful for some of the decisions that are made with regard to ground water. We are hoping to have a prototype to test next summer.

In response to a question from Mr. Erbele, Mr. Langerud noted that the signal radius of the RDO towers is pretty close – within maybe 50 meters or so of the tower feet. It takes an average of the snow depth within 30-50 meters of the tower.

In response to a question from Mr. Bodmer, Mr. Langerud noted that this is a reflected signal from the satellite, to the GPS head and then from the GPS head to the ground and back. The shorter time it takes to reflect, the more depth you have of snow. They can also measure vegetative cover and things like that too.

In response to a question from Mr. Monson, Mr. Langerud stated that the scientist said there is some precision variance. But any depth more than about 3-4 inches, you can


start to see. And then in the summer or fall, they take a footprint of the ground truth and that is the baseline for measurements for each year.

2018 MEETING SCHEDULE

Tentative dates for 2018 board meetings were discussed. The spring meeting will be tentatively scheduled for Wednesday, April 11th via conference call. The fall meeting will be tentatively scheduled for Wednesday, October 24th in Bismarck.

In response to a question from Mr. Hininger, Mr. Schneider reported that he and Mr. Langerud will be meeting with the Williams County Commission on December 5th at 8:30 a.m. CST.

Being no further business the meeting adjourned at approximately 4:13 p.m.


HENRY BODMER
CHAIRMAN


MONTE HININGER
SECRETARY

Transcribed by Kelli Schroeder