10.2 SEEDING AMOUNTS

The amount of silver-iodide nucleating agent dispensed during the 2015 field season totaled 349.2 kg. This was dispensed in the form of 8,127 ejectable (cloud-top) flares (162.5 kg seeding agent), 1138 burn-in-place (cloud-base) flares (170.7 kg seeding agent), and 262.9 gallons of silver iodide seeding solution (16.0 kg seeding agent).

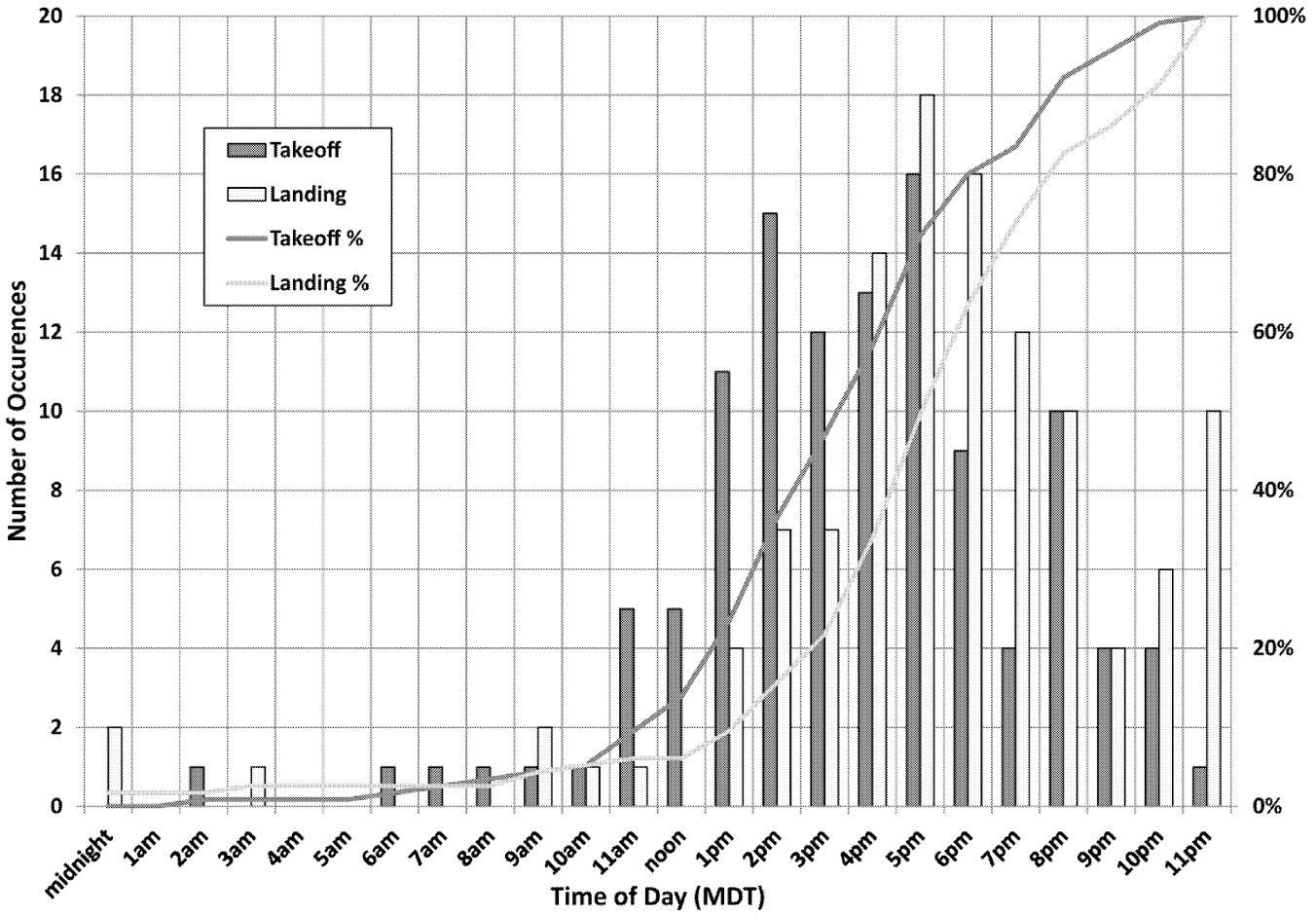

Fig. 24. Diurnal variation in takeoff and landings, 2015 (Mountain Daylight Time). The 115 seeding and patrol flights are included. As is the norm, nocturnal flight operations were limited, especially after midnight.

The amount of AgI dispensed on each day of operations in 2015 is shown in Figure 25. There were 14 days on which more than 10 kg (10,000 grams) of seeding material was dispensed. Most of these were days on which all five aircraft seeded. The amount of seeding agent dispensed per storm was the greatest to date (4.42 kg per storm), significantly more than the long-term project mean of 2.40. This may in part be attributed to the presence of the fifth aircraft, which now enables improved transitions of cloud-top seeding aircraft when one runs out of seeding agent and another must be brought to bear on the storm. In other words, the "gaps" in seeding are now greatly reduced or eliminated altogether.

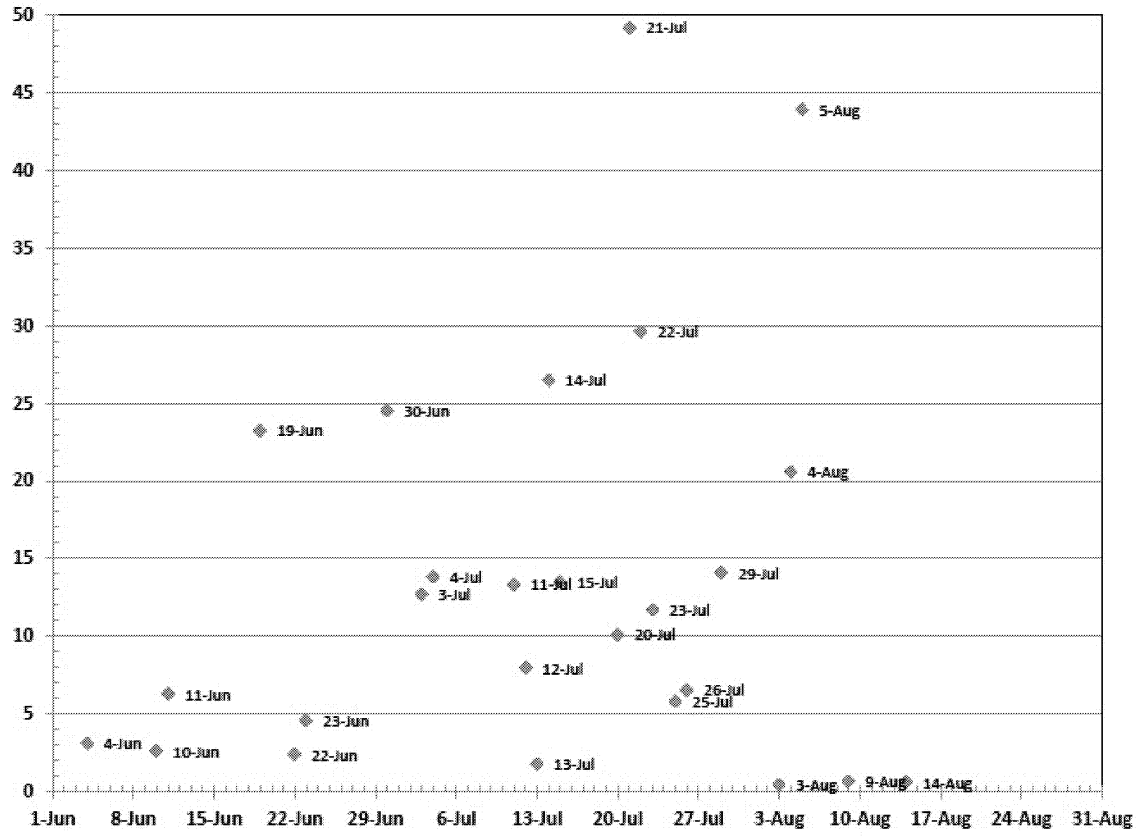

Fig. 25. The amount of seeding agent (silver iodide, AgI) dispensed per operational day, 2015.

Table 5 gives a list of the operational statistics for all twenty seasons of the Alberta Hail Suppression Project. These statistics can be useful in understanding how the current season compared with those before, and for planning purposes. This summer ranked sixth all-time in terms of activity. Seeding occurred on 26 days [mean is 31 days, record (2011) was 48 days]; 115 project missions were flown for patrol and seeding.

Seeding Activity by Season

Season	Storm Days With Seeding	Aircraft Missions (Seeding & Patrol)	Total Flight Time (hours)	Number of Storms Seeded	Total Seeding Agent (kg)	Seeding Agent Per Day (kg)	Seeding Agent Per Hour (kg)	Seeding Agent Per Storm (kg)	Ejectable Flares	Burn-in-place Flares	Seeding Solutions (gallons)	Season Activity Rank
2015	**26**	**115**	**233.3**	**79**	**349.2**	**14.6**	**1.37**	**4.42**	**8127**	**1138**	**262.9**	**6**
Mean	30.9	103.3	212.8	91.8	214.6	6.9	1.02	2.40	5179.6	666.2	162.6	
2014	32	128	259.5	101	382.5	12.0	1.47	3.79	10782	1020	228.6	3
2013	26	103	229.6	70	233.3	9.0	1.02	3.33	6311	636	131.7	10
2012	37	143	300.1	116	314.6	8.5	1.16	2.70	7717	914	260.3	2
2011	48	158	383.0	134	400.1	8.3	1.13	3.00	10779	1020	350.2	1
2010	42	115	271.8	118	263.8	6.3	1.10	2.20	5837	851	227.5	7
2009	20	38	109.3	30	48.4	2.4	0.84	1.60	451	237	56.5	20
2008	26	112	194.7	56	122.9	4.7	1.00	2.20	1648	548	113.5	15
2007	19	76	115.3	41	99.7	5.2	0.90	2.40	1622	413	77	19
2006	28	92	190.2	65	214	7.6	1.10	3.30	4929	703	145.4	12
2005	27	80	157.9	70	159.1	5.9	1.00	2.30	3770	515	94.2	16
2004	29	105	227.5	90	270.9	9.3	1.20	3.00	6513	877	132.7	8
2003	26	92	163.6	79	173.4	6.7	1.10	2.20	4465	518	92.6	14
2002	27	92	157.4	54	124.2	4.6	0.80	2.30	3108	377	80.3	18
2001	36	109	208.3	98	195	5.4	0.90	2.00	5225	533	140.8	9
2000	33	130	265.2	136	343.8	10.4	1.30	2.50	9653	940	141.3	4
1999	39	118	251.3	162	212.7	5.5	0.80	1.30	4439	690	297.5	5
1998	31	96	189.9	153	111.1	3.6	0.60	0.70	2023	496	193.8	11
1997*	38	92	188.1	108	110.8	2.9	0.60	1.00	2376	356	144.3	13
1996*	29	71	159.1	75	163.3	5.6	1.00	2.20	3817	542	80.5	17

**The 1996 and 1997 seasons began on June 15, not June 1, which has been the norm ever since.*

Table 5. Operational statistics for seeding and patrol flights, 1996 through 2015.

The *Season Activity Rank* shown at the far right of Table 5 was calculated as follows: Each parameter for each year was divided by the project mean for that parameter to produce a normalized value. Then, the normalized values of *Storm Days with Seeding*, *Aircraft Missions*, *Total Flight Time*, *Number of Storms Seeded*, *Ejectable Flares*, *BIP Flares*, and *Seeding Solution* were summed for each season. The seasons were then ranked. *Total Seeding Agent*, *Seeding Agent per Day*, *Seeding Agent per Hour*, and *Seeding Agent per Storm* were not included in the ranking as those are all quantities derived from the others.

A summary of the flare and seeding solution usage during the past 20 seasons, by aircraft, is given in Table 6. The Cessna 340s (Hailstop 2 and Hailstop 4) are used mainly as cloud base seeding aircraft because they have lesser performance than the three turbine aircraft and are equipped with the liquid AgI solution burners. Hailstop 1 (Calgary and Springbank) had been a Piper Cheyenne II for all 15 seasons through 2010, but was replaced with a Beech C90 King Air beginning with the 2011 season. The King Airs are newer, have the same engines as the Cheyenne (the Pratt and Whitney of Canada PT-6A), and parts are more readily available. Hailstop 2, based in Springbank, has been a Cessna 340A for all 20 years. Hailstop 3 in Red Deer was a C340 for 4 years (1996-99), a Cheyenne II in 2000, 2003 and 2005, and a King Air C90 in 2004, and now from 2006 to present. The advantages of the C90 are that it has slightly longer endurance for increased seeding time, and good performance for reaching the far western regions of the target area near Rocky Mountain House in a reasonable amount of time (i.e. less than 30 min). The second C340, Hailstop 4, was added in 2008 and based in Red Deer. This was the third season for Hailstop 5, a third King Air C90, which was added to the project in 2013, based at Springbank.

All aircraft remained serviceable for the entire operational period and there were no significant maintenance issues.

The best seeding coverage consists of seeding a storm simultaneously using two aircraft; one at cloud base and another at cloud top (-5 to -10°C) along the upwind "new growth" side of the storm. The King Air aircraft have proven themselves as excellent cloud-top seeders. The seeding strategy has been to stagger the launch of the seeding aircraft, and use one aircraft to seed at cloud base and one aircraft at cloud top when the storm is immediately upwind or over the highest priority areas. However, if multiple storms threaten three or more areas at the same time, generally only one aircraft is used on each storm, or more aircraft are concentrated on the highest population area around Calgary.

Seeding was conducted on the following 26 days: June 4th, 10th, 11th, 19th, 22nd, 23rd, and 30th; July 3rd, 4th, 11th, 12th, 13th, 14th, 15th, 20th, 21st, 22nd, 23rd, 25th, 26th, and 29th; and August 3rd, 4th, 5th, 10th, and 14th. No seeding was conducted in September.

All five aircraft were used for operations (seeding and/or patrol) on the following 6 days (local time) this season: June 19th and 30th; July 20th, 21st, and 22nd; and August 5th. Patrol flights were flown on June 16th, 19th, 23rd, and 30th; July 13th, 20th, 22nd, and 26th; and August 3rd and 14th. No patrol missions were flown in September. Flight operations are summarized in Figure 26.

AIRCRAFT LEGEND:	C340 CESSNA 340A	C90 BEECH KING AIR C90	CHEY PIPER CHEYENNE II

hours = flight hours, EJ = ejectable pyrotechnic, BIP = burn-in-place pyrotechnic, gen hr = hours wingtip solution-burning seeding time

SEASON	Hailstop 1 Springbank (Calgary prior to 2012) FLIGHT HOURS, EJ FLARES, BIP FLARES	Hailstop 2 Springbank (Calgary prior to 2012) FLIGHT HOURS, EJ FLARES, BIP FLARES, GEN HOURS	Hailstop 3 Red Deer FLIGHT HOURS, EJ FLARES, BIP FLARES	Hailstop 4 Red Deer FLIGHT HOURS, EJ FLARES, BIP FLARES, GEN HOURS	Hailstop 5 Springbank FLIGHT HOURS, EJ FLARES, BIP FLARES
2015	C90 55 hours, 2798 EJ, 230 BIP	C340 76 hours, 0 EJ, 272 BIP, 76 gen hr	C90 47 hours, 2845 EJ, 208 BIP	C340 61 hours, 0 EJ, 199 BIP, 55 gen hr	C90 46 hours, 2484 EJ, 229 BIP
2014	C90 71 hours, 3554 EJ, 268 BIP	C340 60 hours, 0 EJ, 198 BIP, 57 gen hr	C90 41 hours, 3558 EJ, 207 BIP	C340 64 hours, 90 EJ, 190 BIP, 58 gen hr	C90 72 hours, 3580 EJ, 157 BIP
2013	C90 41 hours, 1149 EJ, 115 BIP	C340 58 hours, 0 EJ, 148 BIP, 37 gen hr	C90 42 hours, 3381 EJ, 166 BIP	C340 48 hours, 0 EJ, 78 BIP, 31 gen hr	C90 40 hours, 1781 EJ, 129 BIP
2012	C90 76 hours, 3250 EJ, 232 BIP	C340 87 hours, 0 EJ, 224 BIP, 72 gen hr	C90 83 hours, 4464 EJ, 198 BIP	C340 85 hours, 3 EJ, 260 BIP, 63 gen hr	
2011	C90 97 hours, 4783 EJ, 239 BIP	C340 105 hours, 244 EJ, 269 BIP, 91 gen hr	C90 99 hours, 5646 EJ, 273 BIP	C340 108 hours, 106 EJ, 239 BIP, 92 gen hr	
2010	CHEY 62 hours, 1612 EJ, 132 BIP	C340 82 hours, 74 EJ, 236 BIP, 53 gen hr	C90 96 hours, 4154 EJ, 200 BIP	C340 68 hours, 2 EJ, 286 BIP, 64 gen hr	
2009	CHEY 22 hours, 250 EJ, 27 BIP	C340 31 hours, 0 EJ, 65 BIP, 6 gen hr	C90 24 hours, 201 EJ, 48 BIP	C340 33 hours, 0 EJ, 97 BIP, 17 gen hr	
2008	CHEY 65 hours, 953 EJ, 88 BIP	C340 44 hours, 0 EJ, 171 BIP, 27 gen hr	C90 51 hours, 695 EJ, 169 BIP	C340 35 hours, 0 EJ, 120 BIP, 19 gen hr	
2007	CHEY 40 hours, 979 EJ, 81 BIP	C340 41 hours, 0 EJ, 155 BIP, 31 gen hr	C90 34 hours, 643 EJ, 177 BIP		
2006	CHEY 54 hours, 3217 EJ, 179 BIP	C340 70 hours, 72 EJ, 248 BIP, 58 gen hr	C90 66 hours, 1640 EJ, 276 BIP		
2005	CHEY 49 hours, 2750 EJ, 169 BIP	C340 45 hours, 0 EJ, 121 BIP, 38 gen hr	CHEY 64 hours, 1020 EJ, 225 BIP		
2004	CHEY 83 hours, 5574 EJ, 359 BIP	C340 62 hours, 0 EJ, 196 BIP, 53 gen hr	C90 82 hours, 939 EJ, 322 BIP		
2003	CHEY 64 hours, 3598 EJ, 250 BIP	C340 54 hours, 0 EJ, 130 BIP, 37 gen hr	CHEY 46 hours, 867 EJ, 138 BIP		
2002	CHEY 57 hours, 1994 EJ, 163 BIP	C340 49 hours, 2 EJ, 73 BIP, 32 gen hr	CHEY 51 hours, 1112 EJ, 141 BIP		
2001	CHEY 62 hours, 3174 EJ, 216 BIP	C340 75 hours, 4 EJ, 215 BIP, 56 gen hr	CHEY 68 hours, 2093 EJ, 102 BIP		
2000	CHEY 90 hours, 4755 EJ, 379 BIP	C340 77 hours, 164 EJ, 193 BIP, 56 gen hr	CHEY 97 hours, 4734 EJ, 368 BIP		
1999	CHEY 91 hours, 3795 EJ, 313 BIP	C340 81 hours, 244 EJ, 197 BIP, 60 gen hr	C340 79 hours, 400 EJ, 180 BIP, 59 gen hr		
1998	CHEY 62 hours, 1880 EJ, 107 BIP	C340 68 hours, 134 EJ, 199 BIP, 29 gen hr	C340 59 hours, 9 EJ, 190 BIP, 48 gen hr		
1997	CHEY 70 hours, 1828 EJ, 62 BIP	C340 58 hours, 264 EJ, 128 BIP, 26 gen hr	C340 60 hours, 284 EJ, 166 BIP, 32 gen hr		
1996	CHEY 62 hours, 2128 EJ, 143 BIP	C340 46 hours, 895 EJ, 192 BIP, 9 gen hr	C340 52 hours, 794 EJ, 207 BIP, 23 gen hr		

Table 6. Cloud seeding pyrotechnic and seeding solution usage by aircraft, through the 2015 season.

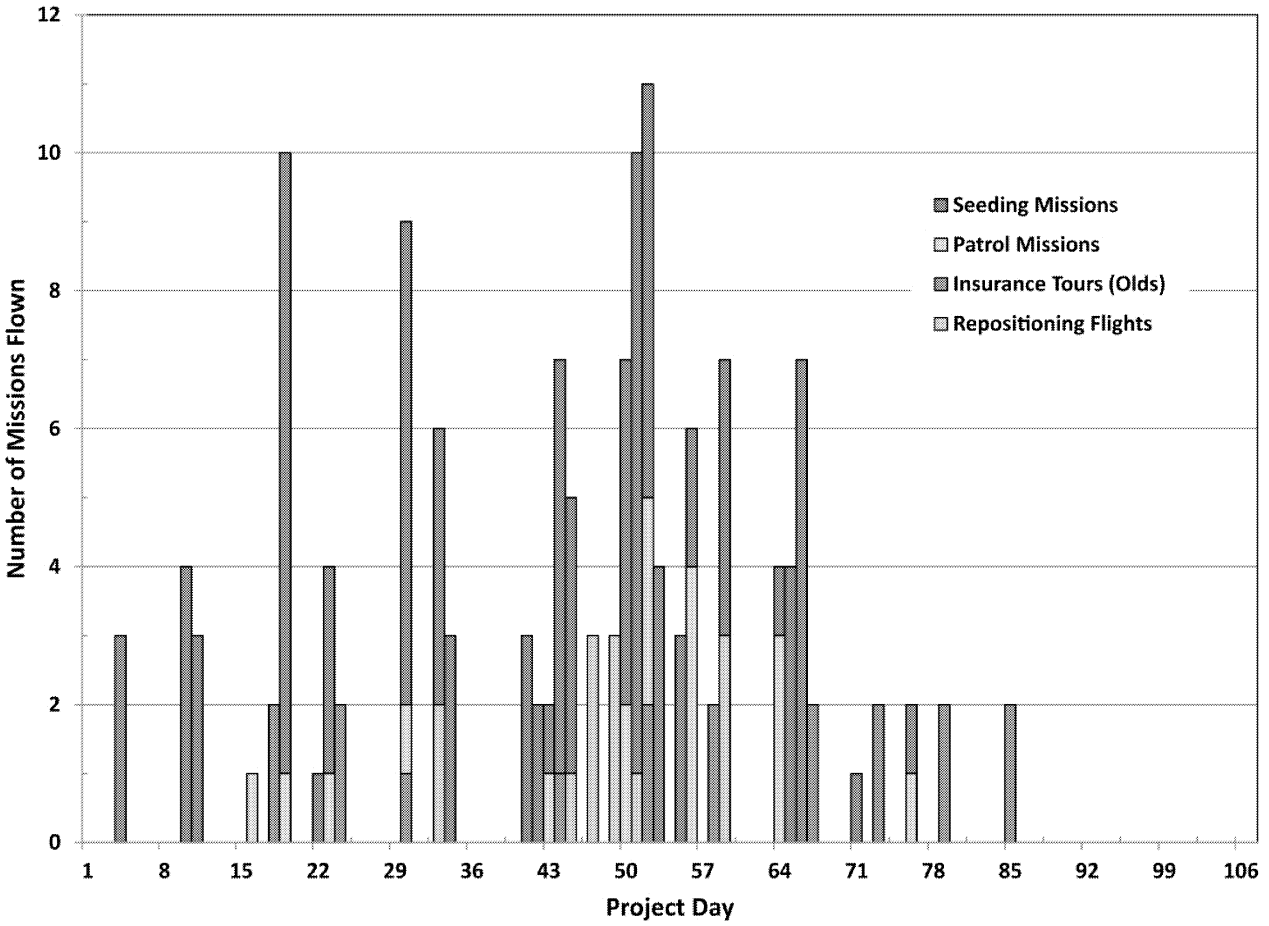

Fig. 26. The number of flights, by type, is shown for each project day of the 2015 season. Months are shown at the top of the graphic. The "Insurance Tours" flights were those made to the Operations Centre at the Olds-Didsbury Airport for the ten continuing education training sessions certified by the Alberta Insurance Industry. On two of the ten days, only one flight is shown in this category because weather developed that caused the departing flight to be a seeding or patrol flight.

10.3 STORM TRACKS

A map of all hailstorm tracks (determined by radar) during 2015 is shown in Figure 27. July was the stormiest month, which is the climatological normal. There were eight storms that tracked across or within the city limits of Calgary during the 2015 season. Hail damage was reported in isolated neighborhoods of the city on four of these days including June 30th, July 11th, and August 4-5th. Fortunately, there were no major "swaths" of damage that tore through Calgary this season.

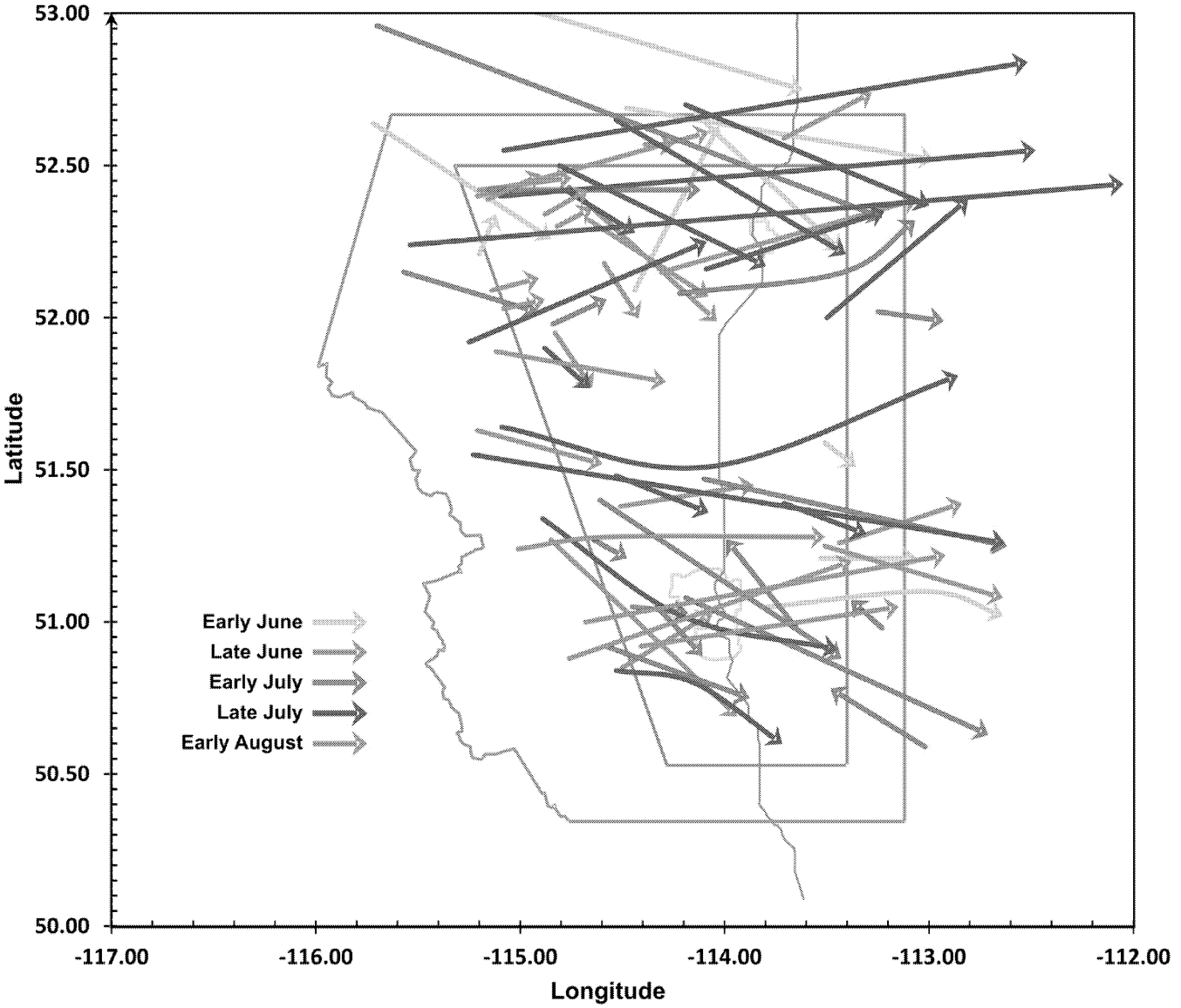

Fig. 27. Map of all potential hailstorm tracks within radar coverage during 2015, as indicated by a minimum vertically-integrated liquid (VIL, from the radar) of at least 30 kg/m^2. This map shows all of the 79 storms seeded, plus others of hail potential that did not move near cities or towns. All storms must be carefully monitored because as the tracks show, direction of movement often changes. June storms are green, July red, and August blue. There were no storms meeting the minimum criterion after August 15th, so no tracks are shown for the latter half of August or September. For June and July, the lighter color denotes storms that occurred during the first half of the month.

The number and distribution of storm tracks during 2015 were similar to previous seasons, with July getting honors for being the most active month. Activity waned sharply after the first week of August, and not even a patrol flight was flown in September. The plotted storm tracks shown in Figures 27-30 include more than just start and end points whenever storms turned appreciably during their lifetimes, giving a better understanding of storm behavior. No plot is shown for September 2015

Hail was reported within the project area (protected area and buffer area) on 46 days. Larger than golf ball size hail was reported on July 21st in the city of Lacombe. Then, on July 22nd, larger-than-golf ball size hail was reported in Calgary.

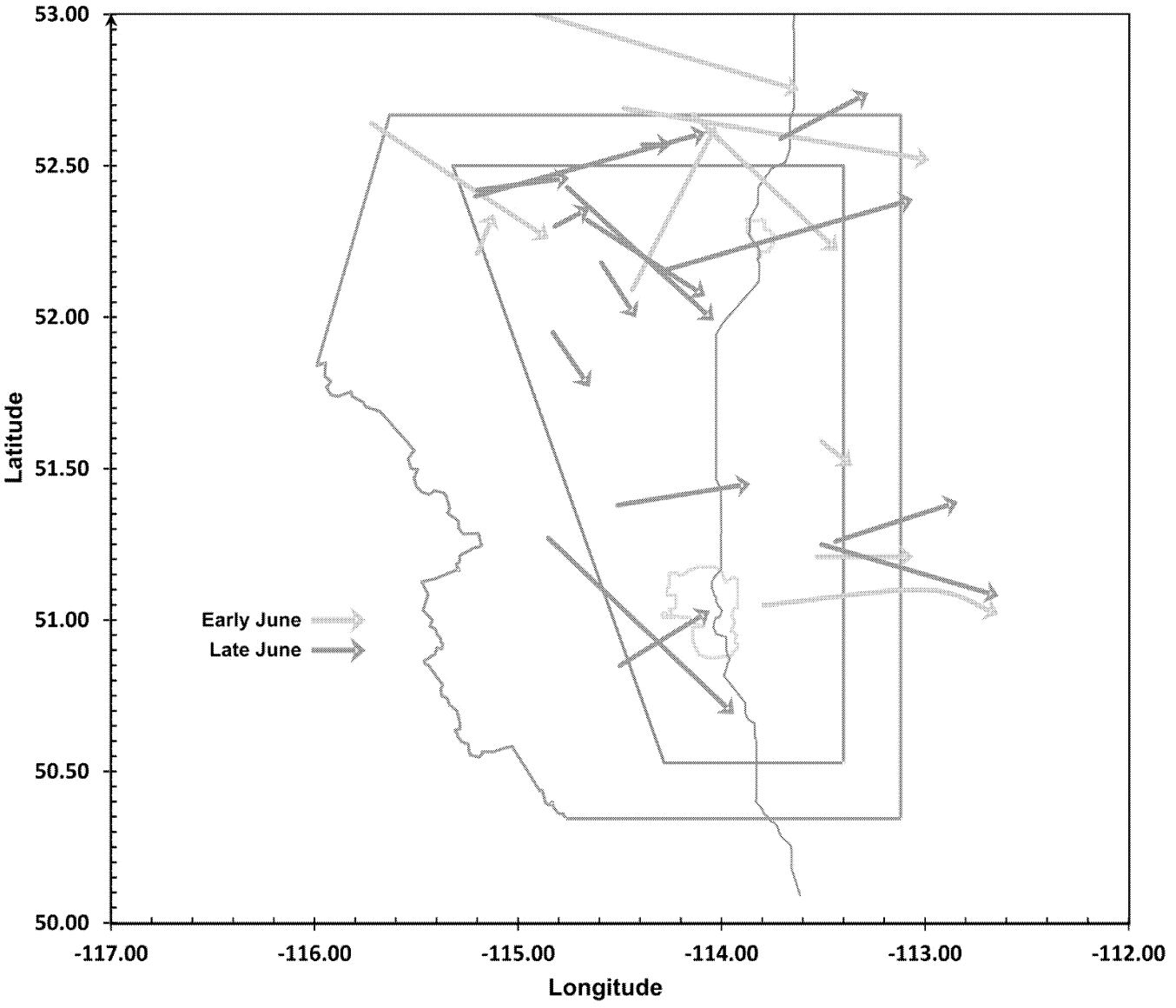

Fig. 28. As in Figure 27, but for the month of June 2015.

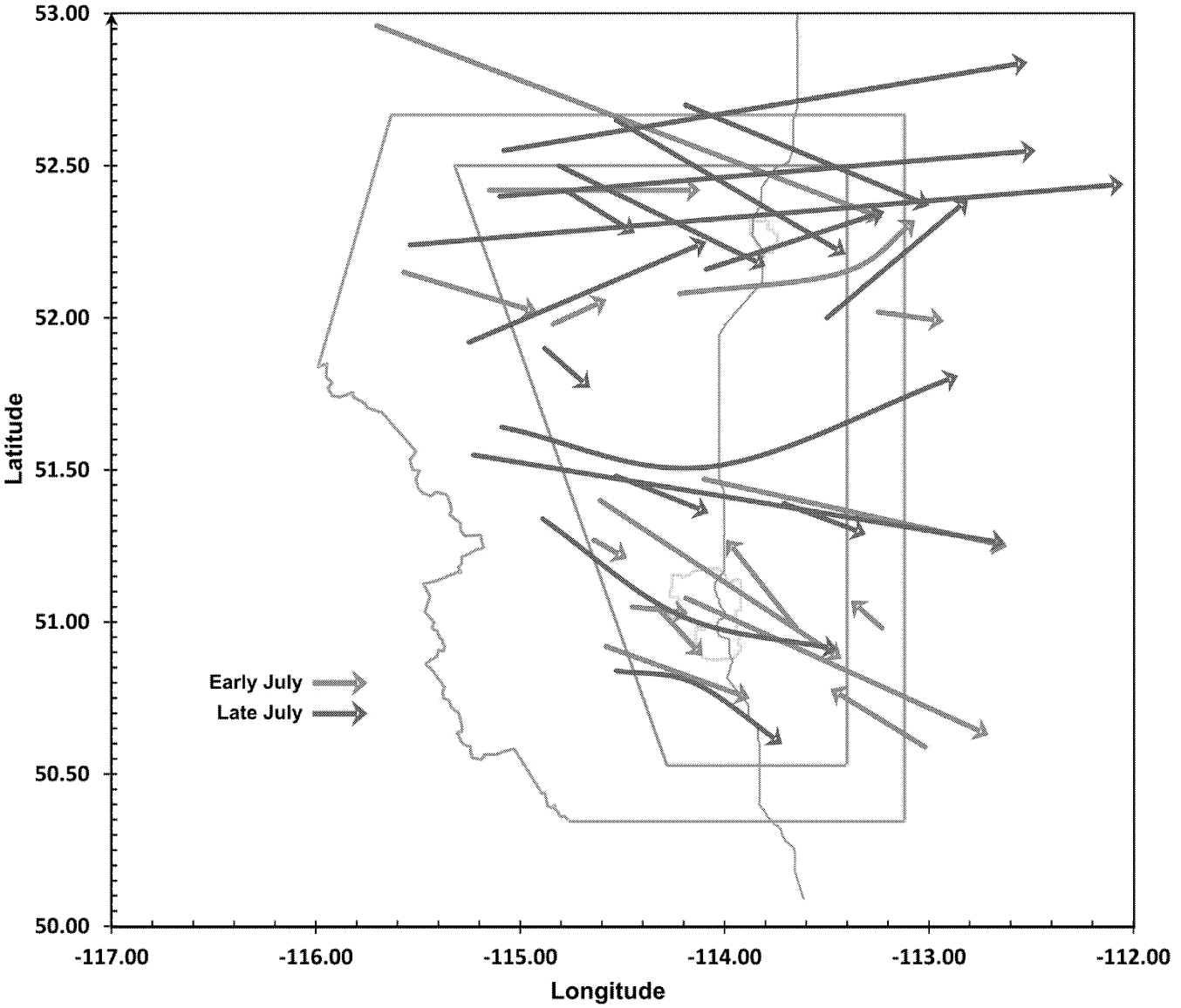

Fig. 29. As in Figure 27, but for the month of July 2015.

Golf ball size hail was reported or observed by radar signature on June 11th south of Ponoka; June 30th southwest of Calgary; near Bentley on July 3rd; the 11th of July southwest of Calgary; on July 23rd east of Lacombe; and on the 5th of August in Calgary.

Walnut size hail was reported or observed by radar signature on June 10th south of Rocky Mountain House; southeast of Airdrie and near Chestermere on July 12th; July 14th southeast of Chestermere; southwest of Cremona on July 26th; July 29th west of Red Deer; and in Calgary on August 4th.

The weather pattern during the summer of 2015 was less active than the previous summer, having 26 seeding days, while the twenty-season average is about 31. However, those twenty-six days were active, for all five Hailstop aircraft flew on six days, and all five aircraft seeded on four of those six days.

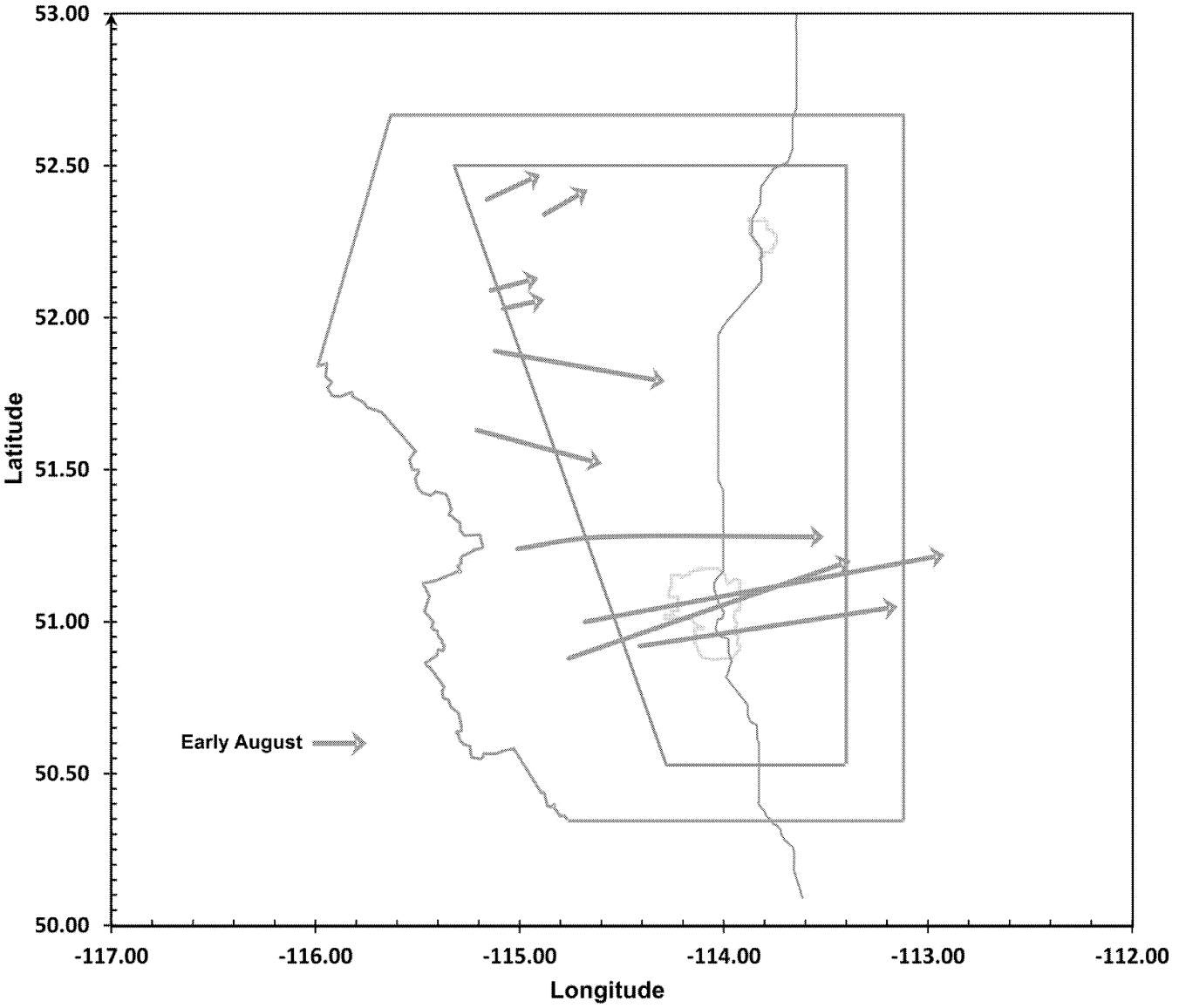

Fig. 30. As in Figure 27, but for the month of August 2015.

11. WEATHER FORECASTING

A project forecast was prepared each operational day throughout the project period by the assigned project meteorologist. In addition to the real-time information available from the project radar at the Olds-Didsbury Airport, the forecasting meteorologist used local weather observations as well as a vast array of weather data available on the internet.

11.1 COORDINATED UNIVERSAL TIME

The standard reference time chosen for the project field operations is universal time coordinates (UTC), also known as coordinated universal time (CUT), or Greenwich Mean Time (GMT). This is the accepted international standard of time for general aviation and meteorological observations, reporting, and communication. In Alberta, UTC is 6 hours ahead of local Mountain Daylight time. For example, 12:00 noon local Alberta time is equal to 18:00 UTC, and 6:00 PM local is equal to 24:00 or 00:00 UTC. This can cause some confusion, especially with non-project personnel, since many of the thunderstorms occurred late in the day and continue beyond 6:00 PM local time, which is midnight or 00:00 hours UTC. The standard convention incorporated by the Alberta project is to report all aircraft, radar, and meteorological times in UTC; however, the for convenience summary tables are all organized according to the local calendar "storm" day with respect to Mountain Daylight Time.

11.2 PURPOSE

The primary function of the daily forecast is to impart to project personnel a general understanding of that day's meteorological situation, particularly as it relates to the potential for hail-producing storms. In this role it is useful, but because the data in hand are limited in temporal and spatial resolution, and because the forecasters themselves are human and thus fallible, the forecast can never be taken as the final word as to whether activity will or will not develop. Forecasts of no or limited convective activity do not relieve any project personnel of their hail-fighting responsibilities, and should not reduce vigilance or readiness of meteorological staff or flight crews. In theory, the project could function effectively without project forecasts. In reality, the forecasts are useful for a number of reasons:

- Elective maintenance of project-critical facilities (radar and aircraft) can be conducted on days when the probability of workable storms is less.
- Forecasts offer insight regarding the time at which convection is likely to initiate, thus allowing some intelligence in handling decisions about aircraft standby times.
- Preferred areas, e.g. northern, central, or southern portions of the protected area that are more prone to see action are identified in the forecasts, providing the logical basis for assignment of which aircraft are initially placed on standby.
- Forecasts attempt to quantify the available atmospheric instability, and thus the likelihood of explosive cloud/storm development. Days having high potential for rapid cloud growth require more immediate action.

Post-hoc forecast verification conducted by the meteorologists is a helpful tool to increase our understanding of Alberta thunderstorms, especially the atmospheric indicators (precursors) in the pre-storm environment. As this knowledge improves, so will our ability to anticipate and react to the initial deep convection.

So, while in theory the forecasts are not needed, they are useful and considered to be essential. The ultimate defense against the unexpected, unforecast, explosively-developing severe storm would be to always have aircraft airborne, patrolling the skies, scanning for the first sign of intense vertical cloud growth. More realistically, one might have flight crews constantly waiting, ready to scramble. The funding available for the project does not allow either of these, however, so the forecast becomes the primary tool through which the available resources can be allocated in the most effective manner.

It is also worth noting that even when equipment and personnel work together efficiently as a well-oiled, smooth-running machine, hail damage can still occur. A typical thunderstorm releases as much energy in its lifetime as a nuclear bomb. Cloud seeding can affect the microphysical (precipitation) processes, but we do not yet have the knowledge or tools to affect the energy released. Nature, in the end, sometimes offers more than can be handled.

11.3 PROCESS AND DISSEMINATION

Project forecasts were valid from 6:00 AM through 6:00 AM the next day, and also include a day-two outlook. The daily forecast preparation began with an assessment of the current weather conditions. The latest METARs (hourly surface weather reports), weather station data, radar and satellite imagery were noted and saved. The latest surface and upper air analysis maps were printed and saved. All data were saved with file names that utilize the proper WMI file naming procedures, with YYYYMMDD (year-month-day) at the beginning of the file name. Once the forecaster had a grasp of the current conditions, outside agency forecasts were examined in order to give a first-best-guess of the day's probable events. Often times, project personnel would request a "pre-forecast" before the official forecast is ready. NAV Canada, Environment Canada forecasts and BUFKIT soundings are always useful for this purpose.

The forecaster then examined the various operational prognostic model output. Typically, the WRF was the most up to date model in the early morning. All forecasters had their own preference for operational models, but some of the choices available include the WRF/NAM, GFS, ECMWF, SREF and the Canadian models. Model data were archived daily (but not printed) for the 250 mb, 500 mb, 700 mb, and surface pressure surfaces. Saved maps include the most current map (usually 12Z) through hour 48. Certain features are always of interest at certain levels:

- The 250 mb level best reflects the location of the upper jet stream winds, around 35,000 feet altitude. This map was analyzed for the general wave pattern (ridge/trough), upper level diffluence, and jet streaks. The right entrance and left exit quadrants of an upper jet streak are considered favorable regions for enhanced upward motions. Storm days with "upper support" tend to produce more vigorous convection than days without.

- The 500 mb level reflects the middle (pressure-wise) of the atmosphere around 18,000 feet, which is generally the boundary between upper and lower level weather features (aka: the level of non-divergence). The 500 mb charts were examined for temperatures, humidity, wave pattern, and especially vorticity (rotation). Advection of 500 mb vorticity from broad scale troughs, lows, or shortwaves tends to cause air to rise. This can be a trigger to help break through low level temperature inversions, or just simply enhance the amount of vertical motion in the atmosphere. Cold, dry conditions at this level are often indicative of an unstable atmosphere. Many convective stability indices utilize temperature and dew point between the surface and 500 mb. History shows that some of the worst Alberta hail storms occurred on days with only moderate instability but with strong 500 mb vorticity advection and upper jet support.

- 700 mb is the lower to mid-level of the atmosphere around 10,000 feet, usually near the height of the convective cloud base. The 700 mb charts are most typically used to determine the amount of low level moisture over a region. Lots of 700 mb moisture contributes to unstable atmospheres. Relative humidity, theta-E (equivalent potential temperature), and vertical velocity charts are all useful tools at this level. Shortwave troughs are sometimes evident on 700 mb vertical velocity charts when they are not easily identified at 500 mb. The presence of a theta-E ridge at or below 700 mb should be a red flag that nocturnal convection is possible. The 700 mb charts are also be analyzed for the presence of inversions or "caps" that inhibit surface-based convection, although this is usually more easily identified on a sounding than on a map.

Surface prognostic (forecast) charts (progs) were analyzed for the presence of lifting mechanisms such as troughs, lows, fronts, and dry lines. Such lifting mechanisms are triggers for initiating thunderstorms when the atmosphere is unstable. Moist, warm surface conditions are indicative of an unstable atmosphere. After sunset however, the lowest levels of the atmosphere tend to "decouple" from the upper and middle atmosphere as the air mass cools from the bottom up. This means that surface temperature and moisture are most important during the daytime and evening hours and can have less impact at night. It is a good idea to consult multiple sources for surface prognostic charts, as some analyses will omit important features. There can be major differences from one source to the next when it comes to surface analysis and timing. In general, surface dew points greater than 9°C are considered sufficient for large hail storms. Thunderstorm development becomes unlikely with dew points less than 5°C. Surface charts may also be utilized to determine areas with upslope flow. Low-level easterly winds flowing up the eastern slopes of the mountains are frequently the cause for storm initiation for the project.

After all model charts were saved, the forecaster created a daily meteorogram. This is a one-page tool that includes multiple strip charts of the forecaster's choosing. Typical parameters for the meteorogram include temperature and dew point, cloud cover, wind direction/speed, CAPE, lifted index, convective inhibition, etc. The meteorogram is typically created for both Calgary and Red Deer every morning, but other locations can be utilized depending on where the forecaster thinks the best chance for deep convection (thunderstorms) will occur on that day. The meteorogram is printed and saved in the archives. The strip charts are valid through at least three days and can be a great tool for determining the extended outlook.

The next step was to create a daily sounding, or Skew-T diagram. Unfortunately, the closest real weather balloon site is Edmonton, which is too far away to use for forecasting in the project area. Forecast soundings from the numerical models were thus preferred, which could be generated through a host of different internet sources.

The 12Z and 00Z WRF/NAM soundings were archived for both Red Deer and Calgary on a daily basis. These data were also utilized for running the HAILCAST model when necessary. At this point the forecaster chose a location and valid time for the daily forecast sounding. This was the time and place with the worst-case scenario for the highest CDC (Convective Day Category) through the next 24 hours, typically Red Deer or Calgary. Most forecasts were made based on expected conditions at 00Z because the atmosphere is usually most unstable in the late afternoon. However this may be sooner or later depending on the timing of surface features, etc. Once the place and time were decided, the selected forecast sounding was opened with the RAOB software and modified as deemed physically plausible, to provide a worst-case scenario (most intense convection possible). This often involved raising or lowering the surface temperature to best represent the expected maximum temperature for the day. The amount of surface moisture could be modified as well, but this was done with care so as not to overdo it. This has a large effect and can be the cause of busted forecasts. Once the sounding was modified, all convective parameters were recorded on the daily metstats sheet, and the sounding was printed. An image of the sounding was always saved, which was emailed with the rest of the forecast.

The forecaster then completed the daily forecast sheet. The map interpretation was drawn by hand, and included the following for the chosen valid time: 500 mb height analysis, surface analysis (including fronts, lows, highs, troughs, and dry lines), position of upper jet streaks, and position of any shortwaves or vorticity maxima/lobes. The Synopsis section included a brief explanation of the features that were most relevant to the forecast. Each forecast box contained a concise description of the expected weather for the entire 24 hour period through the next morning at 9:00 AM. The rest of the forecast parameters and winds were taken directly from the modified sounding, and were identical to the forecast sounding that was printed out. The forecast sheet also included a checklist. The purpose of the checklist is to make sure the forecaster does not inadvertently miss or forget an important weather feature.

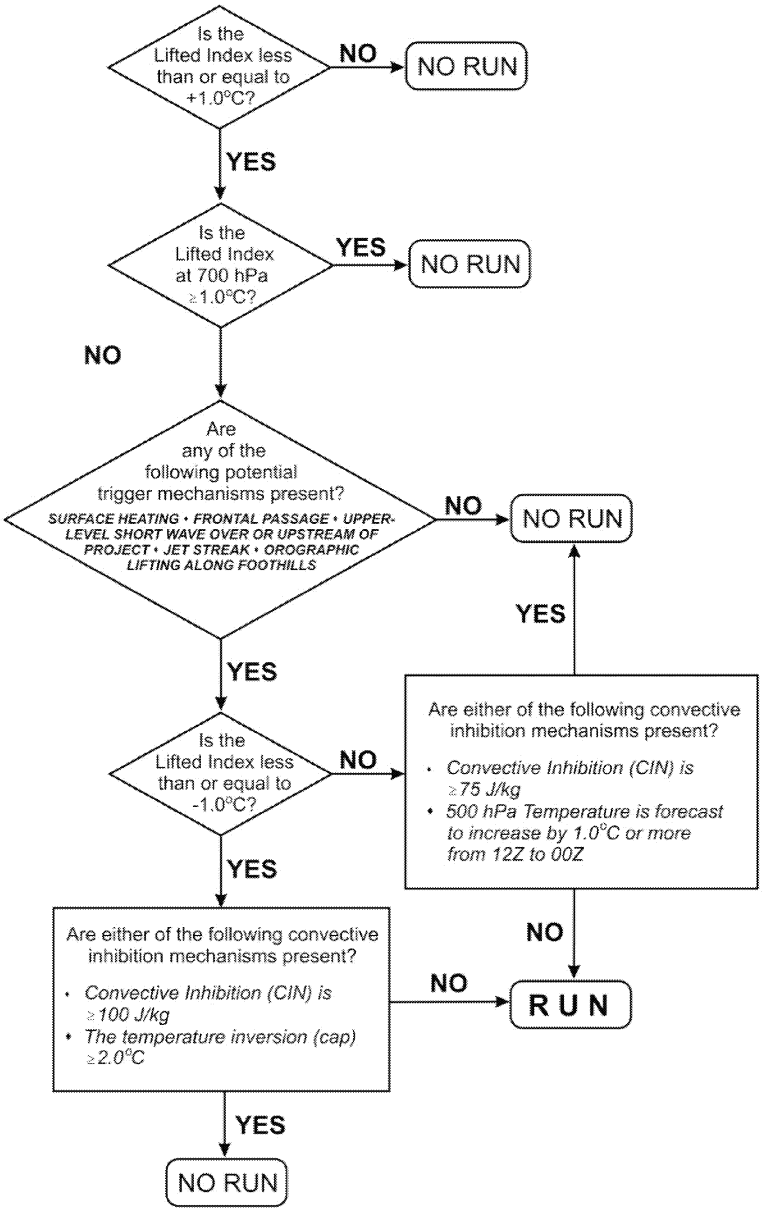

Fig. 31. Hailcast run/no-run flow chart.

Before making the final decision about the likelihood and size of hail, the forecaster sometimes needed to run the HAILCAST model (Brimelow *et al.,* 2006). To determine whether or not to run the model, a decision tree is used (Figure 31). Research has shown that the model works well with some conditions, but has been found lacking under other scenarios. The decision tree is meant to remove situations where the model is not helpful. If the model is to be run, the forecast sounding data was modified to the required HAILCAST sounding format and saved as text files in the appropriate folder. Then the model was run with the expected high temperature and dew point for the day. The average output from the models is included on the forecast sheet.

Finally, the decision was made as to the Convective Day Category (CDC). This was the last decision before the forecast was sent out to project personnel. The CDC was marked on the forecast sheet, and the sheet scanned and saved according to WMI file naming procedures. It was then emailed to the "forecast" list through the company email exchange using the Olds radar email account. The subject line of the email uses the format "YYYYMMDD AB forecast". The forecaster attached the scanned forecast sheet and saved sounding image to the email and sent it at 10:45 local time, or about 15 minutes prior to the daily briefing.

11.4 DAILY BRIEFINGS

All project staff participated in a telephone conference call weather briefing each day at 11:00 AM (local time), a change from recent summers, to allow more time between briefing and the daily onset of convection. Teamwork depends on good communications, and so all personnel were required to attend the daily briefing at one of three locations: the radar, the Calgary Airport office, or the Red Deer Airport office. This briefing session included a debriefing and summary of the previous day's operations (if any), discussion of the weather situation, presentation of the weather forecast and operational meteorological statistics, predicted hail threat, cloud base heights and temperatures, upper level winds, storm motion, equipment status reports, and operational plans for the day. After the briefing, crews were put on telephone standby or asked to remain at the airport on standby. All personnel were equipped with telephones to allow quick access and constant communications, day or night.

If no seeding was expected within the next few hours after briefing (i.e. clear skies), flight crews were put on telephone standby. If operations were likely within the next few hours or actively growing cumulus were present, then crews were put on Airport Standby immediately following the briefing. During briefing, one crew at each site was always designated as "first up" or the first aircraft to be called if needed. Weather conditions and aircraft maintenance dictated which crews will be first up on any given day. If ceilings are very low, top seeders were designated as first up. If an aircraft is scheduled for maintenance, however routine, then it will not be first up since it may have delays in launch time. When not on airport standby, crews are on telephone standby (maximum 60 minutes from airport) at any time unless consulting with the project manager or meteorologists.

11.5 THE CONVECTIVE DAY CATEGORY (CDC)

The daily weather forecast established the Convective Day Category (CDC) that best described the conditions that were expected for each day. The CDC (Strong 1979) is an index that gives the potential for hailstorm activity and thus seeding operations. A description of the weather conditions for each CDC is given in Table 7. The distinction between the -2 and -1 category is sometimes difficult, since overcast or prolonged rains eventually break up into scattered showers. The maximum vertically-integrated liquid (VIL) recorded by TITAN is used for forecast verification of hail size in the absence of surface hail reports. Radar VIL values are used within the project area or buffer zones on the north, east, and south sides (not including the mountains or foothills of the western buffer zone). This may have increased the number of declared hail days from the early project years, which relied on a human report of hail fall at the surface; however, it is believed to be a more realistic measure of hail. The +1 category minimum hail size is assumed to be 5 mm since this is a common minimum size for hail used by numerical modelers, and also the recognized size threshold for hail. Smaller ice particles, those less than 5 mm diameter, are generally called snow pellets or graupel.

Convective Day Category (CDC)

CDC	Strategy	Description
-3	No Seed	Clear skies, fair weather cumulus, or stratus (with no rain). No deep convection.
-2	No Seed	Towering cumulus, altocumulus, alto-stratus, or nimbostratus producing rain for several hours or weak echoes (e.g. virga).
-1	No Seed	Scattered convective rain showers but no threat of hail. No reports of lightning.
0	Patrol flights and potential seeding.	Thunderstorms (at least one) but no hail. VIL < 20 kg/m^2 within the project area or buffer zones on north, east, and south sides.
+1	Seed	Thunderstorms with pea or shot size hail (0.5 to 1.2 cm diameter). 20 kg/m^2 < VIL < 30 kg/m^2
+2	Seed	Thunderstorms with grape size hail (1.3 to 2.0 cm diameter). 30 kg/m^2 < VIL < 70 kg/m^2
+3	Seed	Thunderstorms with walnut size hail (2.1 to 3.2 cm diameter). 70 kg/m^2 < VIL < 100 kg/m^2
+4	Seed	Thunderstorms with golf ball size hail (3.3 to 5.2 cm diameter). VIL > 100 kg/m^2
+5	Seed	Thunderstorms with greater than golf ball size hail (>5.2 cm diameter).

Table 7. The Convective Day Category (CDC).

Various meteorological parameters were also forecast in addition to the CDC. These parameters were used in developing a seeding strategy and were passed on to pilots during the weather briefing. The meteorological parameters were recorded each day and archived for future analysis.

11.6 METEOROLOGICAL STATISTICS

A complete listing of the daily meteorological statistics is given in Appendix I. A summary of the important daily atmospheric parameters used as inputs for the daily forecast of the CDC and threat of hail is given in Table 8. Hail days are defined by either a report of hail at the surface or by a vertically-integrated-liquid water (VIL) measurement from the radar of at least 30 kg/m^2.

Summary of Daily Atmospheric Parameters

Parameter	*For All Days (107)*				*For Hail Days Only (46)*			
	Avg	*StdDev*	*Max*	*Min*	*Avg*	*StdDev*	*Max*	*Min*
Forecast CDC	0.5	1.9	4	-3	1.9	1.3	4	-2
Observed CDC	0.3	2.0	5	-3	2.2	1.2	5	1
Precipitable Water (inches)	0.8	0.2	1.4	0.4	0.9	0.2	1.4	0.5
0°C Level (kft)	11.4	2.1	15.7	6.3	11.6	1.6	15	8.5
-5°C Level (kft)	13.9	2.1	17.9	9.5	14	1.8	17.9	10.3
-10°C Level (kft)	16.6	2.1	21.2	11.9	16.6	1.9	21.2	12.7
Cloud Base Height (kft)	9.3	2.3	14.5	3.8	9.1	1.8	13.5	5.7
Cloud Base Temp (°C)	4.8	3.2	12.3	-2.1	6	3.3	12.3	-0.4
Maximum Cloud Top Height (kft)	29.5	8.5	41.8	8.5	33.7	4.5	41.7	25.1
Temp. Maximum (°C)	21.9	5.5	31	7.5	22.6	3.9	31	14
Dew Point (°C)	8.9	2.9	16	2.4	9.8	2.9	16	3
Convective Temp (°C)	22	6.1	34.2	7.5	22.2	4.3	31.9	13.2
Conv. Avbl. Potential Energy (J/kg)	551.6	481.1	2253	0	797.8	475.6	2253	116
Total Totals	52.5	4.3	64.3	39.8	54.3	3.2	64.3	47.7
Lifted Index	-1.8	2.6	7	-8	-3.1	1.4	-1	-8
Showalter Index	-1	2.7	8.1	-8.2	-2.3	1.5	0.7	-8.2
Cell Direction (deg)	267	56	358	10	259	53.5	329	10
Cell Speed (knots)	21.7	8.3	49	6	21.2	8.2	40	6
Storm Direction (deg)	277	80	359	1	269	76.7	344	1
Storm Speed (knots)	14.4	5.8	36	2	13.5	5.3	29	2
Low Level Wind Direction (deg)	253	66	360	16	249	56.2	344	16
Low Level Wind Speed (knots)	14.3	6.1	40	4	13.4	5.9	40	5
Mid-Level Wind Direction (deg)	265	56	358	2	250	62.2	317	2
Mid-Level Wind Speed (knots)	28	11.6	65	2	26.5	10.7	47	2
High Level Wind Direction (deg)	262	51	350	16	250	47.6	347	106
High Level Wind Speed (knots)	51.2	22.6	114	8	43	17.9	79	8

Table 8. Summary of Daily Atmospheric Parameters.

The statistics exclusively for hail days are provided in the rightmost four columns of Table 8. During the 2015 season, hail was observed or detected by radar on 46 of the 107 project days, or 43% of all days. Tables 8 reveals what one would expect: hail is more common when moisture (precipitable water) is greater, when stability is less (Lifted Index), and when convective available potential energy, or CAPE, is greater. An interesting note is that though a CDC of +5 was never forecast in 2015, two +5 days occurred. The forecasting for the season is examined in greater detail in the following section. However, on the two +5 CDC days, +4 was forecast both times.

11.7 FORECASTING PERFORMANCE

The following tables indicate the forecasting performance for the summer season with respect to the forecast and observed weather conditions as defined by the "Convective Day Category" or CDC within the project area. A CDC greater than zero indicates hail. The forecasts were verified by the weather observations as reported by Environment Canada, crop insurance reports received from the Agriculture Financial Services Corporation in Lacombe, and also by public reports of hail in the press, radio, and television, as well as by the reports from project personnel. The Vertical Integrated Liquid (VIL) radar parameter was also used as a verification tool, but secondary to actual hail reports. The CDCs forecast compared to those actually observed in 2015 are summarized in Table 9.

		Observed Days		
		No Hail	***Hail***	***Totals***
Forecast Days	***No Hail***	47 [44%]	6 [6%]	53 [50%]
	Hail	14 [13%]	40 [37%]	54 [50%]
	Totals	61 [57%]	46 [43%]	107

Table 9. Comparison of CDCs Forecasts & Observations.

In 2015, hail fell within the project area on 46 of 107 days (43%), leaving 61 days without hail (57%). The forecast was correct in forecasting "hail" on 40 of 46 observed hail days (87%) and failed to forecast hail on 6 hail days (13%). The forecast was correct in forecasting "no-hail" on 47 of 61 observed no-hail days (77%). On five of the six "misses", days on which hail occurred but was not forecast, the hail was small (CDC of +1), and on the sixth, only +2. The forecast incorrectly forecast hail (false alarms) on 14 of the 61 days when no-hail was observed (23%). The WMI meteorologists did an excellent job with forecasting large hail in 2015 and didn't miss any of the significant hail days.

The Heidke Skill Score (HSS) for WMI this past year (from Table 10) was 0.63, down slightly from 0.66 in 2014. The HSS varies from –1 for no skill to +1 for perfect forecasts. The forecasting skill is considered significant if HSS is greater than 0.4, which was again greatly exceeded in 2015.

	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002
POD (Hailcast)	.81	.85	.89	.75	.72	.77	.91	.80	.82	.69	.84	.91	.76	.81
POD (WMI)	.87	.90	.97	.98	.85	.85	.83	.68	.76	.69	.61	.60	.86	.83
FAR (Hailcast)	.39	.19	.15	.22	.21	.31	.29	.35	.30	.31	.45	.47	.56	.34
FAR (WMI)	.26	.19	.18	.23	.13	.14	.13	.20	.11	.14	.18	.30	.16	.33
HSS (Hailcast)	.43	.35	.66	.51	.49	.46	.44	.43	.46	.35	.31	.39	.33	.56
HSS (WMI)	.63	.66	.67	.68	.65	.72	.63	.49	.66	.55	.42	.51	.63	.59
CSI (Hailcast)	.54	.71	.77	.62	.64	.56	.45	.52	.50	.42	.40	.51	.39	.57
CSI (WMI)	.67	.74	.80	.76	.75	.73	.56	.52	.62	.53	.42	.49	.59	.59

Table 10. Probability of Detection (POD), False Alarm Ratio (FAR), Heidke Skill Score (HSS) and Critical Success Index (CSI) performance of Hailcast and WMI from 2002 to 2015.

The Critical Success Index (CSI) is the ratio of the successful hail forecasts divided by the sum of all hail forecasts plus the busts. The CSI does not incorporate the null event (no-hail forecast and no-hail observed), and is also a popular measure of the skill of forecasts. The CSI for WMI this past season was 0.67, compared to 0.74 for 2014.

Comparisons of the CDCs that were forecast and observed on a daily basis are made in Table 11. The exact forecast weather type (CDC) was observed on 51 of 107 days or 48% of the time. The forecast was correct to within one CDC category on 90 days or 84% of the time. There were five days when, according to the radar-estimated VIL, pea-size hail was indicated inside the project boundaries when hail was not forecast (not necessarily over a protected city). There was one day when larger hail (grape-size) fell and was not forecast. There were no "surprise storms" this season.

Observed Convective Day Category (CDC) 2015

Green shading indicates that the forecast and observed CDCs were the same (perfect forecasts).
Gray shading indicates that the observed CDC was greater than those forecast (underforecasts).
Blue shading indicates that the observed CDCs were less than those forecast (overforecasts).

Forecast CDC	-3	-2	-1	0	1	2	3	4	5	
-3	5	2								7
-2	1	6	2		1					10
-1		1	14	5						20
0		1	3	7	4	1				16
1	1	1	4	4	5	3				18
2			1	1	6	8	1	4		21
3	1			1		4	4			10
4							1	2	2	5
5									0	0
	8	*11*	*24*	*18*	*16*	*16*	*6*	*6*	*2*	107

Percent correct exact CDC category = 51/107 = 48% (46% in 2014)
Percent correct within one CDC category = 90/107 = 84% (79% in 2014)

Table 11. Forecast vs. Observed CDCs, 2015.

The breakdown of CDC values for each of the past 20 seasons is shown in Table 12. This year had 14 days on which large (walnut or larger) hail fell; the average is 12. There were 28 large-hail days in 2014. There were 64 thunderstorm days in 2015, (65 in 2014), while 63 is average. Golf ball or larger hail fell on 8 days in 2015; the average is 7 days.

	DAYS WITH NO SEEDING			Thunder But No Hail	DAYS WITH HAIL (maximum hail size)					
	Mostly Clear Skies	Clouds, Virga	Showers		Pea	Grape	Walnut	Golf Ball	>Golf Ball	
Season	***CDC -3***	***CDC -2***	***CDC -1***	***CDC 0***	***CDC +1***	***CDC +2***	***CDC +3***	***CDC +4***	***CDC +5***	***Totals***
1996	27	21	12	11	5	12	3	1	1	93
1997	7	19	6	28	19	11	3	0	0	93
1998	14	24	2	29	23	8	2	4	1	107
1999	21	18	8	24	22	10	2	1	1	107
2000	13	21	8	26	18	9	2	9	1	107
2001	20	4	19	18	19	18	5	4	0	107
2002	27	8	20	16	15	17	3	1	0	107
2003	24	7	20	28	8	12	2	5	1	107
2004	11	4	28	29	15	11	3	5	1	107
2005	13	13	22	28	17	9	1	2	2	107
2006	19	14	15	24	19	5	6	3	2	107
2007	15	17	15	26	17	8	5	2	2	107
2008	15	7	10	34	17	15	2	6	1	107
2009	22	11	10	41	15	2	3	2	1	107
2010	3	10	9	37	11	27	8	1	1	107
2011	15	5	14	8	7	22	20	15	1	107
2012	8	7	22	14	4	16	12	22	2	107
2013	17	7	6	12	9	34	10	10	2	107
2014	11	9	22	7	11	19	6	18	4	107
2015	8	11	24	18	16	16	6	6	2	107
Totals	310	237	292	458	287	281	104	117	26	2112
Average	**16**	**12**	**15**	**23**	**14**	**14**	**5**	**6**	**1**	
Maximum	27	24	28	41	23	34	20	22	4	
Minimum	3	4	2	7	4	2	1	0	0	

Table 12. Seasonal Summary for 2015 of Observed Convective Day Categories (CDCs).

For Table 12 and the other tabulations in this report, the "observed CDC" is taken to be the greater of the hail sizes reported by Environment Canada, and the Agricultural Financial Services in Lacombe, or the hail sizes estimated from the vertically-integrated liquid (VIL) measured by the project radar.

11.8 THE HAILCAST MODEL

The Hailcast model (Brimelow, 1999, Brimelow et al., 2006) was again used this summer to objectively forecast the maximum hail size over the project area. Hailcast consists of two components, namely a steady-state one-dimensional cloud model and a one-dimensional, time dependent hail model with detailed microphysics. The reader is referred to Brimelow (1999) for a detailed explanation of the model. Forecast soundings for Red Deer and Calgary were downloaded daily from the Plymouth State or Storm Machine website. A decision tree scheme was used to determine whether or not the soundings should be used to initialize the model. The decision tree is based on the work of Mills and Colquhoun (1998). The Hailcast model was not run if the atmospheric profile showed significant inhibition at 700 mb (approximately 10,000 feet) or warming greater than 1°C aloft during the day.

The performance of the HAILCAST model in 2015 was improved from 2014, the HSS being up to +0.43 from +0.35. [Recall that HSS values greater than +0.40 are considered significantly skilled.] The probability of detection (POD) of hail events was 0.81, but not as high as the WMI forecaster (0.87). The false alarm ratio (FAR) for HAILCAST was 0.39, up from 0.19, in 2014.

The Critical Success Index (CSI) for Hailcast was +0.54, significantly less than the +0.67 for the WMI forecasters. These results demonstrate that while Hailcast is a useful tool it has weaknesses similar to many models and the results need to be interpreted within the context of the overall meteorological situation, taking into consideration other synoptic, mesoscale, and dynamic aspects that are not included in the one-dimensional model. One must also keep in mind that the input to Hailcast was routinely the 12-hour prognostic soundings of the WRF model. It is important to look at the full 24 hours of forecast soundings to use as input for Hailcast. Further research into the refinement of the Hailcast decision tree remains warranted, and of course, due care must be taken to input the proper sounding.

12. COMMUNICATIONS

Reliable communications for all project personnel and managers is essential for smooth and effective operations. These communications take place on a number of levels, with mixed urgencies. Real-time information-sharing and operational decision-making require immediate receipt of messages so appropriate actions can be taken. Time is of the essence. Routine daily activities such as completion of project paperwork and reports manifest less urgency, but still require due short-term attention. There are also project matters of importance on a weekly (or longer) time frame; these can be handled still more casually.

In the current age of widespread cellular telephone usage and coverage, mobile telephones have proven to be the most dependable means for project communications. Other real-time, project-essential communications occur between the Operations Centre and project aircraft; these are accomplished by voice radio transmissions. Aircraft positions and seeding actions are communicated to the Operations Centre via data radio.

For intra-project communications, all project personnel have cellular telephones. Pilots, who were on-call and had flexible hours, always carried their mobile phones, and kept them well-charged and turned on. Meteorological staff did likewise, but because of their more structured hours and location (primarily the Operations Centre) were often reliably contactable via land (telephone) lines, especially while at the operations centre.

12.1 INTERNET ACCESS

High-speed internet access offices for the flight crews based in Springbank and Red Deer was established at the airports. Such access ensured real-time awareness of storm evolution and motion prior to launches, and gave the pilots better knowledge of the storm situations they would encounter once launched.

12.2 USE OF E-MAIL AND TEXT MESSAGES

E-mail and text messaging were discouraged when immediate receipt of information was essential, because the sender would not know with certainty if/when the recipient had received or would receive the message. Both were acceptable for non-urgent situations; however in that context e-mail was preferred whenever any record of the message content and/or timeliness is needed. The on-site program manager routinely sent blanket text message notifications of aircraft launches to all project field personnel, so everybody knew when operations commenced, and which aircraft was (were) flying.

13. CASE STUDIES

A detailed review and summary of the largest events of the 2015 season is provided below. The recapitulation reveals the sequence of events in dealing with the storm: when various aircraft were dispatched to respond to the developing threats, how the storms evolved and where they moved, when seeding began and ended, and how (in a general sense) the storms responded to treatment.

WEATHER SYNOPSIS AND FORECAST FOR 4 AUGUST 2015

On the morning of 4 August 2015, the morning forecaster issued a Convective Day Category of +2 indicating grape-size hail was expected within the project area. The afternoon model sounding indicated moderate, but not extreme instability with just over 900 J/Kg CAPE and a Lifted Index of -3˚C. The wind shear profile showed backing with height in the low levels was likely, and there was only modest speed shear in the effective layer. Upper level charts showed a deep closed low over BC, expected to move through the project area. Midlevel charts indicated numerous small shortwave impulses of vorticity would be rotating around the low into the target area. Low level charts indicated a Theta-E ridge over the region, indicating excellent moisture over the region to fuel thunderstorms. Surface charts indicated a cold front would be moving through the region during the late afternoon and evening hours. The HAILCAST model predicted 2.9 cm hail (walnut size) was possible over Calgary. Up to Toonie-size hail was reported in Calgary, along with some urban flooding.

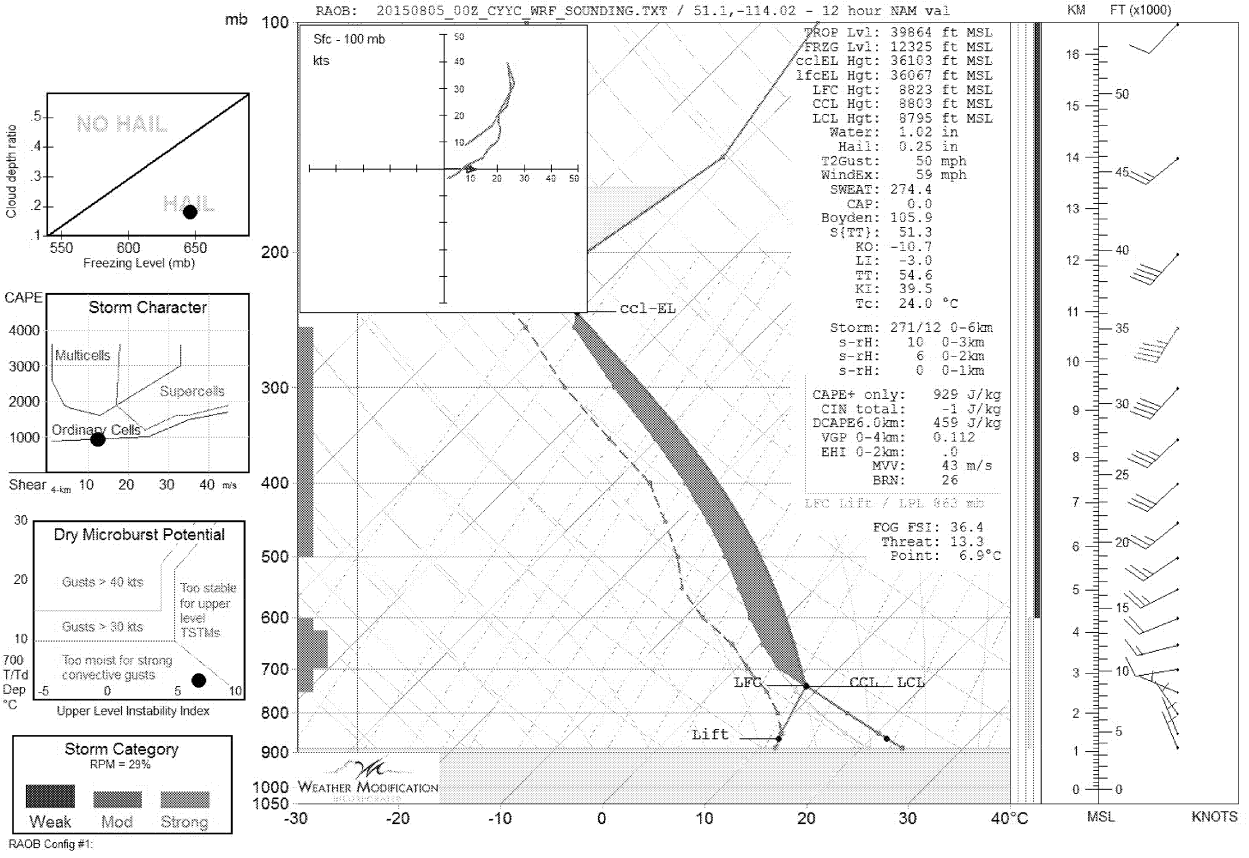

Fig. 32. The atmospheric vertical profiles of temperature, moisture, and winds, as predicted for 6 PM local time on 4 August 2015.

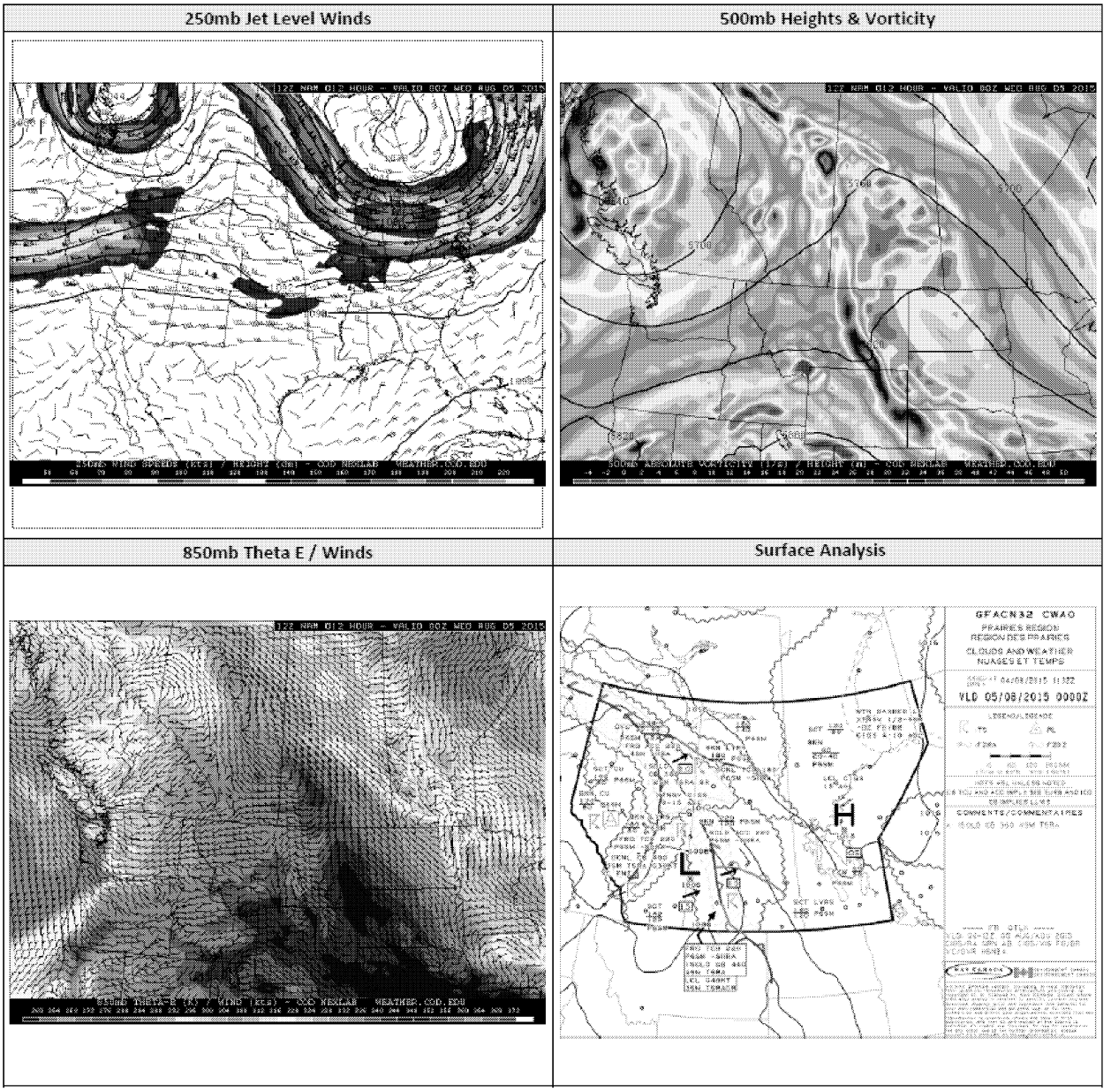

Fig. 33. Jet stream level (~30,000 ft/9.1 km, upper left), mid-Level (~18,000 ft/5.5 km, upper right), low level (~5,000 ft/1.5 km, lower left), and surface chart (lower right) are shown for 4 August 2015. The high (jet stream) level chart revealed a deep low pressure system over British Columbia, ejecting lobes of vorticity (regions of storm-generating cyclonic spin) into southern Alberta. The low level chart indicated warm moist air was in place over southern Alberta, ready to fuel storms. Surface charts indicated a low to the east and a cold front moving through in the late afternoon/evening hours.

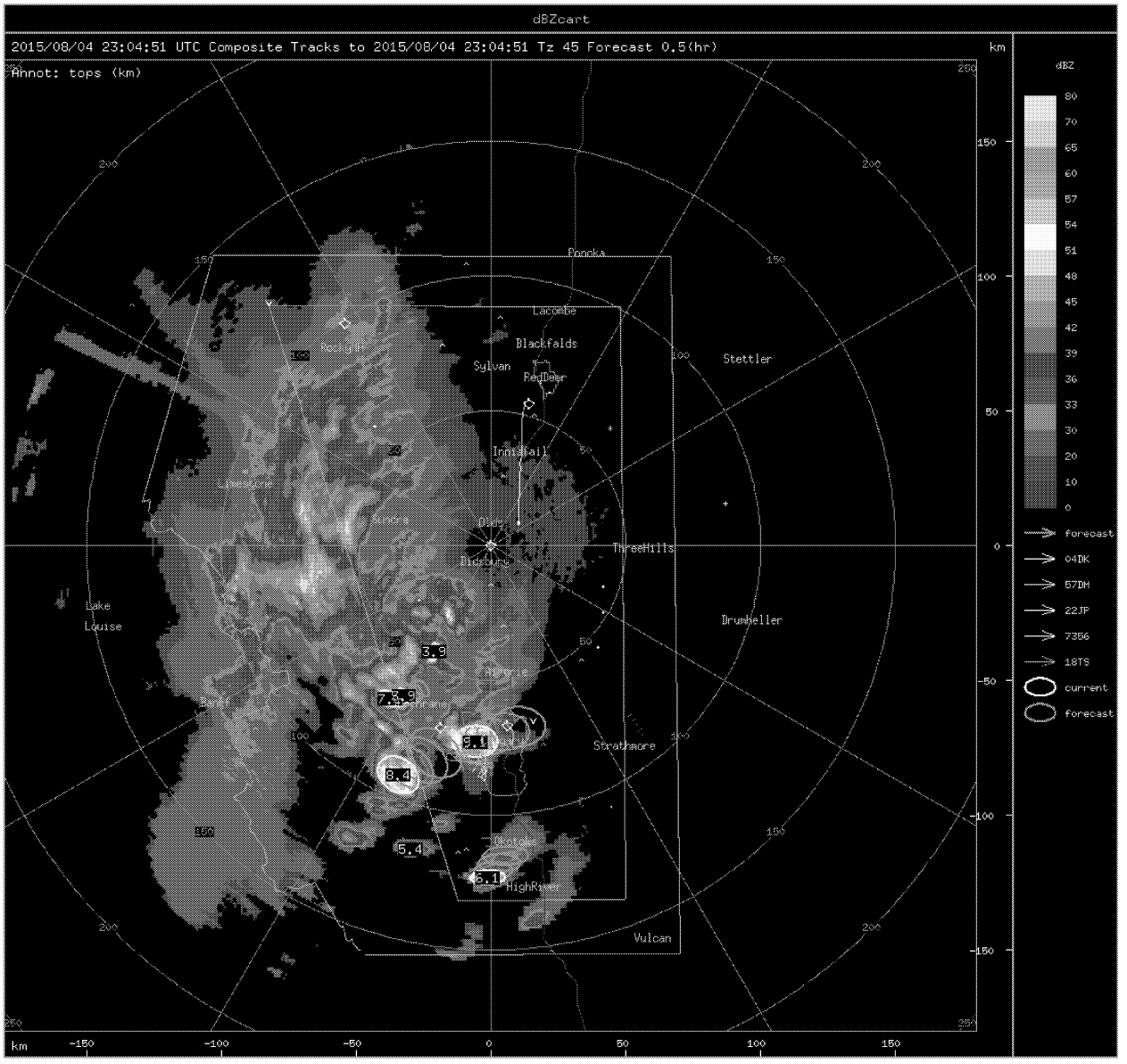

Fig. 34. The Olds Radar reflectivity pattern at 5:04 PM MDT on 4 August 2015.

Weak convection began forming over the foothills in the early afternoon. At 3:16 PM MDT, cells were beginning to move off the foothills west of Calgary heading for the city. The first aircraft, Hailstop 5, (HS5) was then launched for patrol. Hailstop 2 (HS2) was launched to the developing cell at 3:52 PM, as it moved into the boundary of the protected area. Seeding began at 3:55 PM, and continued with both a top and base seeder until the storm moved east of Strathmore. A total of four seeding aircraft (two top seeders, and two base seeders) were used in rotation to continuously seed the storm as it passed over Calgary and Strathmore.

Another weak cell, also seeded, pushed through southern Calgary, but posed only a minor hail threat. A total of 11 hours and 3 minutes of flight time was accumulated on the 4th among HS2, HS3, HS4, and HS5. A total of 20.5 kg of seeding material was released through 458 ejectable flares, 72 burn-in-place flares, and 304 minutes of wingtip generator time.

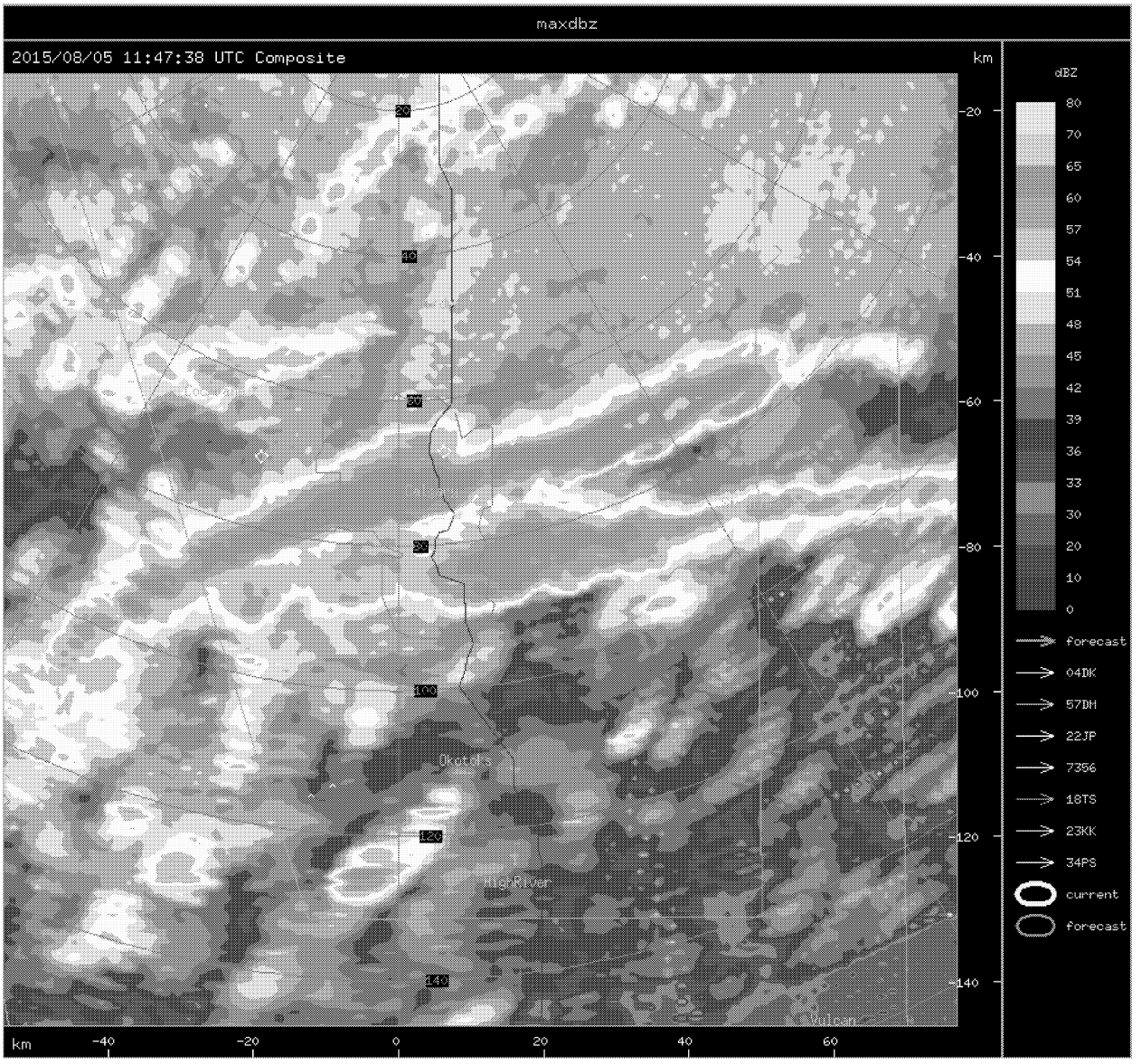

Fig. 35. Composite maximum radar reflectivity is shown for the entire storm day of 4 August 2015. The two most intense storms of the day transited Calgary.

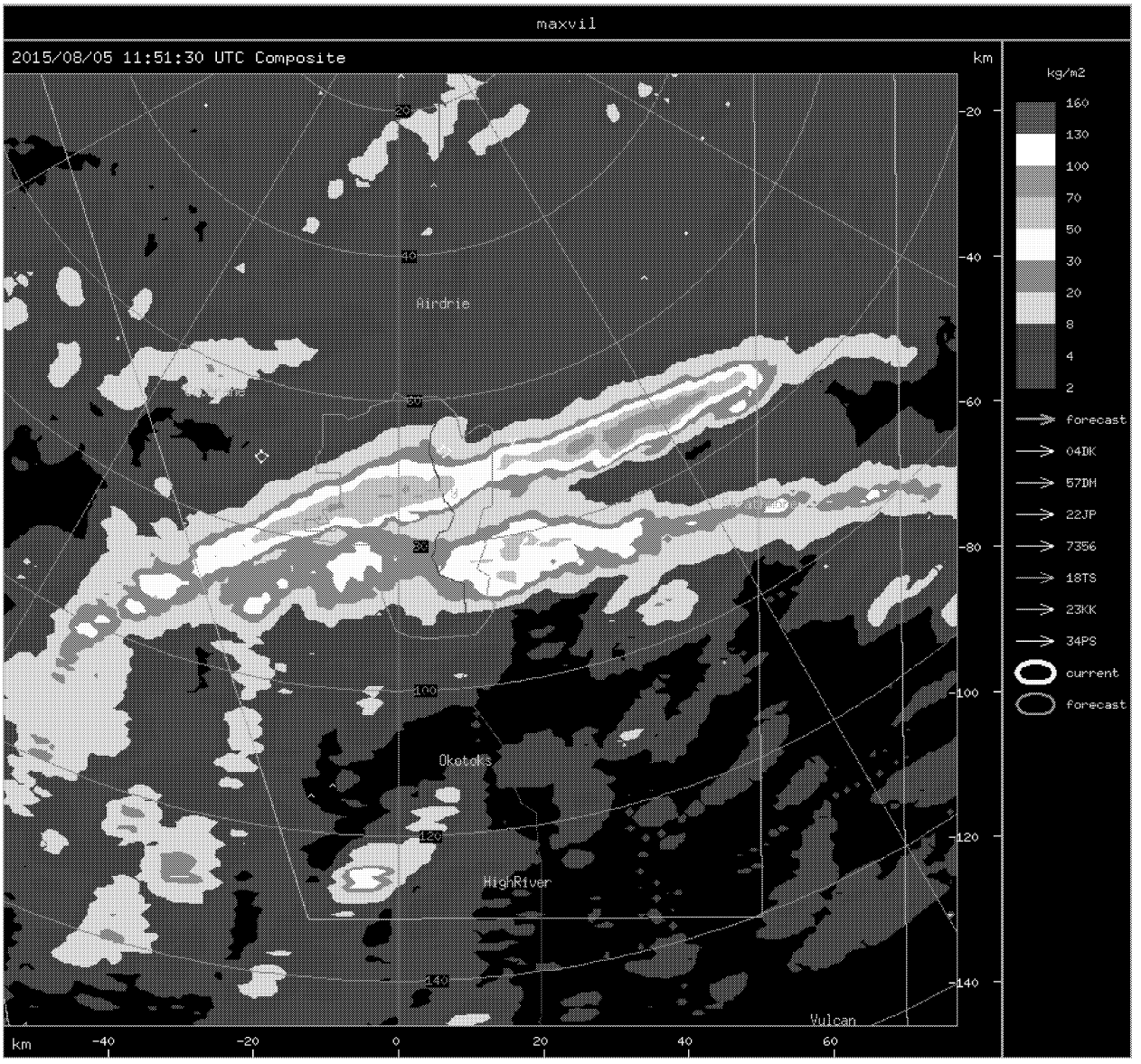

Fig. 36. The maximum vertically-integrated liquid (VIL) measured by the radar is shown.

VIL is well-correlated with hail size. The largest hail swaths are were associated with the track of the main cell that tracked through downtown Calgary. It should be noted that VIL (and thus hail size) are indicated to be less severe over town (oranges, spots of red) town than directly downwind (large red swath) where 70+ VIL (the red) occurred *after seeding ended*.

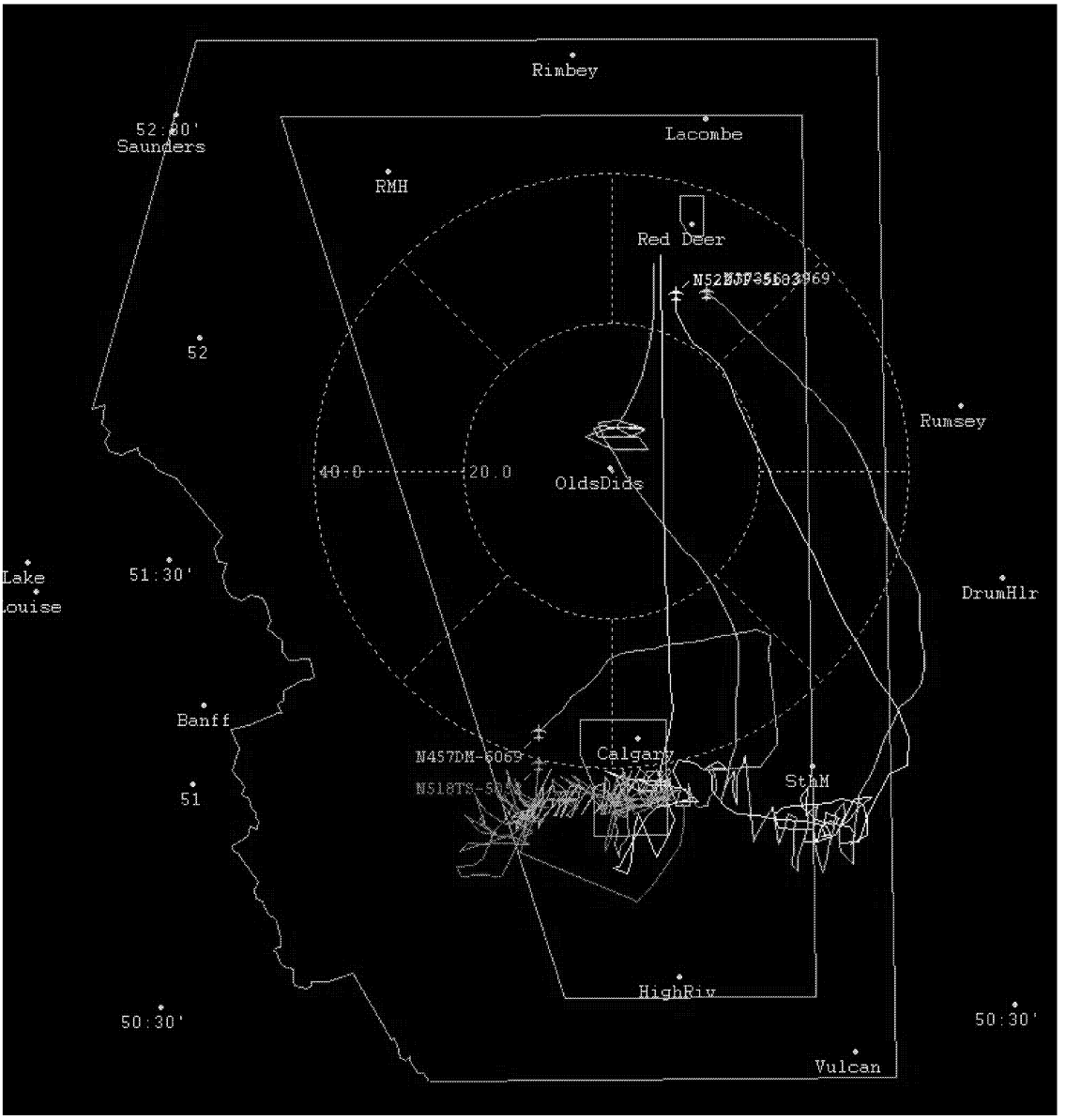

Fig. 37. *AirLink* (GPS) aircraft seeding tracks for the entire storm day of 4 August 2015. Track colors are as follows: Hailstop 2, orange; Hailstop 3, light blue; Hailstop 4 green; and Hailstop 5, pink.

The WMI *AirLink* aircraft tracks show that the storms that passed through Calgary and Strathmore were each seeded by two aircraft (top and base). Seeding began well upwind of the protected cities with sufficient time and dosage for positive seeding affects to be realized.

WEATHER SYNOPSIS AND FORECAST FOR 5 AUGUST 2015

On the morning of 5 August 2015 the forecaster predicted a CDC of +4, indicating golf ball size hail was expected within the project area. The noon model sounding indicated moderate, but not extreme instability for the second day in a row with just over 900 J/Kg CAPE and a Lifted Index of -4˚C. The wind shear profile showed stronger speed shear than the previous day due to a jet streak that was moving into the area. Directional shear was not significant. Upper level charts showed a deep closed low over British Columbia, continuing to push vorticity into the region. Mid-level charts indicated that a large lobe of vorticity would be rotating around the low into the target area in the early afternoon, which would be the main trigger for storm initiation. Low level charts indicated a Theta-E ridge over southern Alberta, indicating considerable moisture (thunderstorm fuel) remained over the region. Surface charts indicated a low would be developing in the lee of the Rocky Mountains during the day. The HAILCAST model predicted 3.6 cm hail (golf ball size) was possible over the Calgary area.

Up to golf ball-size hail was observed in Calgary, but in small patches, and not widespread across the city. Localized urban flooding was also reported in the city for the second day in a row.

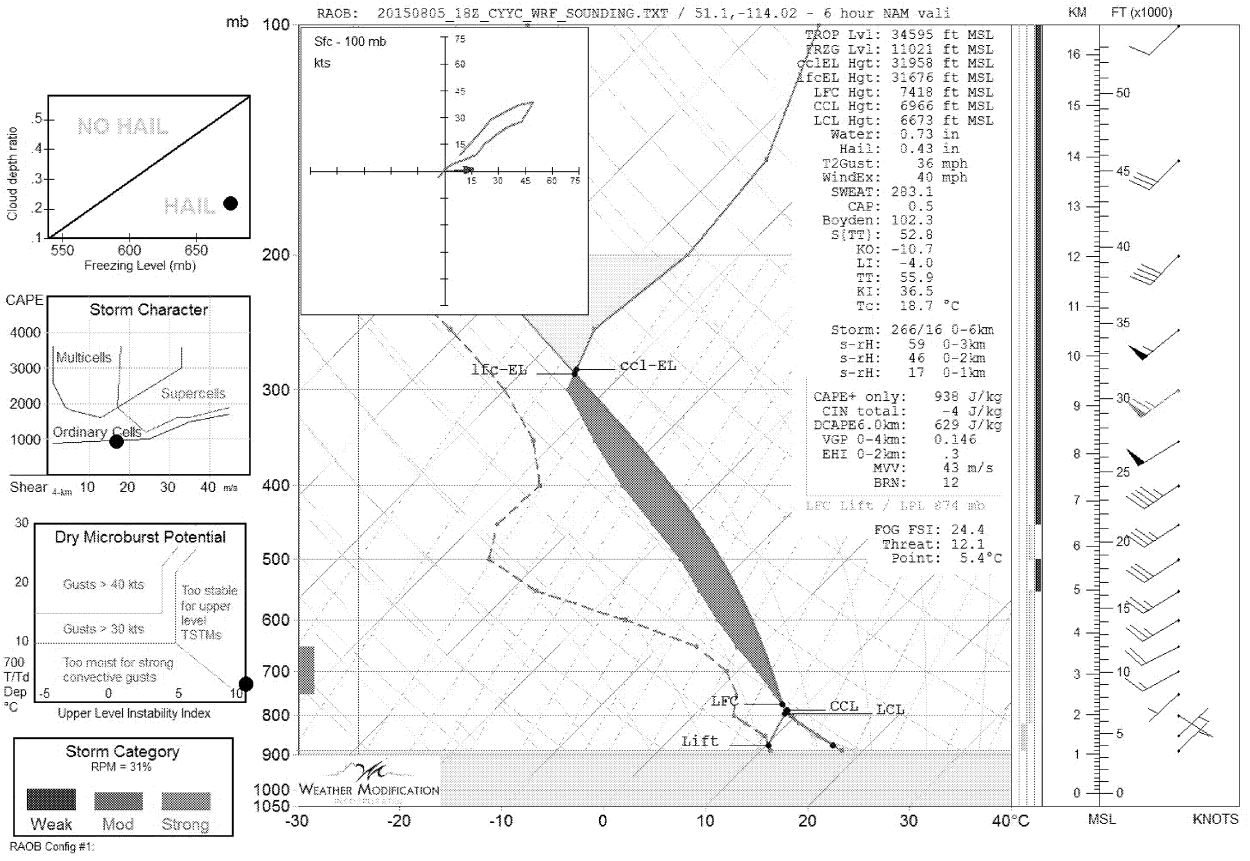

Fig. 38. The atmospheric vertical profiles of temperature, moisture, and winds, as predicted for 6 PM MDT on 5 August 2015.

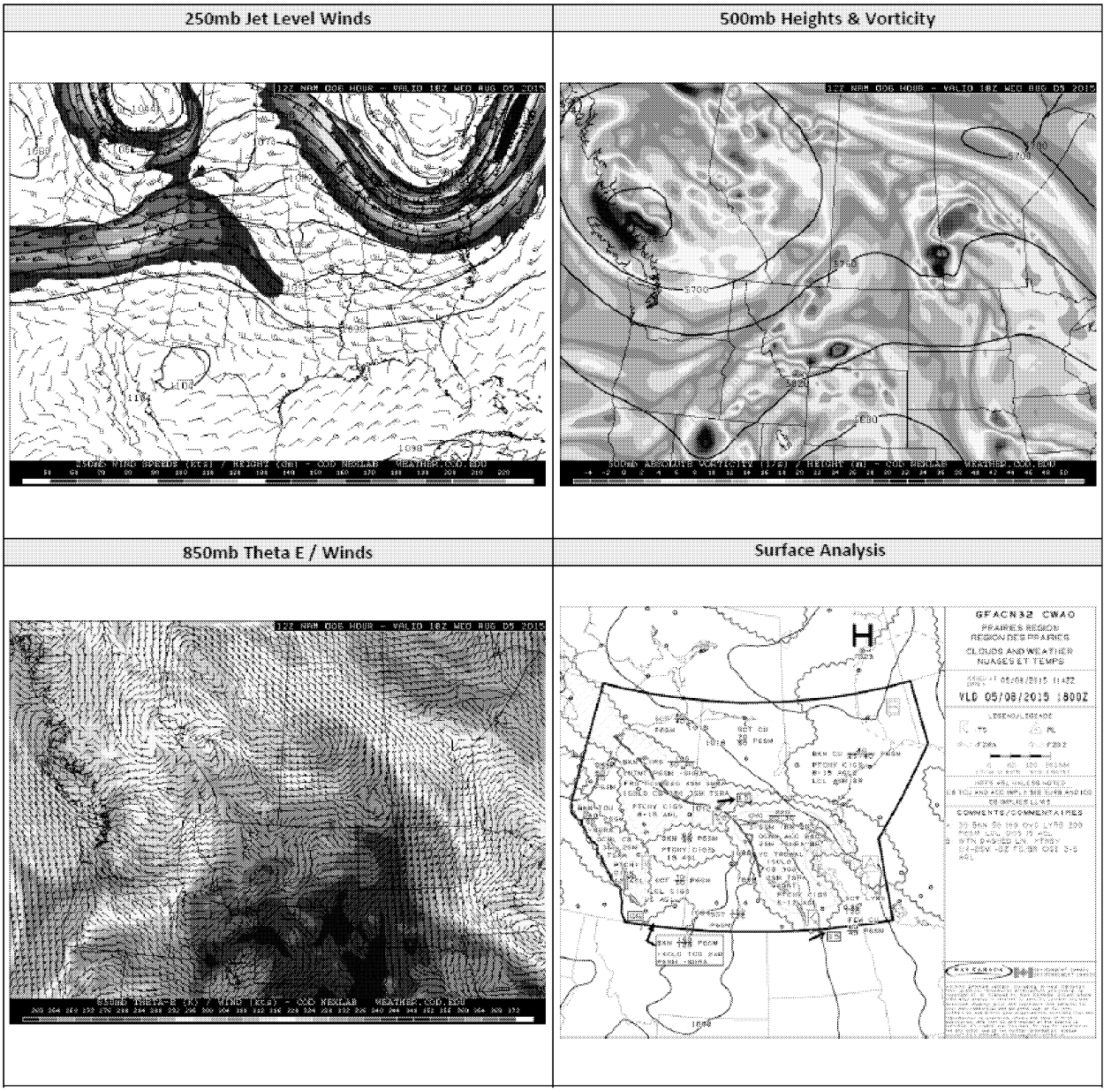

Fig. 39. Jet stream level (~30,000 ft/9.1 km, upper left), mid-Level (~18,000 ft/5.5 km, upper right), low level (~5,000 ft/1.5 km, lower left), and surface chart (lower right) as shown for 5 August 2015.

An upper-level jet streak was moving into the region, creating strong winds aloft and wind shear that favored the development of severe weather. The low level charts indicated warm, moist air remained in place over southern Alberta, ready to fuel another round of storms.

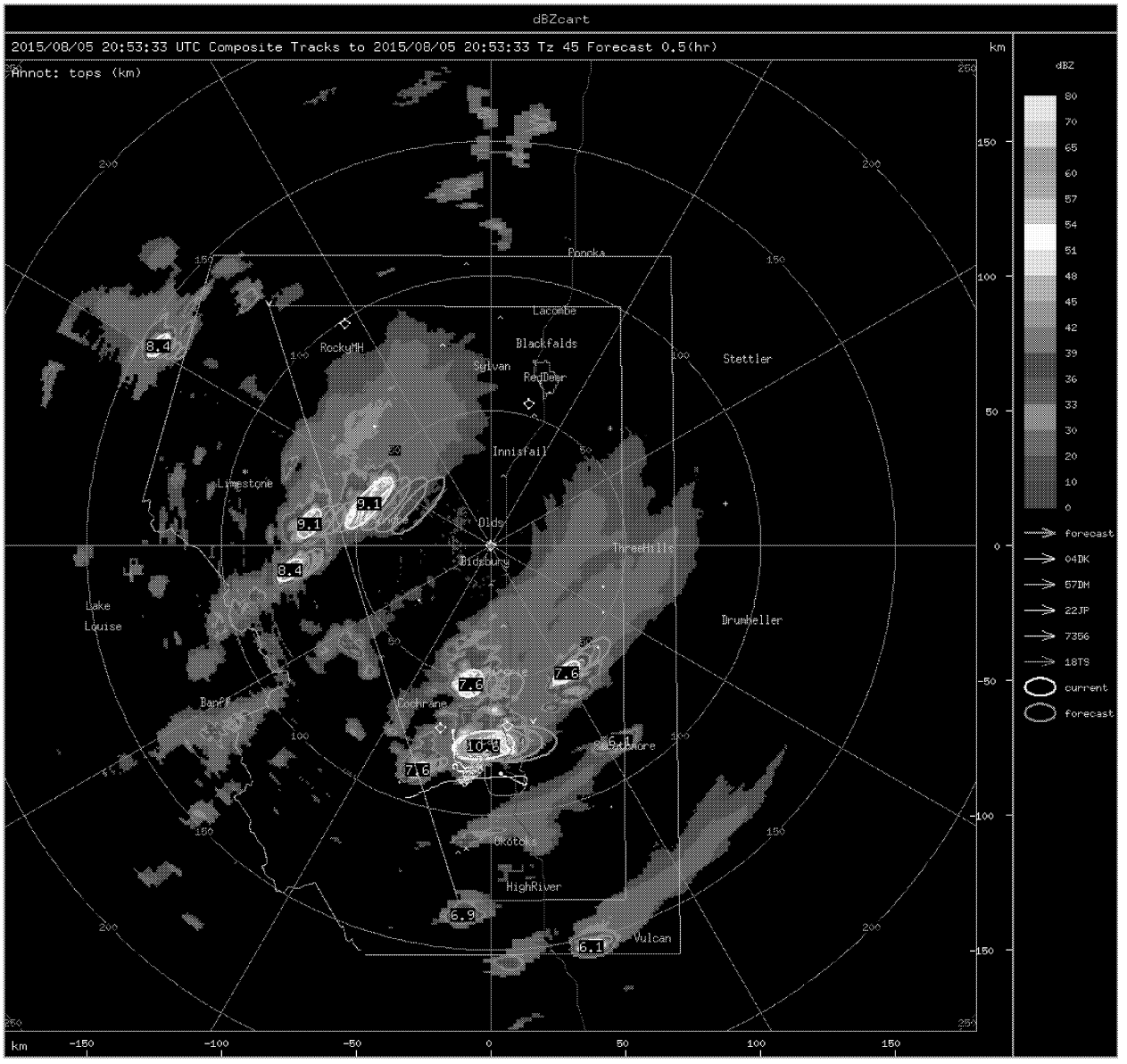

Fig. 40. The Olds Radar reflectivity pattern at 2:53 PM MDT on 5 August 2015.

After watching weak rain showers pass through the northern target area in the morning, the strong vorticity lobe moved over the mountains and began kicking off intense cells right around noon, as forecast.

Numerous storms formed along the western project boundary, but with the largest hail threat over the southern project region, seeding operations would be focused on the Calgary region. The first aircraft were launched at 12:22 PM MDT (HS1 and HS2) to a developing cell a few miles southwest of Springbank. Seeding began immediately upon reaching the cell at 12:40 PM. All five aircraft seeded heavily over Calgary as an intense supercell hailstorm moved through the heart of the city. As the storm was moving through town, four aircraft were seeding at the same time. This was the most aggressively seeded cell of the season.

After the cell had moved east of Chestermere, most of the crews had depleted their flare arsenals and seeding solution and returned to base. Hailstop 1 remained airborne to seed a cell near Olds for a short time. Additional seeding occurred in the far southern project area later in the afternoon for smaller minor hail threats, but none of the additional cells were comparable in size and intensity to the one that passed through Calgary.

For the entire day, a total of 22 hours and 19 minutes of flight time were accrued. A total of 43.9 kg of seeding material was utilized in the form of 961 ejectable flares, 155 burn-in-place flares, and 710 minutes of wingtip generator time.

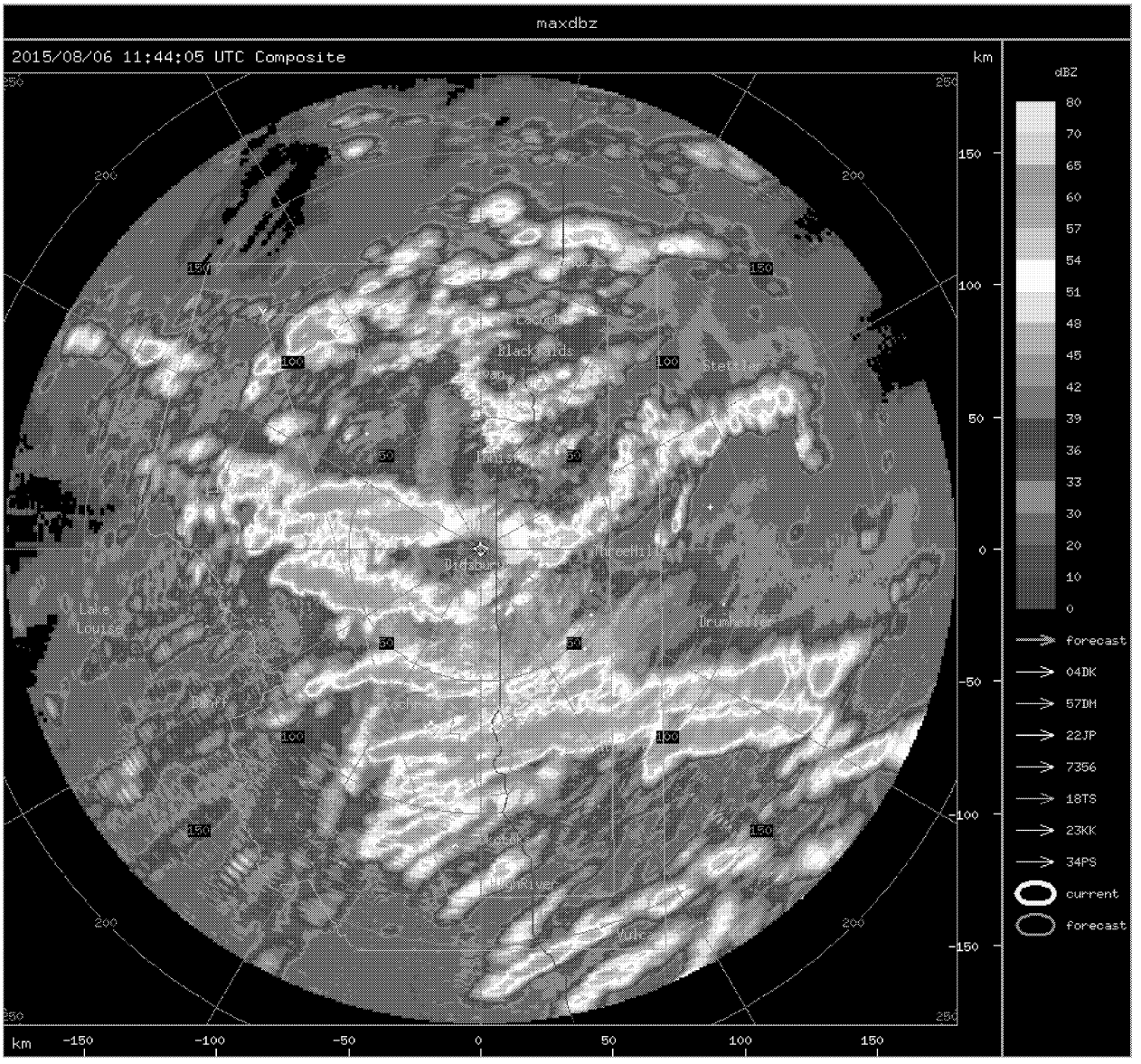

Fig. 41. Composite maximum radar reflectivity plot for the entire storm day of 5 August 2015.

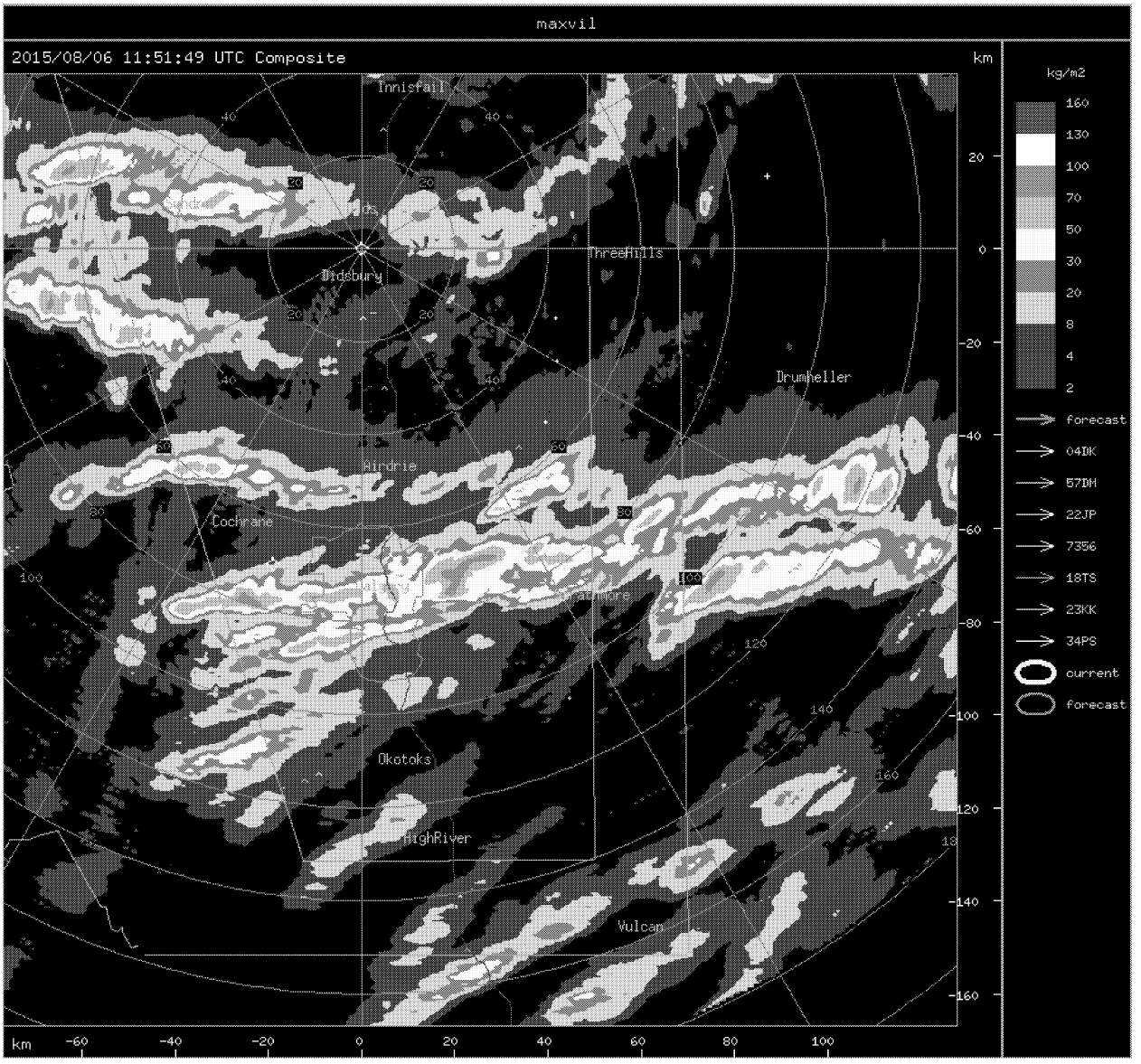

Fig. 42. The maximum vertically-integrated liquid (VIL) measured by the radar on 5 August 2015 is shown.

VIL is well-correlated with hail size. The largest hail swaths are were associated with the tracks of the most intense cell that tracked directly over downtown Calgary. It should be noted that VIL (and hail size) are indicated to be less severe over town than directly upwind and downwind of the city where cores of 70+ VIL (red) occurred.

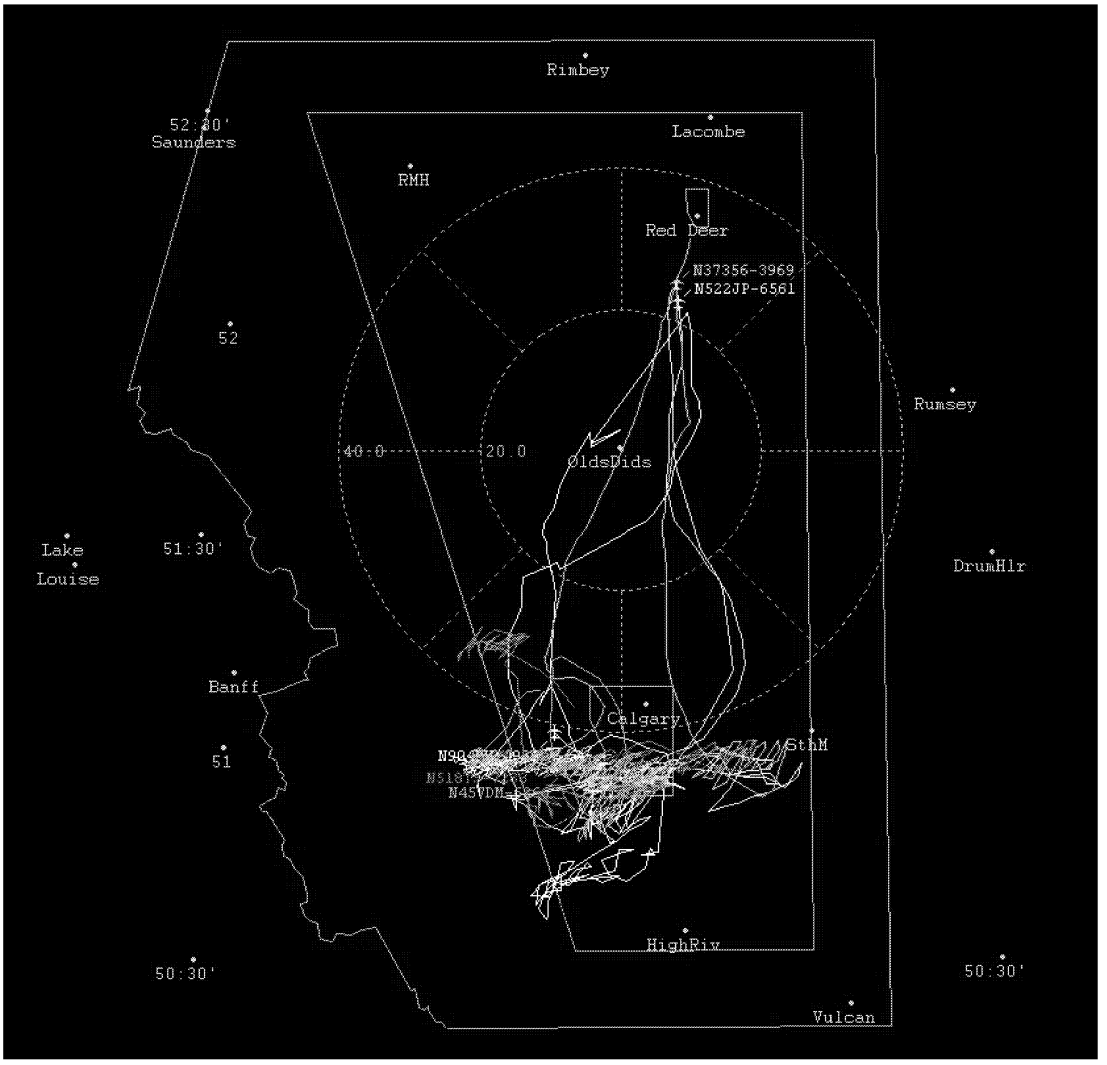

Fig. 43. *AirLink* (GPS) aircraft seeding tracks for the entire storm day of 5 August 2015. Track colors are as follows: Hailstop 1, white; Hailstop 2, orange; Hailstop 3, light blue; Hailstop 4 green; and Hailstop 5, pink.

The WMI *AirLink* aircraft tracks show that the storm that moved through Calgary well seeded very aggressively by multiple aircraft. Seeding began well upwind of the city and continued as long as possible. This was most likely one of the most aggressively seeded cells in project history.

WEATHER SYNOPSIS AND FORECAST FOR 21 JULY 2015

On the morning of 21 July 2015, the project forecaster warned of a CDC of +4, indicating a threat for golf ball-size hail. The greatest severe weather threat was identified for the northern project area, north of a dry line draped across the central project region from west to east. The model sounding for the afternoon indicated over 2000 J/Kg CAPE and a Lifted Index of -6˚C, both indicating very unstable conditions. As a midlevel trough was approaching from the west, a surface low was forming over southern Alberta.

The 850mb Theta-e map depicted impressive low level moisture being drawn around the low into the northern project area. At the upper levels, a jet streak was pushing through Central Alberta creating 50-60 knot winds aloft near Red Deer. The vertical wind shear profile indicated both strong speed shear and directional shear, indicative of supercell thunderstorms. Southeast surface winds were expected to create upslope flow over the foothills, which would be the main trigger for initial thunderstorms in the afternoon. A moderate capping inversion was expected to suppress convection during the morning and early afternoon. Cells were expected to initiate over the foothills, rapidly becoming severe supercells, and then move east through the northern project area with a storm motion vector of 260 degrees (moving nearly due east).

Marble size hail was reported in Crossfield. Up to golf ball-size hail was observed in Blackfalds and northern edge of Red Deer. Greater than golf ball size hail was observed in Lacombe.

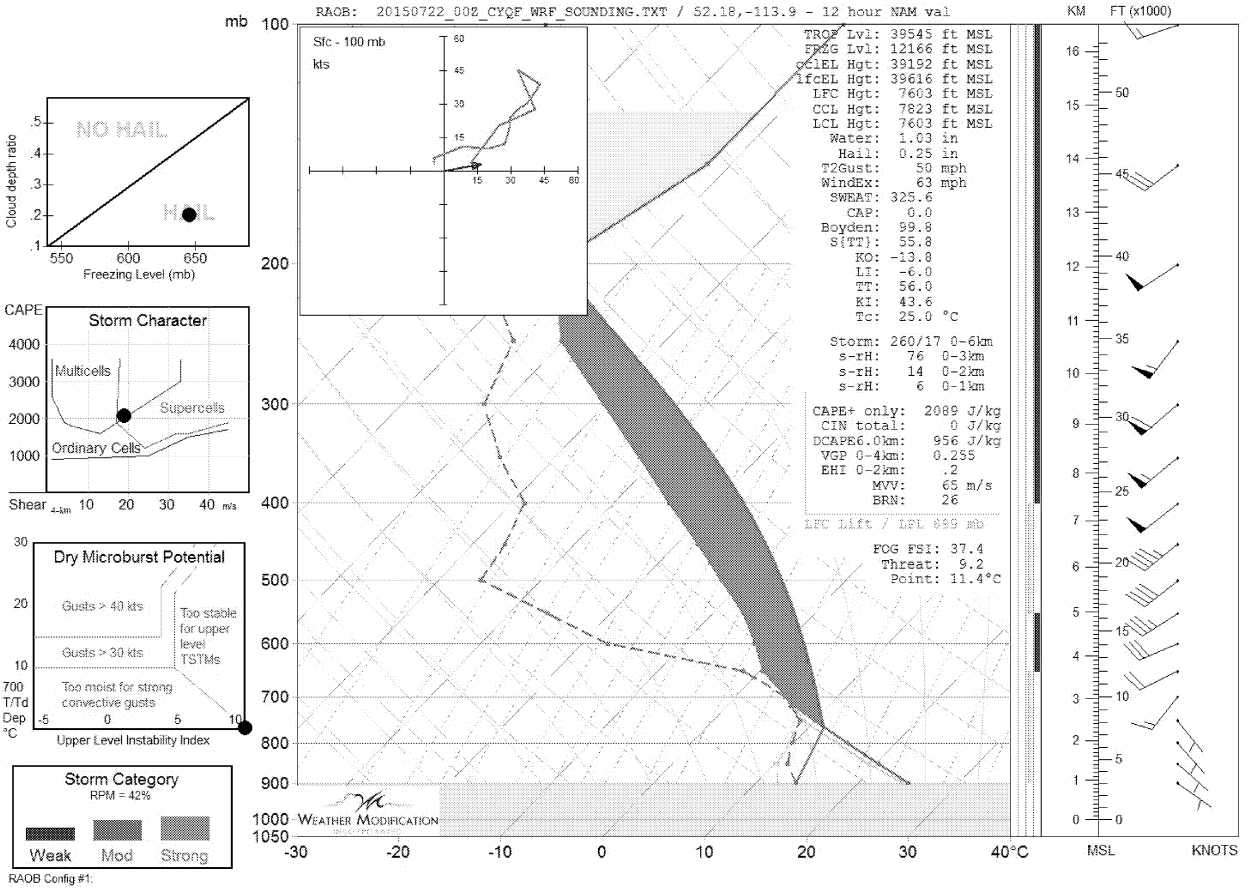

Fig. 44. The atmospheric vertical profiles of temperature, moisture, and winds, as predicted for 6 PM MDT on 21 July 2015.

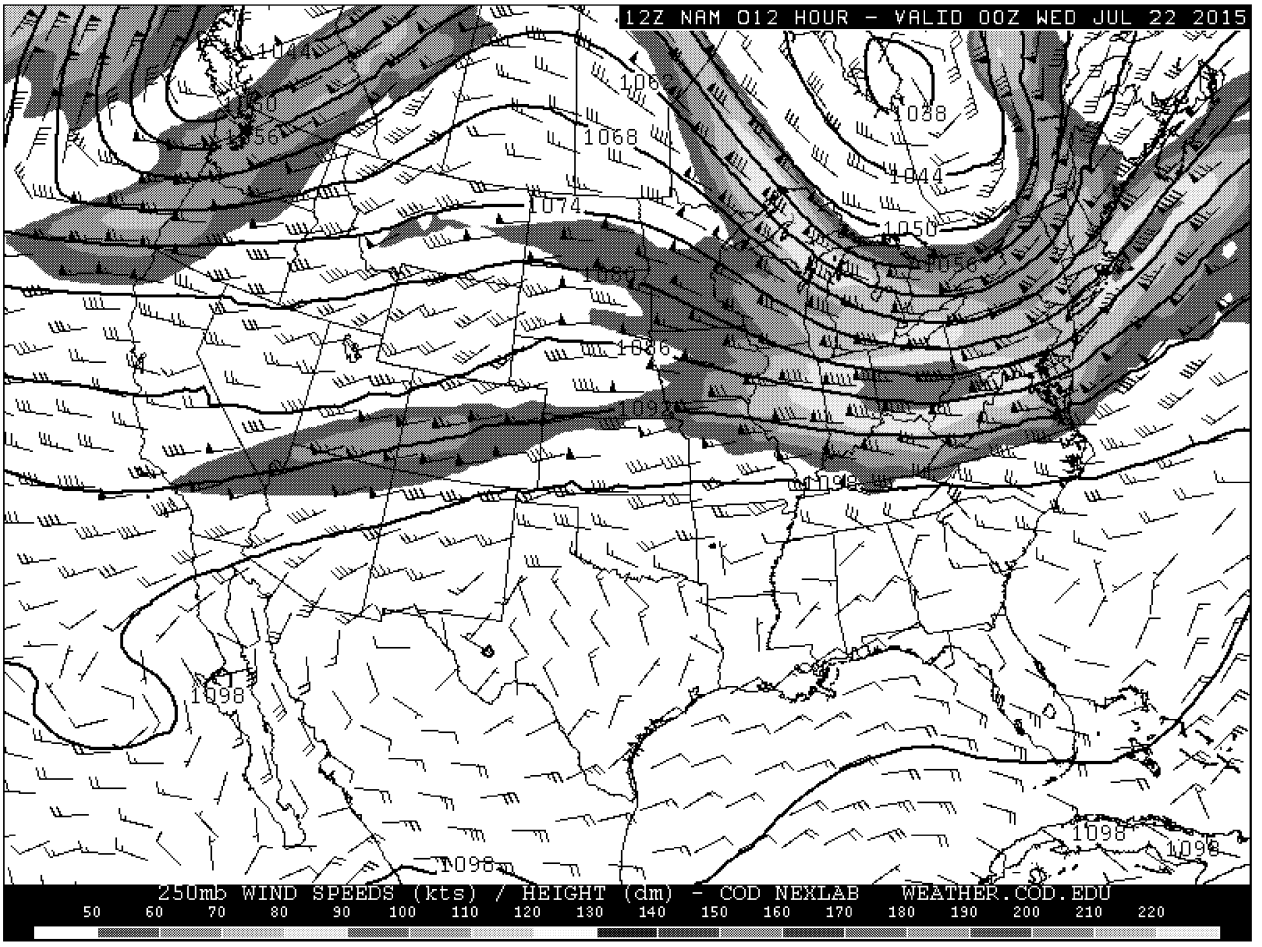

Fig. 45. The 250 mb level jet stream level winds at 6 PM MDT on 21 July 2015 showed 60 knot winds over Southern Alberta, enhancing the wind shear in the vertical wind profile.

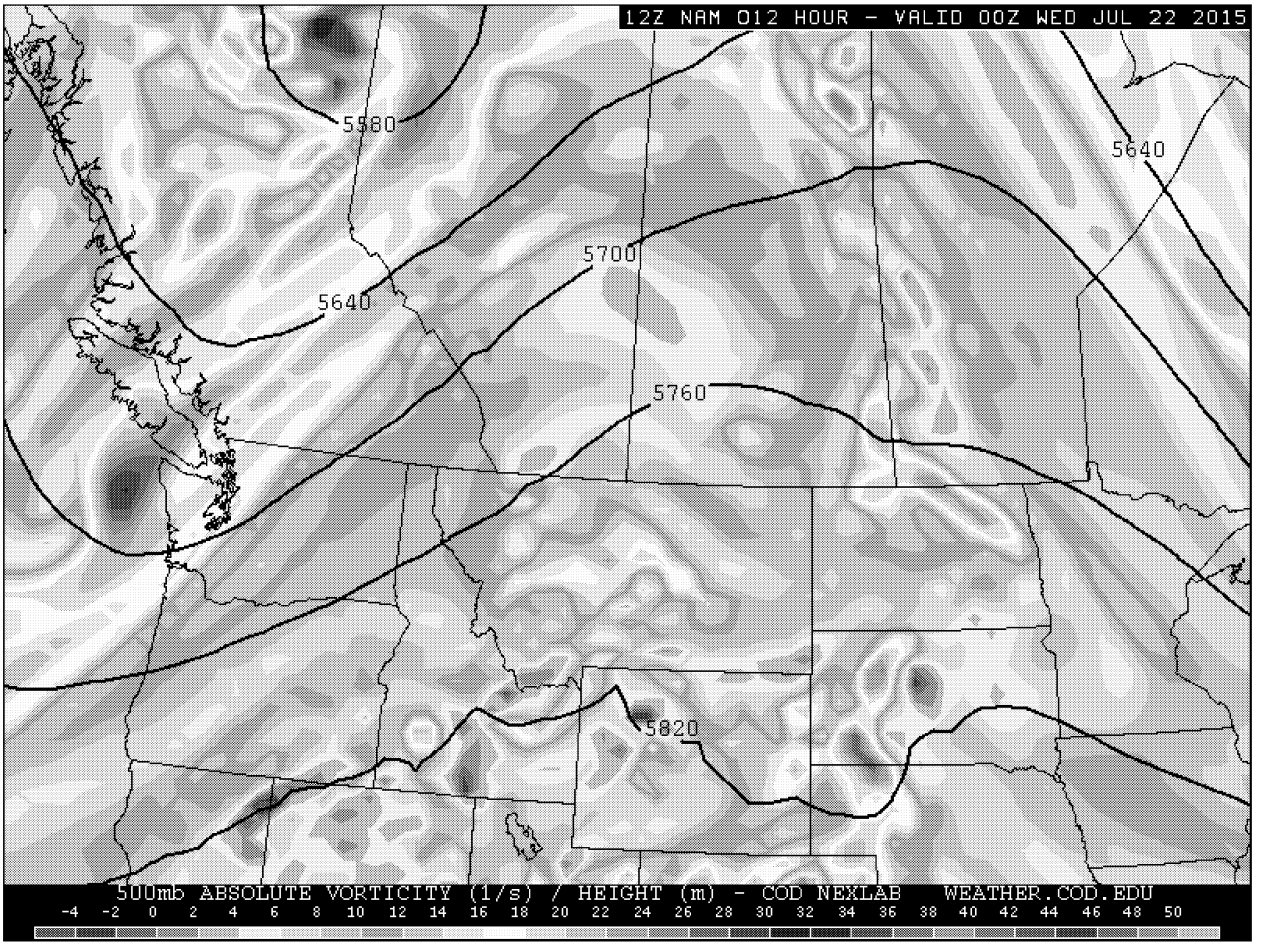

Fig. 46. The mid-level (500 mb) heights and vorticity at 6pm MDT on 21 July 2015 showed southwesterly wind flow, but no significant vorticity moving through the region.

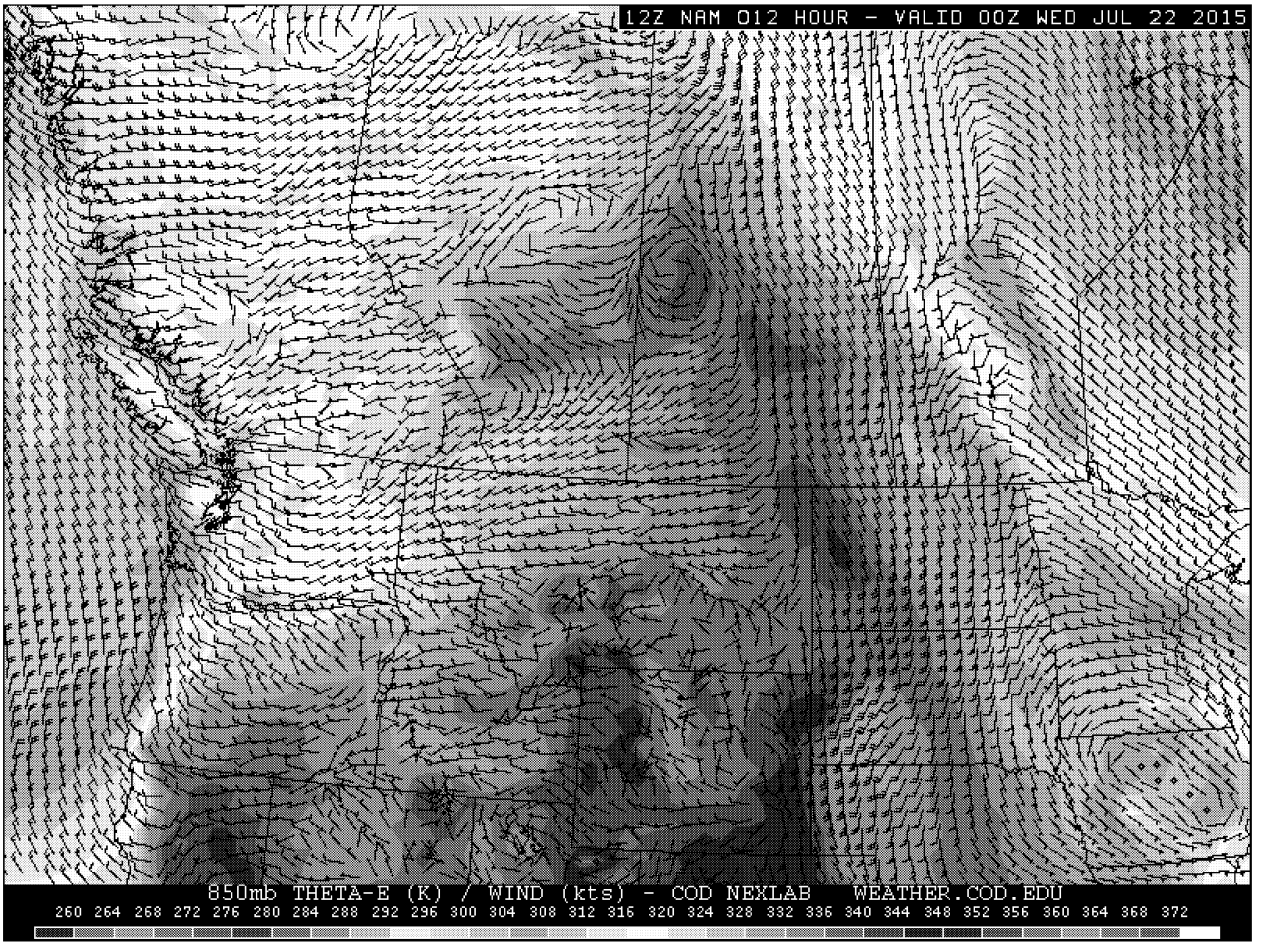

Fig. 47. Low level (850 mb) equivalent potential temperature (Theta E) chart for 6 pm MDT on 21 July 2015 indicated warm moist air was flowing into the region from the east and southeast, being drawn into the region around a low over Southern Alberta.

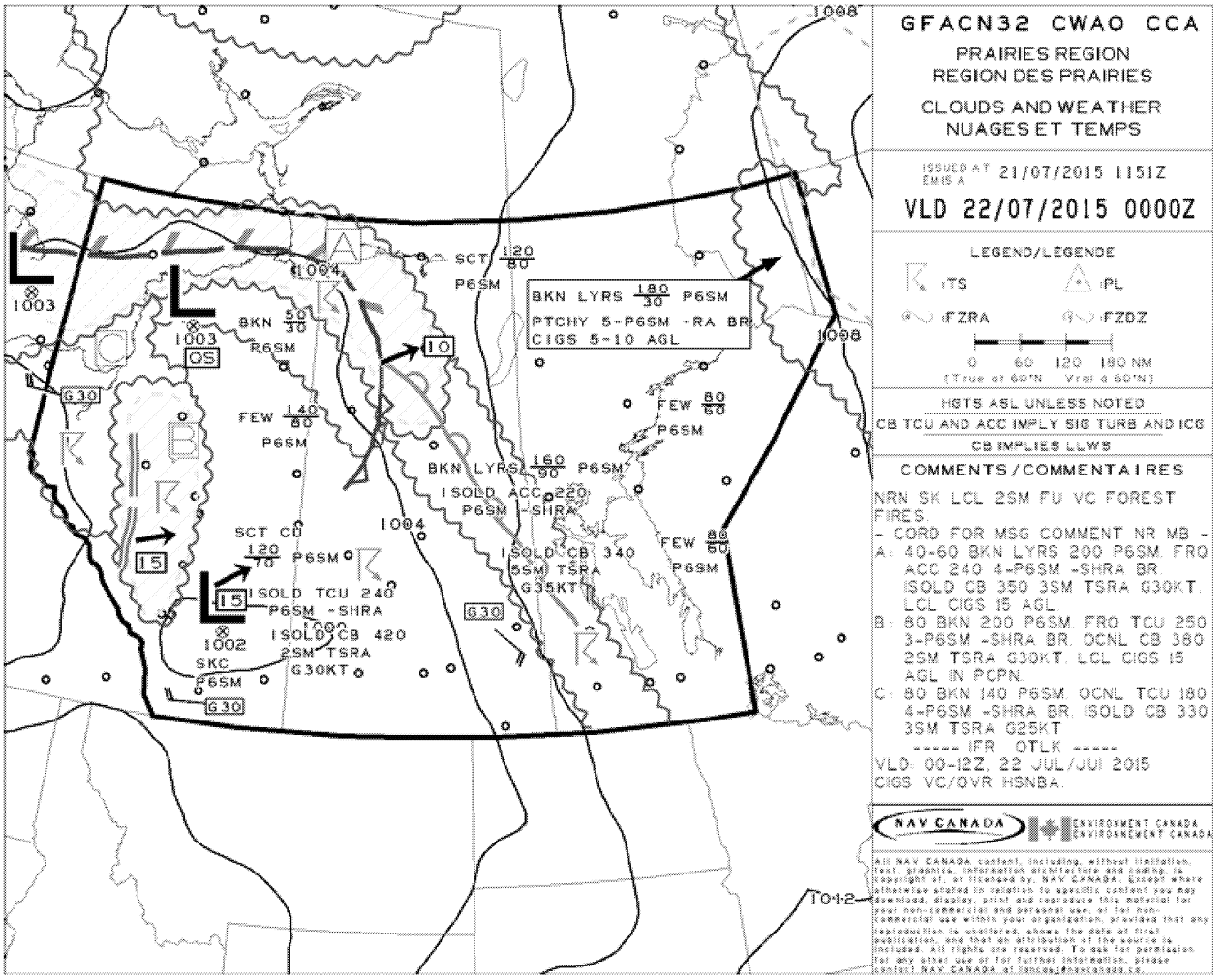

Fig. 48. The surface analysis for 6 pm MDT on 21 July 2015 showed low pressure over Southern Alberta creating southeast winds at the surface, which contributed to the directional wind shear profile.

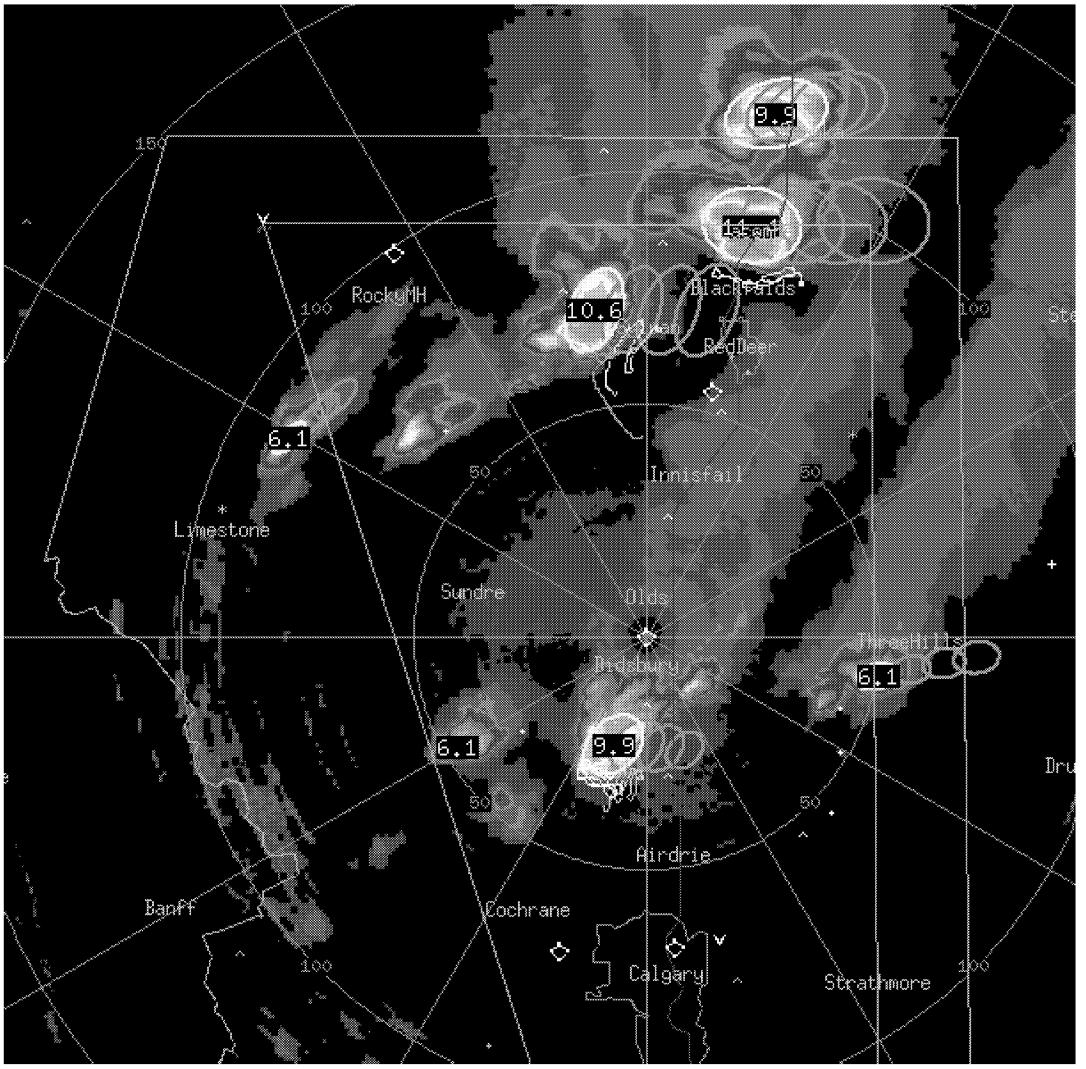

Fig. 49. The Olds-Didsbury radar display at 01:26Z (7:26 PM MDT) indicated four supercell thunderstorms within the radar coverage area. All five HAILSTOP aircraft were seeding at this time. Hailstop 3 was near Blackfalds, HS4 and HS5 were near Sylvan Lake, and HS1 and HS2 were north of Airdrie.

OPERATIONS SUMMARY

Storms initiated along the foothills west of Sundre at 12:45 MDT. The first aircraft was launched at 2:09 PM MDT. By 3:00 PM MDT a line of cells was moving eastward into the protected area. As the line gradually moved eastward, cells intensified into severe, organized supercells, with damaging hail. Seeding was concentrated on three discreet cells upwind of Lacombe, Blackfalds/Red Deer, and Crossfield. All five aircraft were utilized for at least one seeding flight. Hailstop 2 and HS3 each flew two seeding flights, and HS5 flew three seeding flights. July 21st was the most heavily seeded storm day of the 2015 season with 23 hours and 15 minutes of seeding flight time recorded. A total of 1,238 ejectable flares were dispensed at cloud top. A total of 153 burn-in-place flares were utilized among all five planes, and base seeders accumulated a total of 729 minutes of wingtip generator time. On the day, a total of 49,188 grams of silver iodide seeding material was dispensed.

Radar parameters linked to hail size indicate that the worst cell of the day was the one that passed through the Ponoka area. This cell had significantly higher VIL (vertically integrated liquid) parameters. The Ponoka cell was not seeded, as it is not in the project protected area. When the adjacent seeded storm tracks were compared with the unseeded track near Ponoka, there is strong evidence that the seeded storms had reduced hail size.

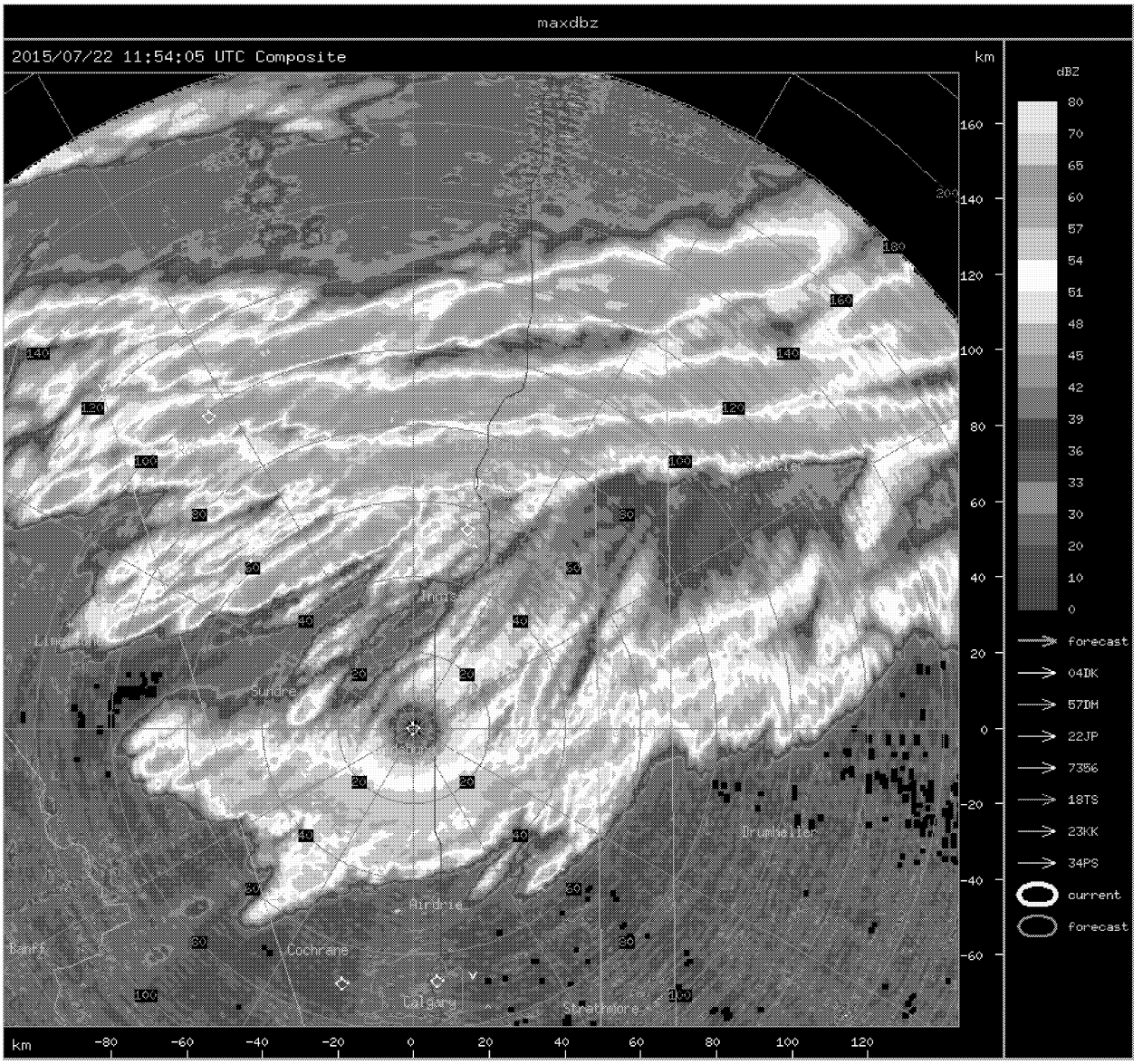

Fig. 50. Composite maximum radar reflectivity plot for the entire storm day of 21 July 2015.

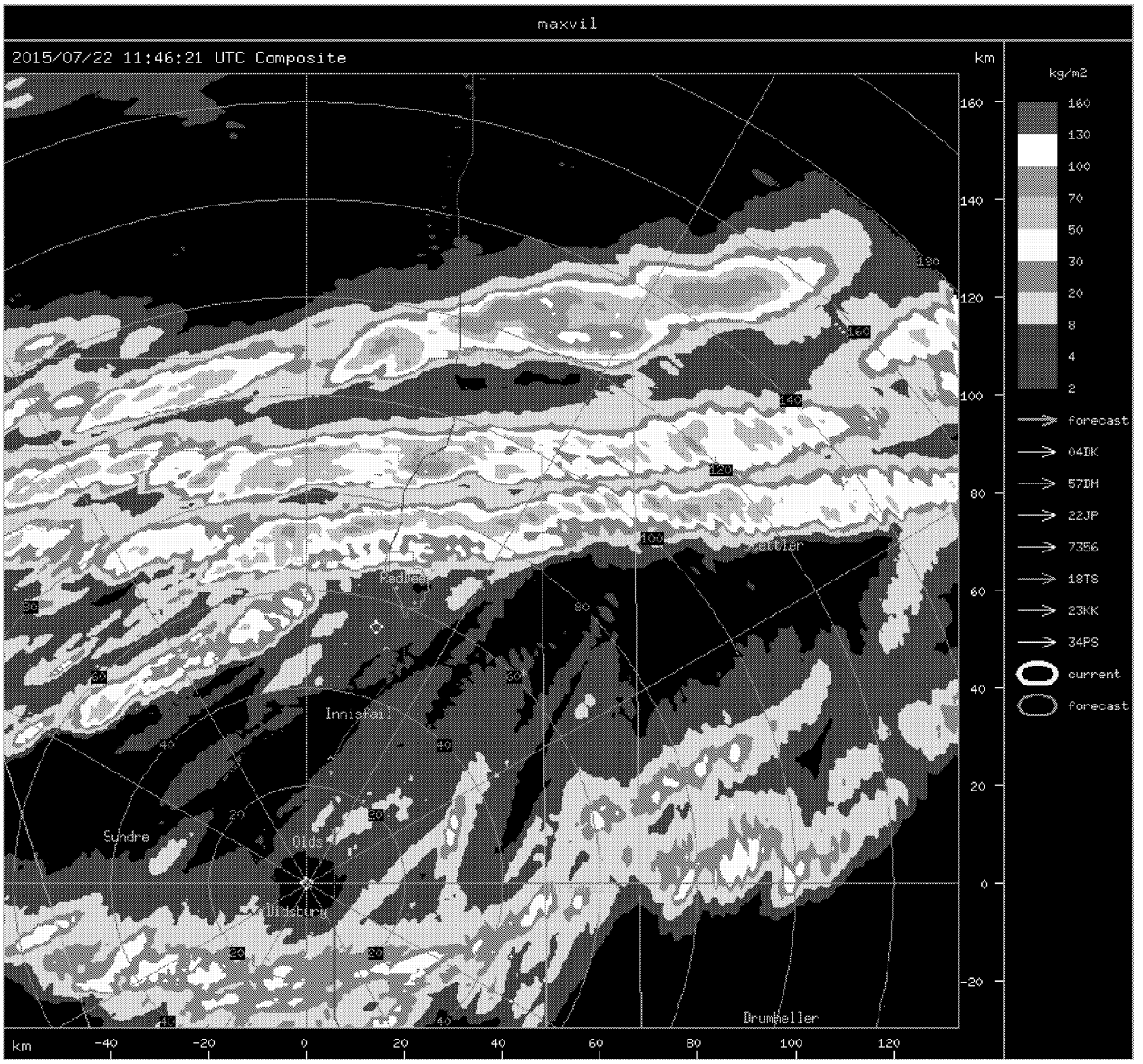

Fig. 51. The maximum vertically-integrated liquid (VIL) measured by the radar on 21 July 2015 is shown.

The largest hail swaths are were associated with the tracks of the three supercells that tracked through Ponoka, Lacombe, Blackfalds, and northern Red Deer. The VIL tracks also indicate small hail occurred in Carstairs and Crossfield. It should be noted that the maximum hail size is indicated in the far northern region on the Ponoka cell which was not seeded. Seeded cells within the project boundaries had significantly lower VIL, and also hail size.

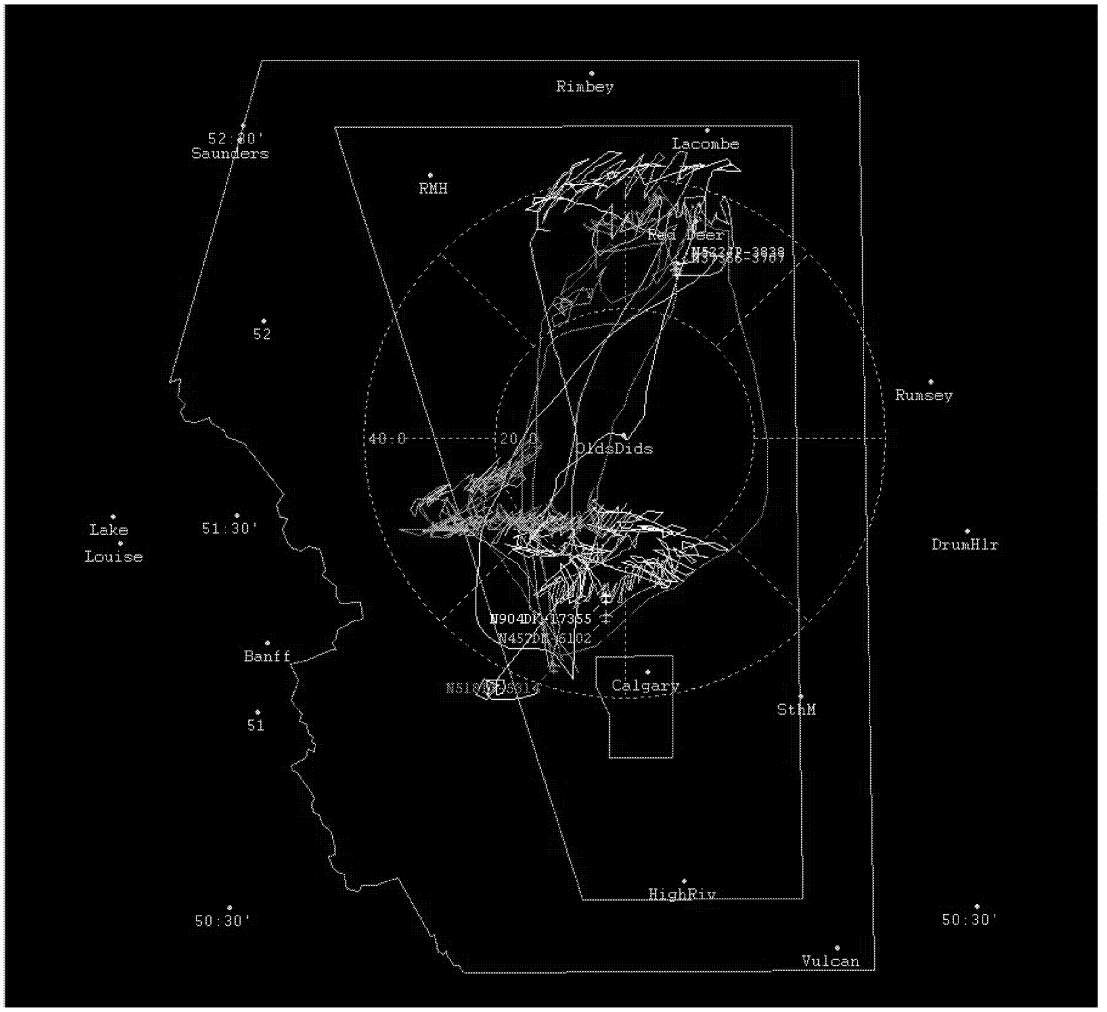

Fig. 52. *AirLink* aircraft seeding tracks for the entire storm day of 21 July 2015. Track colors are as follows: Hailstop 1, white; Hailstop 2, orange; Hailstop 3, light blue; Hailstop 4 green; and Hailstop 5, pink.

The WMI *AirLink* aircraft tracks show that the storms that moved through Carstairs, Red Deer, Lacombe, and Blackfalds were well seeded by multiple aircraft. Seeding began well upwind of the protected cities with sufficient time and dosage for positive seeding affects to be realized.

14. CLIMATIC PERSPECITIVES

The daily and accumulated rainfall for Calgary and Red Deer from 28 December 2014 through 27 December 2015 are shown in Figures 53 and 54, respectively. Calgary was near and a little above normal until May. After that, the summer was slightly drier than normal, but it got wet again in early August and continued in that vein through the first half of September, though much of the precipitation late in the project period was non-convective, that is, rainy and showery, but not close to being a hail threat. Little precipitation fell from late September through the end of the year.

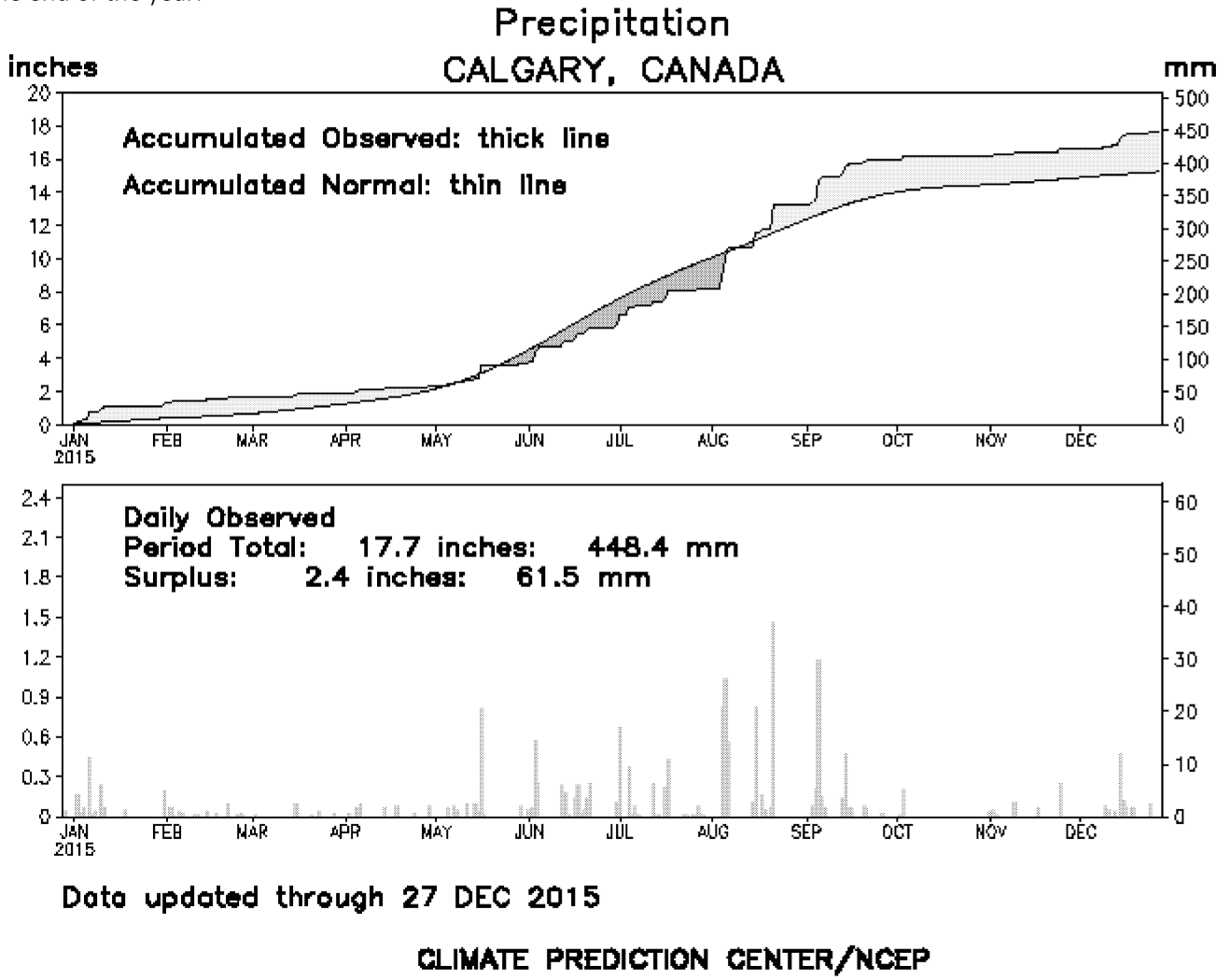

Fig. 53. Calgary precipitation, daily and cumulative, for calendar year 2015. (Data and plot from the National Center for Environmental Prediction, NOAA.)

Conditions were near normal in Red Deer for much of 2015. However, dry periods in late May into early June, and another from mid-June into the second week of July resulted in a precipitation deficit through much of the growing season (Figure 54). Active weather then began in mid-July resulted in a sustained recovery, however, such that the annual precipitation total returned to normal by early September, where it remained for the rest of the year.

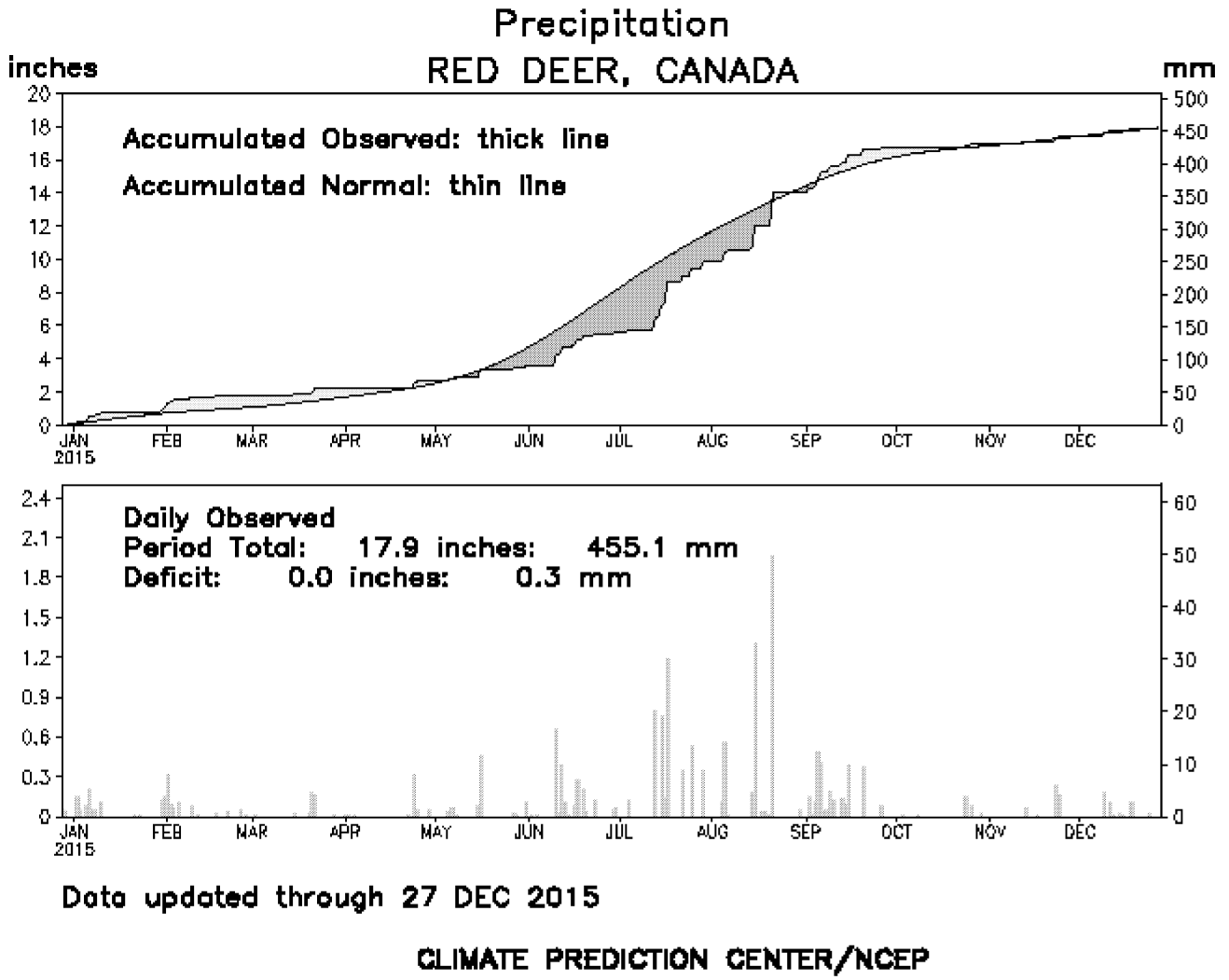

Fig. 54. Red Deer precipitation, daily and cumulative, from NCEP.

14.1 EL NIÑO/SOUTHERN OSCILLATION (ENSO) DISCUSSION

The links between sea surface temperatures in the equatorial Pacific Ocean and the weather and climate of Alberta are not clearly defined. However, there has been a slightly positive correlation between hot, dry summers and El Niño (warm ocean) conditions; and cool, wet, stormy summers with La Niña (cool ocean) conditions.

During June, sea surface temperatures (SST) anomalies exceeded +1.0°C across the central and eastern equatorial Pacific Ocean. Positive subsurface temperature anomalies weakened due to the eastward shift of an upwelling oceanic Kelvin wave, which reduced above-average temperatures at depth in the central and east-central equatorial Pacific. In many respects, the atmospheric anomalies remained firmly coupled to the oceanic warming. Significant westerly winds were apparent in the western equatorial Pacific and anomalous upper-level easterly winds continued. The traditional and equatorial Southern Oscillation Index (SOI) were both negative, which are consistent with enhanced convection over the central and eastern equatorial Pacific and suppressed convection over Indonesia. Collectively, these atmospheric and oceanic features reflected an ongoing and strengthening El Niño.

Through July, sea surface temperatures (SST) anomalies were near +1.0°C in the central equatorial Pacific Ocean, and in excess of +2.0°C across the eastern Pacific. Positive subsurface temperature anomalies strengthened in the central and east-central equatorial Pacific during the month, in association with the eastward movement of a downwelling oceanic Kelvin wave. The atmosphere remained coupled to the oceanic warming, with significant low-level westerly wind anomalies continuing from the western to east-central equatorial Pacific, along with anomalous upper-level easterly winds.

During August, sea surface temperature (SST) anomalies were near or greater than +2.0°C across the eastern half of the tropical Pacific. Large positive subsurface temperature anomalies persisted in the central and east-central equatorial Pacific during the month, with the largest departures exceeding 6°C. The atmosphere remained coupled to the anomalous oceanic warmth, with significant low-level westerly wind anomalies and upper-level easterly wind anomalies persisting from the western to east-central tropical Pacific.

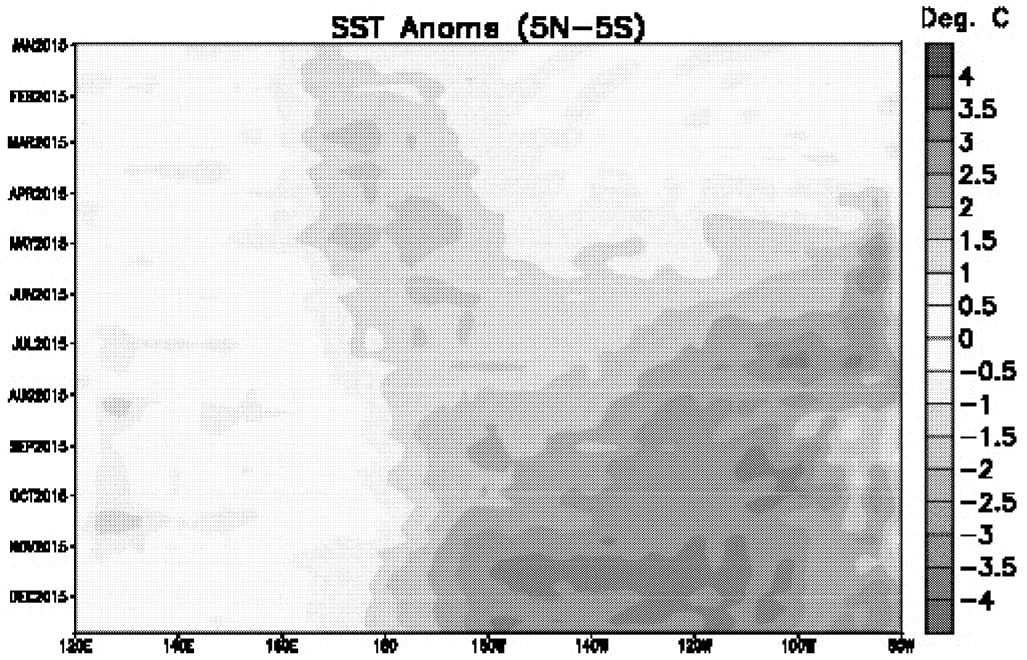

Fig. 55. Sea Surface Temperature (SST) anomalies by date and longitude, for latitudes 5°N through 5°S.

In September SST anomalies were well above average across the central and eastern Pacific Ocean. The Niño indices generally increased. Also, relative to August the strength of the positive subsurface temperature anomalies decreased slightly in the central and eastern Pacific, but the largest departures remained above 3°C. The atmosphere was well coupled with the ocean, with significant low-level westerly wind anomalies and upper-level easterly wind anomalies persisting from the western to the east-central tropical Pacific.

15. ALBERTA CROP INSURANCE SUMMARY

Figure 56 shows the annual Loss-to-Risk ratios for the Province of Alberta as determined by the straight hail crop insurance statistics collected by the Alberta Financial Services Corporation in Lacombe, Alberta. These statistics are for the entire province of Alberta. The average loss-to-risk ratio for the period 1978 to 1995 (before this project began) was 4.3%, and the average for the period 1996 to 2015 (the current project period) is 5.1%. In considering these numbers it is important to remember that the AHSP targets only those storms threatening cities and towns in the protected area. Thus, many storms, even those within the protected area but not posing threats to urban areas are not treated. When coupled with the large number of hailstorms that occur within Alberta but outside the protected area, this suggests that the frequency of damaging hailstorms is increasing climatologically.

The crop-hail loss data are presented herein exactly for that reason, to provide a baseline of sorts as to the natural frequency of storms, and how that may be changing.

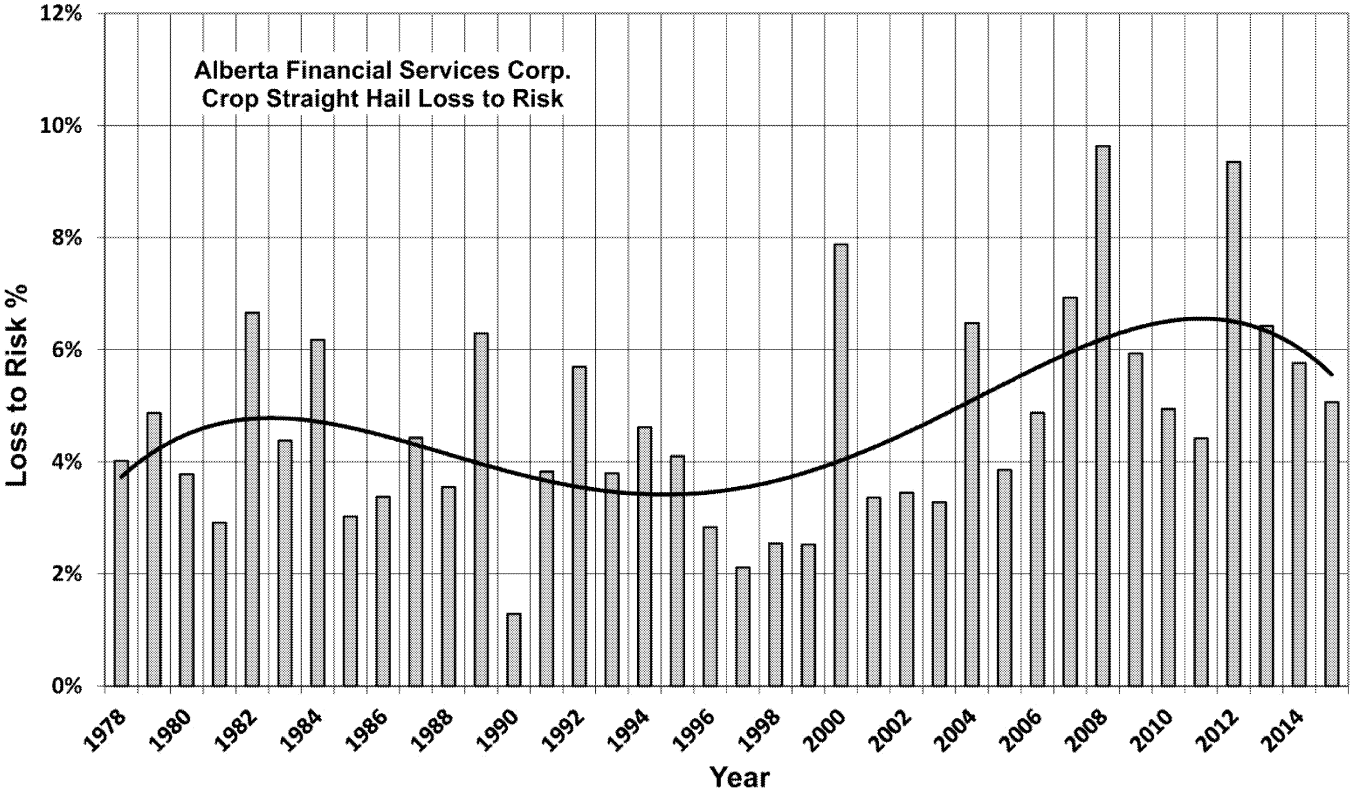

Fig. 56. Alberta Financial Services Corporation straight hail insurance loss-to-risk statistics for the entire Province of Alberta from 1978 through 2015.

Eight of the first ten years of the project period (1996-2005 inclusive) had below-average crop-hail damage in the province, and the hail damage during 2000 and 2004 appeared as spikes with above-average damage. However, the next 3 years experienced an exponential increase in crop-hail damage. Though followed by a decline in the following three years (2009-2011), all of those years are still well above the long-term climatological mean. In 2012, crop-hail losses spiked again, exceeding 9.3%. Losses in 2013 were 6.4%, not as severe as 2012, but still above the long-term average. 2014 was a little better, but losses were still high, at 5.8%. This past season the loss to risk was 5.1%, down again, but still well above the pre-project average of 4.3%. These data suggest that the threat of damaging hail storms in Alberta has increased, especially over the past 10 years.

While the area planted each year to crops remains essentially unchanged, the amount of insurance purchased each growing season varies. This depends largely upon the crops planted and growing conditions (anticipated harvests). There has been no marked trend in the last decade in either the dollar amount of insurance sold, nor in the number of acres insured, so the observed trend is not due to either of these.

The property and casualty insurance industry is quite different, however. Each of the companies belonging to the ASWMS considers its premiums and losses to be confidential, and there at present exists no analog to the Alberta Agriculture Financial Services Corporation, so the changes in risk and losses are not known outside each company. However, it is widely acknowledged that with the population growth of southern Alberta has become significantly increased exposure to property. The Calgary metropolitan area has increased dramatically since the program began in 1996, and most other communities have followed suit. It stands to reason that the apparent increase in damaging hailstorms coupled with the dramatically increased urban area demonstrates the need for this program.

16. CONCLUSIONS

The 2015 field program ran smoothly, without any significant equipment issues. All storms worthy of treatment according to the current operational guidelines were seeded in a timely way. The most significant storms of the season were July 21st near Lacombe and the back to back hail storms in Calgary on August 4th and 5th. A detailed storm summary of these storms is included in this report. Even though eight storms were recorded over the Calgary metroplex, all were treated effectively; none are known to have produced significant damage.

The fifth aircraft, another twin-engine turboprop King Air C90, was a positive asset to the program, allowing more efficient and effective hand-off of seeding at cloud top. The storm frequency was more normal; the season ranked sixth in terms of seeding activity. Having the fifth aircraft available allowed the project Lead Meteorologist to increase aircraft coverage when long-lived storms moved through or near a succession of municipalities, and to seed earlier and at a heavier rate when severe storms threatened high priority cities and towns. The additional aircraft allowed the highest average seeding rate per storm (4.42 kg per storm) in the history of the project.

We are pleased that Ponoka will be included in the official project area in 2016, as it is #15 in population, well within reach by the aircraft, covered by the radar, and it was very narrowly missed by a very severe hail storm on July 21, 2015.

Bruce Boe, Vice President of Meteorology
Daniel Gilbert, Chief Meteorologist, Alberta Lead Meteorologist
Bradley Waller, Field Meteorologist
Jody Fischer, Project Manager, Chief Pilot
Hans Ahlness, Vice President of Operations

December 2015

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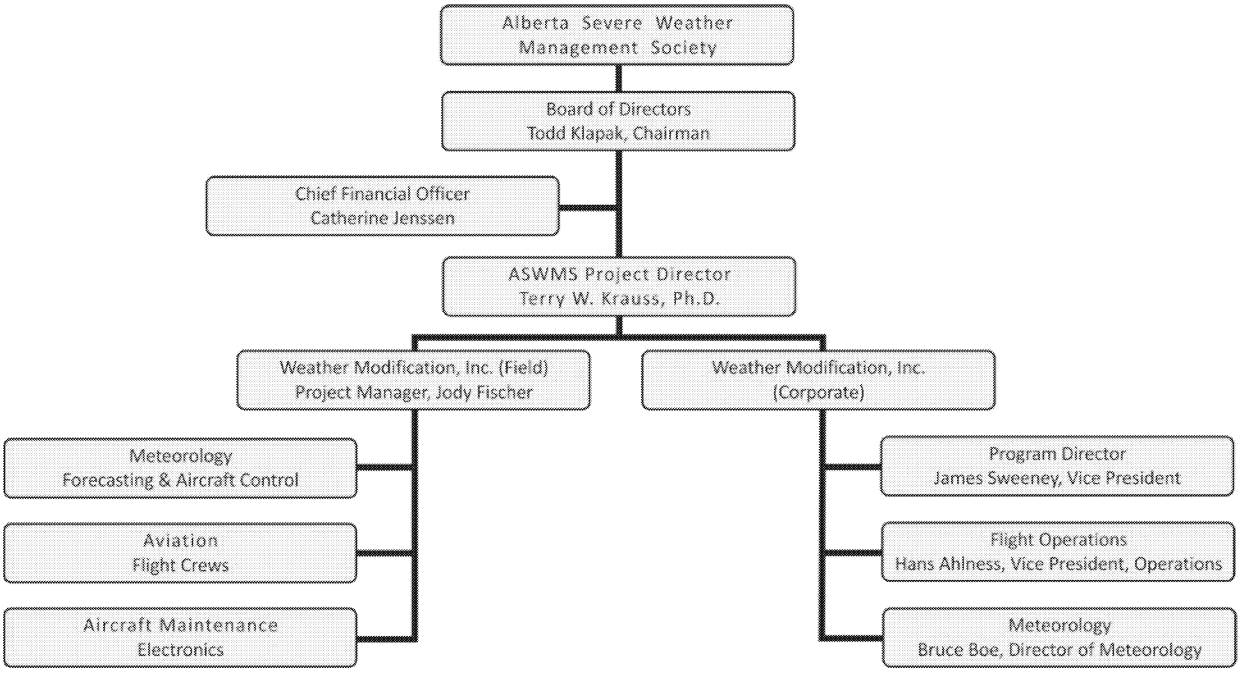
APPENDIX A – ORGANIZATION CHART, WMI



ALBERTA HAIL SUPPRESSION PROJECT 2015
DAILY SUMMARY REPORTS

Date	Weather	Activities Summary
June 1, Monday	The jet stream at the upper levels was expected to extend from the Yukon Territory down through southern MB. Mid-level charts indicated that PVA would be weak across the area. At the surface, a cold front was prognosticated to slide southward into the region during the evening hours. Surface winds looked to be easterly. Area modified model soundings showed a narrow CAPE extending from 10 to 35kft MSL. Towering cumulus clouds were observed along the foothills and inside the protected area in the late morning and afternoon. Some of these towers became tall enough to produce isolated rain showers across parts of the northern project area. In the evening, the cold front triggered a couple thunderstorms near Cochrane as the front pushed southward. Lightning strikes were observed near Cochrane. The Calgary area experienced light convective rain showers. Overnight, the entire region saw scattered rain showers. Max cell top: 5.4km, 54.0 max dBz, 10.1 max VIL Tmax YC = 23.3C and 1.4mm of rain. Tmax QF = 23.0C and no rain. Tmax Radar = 23.2C and no rain.	HS1 flew a maintenance flight. They were airborne at 1800Z. They landed at 1827Z. HS4 flew a currency flight. They were airborne at 2331Z. They landed at 0018Z (06/02). Flight Summary HS1: 1757Z-1830Z; no seeding; maintenance flight. HS4: 2321Z (06/01)-0022Z (06/02); no seeding; currency flight.
June 2, Tuesday	A broad upper level trough was expected to gradually slide from the west coast of BC toward the AB area. Within this larger scale trough a lobe of strong vorticity was expected to slowly push northward into the region. Modified model soundings suggested that embedded weak thunderstorms were possible. Speed shear looked to be very weak, so no long-lived thunderstorms were expected. Stratiform rain showers, with isolated areas of embedded convection, started to fall over the southern protected area in the early afternoon. The light rain showers then became more widespread in the late afternoon and evening. Overnight, scattered stratiform rain showers fell over the southern project area. The northern part of the region saw consistent cloud cover but stayed relatively dry throughout the period. 52.8 max dBz, 8.3 max VIL Tmax YC = 14.1C and 1.7mm of rain. Tmax QF = 18.4C and 0.4mm of rain. Tmax Radar = 16.4C and 0.3mm of rain.	Calgary AM 660 news interviewed Terry Krauss. No aircraft operations.
June 3, Wednesday	The trough over BC was expected to intensify into an open wave, low pressure system. The low pressure system looked to swing a couple lobes of moderately	HS5 flew a maintenance flight. They were airborne out of YBW at 1347Z. They landed in YQF at 1415Z.

	strong vorticity into the area. At the surface, a trough was prognosticated to form in the lee of the Rocky mountains. Area 00Z modified model soundings indicated that the atmosphere would be slightly unstable (300J/kg CAPE) with weak speed shear. Low and midlevel stratus clouds were observed over the area in the morning. In the afternoon embedded convection formed over the southern part of the region. This convection tracked northward into the Calgary area and radar indicated that pea size hail may have fallen in southern Calgary. The tallest thunderstorm of the day formed SE of High River and tracked northward. This storm was very short-lived and radar data suggested that pea size hail may occurred SE of High River. A band of weak convective precipitation then slowly moved northward across the entire project area during the late evening and overnight hours. Max cell top: 8.4 km, 58.7 max dBz, 26.9 max VIL Tmax YC = 14.0C and 14.7mm of rain. Tmax QF = 18.2C and no rain. Tmax Radar = 14.1C and 1.0mm of rain.	HS4 flew a currency flight. They were airborne at 1754Z and landed at 1843Z. HS5 flew a return maintenance flight. They were airborne out of YQF at 2213Z. They landed in YBW at 2240Z. Flight Summary HS5: 1340Z-1417Z; no seeding; maintenance flight; takeoff YBW, land YQF. HS4: 1741Z-1847Z; no seeding; currency flight. HS5: 2201Z-2243Z; no seeding; maintenance flight; takeoff YQF, land YBW.
June 4, Thursday	A mid and upper level, open wave low was centered over the region and was expected to move northeastward toward central SK during the overnight hours. Moderately strong vorticity advection looked to occur during the afternoon and evening. At the surface a lee trough was expected to remain in place for much of the period. Area modified model soundings showed that strong pulse thunderstorms were possible. Towering cumulus clouds were observed during the morning hours. In the early afternoon, the convection started to become taller. Convective cells began forming over the entire region in the midafternoon. Radar data indicated that grape size hail may have occurred SW of Rocky MH. Storm #1 formed over Okotoks and moved northward through southern Calgary. Pea size hail was reported in Calgary. The next organized storm (#2) formed to the south of Didsbury and tracked northward through the town. Pea size hail was reported in Didsbury. The third storm of the day formed northeast of Sundre and tracked northeastward through Eckville and Sylvan. The next storm (#4) developed directly over western Calgary and tracked north-northeastward near Airdrie. Grape size hail was reported west of Airdrie. Storm #5 formed west of Airdrie and moved northeastward through Carstairs, Didsbury, and Olds. Pea size hail was reported in Olds at 2350Z. Max cell top: 10.6 km, 62.5 max dBz, 56.1 max VIL Tmax YC = 20.8C and 6.2mm of rain. Tmax QF = 22.0C and 0.4mm of rain. Tmax Radar = 20.2C and 7.9mm of rain.	HS1 was launched at 2014Z to convection SW of Rocky MH. The flight became airborne at 2034Z and climbed to the top seeding altitude while en route to the Rocky MH area. At 2048Z HS1 started the patrolling the Sundre area before reaching Rocky MH. Then at 2104Z the aircraft was repositioned to the Olds area in order to patrol the convection near the Olds-Didsbury area. HS1 was next redirected to a taller and more organized TITAN cell south of Strathmore at 2111Z. The aircraft then patrolled this area before being redirected to Okotoks at 2127Z. HS1 then started top seeding storm #1 for Calgary at 2148Z. The crew reported that the cell was pulsing down at 2200Z, so they stopped seeding and started patrolling. HS1 then repositioned to a new cluster of convective TITAN cells southwest of Didsbury at 2210Z. They started seeding storm #2 for Didsbury beginning at 2231Z. The aircraft then stopped seeding and repositioned to a new convective cell over western Calgary at 2238Z. They started seeding storm #4 for Calgary starting at 2253Z. HS1 then stopped seeding at 2315Z and was redirected to the northern part of the same storm (#4), which was moving north-northeastward toward Airdrie. They started seeding this same storm (#4) for Airdrie starting at 2319Z. HS1 then stopped seeding and RTB at 2330Z. They landed at 2340Z. HS4 was launched at 2217Z to a cluster of convective cells S of Sylvan. The aircraft was airborne at 2240Z. They then started base seeding for Eckville (storm #3) at 2252Z. HS4 then repositioned to the Didsbury area at

		2312Z. They started seeding storm #5 for Didsbury and Olds at 2335Z. At 2354Z the storm was beginning to move east of the towns, so they stopped seeding and RTB. HS4 landed at 0011Z (06/05). HS3 was launched to a cluster of convective cells moving toward Sylvan at 2240Z. The flight was airborne at 2259Z and started climbing to the top seeding altitude while en route to the storm near Sylvan. At 2312Z they began top seeding storm #3 for Sylvan. The crew then reported that the feeder clouds were becoming scarce at 2317Z, so they stopped seeding and started patrolling the same area. At 2340Z HS3 repositioned to another thunderstorm near Didsbury. HS3 started seeding storm #5 for Didsbury and Olds at 2347Z. Then at 2354Z the storm was starting to move east of the towns, so HS3 stopped seeding and started patrolling east of Carstairs. They then RTB at 2359Z. They landed at 0012Z (06/05). Flight Summary HS1: 2024Z-2346Z; 49 EJ, 6 BIP; patrol Sundre, patrol Olds, patrol Strathmore, #1 Calgary, #2 Didsbury; #4 Calgary to Airdrie. HS4: 2230Z (06/04)-0014Z (06/05); 124 minutes wing-tip generators, 1 BIP; #3 Eckville, #5 Didsbury. HS3: 2248Z (06/04)-0015Z (06/05); 18 EJ, 3 BIP; #3 Sylvan, #5 Didsbury and Olds.
June 5, Friday	A ridge of high pressure was expected to build over southern AB throughout the period. Vorticity advection looked to be fairly weak. 500mb temperatures were expected to warm by around 2C. Surface winds looked to mainly be out of the NW and light. The 18Z and 00Z modified model soundings for the area indicated that the atmosphere would be slightly unstable with weak speed shear. Cumulus clouds started forming over the northern part of the region in the morning. Starting around 18Z, scattered convective rain showers began falling near Sundre and Olds. In the afternoon, the convection became slightly stronger. A few isolated weak thunderstorms briefly formed near Crossfield and Cremona. A few lightning strikes were observed from these short-lived thunderstorms. The atmosphere then stabilized in the evening. Scattered altocumulus and cirrus clouds were then observed over the region for the rest of the period. Max cell top: 6.1 km, 56.0 max dBz, 12.4 max VIL Tmax YC = 21.7C and no rain. Tmax QF = 22.9C and no rain. Tmax Radar = 22.3C and a trace of rain.	Global News Calgary interviewed Jake Mitchem at the Springbank airport in the morning. The news crew then drove to the Olds-Didsbury radar and interviewed Dan Gilbert in the early afternoon. No aircraft operations.
June 6, Saturday	A broad ridge of high pressure looked to stay centered along the coast of BC throughout the period. This same	No aircraft operations.

	ridge was expected to build over southern AB during the day and night. Vorticity advection looked to be weak, so the only trigger mechanism for thunderstorms was expected to be surface heating. Area model soundings showed that the atmosphere would be slight unstable during the daytime. Weak echoes were observed on the Olds-Didsbury radar during the morning hours. These weak radar echoes likely produced virga and perhaps a few sprinkles. In the early afternoon cumulus clouds starting forming over parts of the area. During the overnight hours isolated, light convective rain showers fell over the region. No lightning was observed. 52.4 max dBz, 6.1 max VIL Tmax YC = 24.9C and no rain. Tmax QF = 25.9C and no rain. Tmax Radar = 25.5C and no rain.	
June 7, Sunday	An upper level ridge was expected to move over the project area. There was a moderate area of vorticity modeled to move through the area. Instability was poor underneath the ridge, and no hail threats were expected. No significant weather. The only radar echoes came between 22Z and 0Z, and were elevated virga. 23.2 max dBz Tmax YC = 26.2C and no rain. Tmax QF = 27.5C and no rain. Tmax Radar = 26.0C and no rain.	No aircraft operations.
June 8, Monday	The entire project area sat underneath a broad upper level ridge. A weak frontal boundary, visible as a fine line on radar, was seen near Innisfail at the time of briefing, and was expected to continue pushing southeast across the project area. Ahead of the front, temperatures were projected to hit near record highs, exceeding 30C in the southern project area. Cooler but moister air existed behind the front, with brisk northwest winds. The thermodynamic profile was not favorable for significant convection, but a threat for isolated thunderstorms was still warranted given the frontal forcing. A second weather concern was the forecasted development of rain showers overnight into Tuesday morning associated with significant PVA. No significant weather occurred. Poor instability stifled any frontal lift, and mostly clear conditions prevailed through the day. Clouds moved into the northern project area Monday night, followed by weak rain showers into Tuesday morning. Max cell top: 47.8 max dBz, 4.6 max VIL Tmax YC = 31.9C and no rain. Tmax QF = 26.7C and no rain. Tmax Radar = 28.6C and no rain.	No aircraft operations.

June 9, Tuesday	Flow aloft was mostly zonal. A shortwave trough was departing the project area, with a ridge predicted to follow by the next forecast period. Instability was expected to be weak throughout the period, but synoptic upslope flow was forecast to produce upslope convection. This convection was expected to predominantly stay on the foothills, dissipating quickly by the time it entered the project area. Foothills convection began around 20Z, but was relatively weak. Rain showers from this convection did move through the project area, but there were no hail threats. A slightly stronger cell developed in the late evening near Carstairs producing a few lightning strikes but no hail. Max cell top: 6.9 km, 56.0 max dBz, 11.1 max VIL Tmax YC = 23.6C and no rain. Tmax QF = 22.7C and a trace of rain. Tmax Radar = 21.4C and no rain.	HS2 flew a maintenance flight. They were airborne at 1827Z and landed at 1917Z. Flight Summary HS2: 1814Z-1919Z; no seeding; maintenance flight.
June 10, Wednesday	A shortwave ridge was modeled to pass over the project area today. Mid-level vorticity advection would be benign in the afternoon, but strong PVA was expected in the late evening. Significant instability was forecast, and upslope flow was expected to foster significant foothills convection that would move into the project area. Modest instability was anticipated to persist overnight, with a second round of t-storms forecast. Early rain showers departed the area at 1830Z, coincident with convective initiation in the foothills. Storms stayed on the foothills until about 2030Z, when they began drifting into the project area south of Sundre. Storm #1 developed in this area at 2130Z, and slowly moved southeast toward Calgary before dissipating around 23Z. Storm #2 entered the northwest buffer around 2315Z and moved southeast toward Rocky MH. The storm produced the day's highest VIL and dBz, which occurred south of Rocky MH. This storm weakened became a multicellular complex as it moved across the project area, departing the eastern buffer near 6Z (06/11). A second wave of convection developed in the northern buffer around 4Z (06/11), and potentially produced grape size hail northeast of Red Deer before exiting the project area near 10Z (06/11). Max cell top: 11.4km, 63.7 max dBz, 85.7 max VIL Tmax YC = 24.1C and no rain. Tmax QF = 21.9C and 16.8mm of rain. Tmax Radar = 22.6C and 0.8mm of rain.	HS2 was launched at 2044Z. They took off from Springbank at 2059Z. They began to patrol Cochrane at 2107Z. HS2 began base seeding storm #1 Calgary at 2140Z. HS2 stopped seeding and RTB at 2259Z. They landed at 2307Z. HS5 was launched at 2222Z. They took off from Springbank at 2235Z. HS5 began top seeding storm #1 Calgary at 2245Z. HS5 stopped seeding and began to patrol Calgary at 2259Z. They RTB at 2313Z and landed at 2322Z. HS3 was launched at 2341Z. They took off at 0001Z (06/11). They began top seeding at 0028Z (06/11) storm #2 Rocky MH. HS3 stopped seeding and began patrolling Rocky MH at 0103Z (06/11). They RTB at 0115Z (06/10) and landed at 0128Z (06/11). HS4 was launched at 0008Z (06/11). They took off at 0035Z (06/11). HS4 began base seeding storm #2 Rocky MH at 0054Z (06/11). They stopped seeding and began patrolling Rocky MH to Red Deer at 0115Z (06/11). HS4 resumed seeding 0142Z (06/11) for storm #2 Rocky MH to Red Deer. HS4 stopped seeding and RTB at 0250Z (06/11). They landed at 0300Z (06/11). Flight Summary HS2: 2050Z-2308Z; 158 minutes wing-tip generators, 3 BIP; #1 Calgary HS5: 2228Z-2323Z; 29 EJ, 2 BIP; #1 Calgary HS3: 2351Z (06/10)-0131Z (06/11); 0 EJ, 4 BIP; #2 Rocky MH HS4: 0016Z (06/11)-0303Z (06/11); 176 minutes wing-tip generators, 0 BIP; storm #2 Rocky MH to Red Deer
June 11,	A large upper level trough was seen moving southeast	HS4 was launched at 2246Z. They took off at

Thursday	through British Columbia toward the project area. A strong area of mid-level vorticity was expected to move through during the late evening and early overnight hours, coupled with support from the upper level jet stream. A lee cyclone was modeled to develop somewhere in the central project area, bringing westerly drier air to the southern project area but enhanced convergence to the north. Instability was expected to be sufficient for storm maintenance and development in the project area later in the afternoon. Extensive high to midlevel cloudiness blanketed much of the central project area in the early afternoon. Stronger insolation occurred north of the project area, and convection began developing in this region around 21Z. Storm motion was nearly zonal to the east, and storms in the northern buffer did not initially threaten the project area. At 2230Z an intense potentially supercellular thunderstorm well north of the project area was seen advancing southeast toward Ponoka. This became storm #1, and was seeded before it moved into the north and northeast buffer and dissipated. A second area of convective activity developed just east of Calgary around 23Z. Storm #2 developed at this time, and moved east around Strathmore at 0015Z (06/11). Scattered showers and thunderstorms continued across much of the northern project area from the late evening to overnight, but none became a significant hail threat. Golf ball size hail was reported 10km S of Ponoka. Max cell top: 12.1km, 64.8 max dBz, 80.8 max VIL Tmax YC = 29.1C and no rain. Tmax QF = 25.9C and 0.6mm of rain. Tmax Radar = 25.6C and no rain.	2305Z. HS4 began base seeding at 2322Z storm #1 Ponoka. HS4 stopped seeding and RTB at 0005Z (06/12). They landed at 0018Z (06/12). HS3 was launched at 2248Z. They took off at 2304Z. HS3 started top seeding storm #1 Ponoka at 2322Z. They stopped seeding and began patrolling Ponoka at 0006Z (06/12). HS3 RTB at 0010Z (06/12) and landed at 0019Z (06/12). HS2 was launched at 2321Z. They were airborne at 2331Z and began to patrol Calgary at 2335Z. HS2 started base seeding storm #2 Strathmore at 0001Z (06/12). They stopped seeding and repositioned to Cochrane at 0006Z (06/12). At 0019Z (06/12) they reported no threatening convection in the area so they RTB. HS2 landed at 0028Z (06/12). Flight Summary HS3: 2255Z (06/11)-0024Z (06/12); 183 EJ, 9 BIP; #1 Ponoka HS4: 2300Z (06/11)-0021Z (06/12); 84 minutes wing-tip generators, 7 BIP; #1 Ponoka HS2: 2325Z (06/11)-0030Z (06/12); 10 minutes wing-tip generators, 0 BIP; #2 Strathmore.
June 12, Friday	An extensive upper level trough was observed moving into the project area, with several areas of mid and upper level vorticity forecast to advect across the project area. Instability was expected to be low but not negligible, and scattered thundershowers with small hail were anticipated. Periods of rain with scattered thundershowers were observed across the entire project area. The highest cell top occurred north of Olds, the highest dBz near Eckville, and the highest VIL over Calgary, all within an hour of 00Z (06/13). Pea size hail was reported in Calgary and Cochrane. Max cell top: 7.6km, 57.1 max dBz, 17.8 max VIL Tmax YC = 13.4C and 6.0mm of rain. Tmax QF = 14.6C and 9.8mm of rain. Tmax Radar = 12.3C and 3.0mm of rain.	No aircraft operations.
June 13, Saturday	A broad upper level trough over the project area was forecast to move away to the northeast through the period. Pulses of mid and upper level vorticity associated with the trough were expected to advect through the project area, producing sufficient forcing for several	No aircraft operations.

	rounds of showers and weak thunderstorms. Instability was anticipated to be insolation driven, and limited given extensive cloudiness across the region. Morning rain showers intensified into weak thundershowers as the project area warmed during the afternoon. The strongest cell of the day occurred just after 21Z near Cochrane, but the cell intensity was not sufficient for a significant hail threat. Ice pellets were reported in Calgary, likely due to a low wet bulb temperature and freezing level. Max cell top: 6.1km, 56.1 max dBz, 15.8 max VIL Tmax YC = 14.8C and 4.4mm of rain. Tmax QF = 11.8C and 2.6mm of rain. Tmax Radar = 14.6C and 3.0mm of rain.	
June 14, Sunday	The upper level jet stream was expected to stay south of AB through the evening hours. A broad upper level trough extended from Hudson Bay southwestward through southern AB. The trough looked to shift from southern AB into SK during the period. Nonetheless, the region looked to continue experiencing weak PVA from the trough. Modified model soundings for the daytime hours suggested that the troposphere would be slightly unstable with low freezing levels and weak speed shear. Scattered convective rain showers fell over the area during the morning, afternoon, and evening. Roughly a dozen lightning strikes were observed inside the protected area in the afternoon and evening. During the early nighttime hours isolated non-convective rain showers fell near Rocky MH. The cloud cover then cleared during the late overnight hours. 55.5 max dBz, 11.6 max VIL Tmax YC = 14.8C and 0.2mm of rain. Tmax QF = 14.9C and 0.2mm of rain. Tmax Radar = 12.4C and 3.3mm of rain.	No aircraft operations.
June 15, Monday	The main jet core of the upper level jet stream was centered along the Canada/US border. Weaker jet energy was expected over southern AB. The mid-level wind flow looked to stay out of the west-northwest for most of the period. 500mb temperatures were expected to warm by around 2C during the daytime. Upslope conditions looked to occur during the daytime hours. The 00Z modified model soundings indicated that the atmosphere would be moderately unstable with around 25kts of 0 to 6km bulk shear. Cumulus clouds started forming over the region during the late morning hours. In the midafternoon, isolated thunderstorms began forming along the foothills and mountains. One thunderstorm pushed into the project area SW of Sundre during the late afternoon hours before dissipating. This thunderstorm produced a few lightning strikes, and radar data showed that this thunderstorm likely produced only ice pellets. Scattered convective rain showers fell over the rest of the western half of the project	No aircraft operations.

	area during the late afternoon and evening hours. No significant weather occurred overnight. Max cell top: 7.6km, 54.3 max dBz, 12.9 max VIL Tmax YC = 17.9C and no rain. Tmax QF = 18.0C and no rain. Tmax Radar = 17.4C and no rain.	
June 16, Tuesday	Upper level jet energy was expected to be relatively weak over the area. The mid-level wind flow looked to remain west-northwesterly. At least a couple waves of PVA were expected to move through the mid-level flow during the afternoon and evening. An 850mb theta-e ridge was expected to be in place during the daytime. In the evening, a cold front was prognosticated to begin pushing southward into the northern part of the project area. Both the 18Z and 00Z (06/17) modified model soundings showed a moderately unstable atmosphere with around 25kts of effective bulk shear. Towering cumulus clouds started forming over the foothills during the late morning hours. Several convective cells moved off the foothills in the early afternoon. The strongest of these convective cells developed NW of Sylvan and tracked a short distance eastward toward Lacombe before dissipating. Radar data indicated that grape size hail may have fallen just west of the town of Bentley. Scattered convective rain showers then fell over the region through the time of sunset. Overnight, a band of light rain showers fell over the area as a cold front slowly slid southward over the area. Marble size hail was reported on the south end of Gull Lake which is near the town of Bentley. Max cell top: 8.4 km, 59.0 max dBz, 31.9 max VIL Tmax YC = 23.6C and 3.6mm of rain. Tmax QF = 23.6C and 2.2mm of rain. Tmax Radar = 22.3C and 0.3mm of rain.	HS4 was launched at 2102Z to a north-south oriented line of thunderstorms moving eastward toward the Sylvan and Red Deer area. The flight became airborne at 2120Z. HS4 started patrolling for Red Deer starting at 2124Z. At 2137Z, they repositioned to new convective growth to the west of the Olds area and then patrolled this region. Then at 2146Z, the convection was weakening across the entire northern part of the project area, so they RTB. The aircraft landed at 2156Z. Flight Summary HS4: 2115Z-2200Z; no seeding; patrol Red Deer; patrol Olds.
June 17, Wednesday	The upper level jet was expected to stay along the international border. At the mid-levels, a shortwave trough looked to push northeastward across the area during the afternoon. PVA was expected to be strong over the southern half of the project area. At the surface, winds were prognosticated to be out of the southeast to east for most of the daytime hours. Modified model soundings indicated that the southern part of the region would be unstable enough for small hail. Stratiform rain showers fell over the entire area from the morning through evening. Weak embedded convective rain showers were also observed during this same time. Overnight, a band of weak convective rain showers moved northeastward through Cremona and Carstairs. No lightning strikes were observed. 47.0 max dBz, 3.5 max VIL Tmax YC = 11.0C and 6.0mm of rain.	No aircraft operations.

	Tmax QF = 13.0C and 7.0mm of rain. Tmax Radar = 11.1C and 3.8mm of rain.	
June 18, Thursday	Upper level jet PVA looked to occur over the southern part of the project area. The midlevel wind flow was out of the southwest with a shortwave trough expected to move into the area during the afternoon. An 850mb theta-e ridge was expected to be in place through the overnight hours. Surface winds looked to be out of the south to southeast. Thermodynamic model soundings for the region indicated that the atmosphere would have a moderate amount of instability with moderate speed shear. Convective cells started pushing into the region north of Cochrane during the early afternoon. This line of convection eventually developed into TITAN cells and tracked eastward across the entire project area. The line intensified north of Strathmore before moving eastward out of the area. Radar data indicated that grape size hail may have fallen north of Strathmore. Isolated, weak thunderstorms then formed over the area during the rest of the period. Overnight, the convection slowly weakened into convective rain showers. Max cell top: 9.9 km, 61.6 max dBz, 50.4 max VIL Tmax YC = 20.3C and 0.3mm of rain. Tmax QF = 19.1C and a trace of rain. Tmax Radar = 19.6C and 0.8mm of rain.	A radar tour was conducted at the Olds-Didsbury airport and 23 people were in attendance. HS1 flew a PR flight. They were airborne out of YBW at 1609Z and landed in EA3 at 1627Z. HS1 then flew a return PR flight. The aircraft was airborne out of EA3 at 0026Z (06/19) and landed in YBW at 0048Z (06/19). Flight Summary HS1: 1559Z-1630Z; no seeding; PR flight; takeoff YBW, land EA3. HS1: 0021Z (06/19)-0050Z (06/19); no seeding; PR flight; takeoff EA3, land YBW.
June 19, Friday	The upper level jet was expected to sag southward and would be centered over Montana. The upper level low, which was along the coast of BC, looked to begin moving eastward. A shortwave trough with strong PVA looked to move northeastward across the entire protected area during the afternoon hours. Another wave of PVA was expected during the evening. At 850mb, a theta-e ridge was expected to be centered along the AB/SK border. At the surface, frontogenesis was prognosticated to occur directly over the region. Both the 18Z and 00Z (06/20) modified model soundings showed that the troposphere would be fairly unstable with around 20kts of effective bulk shear. TITAN cells started forming along the southern foothills during the late morning. Storm #1 began moving off the foothills SW of Cochrane starting at 1730Z. This long line of thunderstorms extended from south of Cochrane northward to Sundre. The long line of convection (storm #1) moved eastward through Calgary, Airdrie, Crossfield, Carstairs, Didsbury, and Olds. At around 18Z, new convection started forming west of Innisfail. This cluster of convective cells (storm #2) moved northeastward through Sylvan and Red Deer. During the late afternoon hours, more convection started developing along the foothills of the northern part of the project region. One storm (#3) from this convection became long-lived and tracked eastward through the town of Caroline. During the late afternoon, more TITAN cells grew to the NW of Rocky MH. One of these convective cells intensified into a tall storm and tracked toward the town of Rocky MH.	HS1 was launched at 1724Z to growing TITAN cells NW of Cochrane. The flight became airborne at 1742Z. They started top seeding storm #1 for Calgary at 1756Z. HS1 continued seeding the south end of the long line of thunderstorms as it moved eastward across the Calgary area. The storm was then continuing to dissipate over the Calgary area at 1901Z, so they stopped seeding and RTB. The aircraft landed at 1910Z. HS2 was launched to a cluster of convective cells NW of Cochrane at 1724Z. The aircraft was airborne at 1739Z. The crew began base seeding storm #1 for Calgary at 1752Z. HS2 continued seeding the thunderstorm as it moved eastward through Calgary. Then at 1841Z, the left wing-tip generator stopped working. At 1851Z the storm (#1) was weakening over the Calgary area, so they stopped seeding and RTB. The flight landed at 1901Z. HS4 was launched at 1741Z to new convection W of Innisfail. The flight was airborne at 1800Z. At 1802Z, the aircraft's left wing-tip generator was not working properly, so they were directed to RTB in order to fix the problem. The flight was designated as a maintenance flight. HS4 landed at 1808Z.

	This storm (#4) eventually became more linear and new growth occurred along the south side of the line of thunderstorms. This southwest to northeast oriented line tracked southeastward across most of the northern part of the project area. In general, storm #4 tracked from Rocky MH to the Olds area. Dime size hail was reported W of Penhold at 1921Z. The Red Deer airport reported 0.4cm size ice pellets at roughly 1950Z. Marble size hail was reported in the town of Condor (west of Sylvan) from storm #4. Pea size hail was reported 2km north of Olds. Max cell top: 11.4 km, 63.9 max dBz, 68.0 max VIL Tmax YC = 23.0C and 1.2mm of rain. Tmax QF = 19.5C and 5.2mm of rain. Tmax Radar = 19.8C and 1.0mm of rain.	HS5 was launched at 1809Z to a growing storm W of Airdrie. They became airborne at 1820Z. HS5 started base seeding storm #1 for Airdrie at 1826Z. They continued base seeding this linear storm as it moved east-northeastward toward Didsbury and Olds. Then at 1920Z HS5 extended their seeding line to the southeast end of the line of thunderstorms which was moving east-northeastward toward the town of Acme. At 1939Z, the storm was no longer a threat to any towns in the project area, so they stopped seeding and RTB. The aircraft landed at 2004Z. HS3 was launched at 1818Z to intensifying convection SW of Sylvan. The aircraft was airborne at 1836Z. They started seeding storm #2 for Sylvan with burn-in-place flares while climbing to the top at 1840Z. At 1844Z HS3 started top seeding with ejectable flares and BIPs. They continued seeding the storm in embedded conditions as it moved northeastward toward the Red Deer area. HS3 then stopped seeding and started patrolling the same area at 2018Z. At 2022Z the flight RTB. They landed at 2026Z. HS4 was launched at 1842Z to a cluster of TITAN cells moving toward Sylvan and Red Deer. The aircraft was airborne at 1855Z and started base seeding storm #2 for Sylvan and Red Deer at 1856Z. The left wing-tip generator was inoperative throughout the flight. The crew reported broken and not well-defined cloud bases at 1903Z, so they stopped seeding and started patrolling the Red Deer area. Storm #2 then started to intensify west of Red Deer, so they started seeding again at 1925Z. The crew then reported that there was no longer any seedable base left at 2010Z, so they stopped seeding and RTB. The aircraft landed at 2020Z. HS2 was launched to growing convection W of Caroline at 2018Z. The flight was airborne at 2038Z. At 2059Z HS2 started patrolling for Caroline. The crew then report consistent inflow near the TITAN cell W of Caroline, so they started base seeding storm #3 at 2104Z for Caroline. The aircraft's left wing-tip generator was inoperative for the last half of the flight. They then stopped seeding at 2135Z and started patrolling the same area. At 2141Z the convection near Caroline was continuing to diminish, so they stopped patrolling and RTB. The flight landed at 2202Z. HS4 was launched at 2118Z to a long-lived thunderstorm moving eastward toward the town of Caroline. The aircraft was airborne at 2150Z. Both generators were working. They started patrolling for Rocky MH at 2203Z. Then

		at 2205Z the convection near Rocky MH was diminishing rapidly, so they stopped patrolling and RTB. HS4 landed at 2220Z. HS4 was launched at 2232Z to a new long-lived TITAN cell to the NW of Rocky MH. The flight became airborne at 2251Z. Upon arriving at the storm (#4), they started base seeding at 2313Z for Rocky MH. They continued seeding with both generators along this long line of convective cells as it moved southeastward through Sylvan and toward the Olds area. Then at 0130Z (06/20) the storm was diminishing, so HS4 stopped seeding and RTB. They landed at 0202Z (06/20). HS3 was launched to a strengthening line of thunderstorms near Rocky MH at 2323Z. The aircraft was airborne at 2338Z. At 0015Z (06/20) HS3 started seeding storm #4 for Sylvan. The aircraft continued seeding the storm as it tracked southeastward across the northern part of the project area toward Innisfail. Then at 0116Z (06/20) HS3 stopped seeding and descended to shed ice near the Sundre area. At 0127Z (06/20) the storm was continuing to diminish, so they RTB. HS3 landed at 0146Z (06/20). HS2 was launched to a line of thunderstorms near Rocky MH at 2323Z. The flight was airborne at 2336Z. HS2 started base seeding storm #4 for Caroline at 0003Z (06/20). They seeded the storm as it moved toward the Olds area. Since the strongest new development tended to be along massive shelf cloud on the south side of the storm, they continued seeding the new growth as the long line of thunderstorms moved southeastward across the entire northern part of the project area. At 0130Z (06/20) HS2 stopped seeding and RTB. They landed at 0145Z (06/20). Flight Summary HS1: 1731Z-1918Z; 41 EJ, 6 BIP; #1 Calgary. HS2: 1732Z-1904Z; 110 minutes wing-tip generators, 3 BIP; #1 Calgary. HS4: 1750Z-1819Z; no seeding; maintenance flight. HS5: 1817Z-2006Z; 12 BIP; #1 Airdrie, Didsbury, and Acme. HS3: 1822Z-2031Z; 248 EJ, 15 BIP; #2 Sylvan to Red Deer. HS4: 1850Z-2023Z; 53 minutes wing-tip generators, 6 BIP; #2 Sylvan to Red Deer. HS2: 2031Z-2203Z; 25 minutes wing-tip generators, 1 BIP; #3 Caroline. HS4: 2145Z-2224Z; no seeding; patrol Rocky MH. HS4: 2245Z (06/19)-0205Z (06/20); 274 minutes wing-tip generators, 18 BIP; #4 Rocky MH to Olds.

		HS3: 2328Z (06/19)-0152Z (06/20); 171 EJ, 10 BIP; #4 Sylvan to Innisfail. HS2: 2334Z (06/19)-0147Z (06/20); 174 minutes wing-tip generators, 14 BIP; #4 Caroline to Olds.
June 20, Saturday	An upper level jet streak looked to nose its way into southern AB from the west during the evening hours. A broad trough was expected to slowly move eastward across AB. Model data indicated that PVA would be likely across the region throughout the period. An 850mb theta-e ridge looked to build back into the region late in the day. At the surface, lee cyclogenesis was expected to occur near the Calgary area at around the time of peak heating. Area modified model soundings showed that the troposphere would be moderately unstable with relatively strong speed shear. Convection started to grow along the foothills during late morning. Starting around 18Z, this convection intensified into scattered thunderstorms over the western half of the protected area. This wave of convection gradually made its way eastward across the entire project area. In the evening, the strongest storm of the day formed south of Rocky MH. This thunderstorm moved northeastward before dissipating to the east of Rocky MH. Radar data indicated that grape size hail may have fallen to the southeast of Rocky MH. The overnight hours then saw scattered convective rain showers and a few isolated weak thunderstorms. Max cell top: 8.4km, 61.9 max dBz, 41.2 max VIL Tmax YC = 20.3C and 3.6mm of rain. Tmax QF = 16.4C and 1mm of rain. Tmax Radar = 16.3C and 0.5mm of rain.	No aircraft operations.
June 21, Sunday	A shortwave trough was centered over the project area. This trough was expected to weaken and move out of the region, with substantial warming occurring in the mid-levels. Cool northwesterly flow was observed across the region, which was expected to dampen diurnal surface heating. Instability was expected to be greatest during the early afternoon, waning into the evening as temperatures warmed aloft. No forcing mechanisms were expected overnight. Scattered convective showers began forming after 17Z in the southern project area, and gradually intensified into thunderstorms around 1830Z. The strongest storm of the day occurred at this time in the eastern buffer, briefly becoming a small hail threat. Scattered showers and thundershowers continued across much of the project area through late afternoon, but no further hail threats developed. Conditions stabilized after 00Z, and calm conditions prevailed overnight. Max cell top: 6.9km, 59.8 max dBz, 33.2 max VIL Tmax YC = 18C and 6.2mm of rain. Tmax QF = 18.6C and no rain. Tmax Radar = 17.9C and 1.5mm of rain.	No aircraft operations.

June 22, Monday	Upper level flow was relatively weak and zonal, with a subtle shortwave ridge modeled to move across the area. The only predicted forcing mechanism was orographic lift, and afternoon thunderstorms from the foothills into the western project area were expected. Conditions were expected to stabilize during the overnight hours. A linear band of showers developed around 20Z in the northern buffer and gradually expanded southeast into the project area. This line briefly intensified northwest of Red Deer, and pea size hail was reported in Bentley. The convection weakened quickly, however, and ultimately exited the northeast project area near 23Z. A second wave of convection developed in the northwest project area at 0230Z, and expanded quickly across the northern project area. This elevated convection became slightly stronger than forecast, becoming a small hail threat for several cities in the north half of the project area. The first seeded storm (#1) formed to the northwest of Sundre and moved toward the Sundre area. This thunderstorm was short-lived and dissipated before reaching the Sundre area. Storm #2 developed to the northeast of Sundre. This thunderstorm then quickly moved southeastward through Olds. Convection eventually weakened into rain showers by 2Z, but lingered in the area into Tuesday morning. Max cell top: 9.1 km, 62.1 max dBz, 48.7 max VIL Tmax YC = 22.9C and no rain. Tmax QF = 22.4C and a trace of rain. Tmax Radar = 22.5C and 2.3mm of rain.	HS3 was launched at 0454Z (06/23) to a long-lived storm moving toward Sundre. The aircraft became airborne at 0510Z (06/23). They then started patrolling for Innisfail starting at 0517Z (06/23). HS3 then started seeding storm #1 for Sundre at 0538Z (06/23). At 0541Z (06/23) the aircraft repositioned to an intensifying storm northwest of Olds. Then at 0544Z (06/23) HS3 started seeding storm #2 for Olds. The crew then reported no super-cooled liquid water and only ice crystals, so they stopped seeding at 0559Z (06/23) and started patrolling the Didsbury area. At 0605Z (06/23) the TITAN cells across the project area were continuing to weaken and diminish, so HS3 stopped patrolling and RTB. They landed at 0638Z (06/23). Flight Summary HS3: 0500Z (06/23)-0642Z (06/23); 81 EJ, 5 BIP; patrol Innisfail, #1 Sundre, #2 Olds, patrol Didsbury.
June 23, Tuesday	A shortwave trough, clearly seen from water vapor imagery in southeast B.C, was expected to weaken but move through the project area Tuesday afternoon. Strong vorticity advection was expected with this feature which, combined with substantial instability, was forecast to trigger strong multicellular thunderstorms during the afternoon. Storms were expected to subside and leave the project area after midnight. Convection began developing in the foothills around 18Z and, although very slow moving, began to threaten cities in the western buffer between 19-20Z. The first seeded storm of the day (#1) was a multicellular cluster in the northwest project area near Rocky MH. This storm produced the largest radar indicated hail, tracked across much of the far northern project area, and was patrolled or seeded until it no longer threatened the Lacombe area. Storm #2 initiated on the western project boundary just west of Cochrane. Although the storm was disorganized, radar indicated it produced up to grape size hail north of town. Storm #3 developed south of storm #1 as a broken line of convection moved off the foothills and across the northern half of the project area. Storm #3 hit Sundre directly, but did not produce any radar indicated hail in town. At 2145Z, a gust front was seen on radar emanating from storm #3 and the aforementioned line of convection in the north. This gust front began to initiate	HS4 was launched at 1917Z. They were airborne at 1940Z and proceeded toward Rocky MH for patrol. They began to patrol for Rocky MH at 1956Z. HS4 started base seeding storm #1 Rocky MH at 2014Z. HS4 stopped seeding and began to patrol Eckville at 2115Z. HS4 resumed seeding at 2234Z storm #1 Lacombe. HS4 stopped seeding and RTB at 2250Z. They landed at 2305Z. HS1 was launched at 2000Z. They were airborne at 2020Z. HS1 began top seeding storm #2 Cochrane to Airdrie at 2032Z. HS1 RTB at 2140Z, and landed at 2154Z. There was no AirLink track for this flight due to a GPS antenna connection issue which was resolved after the flight. HS2 was launched at 2033Z. They were airborne at 2053Z. HS2 began base seeding storm #3 Sundre at 2109Z. HS2 stopped seeding at 2142Z and repositioned to Crossfield. HS2 started patrolling Crossfield 2152Z, and found the convection to be non-threatening. They repositioned to Springbank at 2154Z, and repositioned again to Olds at 2221Z. They began seeding storm #4 Olds at

	storms of its own, although this development was stymied by the anvil of the existing convection. Nevertheless, storm #4 developed on this gust front west of Olds, and became a small hail threat. It quickly dissipated, however, and attention turned to the last seeded storm of the day. Storm #5 began intensifying near 2230Z north of Lacombe, and took an anomalous track to the north-northeast. Its unusual track made it a threat for Ponoka, and was seeded until it passed Ponoka out of the project buffer at 2327Z. By 00Z only nonthreatening rain showers remained in the project area, and these dissipated/departed before 4Z. Pea size hail reported in Ponoka. Max cell top: 9.9km, 63.6 max dBz, 63.0 max VIL Tmax YC = 21.2C and no rain. Tmax QF = 22.7C and 3mm of rain. Tmax Radar = 21.9C and 1.5mm of rain.	2236Z. HS2 stopped seeding and repositioned to QF for patrol at 2250Z. They began patrolling Red Deer to Lacombe at 2305Z. At 2315Z HS2 began seeding storm #5 Ponoka. HS2 stopped seeding and RTB at 2327Z. They landed at 0003Z (06/24). HS3 was launched at 2239Z. They were airborne at 2258Z. At 2310Z, HS3 began to patrol from Innisfail to Red Deer. HS3 RTB at 2340Z, and landed at 2347Z. Flight Summary HS4: 1935Z-2307Z; 158 minutes wing-tip generators, 6 BIP; #1 Rocky MH, #1 Lacombe, Patrol Eckville. HS1: 2010Z-2158Z; 65 EJ, 10 BIP; #2 Cochrane to Airdrie. HS2: 2044Z (06/23)-0006Z (06/24); 120 minutes wing-tip generators, 2 BIP; #3 Sundre, #4 Olds, #5 Ponoka, Patrol Crossfield, Patrol Red Deer to Lacombe. HS3: 2250Z-2352Z; no seeding; patrol Innisfail to Red Deer.
June 24, Wednesday	A subtle shortwave ridge was expected to pass over the region, with relatively weak winds aloft. Diurnal instability was expected, though not as impressive as previous days. Foothills convection was expected, though the threat of this activity making it to the western project area was deemed low. A significant pulse of PVA was forecast during the late evening to overnight hours, specifically 3 to 9Z, and scattered elevated convection was predicted in response to this forcing. Isolated convection developed over the foothills throughout the afternoon. A particularly strong storm drifted east on the foothills near Turner Valley, but collapsed as it entered the project area. It did produce the strongest reflectivity and VIL for the day, however, with radar indicated pea size hail on the western project boundary. A second round of convective thundershowers developed after 0530Z. No overnight cells were hail threats, and the precipitation gradually dissipated into Thursday morning. Max cell top: 6.9km, 57.0 max dBz, 20.9 max VIL Tmax YC = 24.3C and no rain. Tmax QF = 24.5C and no rain. Tmax Radar = 23.4C and no rain.	A radar tour was conducted at the Olds-Didsbury airport and 20 people were in attendance. HS2 flew a PR flight. They took off from YBW at 1736Z and landed at EA3 at 1755Z. HS2 flew a return PR flight from EA3 back to YBW. They took off at 2302Z and landed at 2319Z. Flight Summary HS2: 1725Z-1756Z; no seeding; PR flight; takeoff YBW, land EA3. HS2: 2255Z-2321Z; no seeding; PR flight; takeoff EA3, land YBW.
June 25, Thursday	The upper level jet stream was seen transiting the project area as a large scale ridge was advancing toward the region. Strong daytime insolation was expected along with modest moisture, but a tall boundary layer with high cloud bases was also predicted. Mid-level temperatures were modeled to warm considerably through the forecast period, meaning the best instability and opportunity for deep convection was anticipated early in the afternoon. Speed and directional shear were expected to be significant, but the foothills appeared to be the lone forcing mechanism for the day. Despite good shear and	No aircraft operations.

	instability, convection was expected to be confined to the foothills. Weak rain showers were briefly observed Thursday morning, followed by clearing skies across the entire project area. Conditions remained clear much of the day, interrupted only by shallow foothills convection moving into the far western project area between 21Z and 2230Z. This convection did not produce any lightning or meaningful rain, but was responsible for the day's highest reflectivity. The atmosphere then stabilized through the afternoon, as evidenced by the dissipation of the cumulus field on the foothills. No significant radar echoes were observed until Friday morning, when a small band of virga or weak rain showers moved into the northwestern project area just before 12Z. 37.9 max dBz Tmax YC = 27.6C and no rain. Tmax QF = 26.6C and no rain. Tmax Radar = 25.5C and no rain.	
June 26, Friday	The core of the upper level jet stream was modeled to move well north of the project area as a significant upper level ridge built into central AB. Strong surface heating was expected with clear skies, but mid-level subsidence was forecast to create high bases and a very elevated, thin CAPE profile. The only threat of mention was a weak pulse of PVA expected after midnight, but the only predicted consequence was virga or an isolated weak rain shower. A few elevated rain showers were seen Friday morning in response to a weak pulse of PVA. These dissipated into virga around 1430Z. Mostly clear skies then prevailed across the project area through the rest of the day. A brief rain shower developed in the far northeast buffer around 0730Z Friday night, but no other significant radar echoes were observed. 39.9 max dBz Tmax YC = 28.7C and no rain. Tmax QF = 27.1C and no rain. Tmax Radar = 26.1C and no rain.	No aircraft operations.
June 27, Saturday	A large synoptic ridge was observed over the project area. Strong subsidence was modeled to occur under this ridge, intruding dry warm air into the low and mid-levels. Surface temperatures were expected to surge to near 30C, and instability, while strong, was elevated above a layer of convective inhibition. No synoptic forcings were anticipated through the forecast period, and no significant weather was forecast. Conditions were dry and very warm throughout the day. A chinook cloud developed across much of the central project area during the afternoon, producing weak elevated echoes. Skies cleared near dusk, and no meteorological echoes were observed the rest of the period.	No aircraft operations.

	20.6 max dBz Tmax YC = 30.8C and no rain. Tmax QF = 29.3C and no rain. Tmax Radar = 28.1C and no rain.	
June 28, Sunday	Upper level jet energy was expected to stay over the region throughout the period. The axis of the ridge looked to be centered over AB through the nighttime hours. At 700mb, a moderately strong thermal ridge looked to be in place for most of the day. In other words, a cap was expected over the region. Surface winds were expected to be mainly easterly and favor upslope conditions. The 00Z (06/29) modified model sounding for YYC showed that the atmosphere would be very unstable with a decent amount of speed shear. Unmodified model soundings showed a loaded gun situation. Towering cumulus clouds began developing over the foothills during the afternoon. This convection was high based and dissipated rapidly as it moved toward the project area due to the cap. Cirrus and cumulus clouds were observed over the protected area during the daytime. Only very weak echoes were observed on radar. Overnight, stratiform clouds began to overspread the area from the west. 25.5 max dBz Tmax YC = 30.8C and no rain. Tmax QF = 29.4C and no rain. Tmax Radar = 28.6C and no rain.	No aircraft operations.
June 29, Monday	A 95 knot jet streak looked to nose its way into southern AB during the evening hours. The ridge looked to quickly flatten as a shortwave trough moved northeastward into the area during the evening hours. At the low-levels, the cap was also expected to gradually weaken throughout the day. Surface and low level winds were expected to be easterly and favor upslope conditions. The 00Z (06/30) modified model sounding for YYC showed a moderately unstable atmosphere with ample speed shear. Weak thunderstorms formed near Ponoka during the early morning hours. Scattered convective rain showers were then observed over the region during the morning, afternoon, and evening. Shortly after sunset, a band of thunderstorms pushed into the southern part of the project area. The strongest of these relatively weak thunderstorms formed just south of Cochrane and tracked a very short distance to the northeast before dissipating. Radar data indicated that a very small area just south of Cochrane may have experienced grape size hail. This band of thunderstorms and convective rain showers weakened as it tracked northeastward across the region during the nighttime hours. Max cell top: 7.6km, 59.2 max dBz, 31.2 max VIL Tmax YC = 22.9C and a trace of rain.	No aircraft operations.

	Tmax QF = 20.4C and 1.2mm of rain. Tmax Radar = 19.8C and 0.8mm of rain.	
June 30, Tuesday	A southwesterly jet streak looked to begin sliding into southern AB in the evening. During the day, weak PVA was expected. The main trigger for thunderstorms looked to be a shortwave trough. This disturbance was expected to move through during the late evening through morning hours the next day. An 850mb theta-e ridge was expected to stay in place throughout the period. At the surface, the wind flow appeared to be mainly out of the north. Both the YQF and YYC modified model soundings at 00Z (07/01) indicated that the atmosphere would be moderately unstable with 25kts of 0 to 6km bulk speed shear. Scattered weak thunderstorms started forming along the western project boundary starting around 18Z. These storms moved into the region during the early afternoon producing mainly rain showers. In the late afternoon, a storm (#1) formed southwest of Calgary and moved northeastward across the city. Ice pellets and localized flooding was reported in southern Calgary from storm #1. A cluster of convective TITAN cells (storm #2) then formed west of Sundre and then moved southeastward toward the town of Acme. The next storm of the day (storm #3) formed near the Rocky MH area and tracked southeastward toward the town of Innisfail. This thunderstorm eventually moved southeastward through Innisfail during the early evening. In the evening, a particularly strong convective cell formed northwest of Cochrane. This became storm #4 as it moved southeast threatening Calgary, and produced golf ball size hail in Redwood Meadows. The storm ultimately narrowly missed Calgary and Okotoks to the west, but was seeded until it weakened and no longer posed a threat for High River. Once storm #4 dissipated, a three hour lull in the convective activity occurred until a line of elevated thunderstorms crossed the mountains from British Columbia. By 08Z (07/01), it was clear this line would threaten multiple cities in the southern project area, although radar indicated it only had a pea to small grape size hail threat. Nonetheless, it was seeded and became storm #5 as it tracked across the southern project area, and operations targeted the section of the line affecting cities from Calgary to Strathmore. Max cell top: 12.1km, 66.2 max dBz, 109.3 max VIL Tmax YC = 24.6C and 2.6mm of rain. Tmax QF = 22.1C and 1.6mm of rain. Tmax Radar = 22.0C and 2.6mm of rain.	A radar tour was conducted at the Olds-Didsbury airport and 12 people were in attendance. HS3 flew a PR flight. They were airborne out of YQF at 1738Z and landed in EA3 at 1759Z. HS1 was launched at 2115Z to a long-lived cell moving northeastward toward Calgary. The flight became airborne at 2135Z. At 2150Z HS1 started top seeding storm #1 for Calgary. The crew continued seeding this thunderstorm as it moved northeastward across the entire city of Calgary. The thunderstorm was then diminishing over eastern Calgary at 2214Z, so they stopped seeding and repositioned to a cluster of TITAN cells moving toward Sundre. HS1 then started seeding storm #2 at 2232Z for Sundre. The crew continued seeding the long-lived thunderstorm as it moved through Sundre, Cremona, and Carstairs. At 0015Z (07/01) HS1 stopped seeding and RTB. They landed at 0028Z (07/01). HS4 was launched at 2235Z to a TITAN cell moving toward the Sylvan area. They were airborne at 2254Z. The crew then reported an inoperable left wing-tip generator, so they were directed to land in YQF to fix the wing-tip generator. They landed at 2304Z. HS4 had landed briefly in YQF in order to quickly fix the left wing-tip generator. They were then airborne again at 2314Z. They then started base seeding storm #3 at 2334Z for Innisfail. HS4 continued seeding as the line of thunderstorms moved southeastward toward the Innisfail area. At 0042Z (07/01) the crew stopped seeding and RTB. They landed at 0053Z (07/01). HS3 was launched at 2259Z to intensifying convective growth near Cochrane. The aircraft was airborne out of EA3 at 2312Z. At 2315Z HS3 started patrolling for Calgary. They were then redirected to a line of thunderstorms approaching Innisfail at 2350Z. Then at 0008Z (07/01) HS3 started top seeding storm #3 for Innisfail. At 0031Z (07/01) the storm was continuing to weaken, so the aircraft stopped seeding and started patrolling the same area. The crew then RTB at 0042Z (07/01). They landed in YQF at 0056Z (07/01). HS2 was launched at 2259Z to growing convection near Cochrane. They were airborne at 2319Z and started flying northward toward the town of Cremona. At 2331Z they started seeding storm #2 for Carstairs. Then at 0020Z

		(07/01) the storm was no longer a threat to Carstairs, so they stopped seeding and started patrolling the same thunderstorm for the town of Acme. The storm then diminished as it approached Acme, so they RTB at 0030Z (07/01). The aircraft landed at 0044Z (07/01). HS5 was launched at 0251Z (07/01) to a tall storm west of Cochrane. The aircraft was airborne at 0258Z (07/01) and began climbing to the top seeding altitude. At 0300Z (07/01) HS5 started seeding storm #4 for Calgary. The crew continued seeding the storm as it moved toward High River. They then stopped seeding and RTB at 0507Z (07/01). HS5 landed at 0539Z (07/01). HS2 was launched at 0255Z (07/01) to a tall cell west of Cochrane moving toward Calgary. The flight was airborne at 0305Z (07/01). At 0308Z (07/01) HS2 started base seeding storm #4 for Calgary. The aircraft continued seeding along the base of the storm as it moved toward High River. HS2 stopped seeding and RTB at 0512Z (07/01). They landed at 0546Z (07/01). HS3 was launched at 0419Z (07/01) to storm #4 which was tracking toward Okotoks. They were airborne at 0441Z (07/01). The intended target weakened before they arrived and no further convection appeared threatening, so HS3 RTB at 0512Z (07/01). They landed at 0534Z (07/01). HS5 was launched at 0810Z (07/01) to a squall line approaching Calgary. The aircraft became airborne at 0824Z (07/01). The flight was then aborted due to a fuel cap issue. HS5 landed at 0831Z (07/01). HS3 was launched at 0819Z (07/01) to a line of thunderstorms moving east toward the southern half of the project area. They were airborne at 0838Z (07/01). HS3 began top seeding storm #5 for Calgary at 0907Z (07/01). They stopped seeding and began to patrol Strathmore at 0916Z (07/01). HS3 RTB at 0933Z (07/01) and landed at 0949Z (07/01). Flight Summary HS3: 1730Z-1803Z; no seeding; PR flight; takeoff YQF, land EA3. HS1: 2126Z (06/30)-0030Z (07/01); 171 EJ, 25 BIP; #1 Calgary; #2 Sundre to Carstairs. HS4: 2245Z-2306Z; no seeding; maintenance flight. HS3: 2304Z (06/30)-0103Z (07/01); 101 EJ, 4 BIP; patrol Calgary, #3 Innisfail; takeoff EA3, land YQF. HS4: 2306Z (06/30)-0055Z (07/01); 134 minutes wing-tip generators, 7 BIP; #3 Innisfail. HS2: 2311Z (06/30)-0046Z (07/01); 98 minutes

		wing-tip generators, 5 BIP; #2 Carstairs, patrol Acme. HS5: 0253Z (07/01)-0542Z (07/01); 299 EJ, 18 BIP; #4 Calgary to High River. HS2: 0301Z (07/01)-0548Z (07/01); 248 minutes wing-tip generators, 17 BIP; #4 Calgary to High River. HS3: 0431Z (07/01)-0539Z (07/01); no seeding; patrol flight. HS5: 0819Z (07/01)-0834Z (07/01); no seeding; maintenance flight. HS3: 0830Z (07/01)-0954Z (07/01); 29 EJ, 1 BIP; #5 Calgary to Strathmore.
July 1, Wednesday	Jet energy looked to weaken over southern AB during the daytime hours. A shortwave trough began moving through the area early in the day and was expected to trigger off thunderstorms during the early afternoon over the southern part of the area. The low levels of the troposphere looked to remain warm and moist. The 18Z YYC modified model sounding showed a moderately unstable thermodynamic profile. Speed shear values suggested that thunderstorms would be short-lived. A band of precipitation moved southward across the project area during the morning hours. This wave of moisture had areas of convection. In the afternoon the cloud cover became broken. Isolated convective rain showers fell over the area in the afternoon and evening. Overnight saw mostly clear skies. No lightning strikes were observed throughout the period. Max cell top: 3.9km, 54.1 max dBz, 8.1 max VIL Tmax YC = 23.8C and 17.0mm of rain. Tmax QF = 24.2C and no rain. Tmax Radar = 23.5C and 4.1mm of rain.	HS1 flew a maintenance flight. They were airborne out of YBW at 1748Z and landed in YBW at 1757Z. Flight Summary HS1: 1735Z-1801Z; no seeding; maintenance flight; takeoff YBW, land YBW.
July 2, Thursday	Upper level jet energy was expected to stay north of the region. A weak shortwave trough looked to undercut the ridge and move southeastward through southern AB. Model data showed that a wave of weak PVA would move southeastward across the area during the afternoon. Warm moist air looked to stay in place over the region throughout the period. Surface winds were prognosticated to be southerly and light for most of the day. The 00Z (07/03) YYC modified model sounding indicated that the atmosphere would be moderately unstable. Pulse thunderstorms were expected due to very weak speed shear. Convective cells began developing along the entire length of the foothills during the midafternoon. These TITAN cells were back building and gradually diminished as the storms tracked southeastward over the foothills. At around 21Z a TITAN cell began growing over the foothills well west of Sundre. This cell intensified as it tracked southeastward over the foothills. Then at 23Z this organized TITAN cell quickly weakened as it moved into the project area. Radar data indicated that just rain showers fell inside the project area from this thunderstorm. Mostly clear skies were then observed in	HS1 flew a maintenance flight. They were airborne out of YBW at 1449Z and landed in YQF at 1518Z. HS1 then flew a return maintenance flight. They were airborne out of YQF at 1735Z and landed in YBW at 1801Z. Flight Summary HS1: 1434Z-1522Z; no seeding; maintenance flight; takeoff YBW, land YQF. HS1: 1726Z-1804Z; no seeding; maintenance flight; takeoff YQF, land YBW.

	the late evening and overnight. 51.6 max dBz, 7.4 max VIL Tmax YC = 27.0C and no rain. Tmax QF = 27.1C and no rain. Tmax Radar = 25.4C and no rain.	
July 3, Friday	Model data indicated that the upper level jet would sag southward during the day. Jet energy was expected over the region from the midafternoon through the nighttime hours. Zonal flow looked to occur at the mid-levels over southern AB as a closed low moved eastward over the far northern part of AB. A wave of weak PVA looked to move eastward through the flow during the afternoon hours. The low levels were expected to remain warm and moist. A cold front was prognosticated to slide southeastward through the area during the afternoon and evening. Both the YQF and YYC modified model soundings showed that the atmosphere would be very unstable with a moderate amount of bulk speed shear. Area soundings also indicated that a moderately strong cap would be in place through the early afternoon. This cap was expected to erode during the midafternoon hours. The atmosphere stayed capped through the midafternoon hours. In the late afternoon, elevated cumulus clouds started forming over the northwestern part of the protected area. Some of these clouds became tall enough to produce light scattered rain showers over the northern part of the region. Then in the evening, a storm (#1) formed north of Rocky MH and tracked toward the town of Ponoka. The second storm of the evening formed to the northwest of Rocky MH. This storm (#2) intensified and became the strongest thunderstorm of the day as it moved southeastward toward Blackfalds. The third seeded storm of the day grew southwest of Sundre and tracked eastward through the town of Didsbury. Another storm then formed south of storm #3. This thunderstorm (storm #4) was slow to develop, but continued to gradually become taller and stronger as it moved through the towns of Crossfield and Beiseker. Starting around 0330Z (07/04) another wave of TITAN cells intensified north of Rocky MH. This band of thunderstorms (storm #5) moved east-southeastward through the city of Lacombe at roughly 0545Z (07/04). Weaker thunderstorms continued forming over the northern part of the protected area during the overnight hours. Golf ball and walnut size hail was reported near the town of Bentley. Marble size hail was reported in Lacombe. Loonie size hail was reported in Crossfield. Max cell top: 12.1km, 64.1 max dBz, 67.8 max VIL Tmax YC = 29.6C and no rain. Tmax QF = 28.2C and no rain. Tmax Radar = 27.8C and 0.3mm of rain.	HS2 flew a reposition flight. They were airborne out of YBW at 1853Z and landed in YRM at 1928Z. HS2 then flew a return reposition flight. The aircraft was airborne out of YRM at 2139Z and landed in YBW at 2212Z. HS4 was launched at 0127Z (07/04) to a long-lived TITAN cell north of Rocky MH moving toward Lacombe. The aircraft became airborne at 0149Z (07/04). At 0208Z (07/04) HS4 reported finding consistent inflow, so they started base seeding storm #1 for Ponoka. Then at 0230Z (07/04) the storm was continuing to dissipate, so the aircraft repositioned to a tall and stronger TITAN cell to the west. The crew left the wing-tip generators on as they repositioned over to the western storm. HS4 then started seeding storm #2 for Blackfalds at 0234Z (07/04). HS4 stopped seeding and RTB at 0350Z (07/04). They landed at 0400Z (07/04). HS2 was launched at 0147Z (07/04) to a growing storm to the northwest of Rocky MH. The flight was airborne at 0206Z (07/04). They started base seeding storm #2 for Blackfalds at 0240Z (07/04). HS2 stopped seeding and repositioned to Carstairs at 0352Z (07/04). They patrolled briefly, but were repositioned a second time to Springbank at 0404Z (07/04). On the way to Springbank, a storm east of Carstairs intensified and became a hail threat for Beiseker. HS2 began seeding this storm, #4, at 0418Z (07/04). At 0425Z (07/04) HS2 stopped seeding and repositioned to the northern buffer. They began seeding storm #5 Lacombe at 0457Z (07/04). HS2 stopped seeding and RTB 0512Z (07/04). They landed at 0547Z (07/04). HS3 was launched to an intensifying cell moving toward Lacombe at 0153Z (07/04). The aircraft became airborne at 0211Z (07/04). HS3 then started top seeding storm #2 for Blackfalds at 0232Z (07/04). They stopped seeding and RTB at 0353Z (07/04). HS3 landed at 0403Z (07/04). HS5 was launched at 0157Z (07/04) to a tall and long-lived storm north of Rocky MH. The flight was airborne at 0213Z (07/04). HS5 then started patrolling for Innisfail at 0231Z (07/04).

		Then at 0243Z (07/04) the aircraft started patrolling for Cremona. HS5 began top seeding storm #3 for Didsbury at 0308Z (07/04). They stopped seeding, descended to base, and repositioned to the northern buffer at 0322Z (07/04). HS5 began base seeding storm #2 Blackfalds at 0333Z (07/04). They stopped seeding and repositioned to the Rocky MH VOR at 0353Z (07/04), however they were then quickly repositioned again to a more pressing hail threat east of Carstairs at 0401Z (07/04). HS5 began top seeding storm #4 Beiseker at 0419Z (07/04). They stopped seeding and repositioned to the northern buffer at 0425Z (07/04). HS5 began top seeding storm #5 for Lacombe at 0448Z (07/04). They stopped seeding and RTB at 0512Z (07/04). HS5 landed at 0540Z (07/04). Flight Summary HS2: 1844Z-1930Z; no seeding; reposition flight; takeoff YBW, land YRM. HS2: 2134Z-2214Z; no seeding; reposition flight; takeoff YRM, land YBW. HS4: 0140Z (07/04)-0402Z (07/04); 204 minutes wing-tip generators, 10 BIP; #1 Ponoka; #2 Blackfalds. HS2: 0157Z (07/04)-0551Z (07/04); 188 minutes wing-tip generators, 14 BIP; #2 Blackfalds, #4 Beiseker, #5 Lacombe, Patrol Carstairs. HS3: 0203Z (07/04)-0407Z (07/04); 193 EJ, 8 BIP; #2 Blackfalds. HS5: 0207Z (07/04)-0542Z (07/04); 78 EJ, 11 BIP; #3 Didsbury, #2 Blackfalds, #4 Beiseker, #5 Lacombe, patrol Innisfail, patrol Cremona.
July 4, Saturday	The upper level jet stream looked to stay directly over the region during the daytime hours. A mid-level trough looked to move southeastward across southern AB during the afternoon and evening. Moderate to strong PVA was expected with the trough. At the surface, a lee trough looked to develop over the region during the afternoon. Area modified model soundings showed that the atmosphere would contain anywhere from 400 to 700 J/kg of CAPE during the time of peak heating. Speed shear was expected to be rather strong due to an upper level jet streak over southern AB. Scattered convective rain showers fell over the eastern part of the region during the morning hours. In the late morning, convection started forming just south of Limestone mountain. This convection gradually moved southeastward and strengthened into a TITAN cell as it moved into the project area. This storm (#1) eventually moved through Airdrie. The second storm of the day developed to the west of Cremona at 2005Z. This thunderstorm continued to slowly intensify as it tracked southeastward through Cochrane and Calgary. Radar data indicated that grape size hail may have fallen over Calgary. The third seeded storm of the day formed along the foothills northwest of Okotoks. This storm (#3) was a	HS4 was launched at 1908Z to a convective cell moving toward Airdrie and Calgary. The aircraft became airborne at 1928Z. At 1958Z, HS4 started base seeding storm #1 for Airdrie. They then stopped seeding and repositioned to the northwest of Cochrane at 2025Z. Then at 2033Z, the aircraft started patrolling for Cochrane. HS4 started seeding storm #2 for Cochrane at 2059Z. Then at 2224Z the aircraft was redirected to a convective cell northwest of Okotoks. The crew left the wing-tip generators on as they repositioned. They then started seeding storm #3 for Okotoks at 2226Z. HS4 then stopped seeding and RTB at 2248Z. The flight landed at 2343Z. HS1 was launched at 1935Z to thunderstorm moving southeastward toward the Calgary and Airdrie area. The flight was airborne at 1955Z. They started top seeding storm #1 for Airdrie beginning at 2003Z. At 2045Z HS1 stopped seeding and repositioned to the foothills northwest of Cochrane. They then started patrolling for Cochrane at 2047Z. HS1 started seeding storm #2 for Cochrane at 2053Z. At

	line of convective cells which moved southeastward through Okotoks. Scattered convective rain showers then occurred over the area during the evening. Overnight stratiform clouds remained over the region. Pea size hail was reported in Airdrie. Pea to dime size hail was reported in Calgary along with isolated urban flash flooding. Max cell top: 9.1km, 63.7 max dBz, 55.5 max VIL Tmax YC = 23.6C and 9.5mm of rain. Tmax QF = 20.2C and 3.0mm of rain. Tmax Radar = 21.0C and no rain.	2210Z they stopped seeding and descended in order to shed ice. At 2223Z HS1 started seeding storm #3 for Okotoks. Then at 2316Z they stopped seeding and RTB. The aircraft landed at 2330Z. HS2 was launched to a developing storm northwest of Cochrane at 2108Z. They became airborne at 2125Z. The aircraft started seeding storm #2 for Calgary at 2131Z. Then at 2221Z HS2 repositioned to a convective cell northwest of Okotoks. The crew left the wing-tip generators on as they repositioned. At 2223Z they started seeding storm #3 for Okotoks. HS2 stopped seeding and RTB at 2316Z. They landed at 2336Z. Flight Summary HS4: 1920Z-2346Z; 272 minutes wing-tip generators, 18 BIP; #1 Airdrie, #2 Cochrane to Calgary; #3 Okotoks. HS1: 1947Z-2332Z; 267 EJ, 15 BIP; #1 Airdrie; #2 Cochrane to Calgary; #3 Okotoks. HS2: 2119Z-2340Z; 210 minutes wing-tip generators, 17 BIP; #2 Calgary; #3 Okotoks.
July 5, Sunday	A synoptic scale trough was expected to reside over the project area throughout the day. Northerly surface winds were observed, and were expected to continue until the overnight hours when a surface ridge axis would move into the project area. Instability was forecast to be poor, less than 300 J/kg, and no significant PVA or other triggers were expected. Scattered showers moved through the central and southern project area Sunday morning followed by gradually clearing skies in the afternoon. No significant echoes were observed after 22Z. No lightning strikes were observed. Max cell top: 45.6 max dBz Tmax YC = 17.9C and 0.3mm of rain. Tmax QF = 17.3C and no rain. Tmax Radar = 17.0C and no rain.	No aircraft operations.
July 6, Monday	Northwest mid and upper level flow was expected through the day as the project area was situated between a synoptic ridge to the west and a trough to the east. Southerly surface winds were anticipated to bring warm moist air in the region. A prefrontal trough was prognosticated to move across the area from the evening into the overnight hours. This feature was forecast to combine with mid-level PVA to produce thunderstorms that would move off the foothills into the project area Monday evening. Convection was expected to continue overnight, shifting toward the southern project area by midnight. A disorganized mass of showers and embedded thunderstorms pushed into the northwest project area after 23Z. The strongest VIL and reflectivity occurred west	No aircraft operations.

	of Caroline in a cell in the middle of the convective mass, and the highest cell top occurred southwest of Sundre on the southern flank of the complex. Brief hail threats occurred in a few cells with this activity before 0230Z, after which only rain showers affected the project area. These rain showers became more isolated after 7Z, but did not entirely leave the area until Tuesday morning. Lighting was observed in the project area. Max cell top: 7.6km, 57.8 max dBz, 22.9 max VIL Tmax YC = 23.3C and 2.2mm of rain. Tmax QF = 24.1C and no rain. Tmax Radar = 22.4C and 3.8mm of rain.	
July 7, Tuesday	Northwest flow continued aloft as a synoptic ridge was modeled to build toward the region. Instability was expected to be relatively weak in the project area, and no synoptic forcing mechanisms were expected. Convective development was anticipated on the foothills, but given the wind profile and cell motion, was not expected to affect the project. A broad area of low, stable clouds developed late Tuesday morning and blanketed much of the project area for most of the afternoon. This kept instability weak, and while convection developed over the mountains and foothills, no storms threatened the project area. Orographic convection subsided overnight, leaving mostly clear skies across the region. The maximum reflectivity occurred with residual stratiform rain early Tuesday morning. No lightning strikes were observed. Max cell top: 32.2 max dBz Tmax YC = 18.5C and 0.4mm of rain. Tmax QF = 19.2C and no rain. Tmax Radar = 17.3C and 0.3mm of rain.	No aircraft operations.
July 8, Wednesday	Northerly upper level winds were expected as a positively tilted ridge would break into the project area. Instability was forecast to be particularly weak despite strong diurnal heating, as strong mid-level warming and subsidence was also anticipated. No synoptic forcing mechanisms or convective threats were expected. Conditions were very warm but dry through the period. Very few echoes were observed on the radar, as even orographic lift could not initiate storms in the thermodynamic environment. The maximum reflectivity occurred during mid-afternoon in the far eastern project area, and was likely a harmless mass of cloud and ice crystals. No lightning strikes were observed. Max cell top: 20.5 max dBz Tmax YC = 29.7C and no rain. Tmax QF = 29.0C and no rain. Tmax Radar = 27.7C and no rain.	No aircraft operations.
July 9, Thursday	The jet stream was located in northern Alberta, with weaker southerly to westerly flow in the project area.	No aircraft operations.

	Surface winds were light and variable, with little synoptic scale influence. Significant instability was expected along the foothills, but not in the project area. The only anticipated source of lift was upslope flow, and any convection from this was not expected to affect the project. Overnight, a warm front was modeled to develop in the far northern project area, and the threat of an isolated shower forming in that region was forecast. No precipitating convection was observed through the day. At 5Z, a small area of thunderstorms northwest of the project area drifted east into the northern buffer, and briefly became a small hail threat north of Rocky MH between 7-8Z before dissipating. Lightning was observed in the northern buffer with this activity. Max cell top: 8.4km, 55.4 max dBz, 21.7 max VIL Tmax YC = 31.7C and no rain. Tmax QF = 30.5C and no rain. Tmax Radar = 29.0C and no rain.	
July 10, Friday	The upper level jet remained far to the north of the project. Strong diurnal heating was expected, and together with significant moisture and moisture advection, was expected to yield extremely unstable conditions throughout the forecast period. A stalled frontal boundary was modeled to reside across the northern project area, and was expected to be a focus for convective initiation. A lee cyclone was also predicted to develop during the day, connecting with the existing frontal boundary and potentially bringing convection away from the foothills. Directional shear was forecast to be significant, while speed shear was minimal. Mid-level vorticity advection was disorganized and weak due to light mid-level flow, and no other synoptic triggers were expected. Overall, a threat for isolated, strong pulse thunderstorms was predicted through the forecast period. Hail producing thunderstorms occurred in all cardinal directions of the project area, but little convective development occurred in the project area itself. Strong insolation and moisture advection were present throughout the project area. However, very few boundary layer cumulus clouds were observed. One afternoon thunderstorm did develop east of the project area and slid northwest into the eastern buffer, producing lightning and the day's most threatening radar echoes, however it never became a hail threat for a project city. Isolated rain showers continued in the northern project area into the overnight hours, but never reached a concerning intensity. Max cell top: 7.6km, 54.9 max dBz, 12.3 max VIL Tmax YC = 30.2C and no rain. Tmax QF = 27.9C and no rain. Tmax Radar = 28.7C and no rain.	No aircraft operations.
July 11, Saturday	Mid and upper level flow remained weak as the jet stream remained north of the region. Anomalously warm temperatures and high dew points were expected to	HS4 flew a maintenance flight. They were airborne at 1746Z and landed at 1810Z.

	create another day of dangerously strong instability, but wind shear appeared extremely weak. No significant synoptic scale forcing mechanisms were anticipated. However, smaller scale boundaries such as convective outflow were forecast to initiate convection in the project area. Given the weak winds aloft, little to no storm organization was expected, with nearly stationary storm motion forecast. Elevated instability was expected to be significant, but no clear nocturnal forcing mechanisms were identified. Thunderstorms began in the far southeast buffer around 2130Z, and remained in that region for several hours. The first seeded storm of the day developed at 2230Z immediately west and south of Calgary, and rapidly expanded into a disorganized cluster of pulsing convection affecting the far western and southern regions of town. This storm was seeded from the top and at base, and while it expanded south about a dozen miles, the cells remained nearly stationary until the cluster dissipated into rain showers at 4Z. While the Calgary storm cluster dissipated, a new area of elevated convection developed in the southeast buffer and began moving northwest toward High River. This storm was top seeded until it dissipated east of town between 5-6Z. Non-concerning thundershowers continued in the far southern project area through the night, though cells showed signs of intensifying as dawn approached Sunday. A single report of Loonie size hail was noted in far southwest Calgary. Most of the hail was significantly smaller. Max cell top: 12.1km, 65.0 max dBz, 106.3 max VIL Tmax YC = 28.9C and no rain. Tmax QF = 27.6C and no rain. Tmax Radar = 26.8C and no rain.	HS2 flew a maintenance flight. They were airborne at 1820Z and landed at 1828Z. HS5 was launched at 2238Z to patrol Calgary as strong pulse thunderstorms were developing in the region. They were airborne at 2257Z and began to patrol Calgary at 2301Z. They repositioned to patrol Sundre at 2308Z, and began said patrol at 2325Z. At 2339Z, HS5 repositioned back to Calgary, and began top seeding storm #1 Calgary at 2355Z. HS5 stopped seeding and RTB at 0235Z (07/12). They landed at 0251Z (07/12). HS2 was launched at 2352Z. They were airborne at 0005Z (07/12). HS2 began base seeding at 0011Z (07/12) storm #1 Calgary. They extended their line south toward Turner Valley at 0122Z (07/12), but found the best targets closer to Calgary. HS2 stopped seeding and RTB at 0147Z (07/12). They landed at 0154Z (07/12). HS1 was launched at 0412Z (07/12). They were airborne at 0436Z (07/12). HS2 began top seeding storm #2 High River at 0454Z (07/12). They stopped seeding and RTB at 0543Z (07/12). They landed at 0601Z (07/12). Flight Summary HS4: 1740Z-1813Z; no seeding; maintenance flight. HS2: 1813Z-1832Z; no seeding; maintenance flight. HS5: 2251Z (07/11)-0254Z (07/12); 27 BIP, 242 EJ; #1 Calgary HS2: 2355Z (07/11)-0156Z (07/12); 194 minutes wing-tip generators, 9 BIP; #1 Calgary. HS1: 0426Z (07/12)-0605Z (07/12); 8 BIP, 75 EJ; #2 High River
July 12, Sunday	A southerly upper level jet streak looked to shift eastward into the area in the evening. A wave of PVA was expected to track northeastward across the region in the morning and early afternoon. Another lobe of PVA looked to move through the area overnight. Midlevel charts indicated that southwest flow would continue over southern AB throughout the period. Warm and moist air looked to remain in place over the area throughout the day and night. At the surface, a cold front looked to strengthen over the foothills during the late afternoon. This front was prognosticated to move eastward across the area. The 18Z, 21Z, 00Z (07/13), and 03Z (07/13) modified model soundings showed a fairly unstable troposphere, but speed shear looked to stay very weak, only around 5kts. A tall storm began to develop between Calgary and Strathmore during the early morning hours. This storm (#1) was nearly stationary and developed new growth over the eastern part of Calgary. As a result, the storm propagated toward the west over Calgary. Due to the	HS1 was launched for developing convection near Calgary at 1215Z. They were airborne at 1250Z and began top seeding storm #1 for Calgary at 1300Z. The crew continued seeding the thunderstorm as it developed new growth directly over the eastern part of Calgary. The aircraft started seeding storm #2 at 1351Z for Airdrie. After discussion with Terry Krauss regarding flash flood potential in Chestermere, HS1 stopped seeding and RTB at 1458Z. They landed at 1513Z. HS2 was launched for convection near Calgary at 1241Z. They were airborne at 1303Z. HS2 began base seeding storm #1 for Calgary at 1312Z. The aircraft continued to seed along the western side of the cell as new growth occurred along that flank of the thunderstorm. After discussion with Terry Krauss regarding flash flood potential in Chestermere, HS2 stopped seeding at 1458Z and RTB. They

	slow moving nature of this tall storm, flooding occurred in Chestermere. In the early morning hours another storm (#2) formed just south of Didsbury and tracked southeastward toward Airdrie. Scattered, weaker thunderstorms then formed over the region during the afternoon and evening. The afternoon and evening thunderstorms posed a minimal hail threat for the protected area because this convection was short-lived and did not become organized. Overnight, numerous thunderstorms developed over the project area. These thunderstorms produced rain showers across the region. Max cell top: 12.9km, 63.9 max dBz, 90.5 max VIL Tmax YC = 26.8C and 6.2mm of rain. Tmax QF = 26.1C and no rain. Tmax Radar = 25.7C and no rain.	landed at 1505Z. Flight Summary HS1: 1245Z-1518Z; 181 EJ, 24 BIP; #1 Calgary, #2 Airdrie. HS2: 1254Z-1508Z; 212 minutes wing-tip generators, 2 BIP; #1 Calgary.
July 13, Monday	Upper level charts showed a 70kt jet streak centered over AB during the daytime. A large scale trough was expected to be centered along the coast of BC, and an upper level ridge looked to be centered over SK. Several waves of moderate PVA looked to move northeastward across the region throughout the period. Surface winds were expected to be light and variable. Area thermodynamic modified model soundings indicated that the troposphere would become moderately unstable during the time of peak heating. 0 to 6km bulk shear values looked to be around 20kts. In the late morning, convection intensified over the foothills. This convection developed into a line of thunderstorms which moved eastward across the entire area during the afternoon hours. The first seeded thunderstorm of the period, storm #1, formed over YBW and tracked eastward through Calgary. Storm #1 was part of a line of thunderstorms which extended from Turner Valley north-northeastward all the way to Innisfail. This long line of thunderstorms moved eastward across the entire region during the afternoon. Radar data indicated that grape size hail may have fallen over the far western part of Calgary from storm #1. Isolated thunderstorms and convective rain showers were then observed over the area during the evening and overnight hours. Large pea size hail was reported in Cochrane. Max cell top: 10.6km, 62.8 max dBz, 54.4 max VIL Tmax YC = 22.6C and 0.2mm of rain. Tmax QF = 22.6C and 20.2mm of rain. Tmax Radar = 21.1C and 5.1mm of rain.	HS5 was launched to a developing storm south of Cochrane at 1905Z. The aircraft became airborne at 1920Z. HS5 started top seeding storm #1 for Calgary at 1927Z. The crew continued seeding the storm as it slowly moved eastward over the city of Calgary. Then at 2001Z HS5 reported no new growth over the city, so they stopped seeding and RTB. The flight landed at 2010Z. HS1 was launched at 0219Z (07/14) for convective development in the southwest project area. They were airborne at 0245Z (07/14), and began to patrol Turner Valley and Black Diamond area at 0301Z (07/14). Pilots reported this convection to be weak and non-threatening, and HS1 RTB at 0312Z (07/14). They landed at 0322Z (07/14). Flight Summary HS5: 1914Z-2013Z; 42 EJ, 6 BIP; #1 Calgary. HS1: 0235Z (07/14)-0326Z (07/14); no seeding; patrol Turner Valley and Black Diamond.
July 14, Tuesday	The southerly upper level jet shifted to the east and was expected to be over SK during the period. A broad trough looked to remain centered along the west coast of North America. WSW wind flow at the mid-levels looked to continue throughout the forecast period. PVA was expected to be strongest in the late afternoon and early evening. Warm moist air was expected to remain in place over the region throughout the day. Surface winds were	A radar tour was conducted at the Olds-Didsbury airport and 15 people were in attendance. HS4 flew a PR flight. The aircraft was airborne out of YQF at 1735Z and landed in EA3 at 1755Z.

	expected to be light and variable. The afternoon modified model soundings showed that the atmosphere would contain enough instability and speed shear for marginally severe pulse thunderstorms. In the early morning, a TITAN cell formed to the northwest of Airdrie and tracked eastward across the QE2 highway. Starting around 17Z, convection began forming over the foothills northwest of Cochrane. This convection began to develop into storm (#1) at around 18Z which tracked east-southeastward through Airdrie, northeastern Calgary, and Chestermere during the early afternoon hours. Radar data indicated that walnut size hail may have fallen southeast of Chestermere. The second seeded storm of the day formed along the foothills west of Turner Valley. This thunderstorm moved toward High River before dissipating. In the late afternoon, a cluster of convective cells formed along the foothills to the southwest of Calgary. This cluster of convective cells gradually merged into a TITAN cell (storm #3) as it tracked east-northeastward toward Calgary. The thunderstorm diminished before pushing into Calgary. The fourth storm of the day grew along the foothills west of Caroline. This storm tracked eastward through the town of Caroline during the early evening hours. The thunderstorm activity then weakened into convective rain showers during the rest of the evening and early nighttime hours. Pea size hail was reported in northeast Calgary and Chestermere. Localized flooding occurred in Chestermere. Max cell top: 10.6km, 64.2 max dBz, 98.4 max VIL Tmax YC = 22.8C and 0.2mm of rain. Tmax QF = 23.4C and a trace of rain. Tmax Radar = 22.0C and no rain.	HS1 was launched at 1907Z to a growing thunderstorm north of Cochrane. The aircraft was airborne at 1922Z. HS1 started top seeding storm #1 for Airdrie at 1932Z. Then at 2039Z the aircraft stopped seeding and descended to the west of Calgary in order to shed ice. At 2053Z, HS1 resumed top seeding storm #1 for Calgary. The aircraft was then out of ejectable flares, so they stopped seeding and repositioned to a growing storm west of High River at 2129Z. They descended to the base seeding altitude while en route to the thunderstorm. At 2140Z they started base seeding storm #2 for High River. HS1 then stopped seeding and RTB at 2209Z. They landed at 2227Z. HS2 was launched to an intensifying TITAN cell north of Cochrane at 1903Z. The flight became airborne at 1924Z. HS2 started base seeding storm #1 for Airdrie at 1932Z. They continued seeding the thunderstorm as it moved east-southeastward toward Airdrie and the northeastern part of Calgary. At 2017Z, they were restricted from crossing the departure path of aircraft out of YYC, so they extended their seeding line farther to the southwest. HS2 then stopped seeding and RTB at 2156Z. They landed at 2213Z. HS3 was launched to a growing TITAN cell west of Turner Valley at 2038Z. The flight was airborne at 2103Z and was redirected to a long-lived thunderstorm beginning to move over Calgary. They started top seeding storm #1 for Calgary at 2133Z, and the aircraft replaced HS1 with top seeding the thunderstorm at this same time. HS3 stopped seeding at 2201Z and repositioned to the YBW area. They then started patrolling the Calgary area at 2223Z. A new thunderstorm then began to track off the foothills to the southwest of Calgary, so the aircraft started seeding storm #3 for Calgary at 2300Z. At 2349Z HS3 stopped seeding and RTB. The aircraft landed at 0016Z (07/15). HS4 was launched at 2300Z to an intensifying storm southwest of Calgary. The aircraft was airborne out of EA3 at 2315Z. They started base seeding storm #3 for Calgary at 2335Z. Then at 2359Z, they stopped seeding and started patrolling the same area. HS4 next repositioned to a new thunderstorm west of Caroline at 0003Z (07/15). The flight then started seeding storm #4 for Caroline at 0043Z (07/15). HS4 stopped seeding and RTB at 0135Z (07/15). They landed in YQF at 0150Z (07/15). HS1 was launched at 2321Z to a TITAN cell moving northeastward toward Calgary. The flight became airborne at 2338Z. At 2359Z

		HS1 started patrolling the Calgary area. They repositioned to the Rocky MH area at 0017Z (07/15). At 0041Z (07/15) HS1 started top seeding storm #4 for Caroline. The thunderstorm was then diminishing, so they stopped seeding and repositioned to near the town of Sylvan at 0134Z (07/15). At 0153Z (07/15) the aircraft began patrolling the Red Deer area. They RTB at 0157Z (07/15) and landed at 0221Z (07/15). HS2 was launched to a storm moving toward Sundre at 0041Z (07/15). The aircraft was airborne at 0055Z (07/15). At 0115Z (07/15) they started base seeding storm #4 for Caroline. At 0153Z (07/15) the thunderstorm was continuing to weaken, so HS2 stopped seeding and RTB. They landed at 0215Z (07/15). Flight Summary HS4: 1726Z-1759Z; no seeding; PR flight; takeoff YQF, land EA3. HS1: 1916Z-2231Z; 299 EJ, 28 BIP; #1 Airdrie and Calgary; #2 High River. HS2: 1918Z-2216Z; 290 minutes wing-tip generators, 22 BIP; #1 Airdrie and Calgary. HS3: 2055Z (07/14)-0020Z (07/15); 291 EJ, 15 BIP; #1 Calgary, #3 Calgary. HS4: 2310Z (07/14)-0155Z (07/15); 154 minutes wing-tip generators, 5 BIP; #3 Calgary, #4 Caroline; takeoff EA3, land YQF. HS1: 2330Z (07/14)-0224Z (07/15); 105 EJ, 6 BIP; patrol Calgary, #4 Caroline, patrol Red Deer. HS2: 0049Z (07/15)-0217Z (07/15); 78 minutes wing-tip generators, 1 BIP; #4 Caroline.
July 15, Wednesday	A weak part of the upper level jet looked to start nosing its way into central AB in the early evening. Model data suggested that the mid and upper level trough over BC would intensify into a closed low. This low was expected to start sliding southeastward into central AB during the overnight hours. The mid-level flow looked to stay out of the SW throughout the period. PVA looked to be strongest during the evening into the early nighttime hours. Warm moist air was expected to stay in place over the area through the early nighttime hours. At the surface, lee-cyclogenesis was forecast over the northern part of the project area. A cold front also looked to push into the northern project area starting around midnight. The 00Z (07/16) and 03Z (07/16) modified model soundings showed fairly unstable conditions would be present during the late afternoon through the early nighttime hours. Bulk speed shear (0 to 6km) values were expected to be around 20kts. Altocumulus castellanus clouds were observed over the eastern part of the region in the early morning. Cumulus clouds then started forming in the late morning. Towering cumulus clouds were seen over the far northern and eastern parts of the project area during the early	HS4 flew a reposition flight. The aircraft was airborne out of YQF at 1932Z and landed in YRM at 1957Z. HS4 was launched at 2307Z to a storm moving off the foothills toward Rocky MH. The flight became airborne out of YRM at 2317Z. The aircraft started base seeding storm #1 for Rocky MH at 2320Z. Then at 0054Z (07/16) they continued seeding as they repositioned to another storm (#3) moving toward Red Deer. The aircraft started seeding storm #3 for Red Deer at 0059Z (07/16). HS4 stopped seeding and RTB at 0154Z (07/16). They landed in YQF at 0209Z (07/16). HS2 was launched to a long-lived thunderstorm moving eastward toward the Sylvan area at 2324Z. The aircraft was airborne at 2341Z. HS2 started base seeding storm #1 for Sylvan at 0009Z (07/16). At 0059Z (07/16) they continued seeding as they repositioned to another storm (#3) moving toward the city of Red Deer. Then at 0104Z (07/16) HS2 started

	afternoon. Thunderstorms began to build to the west of Rocky MH in the late afternoon. One of these thunderstorms (storm #1) was able to push off the foothills and intensified at it moved toward Rocky MH. This isolated thunderstorm moved eastward through Rocky MH, Sylvan, and Blackfalds. Radar data indicated that grape size hail may have fallen northwest of Eckville. During this same time period, a cluster of convection developed southwest of Innisfail. This convection grew into a TITAN cell (storm #2) as it tracked east-northeastward toward Innisfail. The third seeded storm of the day formed to the southwest of Red Deer. This thunderstorm moved east-northeastward through Penhold and the far southern part of Red Deer. Scattered thunderstorms continued to form over the northern part of the project area through the overnight hours. Dime size hail reported in Penhold. Max cell top: 11.4km, 62.2 max dBz, 50.5 max VIL Tmax YC = 26.6C and no rain. Tmax QF = 24.2C and 19.2mm of rain. Tmax Radar = 23.3C and no rain.	seeding storm #3 for Red Deer. HS2 stopped seeding and RTB at 0149Z (07/16). The flight landed at 0218Z (07/16). HS3 was launched at 2342Z to a growing thunderstorm west of Sylvan. The flight was airborne at 0002Z (07/16). They started top seeding storm #1 for Sylvan at 0011Z (07/16). HS3 reported no visual feeders, so they stopped seeding and started patrolling the same area at 0032Z (07/16). At 0045Z (07/16) they resumed seeding storm #1 for Blackfalds. At 0056Z (07/16) HS3 stopped seeding and started patrolling the same area. HS3 started seeding storm #3 for Red Deer at 0111Z (07/16). The crew then reported problems with their ejectable rack, so they stopped seeding at 0136Z (07/16). As a result, HS5 replaced HS3 with top seeding storm #3 for Red Deer and Penhold. HS3 RTB shortly after the storm cleared the YQF airport. They landed at 0155Z (07/16). HS5 was launched to growing convection near the Sundre area at 0010Z (07/16). They became airborne at 0019Z (07/16). HS5 began patrolling the Olds area at 0038Z (07/16). The aircraft started top seeding storm #2 for Innisfail at 0040Z (07/16). Then at 0054Z (07/16) HS5 stopped seeding and repositioned to storm #3 which was moving northeastward toward Red Deer. They started seeding storm #3 for Red Deer at 0056Z (07/16). HS5 then extended their line to the southwest starting at 0114Z (07/16). The aircraft then started seeding storm #2 for Innisfail at 0120Z (07/16). At 0136Z (07/16) HS3 was encountering issues with their ejectable flare rack, so HS5 stopped seeding storm #2 and repositioned to storm #3 in order to take over top seeding for HS3. The aircraft started seeding storm #3 for Penhold at 0139Z (07/16). At 0152Z (07/16) HS5 stopped seeding and RTB. The aircraft landed at 0219Z (07/16). Flight Summary HS4: 1925Z-2000Z; no seeding; reposition flight; takeoff YQF, land YRM. HS4: 2315Z (07/15)-0212Z (07/16); 308 minutes wing-tip generators, 16 BIP; #1 Rocky MH to Blackfalds, #3 Penhold and Red Deer; takeoff YRM, land YQF. HS2: 2333Z (07/15)-0220Z (07/16); 200 minutes wing-tip generators, 14 BIP; #1 Sylvan to Blackfalds, #3 Penhold and Red Deer. HS3: 2353Z (07/15)-0200Z (07/16); 189 EJ, 13 BIP; #1 Sylvan to Blackfalds; #3 Penhold and Red Deer. HS5: 0014Z (07/16)-0221Z (07/16); 81 EJ, 4 BIP; #2 Innisfail, #3 Penhold and Red Deer.
July 16,	Jet energy was expected to round the southern end of a	No aircraft operations.

Thursday	closed mid and upper level low. This low pressure system looked to stay centered over central AB during the daytime hours. PVA looked to rotate counter-clockwise around the low and was expected to be abundant. Model data indicated that 500mb temperatures would cool significantly aloft (~5C) during the daytime. Overnight, a strong northerly low level jet looked to set up over Central AB. Modified model soundings showed that the atmosphere would be slightly unstable. Stratiform rain showers fell over the entire project area during the morning. Scattered thunderstorms then developed directly over the project area during the afternoon and early evening. These thunderstorms were generally short-lived and linear in nature. Radar data indicated that grape size hail may have fallen east of Red Deer. Overnight stratiform rain showers occurred over the entire region. Max cell top: 8.4km, 61.3 max dBz, 39.2 max VIL Tmax YC = 14.0C and 5.6mm of rain. Tmax QF = 16.5C and 3.4mm of rain. Tmax Radar = 15.2C and 7.4mm of rain.	
July 17, Friday	A closed mid and upper level low was centered over southern SK and was expected to continue tracking eastward during the period. A weak lobe of PVA looked to push southward across the area in the afternoon and early evening. A strong low level northerly jet was expected to stay in place over the region through at least the time of peak heating. As a result, a barrier jet looked to stay in place over the project area through the early evening. Very gusty northwesterly surface winds were expected to persist through the early evening. Afternoon modified model soundings showed that the troposphere would have around 400J/kg of CAPE with weak speed shear. Stratiform rain showers fell over the region through the early afternoon. The cloud cover then became broken in the midafternoon. Weak thunderstorms were observed over the northeast part of the project area during the late afternoon. Radar data indicated that pea size hail may have fallen north of the town of Three Hills. In the evening, scattered convective rain showers continued to fall over the northern part of the area. Overnight, the skies became mostly clear. Max cell top: 5.4km, 61.6 max dBz, 28.7 max VIL Tmax YC = 18.6C and 11.1mm of rain. Tmax QF = 19.2C and 30.2mm of rain. Tmax Radar = 18.9C and 29.7mm of rain.	Due to an airshow in Springbank, all YBW planes were repositioned to EA3 for the weekend. HS1 flew a reposition flight. The aircraft was airborne out of YBW at 1727Z and landed in EA3 at 1756Z. HS5 flew a reposition flight. The aircraft was airborne out of YBW at 1752Z and landed in EA3 at 1813Z. HS2 flew a reposition flight. The aircraft was airborne out of YBW at 1806Z and landed in EA3 at 1833Z. Flight Summary HS1: 1722Z-1759Z; no seeding; reposition flight; takeoff YBW, land EA3. HS5: 1743Z-1814Z; no seeding; reposition flight; takeoff YBW, land EA3. HS2: 1755Z-1835Z; no seeding; reposition flight; takeoff YBW, land EA3.
July 18, Saturday	The northerly jet positioned over AB looked to shift northeast of the protected area late in the day. Mid-level charts indicated that northwesterly flow would remain in place throughout the period. 500mb temperatures were expected to warm by around 6C during the daytime. A shortwave trough looked to slide southeastward through central AB during the late evening and overnight hours.	No aircraft operations.

	Surface winds were prognosticated to mainly be westerly which would potentially favor down slope conditions. Area modified model soundings showed a relatively stable air mass in place over the region during the daytime. The troposphere was then expected to destabilize during the overnight hours, but thunderstorms looked to be fairly unlikely. Cirrus and fair weather cumulus clouds formed over the area during the afternoon and early evening hours. In the late evening, a layer of stratocumulus clouds began to form over the northern part of the region. Overnight, scattered convective rain showers were observed over the northern part of the region. Max cell top: 44.8 max dBz, 2.0 max VIL Tmax YC = 28.6C and no rain. Tmax QF = 24.2C and no rain. Tmax Radar = 25.1C and no rain.	
July 19, Sunday	An upper level jet streak in north central Alberta was expected to remain north and east of the project area as a shortwave ridge built overhead. Weak high pressure at the surface was expected to pass over the region in the late evening, turning winds from northwest to southeast. Minimal synoptic forcing was expected, although convection was expected along the foothills. This activity was forecast to largely remain on the foothills and not be a major factor for the project area. Scattered showers or thundershowers were expected overnight, but they were not predicted to be a hail threat. Scattered weak rain showers gradually exited the project area in the early afternoon, leaving partly cloudy skies. Isolated convection began to develop over the foothills around 21Z, and dissipated as it moved into the western project area over the next several hours. All activity was relatively weak, although one cell produced radar indicated pea size hail on the western project border southwest of Turner Valley. Isolated rain showers continued overnight, primarily in the northern project area, but no hail threats developed. Max cell top: 6.1km, 58.6 max dBz, 20.2 max VIL Tmax YC = 27.1C and a trace of rain. Tmax QF = 22.7C and a trace of rain. Tmax Radar = 22.6C and a trace of rain.	HS5 flew a reposition flight. They were airborne from EA3 at 0032Z (07/20) and landed in YBW at 0047Z (07/20). HS2 flew a reposition flight. They were airborne from EA3 at 0041Z (07/20) and landed in 0104Z (07/20). HS1 flew a reposition flight. They were airborne from EA3 at 0045Z (07/20) and landed in YBW at 0101Z (07/20). Flight Summary HS2: 0025Z (07/20)-0108Z (07/20); no seeding; reposition flight; takeoff EA3, land YBW. HS5: 0026Z (07/20)-0048Z (0720); no seeding; reposition flight; takeoff EA3, land YBW. HS1: 0035Z (07/20)-0105Z (07/20); no seeding; reposition flight; takeoff EA3, land YBW.
July 20, Monday	A subtle upper level ridge over the project area was forecast to move away through the period as a trough and upper level jet streak approached. A significant area of PVA was anticipated behind the departing ridge, and this was forecast to trigger linear convection that would move off the foothills into the project area. Strong diurnal instability was expected, along with moderate wind shear. Isolated convection was predicted late overnight as well, with significant elevated instability. An early line of convective rain showers developed around 15Z along the western project border, and moved	HS2 flew a maintenance flight. They were airborne from YBW at 1302Z and landed in YQF at 1330Z. HS5 was launched at 1526Z for a line of towering cumulous west of Cochrane moving east into the project area. They were airborne at 1536Z. HS5 began to patrol the Cochrane area at 1541Z but never found a substantial convective threat. They RTB at 1647Z and landed at 1701Z.

	east into the project area. No hail threats occurred with this activity. A second, stronger line of convection developed in the southwest buffer at 2030Z which threatened the far southern project cities. Storm #1 was among these cells, and it was seeded for High River and Okotoks until it dissipated around 22Z. Conditions were then docile for several hours, before a line of intense thunderstorms dropped toward the far northern project area around 0230Z. This complex became the second seeded of the day as it moved southeastward into the area after 03Z (07/20). This activity was seeded as it moved across the northern buffer until it weakened and passed pertinent project cities around 5Z. No significant weather occurred after this time. Max cell top: 10.6km, 62.1 max dBz, 56.8 max VIL Tmax YC = 28.5C and no rain. Tmax QF = 24.8C and a trace of rain. Tmax Radar = 24.7C and no rain.	HS2 flew a maintenance flight. They were airborne from YQF at 1802Z and landed in YBW at 1831Z. HS1 was launched at 2020Z for a cluster of convection moving toward the southwest project area. They were airborne at 2042Z. HS1 arrived at the convection and began top seeding at 2057Z storm #1 High River to Okotoks. HS1 stopped seeding at 2206Z and began to patrol southwest of Strathmore. HS1 RTB at 2217Z and landed at 2232Z. HS2 was launched at 2100Z. They were airborne at 2120Z. HS2 began base seeding storm #1 Okotoks at 2129Z. They stopped seeding and began to patrol southwest of Strathmore at 2206Z. HS2 RTB at 2210Z and landed at 2225Z. HS4 was launched at 2106Z. They were airborne at 2127Z. HS4 began to patrol the Olds-Didsbury area at 2135Z. They RTB at 2144Z and landed at 2157Z. HS4 was launched at 0231Z (07/21) to an organized storm moving toward the northern part of the project area. The aircraft became airborne at 0258Z (07/21). At 0320Z (07/21) HS4 started base seeding storm #2 for Rocky MH. The aircraft continued to seed this line of thunderstorms as it moved eastward across the far northern part of the project area. Then at 0446Z (07/21) HS4 stopped seeding and RTB. They landed at 0455Z (07/21). HS3 was launched to the Rocky MH area at 0238Z (07/21). The flight was airborne at 0302Z (07/21). HS3 started top seeding storm #2 for Rocky MH at 0326Z (07/21). At 0411Z (07/21) HS3 stopped seeding and descended near the Sundre area in order to shed ice. They then started patrolling the Sylvan area at 0422Z (07/21). At 0434Z (07/21) HS3 started base seeding storm #2 for Lacombe. The aircraft then stopped seeding and started patrolling the Sylvan area at 0449Z (07/21). They RTB at 0457Z (07/21). The aircraft landed at 0533Z (07/21). HS2 was launched at 0310Z (07/21) to a long-lived thunderstorm moving into the northern part of the project area. They were airborne at 0329Z (07/21). The aircraft began base seeding storm #2 for Rocky MH at 0359Z (07/21). They continued seeding this line of thunderstorms as it moved toward Ponoka. Then at 0507Z (07/21) HS2 stopped seeding and RTB. The flight landed at 0547Z (07/21). Flight Summary HS2: 1251Z-1333Z; no seeding; maintenance

		flight; takeoff YBW, land YQF. HS5: 1530Z-1703Z; no seeding; patrol Cochrane. HS2: 1754Z-1835Z; no seeding; maintenance flight. HS1: 2030Z-2236Z; 86 EJ, 9 BIP; #1 High River to Okotoks. HS2: 2111Z-2227Z; 76 min wing-tip generators, 0 BIP; #1 High River to Okotoks. HS4: 2120Z-2200Z; no seeding; patrol Olds-Didsbury. HS4: 0250Z (07/21)-0458Z (07/21); 172 minutes wing-tip generators, 7 BIP; #2 Rocky MH to Lacombe. HS3: 0251Z (07/21)-0537Z (07/21); 110 EJ, 15 BIP; #2 Rocky MH to Lacombe; patrol Sylvan. HS2: 0320Z (07/21)-0549Z (07/21); 136 minutes wing-tip generators, 5 BIP; #2 Rocky MH to Ponoka.
July 21, Tuesday	An upper level trough and jet streak was modeled to advance into the project area. Vorticity advection was predicted to be neutral through the day, but turn positive overnight. Lee cyclogenesis was forecast, creating a significant moisture gradient in the region. Extreme instability was expected, complimented by strong wind shear. Supercell thunderstorms were predicted to develop in this environment, moving off the foothills into the project area. Convection initiated on the foothills just after 19Z and immediately began moving east toward the project area. Initial cells were relatively weak, but subsequent development after 20Z became a significant hail threat to western project cities. Storm #1 developed on the foothills west of Sundre and moved toward Cremona. It began to weaken as it entered the project area, and attention turned to storm #2 developing behind it closer to the foothills. This cell showed much more intense growth, became supercellular, and continued intensifying away from the foothills as it passed over Cremona. It was seeded until it passed the QE2 near Carstairs. Storm #3 and #5 moved into the northwest project area shortly after 23Z. Both storms were supercellular, with #3 located roughly 15nm northeast of #5. Storm #3 was seeded until it passed the QE2 at Lacombe and no longer threatened a project city. Storm #5 was also seeded during this time until it passed the QE2 near Blackfalds. Storm #4 developed behind storm #2 at 0Z (07/22) in the west central project area. It also showed supercell characteristics, and was seeded until it passed the QE2 at Crossfield. Storm #6 developed north of Cochrane at 0130Z (07/22). It tracked east toward Airdrie, and was seeded until it passed north of Airdrie and weakened just before 3Z (07/22). As storm #6 dissipated, storm #7 formed behind it directly over Carstairs. It was seeded briefly until it moved northeast and no longer posed a near term threat to a project city. The eighth and final seeded storm of the day developed northwest of Sundre and tracked northeastward through Sylvan and Red Deer	HS2 was launched at 2009Z for a developing thunderstorm on the foothills moving toward the project area. They were airborne at 2026Z. HS2 began base seeding storm #1 Cremona 2045Z. HS2 stopped seeding but continued to patrol Cremona at 2123Z. HS2 began seeding storm #2 Cremona at 2155Z. HS2 stopped seeding and RTB at 2308Z. They landed at 2319Z. HS5 was launched at 2045Z for a thunderstorm in the far western project area. They were airborne out of YBW at 2059Z. HS5 began to patrol Cremona at 2111Z. HS5 began top seeding storm #2 Cremona at 2259Z. HS5 RTB to YQF at 2359Z (07/21). They landed in YQF at 0011Z (07/22). HS4 was launched at 2219Z to a supercell near Cremona. They were airborne at 2243Z. HS4 began base seeding storm #2 Carstairs at 2304Z. HS4 stopped seeding and repositioned to thunderstorms near Rocky Mountain House at 0000Z (07/22). HS4 began seeding storm #3 Bentley at 0025Z (07/22). HS4 continued seeding while they repositioned to a separate storm west of Sylvan at 0111Z (07/22). They began seeding this storm, #5 for Sylvan, at 0118Z (07/22). HS4 stopped seeding and RTB at 0206Z (07/22). They landed at 0215Z (07/22). HS1 was launched at 2312Z for the supercell thunderstorm approaching Carstairs. They were airborne at 2335Z. HS1 began top seeding storm #2 Carstairs at 0001Z (07/22). HS1 stopped seeding and repositioned west to a new storm near Cremona at 0028Z (07/22). They began seeding storm #4 Crossfield at 0036Z (07/22). HS1 repositioned to a developing storm at 0134Z (07/22). They began seeding this storm, #6 for Airdrie at 0138Z

	between 4Z and 530Z (07/22). Thunderstorms with marginal or no hail threats continued until 9Z (07/22), followed by clearing conditions across the project area. Pea size hail reported in Rimbey. Marble size hail reported in Crossfield. Golf ball size hail reported in northern Red Deer and Blackfalds. Greater than golf ball size hail reported in Lacombe. Max cell top: 13.6km, 66.1 max dBz, 105.2 max VIL Tmax YC = 27.8C and no rain. Tmax QF = 23.4C and a trace of rain. Tmax Radar = 22.8C and 4.1mm of rain.	(07/22). HS1 stopped seeding and RTB at 0247Z (07/22). They landed at 0256Z (07/22). HS3 was launched at 2342Z for strong thunderstorms near Rocky Mountain House. They were airborne from YQF at 0007Z (07/22). HS3 began top seeding storm #3 Bentley at 0018Z (07/22). HS3 stopped seeding and RTB to EA3 at 0133Z (07/22). They landed in EA3 at 0146Z (07/22). HS2 was launched at 0027Z (07/22) for new development southwest of Cremona. They were airborne at 0047Z (07/22). HS2 began base seeding storm #4 Crossfield at 0057Z (07/22). HS2 continued seeding but repositioned to new convective development west of Airdrie at 0139Z (07/22). They began seeding storm #6 Airdrie at 0147Z (07/22). HS2 stopped seeding and RTB at 0307Z (07/22). They landed at 0320Z (07/22). HS5 was launched at 0059Z (07/22) for convection east of Rocky MH. They were airborne from YQF at 0105Z (07/22). HS5 began top seeding storm #5 Sylvan at 0124Z (07/22). HS5 stopped seeding and RTB at 0209Z (07/22). They landed in YBW at 0237Z (07/22). HS3 was launched at 0222Z (07/22) for convective development northwest of Airdrie. They were airborne from EA3 at 0240Z (07/22). HS3 began top seeding storm #6 Acme at 0257Z (07/22). HS3 stopped seeding and repositioned to Carstairs at 0344Z (07/22). At 0350Z (07/22) they started seeding storm #7 for Carstairs. The aircraft stopped seeding and RTB Springbank at 0406Z (07/22). They landed in YBW at 0418Z (07/22). HS5 was launched to a thunderstorm north of Sundre at 0340Z (07/22). The flight became airborne at 0357Z (07/22). HS5 began top seeding storm #8 for Sylvan at 0415Z (07/22). Then at 0422Z (07/22) they stopped seeding and started patrolling for Red Deer. HS5 resumed seeding storm #8 at 0430Z (07/22) for Red Deer. The aircraft then stopped seeding and RTB at 0454Z (07/22). They landed at 0524Z (07/22). HS3 flew a reposition flight. The aircraft was airborne out of YBW at 0534Z (07/22) and landed in YQF at 0610Z (07/22). Flight Summary HS2: 2016Z-2321Z; 155 minutes wing-tip generators, 18 BIP; #1 Cremona, #2 Cremona to Carstairs. HS5: 2055Z (07/21)-0014Z (07/22); 304 EJ, 20 BIP; #2 Cremona to Carstairs; takeoff YBW,

		land YQF. HS4: 2235Z (07/21)-0218Z (07/22); 314 minutes wing-tip generators, 23 BIP, #2 Carstairs, #3 Bentley to Lacombe, #5 Sylvan to Red Deer. HS1: 2324Z (07/21)-0258Z (07/22); 273 EJ, 24 BIP, #2 Carstairs, #4 Crossfield, #6 Airdrie. HS3: 2356Z (07/21)-0149Z (07/22); 276 EJ, 15 BIP; #3 Bentley to Lacombe; takeoff YQF, land EA3. HS2: 0041Z (07/22)-0323Z (07/22); 260 minutes wing-tip generators, 22 BIP; #4 Crossfield, #6 Airdrie. HS5: 0101Z (07/22)-0240Z (07/22); 201 EJ, 8 BIP; #5 Sylvan to Red Deer; takeoff YQF, land YBW. HS3: 0235Z (07/22)-0422Z (07/22); 124 EJ, 16 BIP; #6 Acme, #7 Carstairs; takeoff EA3, land YBW. HS5: 0352Z (07/22)-0525Z (07/22); 60 EJ, 7 BIP; #8 Sylvan to Red Deer. HS3: 0526Z (07/22)-0614Z (07/22); no seeding; reposition flight; takeoff YBW, land YQF.
July 22, Wednesday	A strong jet streak was forecast to push across far south and southeast Alberta. An intense shortwave trough was observed approaching the project area, and was expected to traverse northeast across the project area through the early afternoon. Instability was expected to be very high, with robust wind shear. Supercell thunderstorms were again forecast, particularly in the central and southern project areas. Negative vorticity advection was expected following the shortwave trough passage, leaving calm conditions from Wednesday evening through the overnight hours. Convection began to develop along the foothills during the early morning hours Wednesday. By midmorning the thunderstorms began to shift eastward into the northern project area. The first seeded storm of the day became organized over the foothills southwest of Sundre. It was seeded briefly before more threatening convection developed further south and threatened Calgary. This cell, #2, matured into a supercell, and produced a tornado visible to base seeders as it approached western Calgary. This storm was seeded throughout its life as it tracked across southern Calgary, with the tornado lifting before it reached town. The storm stopped being seeded once it moved east of Calgary and no longer threatened other project cities. Storm #3 developed just before 18Z and quickly threatened Airdrie. The cell was briefly seeded until it merged with another cell to the north and no longer threatened the town. The fourth and final seeded storm appeared to develop on a remnant mesoscale boundary near Sundre several hours after the previous group of seeded storms departed. The storm was relatively short lived, but posed a modest hail risk to Sundre before dissipating. Following this storm, skies cleared across the project area, and no significant radar returns were observed the rest of the period. Pea size hail reported in Sundre.	A radar tour was conducted at the Olds-Didsbury airport with 17 people in attendance (tour number 5 for the season). HS1 was launched at 1403Z to growing convection west of Sundre. The flight became airborne out of YBW at 1425Z. HS1 started patrolling for Sundre starting at 1443Z. At 1457Z the aircraft began patrolling the Red Deer area. HS1 stopped patrolling and RTB at 1616Z. They landed in EA3 at 1628Z. HS2 launched at 1634Z to the southwest of Sundre. The aircraft became airborne at 1704Z. HS2 began base seeding storm #2 Calgary at 1718Z. HS2 stopped seeding and RTB at 1940Z. They landed at 1952Z. HS1 was launched to a growing storm southwest of Sundre at 1640Z. The flight became airborne out of EA3 at 1654Z. HS1 began top seeding storm #1 Cremona at 1707Z. HS1 stopped seeding and repositioned to a new storm west of Cochrane at 1713Z. They began seeding this storm, #2 for Calgary, at 1718Z. HS1 stopped seeding and RTB Olds at 1904Z. They landed in EA3 at 1951Z. HS4 was launched at 1714Z for developing convection west of Cochrane. They were airborne at 1732Z. HS4 began base seeding storm #3 Airdrie at 1758Z. HS4 continued seeding and repositioned to Calgary at 1821Z. They began seeding storm #2 Calgary at 1828Z. HS4 continued seeding and repositioned to a new storm northwest of Calgary at 1945Z. They found this new convection weak with no updraft, and RTB to

	Marble size hail reported in Springbank. Greater than golf ball size hail measured in Calgary. Max cell top: 10.6km, 62.6 max dBz, 56.8 max VIL Tmax YC = 23.6C and 0.2mm of rain. Tmax QF = 18.0C and 9.0mm of rain. Tmax Radar = 18.9C and 8.9mm of rain.	Springbank 1959Z. HS4 landed in YBW at 2012Z. HS5 was launched at 1718Z. They were airborne at 1729Z. HS5 began base seeding storm #1 Cremona at 1739Z. They stopped seeding, climbed top seeding altitude, and repositioned to Calgary at 1748Z. HS5 began top seeding storm #2 Calgary at 1904Z. HS5 stopped seeding and RTB at 2009Z. They landed at 2020Z. HS3 was launched at 1920Z to backup HS1 in Calgary. They were airborne at 1943Z. HS3 began to patrol Calgary at 2009Z. HS3 RTB to Red Deer, stopping briefly in Olds. They landed in Red Deer at 2057Z. HS1 was launched at 2147Z. They were airborne from Olds at 2157Z. HS1 began top seeding storm #4 Sundre at 2206Z. HS1 stopped seeding and RTB at 2257Z. They landed in YBW at 2314Z. HS4 was launched at 2147Z. They were airborne from Springbank at 2200Z. HS4 began base seeding storm #4 Sundre at 2220Z. HS4 stopped seeding and RTB at 2300Z. They landed in Red Deer at 2325Z. HS5 was launched at 2247Z. They were airborne at 2259Z. HS5 began to patrol Cochrane at 2301Z. HS5 RTB at 2303Z, and landed at 2309Z. Flight Summary HS1: 1414Z-1630Z; no seeding; patrol Sundre, patrol Red Deer; takeoff YBW, land EA3. HS1: 1647Z-1954Z; 299 EJ, 16 BIP; #1 Cremona, #2 Calgary; takeoff EA3, land EA3. HS2: 1653Z-1955Z; 284 minutes wing-tip generators, 22 BIP; #2 Calgary. HS5: 1723Z-2023Z; 289 EJ, 17 BIP; #1 Cremona, #2 Calgary. HS4: 1725Z-2017Z; 77 minutes wing-tip generators, 17 BIP; #3 Airdrie, #2 Calgary; takeoff YQF, land YBW. HS3: 1935Z-2101Z; no seeding; patrol Calgary. HS1: 2154Z-2317Z; 226 EJ, 7 BIP; #4 Sundre; takeoff EA3, land YBW. HS4: 2155Z-2326Z; 80 minutes wing-tip generators, 4 BIP; #4 Sundre; takeoff YBW, land YQF. HS5: 2254Z-2313Z; no seeding; patrol Cochrane.
July 23, Thursday	A strong upper level jet streak in western Saskatchewan was projected to shift further from the region. A subtle shortwave with strong PVA was forecast to affect the project area Thursday afternoon, utilizing substantial CAPE and considerable wind shear to produce convective hail threats. The strongest activity was	HS2 was launched at 1937Z. They were airborne at 1949Z. HS2 began base seeding storm #1 Okotoks at 2000Z. HS2 stopped seeding and RTB at 2148Z. They landed at 2210Z.

	expected in the central and southern project areas, where chinook clouds were less pervasive and better instability and shear was anticipated. No significant weather was expected later in the afternoon and late evening. A broad area of virga and weak rain showers were observed Thursday morning at the leading edge of the PVA. Thunderstorms then erupted along this line inside the project area after 19Z, forming a broken line from Airdrie southwest to the western project border near Turner Valley. Storm #1 was the most prominent cell in this line, and it became roughly supercellular as it moved east southeast toward Okotoks. The core of the cell marginally missed Okotoks to the north, and the storm was no longer seeded after it moved east of the QE2. A second area of convective development occurred north of the project area around 2230Z. Storm #2 was among this group, initiating north of Rimbey, and eventually became supercellular and moved into the northern buffer. This supercell was seeded between Rimbey and Morningside, as it threatened Lacombe, and was abandoned after it passed the QE2. Forty-five minutes after storm #2 was no longer seeded robust intensification occurred, and the supercell produced the day's highest reflectivity and VIL in the northeastern project buffer. Scattered light rain showers and virga continued in the far northern project area into the evening and overnight hours, but no significant convection developed. Pea size hail reported in Okotoks. Ping pong size hail reported in southeast Calgary. Golf ball size hail reported northwest of Okotoks. Max cell top: 9.9km, 64.9 max dBz, 100.9 max VIL Tmax YC = 23.5C and 0.4mm of rain. Tmax QF = 22.4C and a trace of rain. Tmax Radar = 23.1C and no rain.	HS5 was launched at 1938Z. They were airborne at 1948Z. HS5 began top seeding storm #1 Okotoks at 2003Z. HS5 stopped seeding and repositioned toward Cochrane at 2151Z. HS5 began to patrol Cochrane at 2203Z. HS5 RTB at 2231Z. They landed at 2244Z. HS4 was launched at 2307Z for convection in the northern buffer. They were airborne at 2320Z. HS4 began seeding storm #2 Lacombe at 2337Z. They stopped seeding and RTB at 0005Z (07/24). HS4 landed at 0013Z (07/24). HS3 was launched at 2307Z for convection in the northern buffer. They were airborne at 2322Z. HS3 began top seeding storm #2 Lacombe at 2333Z. They stopped seeding and RTB at 0006Z (07/24). HS3 landed at 0014Z (07/24). Flight Summary HS2: 1942Z-2212Z; 216 minutes wing-tip generators, 11 BIP; #1 Okotoks to High River. HS5: 1943Z-2245Z; 194 EJ, 17 BIP; #1 Okotoks to High River. HS4: 2315Z (07/23)-0016Z (07/24); 56 minutes wing-tip generators, 2 BIP; #2 Lacombe. HS3: 2315Z (07/23)-0018Z (07/24); 100 EJ, 5 BIP; #2 Lacombe.
July 24, Friday	A shortwave ridge depicted over central Alberta was forecast to quickly depart as a longwave trough moved onshore in B.C. Vorticity advection was expected to be weak, although stronger PVA was anticipated close by to the north. Instability and low level moisture were low and forecast to remain so, and instability was consequently limited. Isolated orographic convection was anticipated, particularly in the northwest closer to the synoptic forcing and better instability. Pleasant conditions were observed throughout the project area through much of the period. A line of mid-level clouds and virga was seen moving across the central and northern project area from the late afternoon through the evening, but no convection was triggered. Small convective rain showers and virga developed late overnight in the far southwest project area, but no lightning was observed. Max cell top: 35.5 max dBz Tmax YC = 28.4C and no rain. Tmax QF = 24.6C and no rain.	No aircraft operations.

	Tmax Radar = 24.1C and no rain.	
July 25, Saturday	The upper level jet was located across far southern Alberta, and was expected to remain there through the period. A broad upper level trough was observed across central B.C., and was predicted to move slowly toward the project area in the coming days. Strong pulses of PVA were anticipated ahead of the aforementioned feature, creating sufficient lift for daytime convective threats. Instability was expected to be modest, hindered by considerable chinook cloudiness, but aided by cooling temperatures aloft. Wind shear was forecast to be robust, but almost too high for the amount of instability expected. However, low topped supercells were feared if the chinook cloud dissipated, leading to enhanced insolation and instability in the early afternoon hours. Scattered weak rain showers occurred in the far western project area Saturday morning. A significant chinook cloud was also observed across much of the project area throughout the morning. However, it began to dissipate in the southwestern project area near noon. A wave of showers and thunderstorms was observed moving toward the project area from southeast B.C. in the late morning. Thunderstorms began to develop with this feature in the foothills west of the project area around 19Z. These storms intensified as they moved northeast into the project area, forming a jagged meridional line across most of the western project area at 2030Z. The first seeded storm of the day encompassed an area at the southern tip of this line. This area of storms threatened Calgary, and was seeded until it passed through the city. While most of the strongest development occurred in this region, at the southern extent of the line, new intensification occurred at the top of the line west of Innisfail just before 2120Z. This enhanced development threatened Red Deer, and was seeded until it moved past the city. The line of convection departed the project area at 2315Z. Scattered clouds and rain showers continued into the evening, but did not become a convective hail concern. Precipitation ended and skies gradually cleared Saturday night. Pea size hail reported at YQF. Grape size hail reported in Red Deer. Strong convective downdrafts were recorded at YYC and YQF. Each site reported a peak wind of 50kts. Max cell top: 11.4km, 62.3 max dBz, 50.8 max VIL Tmax YC = 24.2C and 0.2mm of rain. Tmax QF = 19.3C and 13.6mm of rain. Tmax Radar = 17.8C and 3.3mm of rain.	HS4 was launched at 2013Z for a line of convection moving into the project area. They were airborne at 2030Z. HS4 started base seeding storm #1 Airdrie at 2104Z. At 2135Z, they repositioned along the storm to Red Deer, leaving burners on in transit. They began seeding storm #2 Red Deer at 2151Z. HS4 stopped seeding and RTB at 2215Z. They landed at 2252Z. HS1 was launched at 2020Z for developing convection west of Springbank. They were airborne at 2040Z. HS1 began top seeding at 2042Z storm #1 Calgary. HS1 stopped seeding and RTB at 2123Z. They landed at 2143Z. HS2 was launched at 2026Z for developing convection west of Springbank. They were airborne at 2042Z. HS2 began base seeding at 2043Z storm #1 Calgary. HS2 stopped seeding and RTB at 2124Z. They landed at 2149Z. Flight Summary HS4: 2020Z-2255Z; 142 minutes wing-tip generators, 11 BIP; #1 Calgary, #2 Red Deer. HS1: 2032Z-2145Z; 72 EJ, 8 BIP; #1 Calgary. HS2: 2032Z-2151Z; 82 minutes wing-tip generators, 7 BIP; #1 Calgary.
July 26, Sunday	A southwesterly upper level jet looked to be in place over the far SE part of AB. Nonetheless, weak jet PVA was still expected over the region. Model data showed a closed low pressure system would dig southeastward over BC during the day and night. Strong PVA looked to occur over the area through the early nighttime hours as a large lobe of vorticity slowly moved northeastward across the region. The low levels and surface were prognosticated to experience weak upslope conditions	HS5 was launched to a low top supercell just south of Cremona at 2007Z. The flight was airborne at 2014Z. Then at 2031Z they started top seeding storm #1 for Airdrie. HS5 then stopped seeding and descended to shed ice at 2128Z. At 2143Z they began their climb back up to the top seeding altitude. The aircraft then resumed top seeding storm #1 for Airdrie at 2152Z. HS5 stopped seeding and RTB at

	during the afternoon and evening hours. Afternoon modified model soundings indicated that the troposphere would be moderately unstable with decent 0 to 6km bulk speed shear values of around 35kts. During the late morning, towering cumulus clouds started forming along the foothills. In the early afternoon, this convection strengthened and began to push into the western part of the project area. At around 18Z, storm #1 formed to the southwest of Cremona. The multicellular storm slowly tracked eastward toward Airdrie. This same storm exhibited low top supercellular tendencies off and on throughout its lifetime. Radar data indicated that grape size hail may have fallen south of Cremona and northwest of Airdrie from storm #1. During the afternoon, weak thunderstorms were observed over the rest of the protected area. In the evening hours the convection diminished as stratiform rain showers fell over the area. Overnight, stratiform cloud cover remained over the area. Quarter size hail was reported in Water Valley. Pea size hail was reported north of Strathmore. Max cell top: 8.4km, 61.4 max dBz, 42.5 max VIL Tmax YC = 21.9C and 0.4mm of rain. Tmax QF = 19.5C and a trace of rain. Tmax Radar = 17.2C and 8.1mm of rain.	2214. They landed at 2225Z. HS2 was launched at 2007Z to an organized storm just south of Cremona. The aircraft became airborne at 2021Z. At 2029Z HS2 started base seeding storm #1 for Airdrie. They then extended their seeding line to new development to the southwest toward Cochrane at 2102Z. At 2117Z HS2 extended their seeding line back up to the northeast end of the line of thunderstorms. They then stopped seeding and repositioned to the Turner Valley area at 2205Z. The aircraft began patrolling for Calgary while near the Turner Valley area at 2217Z. At 2223Z HS2 RTB and they landed at 2236Z. HS4 was launched at 2202Z to a growing thunderstorm near Innisfail. The aircraft was airborne at 2218Z and started patrolling the Sylvan area at 2220Z. At 2223Z the aircraft RTB. They landed at 2232Z. Flight Summary HS5: 2012Z-2227Z; 157 EJ, 12 BIP; #1 Airdrie. HS2: 2013Z-2238Z; 192 minutes wing-tip generators, 8 BIP; #1 Airdrie; patrol Calgary. HS4: 2210Z-2236Z; no seeding; patrol Sylvan.
July 27, Monday	A relatively strong southwesterly jet looked to be over southern AB as a mid and upper level closed low developed over the far SE part of BC. This low was expected to slide eastward along the international border during the period. PVA looked to be plentiful due to the presence of the low. Model data indicated that PVA would be somewhat stronger during the afternoon and early evening. Surface winds near the foothills were prognosticated to be northerly to north-northeasterly during the afternoon. Area afternoon modified model soundings suggested that the atmosphere would be moderately unstable with CAPE values of 200 to 400J/kg. 0 to 6km bulk speed shear values looked to be roughly 35kts. Scattered convective rain showers and weak thunderstorms occurred over the area during the afternoon and evening. According to radar data, these storms did not become intense enough to produce hail. Overnight, the skies cleared across the region. Max cell top: 6.9km, 57.9 max dBz, 16.2 max VIL Tmax YC = 18.3C and 2.0mm of rain. Tmax QF = 18.8C and no rain. Tmax Radar = 18.0C and no rain.	No aircraft operations.
July 28, Tuesday	Jet energy looked to be fairly weak over the region during the daytime hours. A closed low was over southern SK and was expected to continue moving eastward into MB. A shortwave ridge looked to briefly build over the area through the evening hours. Nonetheless, two waves of PVA were expected to move eastward across the area.	Radar tour #6 was conducted at the Olds-Didsbury airport and 25 people were in attendance. HS5 flew a PR flight. The aircraft was airborne out of YBW at 1737Z and landed in EA3 at

	The first wave looked to move through during the afternoon, and the second wave was expected to move through overnight. Low level and surface winds were prognosticated to be westerly to northwesterly and would potentially favor down slope conditions at times. The 00Z (07/29) modified model sounding for CYYC suggested that enough instability and speed shear would be present for weak pulse thunderstorms. Towering cumulus clouds and scattered convective rain showers were observed during the afternoon. At around 00Z (07/29) a thunderstorm developed east of Airdrie and tracked southeastward a short distance before dissipating. Radar data indicated that pea size hail may have fallen over a small area to the northeast of Calgary. Scattered convective rain showers continued to fall over the region through the late evening hours. Max cell top: 6.1km, 58.2 max dBz, 22.8 max VIL Tmax YC = 23.6C and 0.2mm of rain. Tmax QF = 22.2C and no rain. Tmax Radar = 21.7C and 0.8mm of rain.	1751Z. HS5 then flew a return PR flight. The aircraft was airborne out of EA3 at 2302Z and landed in YBW at 2318Z. Flight Summary HS5: 1730Z-1752Z; no seeding; PR flight; takeoff YBW, land EA3. HS5: 2255Z-2319Z; no seeding; PR flight; takeoff EA3, land YBW.
July 29, Wednesday	The left-exit region of a northwesterly 95kt jet streak was expected be over AB during the daytime hours. A shortwave trough looked to begin pushing into the area from the west during the early afternoon. This shortwave looked to bring moderately strong PVA to the region. The low levels and surface were expected to contain enough warm moist air for unstable tropospheric conditions. Surface winds were expected to remain westerly to northwesterly. The CYQF and CYYC 00Z (07/30) modified model soundings showed that the troposphere would be fairly unstable with 0 to 6km bulk speed shear values of 20kts. A layer of chinook clouds drifted eastward across the region during the morning and early afternoon. After the cloud cover dissipated, thunderstorms began to develop along the foothills in the midafternoon. The strongest convection of the day developed to the north of Rocky MH. Storm (#1) developed into a low top supercell as it quickly tracked east-southeastward through Blackfalds and Red Deer. Radar data indicated that walnut size hail may have fallen to the northwest of Bentley. During the same time period another storm (#2) also formed to the north of Rocky MH and rapidly tracked east-southeastward through Sylvan, Red Deer, and Penhold. The third seeded storm of the day formed west of Innisfail and tracked eastward through Innisfail. During the early evening hours, the thunderstorm activity shifted to the east of Red Deer and Olds. The region then saw mostly clear skies during the late evening and overnight hours. Nickle size hail was reported west of Red Deer. 1cm size hail was reported at Terry Krauss' house. Ice pellets and heavy rain were reported at YQF. Max cell top: 9.9km, 65.1 max dBz, 94.4 max VIL Tmax YC = 24.1C and 0.2mm of rain.	HS4 flew a reposition flight. The aircraft was airborne out of YQF at 1845Z and landed in YRM at 1908Z. HS1 was launched to a thunderstorm intensifying over the foothills west of Cremona at 2033Z. The aircraft became airborne at 2051Z. The flight started patrolling the Cochrane area at 2100Z. At 2150Z they started patrolling and orbiting over the Sundre area. HS1 then reposition to the west of Eckville at 2204Z. The aircraft began top seeding storm #2 for Sylvan with burn-in-place flares at 2215Z. At 2220Z they then started top seeding the same storm (#2) with ejectable flares as well. HS1 then stopped seeding and RTB at 2255Z. They landed at 2318Z. HS2 was launched at 2036Z to growing convection west of Cremona. The flight was airborne at 2055Z. HS2 began patrolling the Cochrane area at 2100Z. At 2110Z they repositioned to a growing storm north of Rocky MH. The crew started base seeding storm #2 for Sylvan at 2133Z. At 2303Z they stopped seeding and RTB. The aircraft landed at 2328Z. HS4 was launched to a TITAN cell growing near Rimbey at 2047Z. The aircraft was airborne out of YRM at 2103Z. At 2113Z HS4 started base seeding storm #1 for Red Deer and Blackfalds. HS4 then continued seeding with the wing-tip generators as they repositioned to an intensifying storm west of Innisfail at 2224Z. The crew then started seeding storm #3 for Innisfail at 2240Z. HS4 stopped seeding and RTB at 2249Z. They

	Tmax QF = 22.5C and 8.8mm of rain. Tmax Radar = 22.9C and no rain.	landed in EA3 at 2305Z. HS3 was launched to a growing thunderstorm near Rimbey at 2102Z. The flight became airborne out of YQF at 2120Z. Then at 2131Z the crew started top seeding storm #1 for Red Deer. HS3 stopped seeding and RTB at 2219Z. They landed in YBW at 2254Z. HS4 flew a reposition flight. The aircraft was airborne out of EA3 at 2345Z and landed in YQF at 0000Z (07/30). HS3 flew a reposition flight. The aircraft was airborne out of YBW at 2358Z and landed in YQF at 0022Z (07/30). Flight Summary HS4: 1832Z-1910Z; no seeding; reposition flight; takeoff YQF, land YRM. HS1: 2042Z-2322Z; 108 EJ, 7 BIP; patrol Cochrane, patrol Sundre, #2 Sylvan to Red Deer and Penhold. HS2: 2047Z-2329Z; 180 minutes wing-tip generators, 5 BIP; patrol Cochrane; #2 Sylvan to Red Deer and Penhold. HS4: 2055Z-2310Z; 194 minutes wing-tip generators, 12 BIP; #1 Red Deer and Blackfalds, #3 Innisfail; takeoff YRM, land EA3. HS3: 2113Z-2256Z; 280 EJ, 13 BIP; #1 Red Deer and Blackfalds; takeoff YQF, land YBW. HS4: 2340Z (07/29)-0005Z (07/30); no seeding; reposition flight; takeoff EA3, land YQF. HS3: 2351Z (07/29)-0026Z (07/30); no seeding; reposition flight; takeoff YBW, land YQF.
July 30, Thursday	The main upper level jet core looked to remain to the north throughout the period. A mid and upper level ridge was expected to be positioned over BC. No PVA was expected during the daytime hours. A wave of weak PVA then looked to move through at around the time of sunset. At the low levels, a 700mb thermal ridge was expected to build over AB. Surface high pressure was prognosticated to be centered over central AB during the daytime. Area modified model soundings showed only slightly unstable tropospheric conditions with a strong low level cap. Cumulus and isolated towering cumulus clouds were observed over the western half of the project area during the afternoon. Mostly clear skies then occurred during the evening and overnight. There were no radar echoes. No TITAN cells. Tmax YC = 26.8C and no rain. Tmax QF = 23.5C and no rain. Tmax Radar = 23.7C and no rain.	No aircraft operations.
July 31, Friday	Jet energy looked to stay north of the area throughout the forecast period. A mid and upper level ridge of high pressure was expected to be centered over AB during the daytime. This ridge then looked to flatten somewhat	No aircraft operations.

	during the overnight hours as a shortwave trough pushed eastward over northern AB. Weak PVA appeared to be possible during the late evening and overnight hours. At the surface, weak lee cyclogenesis was prognosticated to occur at around the time of peak heating. The modified model sounding for CYQF at 03Z showed a moderate amount of instability with around 35kts of bulk speed shear. Cumulus, altocumulus, altocumulus castellanus, and cirrus clouds were observed over the region during the daytime hours. During the early nighttime hours, convective rain showers fell inside the northern buffer zone near Lacombe and Ponoka. This convective activity then shifted east of the area during the overnight hours. 48.8 max dBz, 6.1 max VIL Tmax YC = 31.5C and no rain. Tmax QF = 28.0C and no rain. Tmax Radar = 27.4C and no rain.	
August 1, Saturday	The core of the upper level jet stream looked to stay north of the area, but weaker jet energy was expected to strengthen over the region during the evening. Model data indicated that mid-level zonal flow was likely for most of the forecast period. A wave of moderate PVA looked to move eastward through the northern project area during the evening hours. Low level and surface winds were expected to be northeasterly to easterly and would potentially favor upslope conditions through around 06Z (08/02). The 00Z (08/02) CYQF modified model sounding showed around 800J/kg of CAPE with approximately 35kt for the 0 to 6km bulk speed shear. Cumulus, altocumulus, and cirrus clouds were observed over the project area during the morning and afternoon hours. Convective rain showers then fell to the northwest of Rocky MH in the early evening. Starting around 04Z (08/02) elevated thunderstorms began to develop over the northeast quadrant of the project area. These storms were generally fast moving and weak. The nocturnal thunderstorm activity then shifted east of the protected area around 09Z (08/02). Radar data suggested that pea size hail may have fallen to the northeast of Three Hills. Max cell top: 8.4km, 59.5 max dBz, 26.9 max VIL Tmax YC = 26.7C and no rain. Tmax QF = 23.1C and no rain. Tmax Radar = 22.7C and no rain.	No aircraft operations.
August 2, Sunday	The upper level jet was located north of the project area. No synoptic convective triggers were forecast. Instability was modeled to be moderate on the foothills, but capped and weaker in the project area. Elevated instability was a small threat overnight, but any development was anticipated to remain high based and weak. Weak convective rain showers moved across the far northern buffer near Ponoka between 12 and 14Z Sunday morning. Conditions were then quiet until 22Z, when	No aircraft operations.

	isolated weak convection began to develop on the foothills southwest of Rocky MH. These cells were not able to survive away from the foothills, and only produced decaying clouds and virga in the project area. A wave of elevated echoes began moving toward the southwest project area late Sunday night into Monday morning. No lightning was observed in the project area. Max cell top: 35.9 max dBz Tmax YC = 27.9C and no rain. Tmax QF = 26.0C and no rain. Tmax Radar = 25.4C and no rain.	
August 3, Monday	A shortwave ridge over the project area was gradually moving east into Saskatchewan as a broad upper level trough was moving onshore in B.C. Extensive areas of vorticity were associated with the trough. An initial wave of PVA was observed traversing the project area Monday morning, with another wave expected overnight. Strong diurnal heating was forecast through the afternoon, gradually eroding the cap and destabilizing the atmosphere by evening. Wind shear was modeled to be strong, sufficient for storm organization. The best forcing was predicted to favor the southern project area. Weak rain showers moved across the far southern project area between 12 and 16Z. Clearing followed, however a pronounced area of weak echoes overspread the region after 0Z (08/04). These echoes slowly intensified, with two cells becoming marginal hail threats after 2Z (08/04). At 0230Z (08/04) a TITAN cell (storm #1) formed to the west of Olds. This convective storm gradually diminished as it tracked northeastward toward the Red Deer area. Widespread rain with embedded thundershowers continued throughout the night. No additional hail threats materialized. Max cell top: 10.6km, 58.9 max dBz, 25.0 max VIL Tmax YC = 30.7C and a trace of rain. Tmax QF = 27.2C and a trace of rain. Tmax Radar = 26.4C and a trace of rain.	HS5 was launched at 0059Z (08/04) for intensifying convection in the southern project area. They were airborne at 0107Z (08/04) and began to patrol Cochrane at 0116Z (08/04). HS5 RTB at 0149Z (08/04). They landed at 0158Z (08/04). HS2 was launched at 0059Z (08/04) for intensifying convection in the southern project area. They were airborne at 0113Z (08/04), and began patrolling Calgary at 0116Z (08/04). HS2 RTB at 0146Z (08/04). They landed at 0152Z (08/04). HS2 was launched at 0243Z (08/04) for new development north of Olds. They were airborne at 0254Z (08/04). HS2 started patrolling for Red Deer at 0314Z (08/04). They then RTB at 0344Z (08/04). The flight landed at 0409Z (08/04). HS5 was relaunched at 0243Z (08/04) for new development north of Olds. They were airborne at 0255Z (08/04). At 0314Z (08/04) HS5 started top seeding storm #1 for Red Deer. At 0324Z (08/04) they stopped seeding and started patrolling the same area. The aircraft then RTB at 0344Z (08/04). They landed at 0409Z (08/04). Flight Summary HS5: 0103Z (08/04)-0200Z (08/04); no seeding; patrol Cochrane to Airdrie. HS2: 0105Z (08/04)-0154Z (08/04); no seeding; patrol Calgary. HS2: 0249Z (08/04)-0413Z (08/04); no seeding; patrol Red Deer. HS5: 0250Z (08/04)-0411Z (08/04); 4 EJ, 2 BIP; #1 Red Deer.
August 4, Tuesday	A closed upper level low in western B.C. was observed slowly moving slowly east toward the project area. Multiple shortwave disturbances were modeled orbiting this feature, and were expected to bring several rounds of PVA to the region. Rapid surface destabilization was expected as morning clouds cleared, complimented by cooling temperatures aloft. Wind shear was observed to be backing across the region, but directional and speed	HS5 was launched at 2116Z for foothills convection advancing toward the project area west of Turner Valley. They were airborne at 2124Z. HS5 began patrol southwest of Calgary at 2138Z. HS5 began top seeding storm #1 Calgary at 2155Z. They descended and began base seeding storm #1 Calgary at 2310Z. At 2334Z HS5 repositioned to a new storm west of

	shear was still forecast to allow storm organization Tuesday afternoon. Morning clouds and stratiform rain showers gave way to clearing from south to north by noon. Convective initiation began along the foothills west of Cochrane shortly before 20Z, although storms were unable to survive away from the foothills until 22Z. Storm #1 was the first cell to survive away from the foothills. It crossed the western project border south of Springbank, and was seeded from before its arrival into the project area until it moved past Calgary and it became clear it would pass north of Strathmore. Radar indicated isolated walnut sized hail may have fallen from this storm in Calgary, corroborated by up to Toonie size hail reports in the city. Storm #2 developed close behind storm #1, and took a similar path immediately south of the first cell. While generally less organized and less intense, it also tracked across the width of Calgary, and was also a hail threat for Strathmore. Radar indicated up to grape size hail may have occurred in central Calgary from this cell. All convection generally weakened after 1Z (08/05), and a line of residual rain showers lingered in the project area until around 0430Z (08/05). New convective rain showers developed throughout the night in the southern project area, but produced little to no thunder or convective hail threats. Dime size hail reported in Bragg Creek. Dime size hail reported in Strathmore. Up to golf ball size hail reported in Calgary. Localized flooding reported in Calgary. Max cell top: 10.6km, 66.1 max dBz, 93.2 max VIL Tmax YC = 24.0C and 20.8mm of rain. Tmax QF = 21.2C and 2.6mm of rain. Tmax Radar = 21.0C and 5.8mm of rain.	Calgary. They began base seeding storm #2 Calgary at 2337Z (08/05). HS5 stopped seeding and RTB at 2351Z. They landed at 0013Z (08/05). HS2 was launched at 2152Z for foothills convection threatening Calgary. They were airborne at 2205Z. HS2 began seeding storm #1 Calgary at 2215Z. They repositioned, leaving generators on in transit, to storm #2 at 2337Z. They began seeding storm #2 Calgary at 2340Z. HS2 stopped seeding and RTB at 0012Z (08/05). They landed at 0044Z (08/05). HS3 was launched at 2237Z to provide backup for an intense storm threatening Calgary. They were airborne at 2253Z. They began seeding storm #1 Calgary at 2318Z. HS3 repositioned to a new storm west of Calgary at 2334Z. They began seeding storm #2 Calgary at 2342Z. At 0007Z (08/05) they repositioned back to storm #1, and began seeding it for Strathmore. HS3 repositioned back to storm #2 at 0011Z (08/05). They descended to shed ice at 0017Z (08/05). HS3 began top seeding storm #2 Strathmore at 0031Z (08/05). They stopped seeding but continued to patrol Strathmore at 0043Z (08/05). HS3 RTB at 0057Z (08/05) and landed at 0123Z (08/05). HS4 was launched at 2245Z. They were airborne at 2305Z. HS4 began to patrol Olds at 2320Z. They repositioned to the Chestermere area at 2337Z. HS4 began seeding storm #1 Strathmore at 0003Z (08/05). HS4 repositioned to storm #2 east of Calgary at 0014Z (08/05), seeding in transit. They began seeding storm #2 Strathmore at 0019Z (08/05). HS4 stopped seeding but continued to patrol Strathmore at 0044Z (08/05). They RTB at 0057Z (08/05) and landed at 0135Z (08/05). Flight Summary HS5: 2121Z (08/04)-0015Z (08/05); 302 EJ, 24 BIP; #1 Calgary (top and base), #2 Calgary (base). HS2: 2157Z (08/04)-0046Z (08/05); 224 minutes wing-tip generators, 22 BIP; #1 Calgary, #2 Calgary. HS3: 2244Z (08/04)-0126Z (08/05); 156 EJ, 21 BIP; #1 Calgary and Strathmore, #2 Calgary and Strathmore. HS4: 2300Z (08/04)-0138Z (08/05); 80 minutes wing-tip generators, 5 BIP; #1 Strathmore, #2 Strathmore.
August 5, Wednesday	A broad upper level trough over central B.C. was observed advancing toward the project area. Models indicated the southern and eastern project areas were in the left exit region of a jet streak. Significant PVA associated with the upper level trough was forecast to aid convective development. Instability was predicted to rapidly build as skies cleared in the late morning, and	HS2 was launched at 1822Z for convection developing west of Springbank. They were airborne at 1836Z. HS2 began seeding storm #1 Cochrane at 1840Z. HS2 stopped seeding and RTB at 2129Z. They landed at 2140Z. HS1 was launched at 1822Z for convection

	wind shear was expected to remain strong. A lee cyclone was anticipated to develop just south of the project area, enhancing easterly upslope flow in the southern project area. Foothills convection was expected shortly after briefing, quickly moving into the project area and posing a severe hail threat through the afternoon. The most dangerous activity was predicted in the southern half of the project area. A second wave of rain and weaker thunderstorms was forecast overnight. Convection initiated quickly after 18Z across the foothills. The first seeded storm developed less than 10 miles southwest of the Springbank airport, and slowly drifted into the project area at 1930Z. This storm, #1, was seeded aggressively as it became organized and tracked directly across the city of Calgary. It exited the project area just north of Strathmore around 2230Z. Radar indicated up to grape size hail may have fallen in Calgary, with larger hail up to walnut size both east and west of the city limits. This cell was also responsible for both golf ball size hail reports listed below. It also produced a brief tornado northeast of Langdon around 2155Z. Storm #2 developed north of storm #1 along the foothills west of Cochrane. It was seeded until it was clear it would miss Cochrane, and it dissipated before affecting any other project city. Storm #3 developed on the foothills south of Springbank, approximately 10 miles southwest of storm #1. It also took a track across Calgary, although it eventually encountered the cool stable air behind storm #1 and dissipated over the city. Storm #4 developed on the foothills west of Sundre just before 20Z. It moved east through Sundre, and was seeded to protect Olds. After passing the QE2, storm #4 weakened and merged into a line of convective rain showers after 0Z (08/06). Storm #5 developed along the foothills 15 miles southwest of storm #2, and became the third storm to threaten Calgary. Storm #5 tracked just south of storms #1 and #2, and moved across the width of southern Calgary. It was seeded until it passed east of Calgary and weakened just before 23Z. Storm #6 developed over foothills west of Cremona, but floundered shortly after entering the project area. Radar indicated it may have produced pea size hail in Cremona, and it was seeded briefly for Crossfield before it dissipated into a rain shower. Storm #7 developed over the foothills approximately 15 miles west of Black Diamond near 2230Z, and became the fourth storm of the day to threaten Calgary. It was seeded as it approached the southwest corner of the city, and it weakened as it pushed northeast across southern Calgary. Storm #8, the final seeded storm of the storm day, developed behind storm #7 on the foothills west of Turner Valley. It briefly showed signs of organization, but ultimately passed just north of Turner Valley and Black Diamond and edged across the southern border of Calgary with diminishing rain showers. Rain showers continued across the southern half of the project area	developing west of Springbank. They were airborne at 1843Z. HS1 began top seeding storm #1 Cochrane at 1854Z. HS1 RTB at 2052Z and landed at 2101Z. HS5 was launched to base seed convection at 1904Z. They were airborne at 1915Z. HS5 began base seeding storm #2 Airdrie at 1927Z. At 2005Z HS5 stopped seeding and repositioned to storm #1. They began base seeding storm #1 Calgary at 2012Z. At 2201Z HS5 repositioned west back to Calgary, and climbed to top seeding altitude. They began top seeding storm #5 Calgary at 2222Z. HS5 stopped seeding and RTB at 2317Z, and landed at 2325Z. HS4 was launched at 1908Z for convection threatening Calgary. They were airborne at 1928Z. HS4 began base seeding storm #1 for Calgary at 2002Z. At 2215Z they stopped seeding and RTB. They landed at 2246Z. HS3 was launched at 1947Z for a severe thunderstorm threatening Calgary. They were airborne at 2004Z. HS3 began top seeding storm #1 Calgary at 2055Z. HS3 repositioned to a different cell threatening southern Calgary at 2137Z. They began top seeding storm #3 Calgary at 2143Z. At 2155Z HS3 repositioned back to storm #1, and began top seeding it for Strathmore at 2158Z. HS3 descended to a base seeding altitude at 2213Z, and repositioned to new development west of Calgary at 2219Z. They began base seeding storm #5 for Calgary at 2230Z. HS3 stopped seeding and RTB at 2324Z. They landed at 2348Z. HS1 was launched at 2123Z for convection near Sundre. They were airborne at 2140Z. HS1 started top seeding storm #4 Olds at 2155Z. At 2221Z they stopped seeding and repositioned north toward Sylvan Lake. They were redirected at 2233Z back to the south toward a cell west of Didsbury. They were redirected again at 2244Z, this time to convection near Cremona, and began seeding storm #6 for Crossfield at 2254Z. They stopped seeding but continued to patrol Crossfield at 2259Z. At 2306Z HS1 repositioned to new growth north of Turner Valley. They began top seeding storm #7 for Calgary at 2328Z. HS1 stopped seeding but continued to patrol Calgary at 2340Z. At 2356Z HS1 repositioned to new growth west of Turner Valley. HS1 began seeding storm #8 for Turner Valley and Black Diamond at 0017Z (08/06). HS1 stopped seeding and RTB at 0049Z (08/06). They landed at 0104Z (08/06). HS2 was launched at 2228Z for new

	much of the night, but no significant thunderstorms or hail threats occurred. Pea size hail reported northwest of Sundre. Golf ball hail size reported in Calgary. Golf ball hail sized reported north of Redwood Meadows. Localized flooding reported in Calgary. Max cell top: 11.4km, 66.3 max dBz, 97.6 max VIL Tmax YC = 20.8C and 26.2mm of rain. Tmax QF = 19.4C and 14.2mm of rain. Tmax Radar = 19.4C and 0.3mm of rain.	convection threatening Calgary. They were airborne at 2243Z. HS2 began base seeding storm #5 Calgary at 2254Z. HS2 stopped seeding and repositioned to new development north of Turner Valley at 2320Z. They began seeding storm #7 Calgary at 2327Z. HS2 stopped seeding and RTB at 2347Z. They landed at 2357Z. Flight Summary HS2: 1829Z-2143Z; 338 minutes wing-tip generators, 24 BIP; #1 Cochrane to Calgary. HS1: 1833Z-2103Z; 294 EJ, 15 BIP; #1 Cochrane to Calgary. HS5: 1913Z-2328Z; 202 EJ, 42 BIP; #2 Airdrie (base), #1 Calgary (base), #5 Calgary (top). HS4: 1920Z-2250Z; 266 minutes wing-tip generators, 24 BIP; #1 Calgary. HS3: 1955Z-2353Z; 278 EJ, 30 BIP; #1 Calgary and Strathmore (top), #3 Calgary (top), #5 Calgary (base). HS1: 2133Z (08/05)-0105Z (08/06); 187 EJ, 16 BIP; #4 Olds, #6 Crossfield, #7 Calgary, #8 Turner Valley and Black Diamond. HS2: 2239Z-2359Z; 106 minutes wing-tip generators, 4 BIP; #5 Calgary, #7 Calgary.
August 6, Thursday	A broad synoptic trough was observed crossing into southwest Alberta, and was forecast to depart to the east by late evening. The strongest PVA was modeled to occur early Thursday morning, with vorticity advection weakening to neutral then becoming negative by the overnight hours. Instability was projected to be most unstable Thursday morning, with warming mid-level temperatures causing gradual stabilization across the region. No synoptic convective triggers were expected overnight. A broad band of rain showers with embedded convective cells moved south across the central and eastern project area Thursday morning. The only hail threat occurred with this activity shortly after 12Z in the eastern buffer region. This activity departed to the east around 21Z. A second line of activity entered the project area near Rocky MH, and moved southeast, bringing weak thundershowers across most of the project through the late afternoon and evening. Scattered rain showers continued in the central and southern project area overnight. Max cell top: 6.9km, 58.2 max dBz, 24.2 max VIL Tmax YC = 16.8C and 14.3mm of rain. Tmax QF = 17C and 0.4mm of rain. Tmax Radar = 16.7C and 2.0mm of rain.	Radar tour #7 was conducted at the Olds-Didsbury airport with 17 people in attendance. HS2 flew a PR flight. They were airborne from YBW at 1743Z and landed in EA3 at 1807Z. HS2 flew a return PR flight. They were airborne from EA3 at 2159Z and landed in YBW at 2218Z. Flight Summary HS2: 1732Z-1810Z; no seeding; PR flight; takeoff YBW, land EA3. HS2: 2155Z-2221Z; no seeding; PR flight; takeoff EA3, land YBW.
August 7, Friday	A shortwave ridge was predicted to approach the project area, but negative vorticity advection was modeled to dominate the day, becoming neutral overnight. Instability was expected to remain weak, although sufficient over the foothills for minor orographic convection. Mid-level winds were forecast to push this activity into the far western project area. All activity was expected to be relatively weak, with only debris clouds and dissipating	No aircraft operations.

	showers predicted to survive into the project. Calm, clear conditions were anticipated overnight. Fair weather cumulus developed late Friday morning, transitioning to widely scattered convective rain showers by 20Z. No lightning was observed with this activity, and no cells became hail threats. All convection dissipated by 3Z (08/08), and no significant weather occurred overnight. 48.0 max dBz, 3.9 max VIL Tmax YC = 22.6C and no rain. Tmax QF = 21.8C and no rain. Tmax Radar = 21.6C and no rain.	
August 8, Saturday	Upper level winds were predicted to diminish as a shortwave ridge axis passed over the project area. The only convective trigger anticipated was orographic lift. Instability was forecast to remain relatively weak, yet sufficient for weak convection over the foothills. This activity was expected to penetrate the western project area in the late afternoon into the evening. No convective hazards were anticipated overnight. The first convective cell to affect the project area initiated over the foothills west of Sundre around 22Z. This cell weakened away from the foothills, only bringing virga and dissipating clouds to the Sundre area. A more significant period of convective development occurred along the foothills in the southwest buffer shortly after 0Z (08/09). This activity spread across the southern project area from 2-7Z (08/09), bringing convective rain showers to cities including Turner Valley and Calgary. Skies cleared and tranquil conditions prevailed after 7Z (08/09). No lightning was detected. 49.8 max dBz, 5.9 max VIL Tmax YC = 25.8C and a trace of rain. Tmax QF = 25.5C and no rain. Tmax Radar = 24.2C and no rain.	No aircraft operations.
August 9, Sunday	The region looked to have southwesterly mid-level flow throughout the period due to a large low off the coast of BC and a ridge along the border of AB/SK. Two waves of PVA were expected to slide northeastward across the area. The first wave looked to push into the protected area during the afternoon, and the second wave appeared to move through during the early nighttime hours. A low level cap was expected to be in place over the area. Model output data indicated this cap would be weakest near the foothills and over the southern part of the region. At the surface, a lee trough was expected to form late in the day. Area modified model sounding data showed the troposphere would be moderately unstable with 20 to 25kts of bulk speed shear. Thunderstorms formed along the foothills to the west of Rocky MH and Sundre during the afternoon and early evening. These convective cells gradually dissipated as they moved eastward into the project area. The strongest storm (#1) of the forecast period formed along the	HS3 was launched at 0207Z (08/10) to a cluster of TITAN cells to the west of Caroline. The aircraft became airborne at 0228Z (08/10). At 0245Z (08/10) HS3 started top seeding storm #1 for Caroline. HS3 then stopped seeding and started patrolling the same thunderstorm at 0252Z (08/10). They RTB at 0334Z (08/10) and landed at 0348Z (08/10). Flight Summary HS3: 0219Z (08/10)-0352Z (08/10); 17 EJ, 2 BIP; #1 Caroline.

	foothills just north of Limestone mountain at around 01Z (08/10). The elevated and tall thunderstorms tracked eastward through the town of Caroline. Radar data indicated that grape size hail may have fallen to the west of Caroline. Thunderstorms also moved through the Rocky MH area during the evening hours. The multicellular thunderstorm activity then shifted to north of the project area during the early nighttime hours. Max cell top: 11.4km, 63.4 max dBz, 62.8 max VIL Tmax YC = 28.6C and no rain. Tmax QF = 27.3C and no rain. Tmax Radar = 26.8C and no rain.	
August 10, Monday	Weak jet energy was expected over central AB. 500mb heights looked to rise slightly over the area during the daytime suggesting that weak ridging would be occurring. 500mb temperatures were expected to warm by roughly 1C. A shortwave trough looked to slide northeastward across central AB during the evening hours. This shortwave looked to contain weak PVA. Surface winds were prognosticated to be light and variable. Surface pressure values looked to steadily fall through roughly 00Z (08/11). The 00Z (08/11) modified model soundings showed that the troposphere would be moderately unstable with a combination of both speed and directional shear. 0 to 6km bulk speed shear values were expected to be around 20kts. Cirrus and cumulus clouds were observed over the project area through the afternoon. In the evening, convection started to develop along the northern foothills. At this same time, convection also began to grow south of Rocky MH. The convection near Rocky MH intensified into an elevated thunderstorm which quickly tracked northeastward toward Ponoka during the late evening hours. Radar data indicated that pea size hail may have fallen north of Eckville. The thunderstorm activity then shifted to the northeast of the project area during the early nighttime hours. Max cell top: 9.1km, 57.9 max dBz, 23.6 max VIL Tmax YC = 28.1C and no rain. Tmax QF = 27.1C and no rain. Tmax Radar = 26.1C and no rain.	No aircraft operations.
August 11, Tuesday	Model output data indicated that a broad trough would move eastward across the far northern part of AB and SK during the period. This trough was expected to flatten the ridge over SK. As a result, the region looked to see west-southwesterly flow during the period. In terms of PVA, a weak wave was expected to slide east-northeastward across the region in the afternoon. Another wave of somewhat stronger PVA appeared to move through with the same trajectory during the late evening. A surface high was expected to form near the Edmonton area during the afternoon. The anti-cyclonic flow of the high looked to cause some moisture pooling along the foothills in the project area. Area modified model soundings showed a moderately unstable air mass would be in place	No aircraft operations.

	with bulk speed shear values around 25kts. During the morning hours, a band of convective rain showers moved northeastward across the southern part of the region. Thunderstorms then grew along the northern foothills during the midafternoon hours. These storms dissipated rather quickly as they moved into the project area. Radar data indicated that convective rain showers fell over the northwestern quadrant of the project area during the afternoon. Cumulus and cirrus clouds then formed over the region in the evening and overnight. Max cell top: 4.6km, 52.0 max dBz, 7.9 max VIL Tmax YC = 29.0C and no rain. Tmax QF = 28.2C and no rain. Tmax Radar = 28.1C and no rain.	
August 12, Wednesday	Westerly flow was expected at the mid-levels during the period, and 500mb heights looked to rise slightly. A shortwave trough looked to push northeastward across the far southern part of AB during the afternoon. The dynamics with this disturbance looked to be much weaker over the project area. Low level and surface winds appeared to be westerly to southwesterly which would potentially aid in keeping dew points relatively dry in the boundary layer. The 00Z (08/13) modified model sounding for CYYC showed a moderately unstable troposphere, approximately 500J/kg of CAPE. Mostly clear skies were seen over the area during the morning. Weak echoes were then observed on radar during the afternoon and early evening hours as a mesoscale boundary slowly pushed southward over the project area. Radar data showed weak echoes and a few small areas of virga during this same time period. 30.2 max dBz Tmax YC = 30.9C and no rain. Tmax QF = 29.1C and no rain. Tmax Radar = 31.8C and no rain.	Radar tour #8 was conducted at the Olds-Didsbury airport and 22 people were in attendance. HS4 flew a maintenance flight. They were airborne at 1733Z and landed at 1744Z. HS3 flew a PR flight. The aircraft was airborne out of YQF at 1754Z and landed in EA3 at 1809Z. HS3 then flew a return PR flight. The flight became airborne out of EA3 at 2249Z and landed in YQF at 2301Z. Flight Summary HS4: 1720Z-1747Z; no seeding; maintenance flight. HS3: 1745Z-1811Z; no seeding; PR flight; takeoff YQF, land EA3. HS3: 2242Z-2306Z; no seeding; PR flight; takeoff EA3, land YQF.
August 13, Thursday	A 95kt jet streak was expected to be in place just north of the project area in the afternoon and evening. A shortwave trough looked to move eastward across the region in the afternoon. The best dynamics and PVA appeared to be over the northern protected area. Hot and moist air looked to be in place at the surface and low levels through around midnight MDT. Overnight, the 850mb theta-e ridge was expected to break down over the region and shift into SK. At the surface, a cold front looked to quickly push southward across the area during the overnight hours. Modified model soundings for CYQF showed an unstable troposphere with a decent amount of bulk speed shear. Model data indicated that the troposphere would quickly stabilize after sunset. Upper level chinook clouds moved eastward over the area during the morning and early afternoon hours. High based cumulus clouds were then observed over the region during the rest of the afternoon and evening.	HS2 flew a maintenance flight. They were airborne at 1733Z and landed at 1800Z. Flight Summary HS2: 1724Z-1803Z; no seeding; maintenance flight.

	Overnight, light scattered convective rain showers fell over the region. 41.6 max dBz, 3.0 max VIL Tmax YC = 33.6C and no rain. Tmax QF = 32.2C and no rain. Tmax Radar = 32.9C and no rain.	
August 14, Friday	The upper level jet core was expected to be directly over the region for most of the period. The large mid and upper level trough was centered along the coast of Oregon at 17Z but model output showed that this disturbance would quickly slide northeastward toward the area during the period. This trough was expected to begin moving into AB overnight. A shortwave trough with strong PVA appeared to move through at around the time of peak. A strong cap looked to be in place at the low levels throughout the time period. Low level model charts indicated that the 850mb theta-e ridge would mainly be east of the area. Area model soundings showed a tight gradient of instability over the area. Tropospheric conditions were expected to be only slightly unstable over the northern part of the area, whereas a moderately unstable air mass would potentially be in place further south. Convective rain showers fell over the area during the morning, afternoon, and early evening. At 0415Z (08/15) storm #1 moved quickly off the foothills near Sundre, but weakened dramatically as it advanced northeast. It joined an existing broken line of convection across the western project area, and this line pushed across the project area between 04Z (08/15) and 07Z (08/15). Radar data indicated that pea size hail may have fallen south of Rocky MH and to the SW of Sundre. The rest of the nighttime hours continued to see widespread convective rain showers. Max cell top: 10.6km, 59.4 max dBz, 23.7 max VIL Tmax YC = 22.8C and 2.6mm of rain. Tmax QF = 21.9C and 4.4mm of rain. Tmax Radar = 20.1C and 1.0mm of rain.	HS2 was launched at 0355Z (08/15). They were airborne at 0409Z (08/15). HS2 began to patrol Calgary at 0412Z (08/15). HS2 RTB at 0506Z (08/15). They landed at 0515Z (08/15). HS3 was launched at 0353Z (08/15). They were airborne at 0414Z (08/15). HS3 began seeding storm #1 for Sundre at 0433Z (08/15). HS3 stopped seeding and RTB at 0457Z (08/15). They landed at 0506Z (08/15). Flight Summary HS2: 0403Z (08/15)-0518Z (08/15); no seeding; patrol Calgary. HS3: 0408Z (08/15)-0511Z (08/15); 4 BIP; #1 Sundre.
August 15, Saturday	Jet energy was expected to stay south of the area throughout the period. Mid and upper level model data showed that the trough of low pressure would continue to move eastward out of the area. A shortwave trough was then expected to slowly move eastward across southern AB in the late afternoon through the overnight hours. This shortwave trough looked to contain moderately strong PVA. The low levels and surface would likely experience cold air advection from the north through at least the early evening. The 00Z (08/16) and 03Z (08/16) area modified model soundings showed stable conditions above 11kft MSL. From the surface to 11kft MSL, the troposphere appeared to be only slightly unstable. Short-lived thunderstorms formed over the southeast quadrant of the protected area during morning hours. During this same time, stratiform rain showers, with areas of embedded convection, fell over the rest of the project	No aircraft operations.

	area. Rain showers occurred over the region off and on throughout the period. Max cell top: 6.1km, 51.5 max dBz, 14.2 max VIL Tmax YC = 13.3C and 21.0mm of rain. Tmax QF = 12.6C and 33.0mm of rain. Tmax Radar = 12.4C and 24.4mm of rain.	
August 16, Sunday	A broad upper level trough was centered over Saskatchewan with the jet stream well south of the project area. A modest pulse of PVA was expected over far southern Alberta. A weak surface high was depicted over the central project area, enhancing upslope flow in the far southern project area. Instability and wind shear were both modeled to be unimpressive. Convective showers were projected to develop along the foothills and move into the southern project area, but no hail threats were forecast. Tranquil and clearing conditions were expected overnight. Scattered light convective rain showers moved from the foothills across the central and southern project area between 19Z and 2Z (08/17). No TITAN cells formed with this activity, however a few lightning strikes were observed. A second period of weak showers occurred in the far western project area before dawn Monday. Lightning was observed in the project area. Max cell top: 52.2 max dBz, 5.3 max VIL Tmax YC = 17.1C and a trace of rain. Tmax QF = 15.7C and no rain. Tmax Radar = 14.4C and 0.5mm of rain.	No aircraft operations.
August 17, Monday	The left exit region of a strong jet streak was modeled to move over the project area late in the evening. Mid and upper level PVA was expected with this feature. Wind shear was forecast to increase significantly through the period, with CAPE rising to near 600 J/kg during peak heating. A cold front was projected to drop south across the project area from late evening into the early overnight hours, with only minor convective showers expected after frontal passage. Thunderstorms developed along the foothills near Sundre shortly after 21Z. This activity quickly moved east into the project area, and gradually spread into a meridional line of thundershowers that pushed southeast across the region. No large hail threats developed with this activity, but pea size hail was reported northwest of Sundre. The convective line departed the eastern buffer around 3Z (08/18). Widespread rain showers continued throughout much of the project area overnight, finally dissipating around 11Z (08/18). Max cell top: 6.9km, 60.7 max dBz, 26.0 max VIL Tmax YC = 21.1C and 4.2mm of rain. Tmax QF = 20.1C and 0.8mm of rain. Tmax Radar = 19.6C and 4.1mm of rain.	No aircraft operations.

August 18, Tuesday	The core of the upper level jet was modeled to shift east of the area. Negative vorticity advection was forecast to occur throughout the day. Instability was predicted to be limited to the lowest layer of the troposphere, with a robust cap above. No significant synoptic trigger mechanisms were expected. Mostly clear and pleasant conditions were observed throughout the day. The only notable radar returns came before dawn Wednesday morning, when virga or weak rain showers developed in the northern project area. Max cell top: 37.5 max dBz Tmax YC = 19.1C and 1.2mm of rain. Tmax QF = 19.4C and 1.0mm of rain. Tmax Radar = 18.9C and 0.3mm of rain.	Radar tour #9 was conducted at the Olds-Didsbury airport with 24 people in attendance. HS4 flew a PR flight. They were airborne from YQF at 1724Z and landed in EA3 at 1740Z. HS4 flew a return PR flight. They were airborne from EA3 at 2224Z and landed in YQF at 2238Z. Flight Summary HS4: 1715Z-1743Z; no seeding; PR flight; takeoff YQF, land EA3. HS4: 2218Z-2242Z; no seeding; PR flight; takeoff EA3, land YQF.
August 19, Wednesday	A modest upper level jet streak was predicted to move into central Alberta overnight. PVA with this disturbance was expected to remain north of the project area. Speed shear was modeled to be very strong, too strong for the limited amount of instability anticipated. A significant cap was forecast to hold over the central and southern project area, but was weaker to the north. A lee trough was expected to develop, with the greatest surface convergence in the far northern project area. Isolated elevated showers were expected to continue overnight. Convective rain showers initiated in the northern project buffer near Rimbey around 0Z (08/19). This activity was relatively shallow and cells were short-lived, but convective initiation spread south into the northern and central project areas between 0Z and 4Z (08/19). Lightning was observed in some of these convective cells. Isolated rain showers continued in the northern project area overnight. Max cell top: 6.9km, 59.4 max dBz, 17.0 max VIL Tmax YC = 27.7C and no rain. Tmax QF = 26.0C and 0.2mm of rain. Tmax Radar = 25.9C and no rain.	No aircraft operations.
August 20, Thursday	Strong upper level winds were forecast to weaken as a longwave trough moved onshore in B.C. Wind shear was predicted to remain strong, but instability was expected to be limited by clouds and warming mid-level temperatures. A nearly stalled cold front was observed near Airdrie Thursday morning, and was predicted to drift slowly north as a warm front by the evening. Thundershowers were expected to develop along the foothills and move east across the project area, with the greatest threat in the south where greater insolation and moisture transport was predicted. Weak rain showers moved east across the northern and far southern project area Thursday morning. New shallow convection began to initiate along the foothills after 20Z, moving east and becoming more widespread around 22Z. A particularly strong cell formed south of Airdrie at 2Z	No aircraft operations.