FIREICE REPORT

MINNESOTA DNR - SPRING FIRE SEASON - 2015

An evaluation on the effectiveness of FireIce to aid in the suppression of wildfires.

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Cover: Tanker 801, CL 4, FM 10, 'Lost Fire', near Bagley MN, April 2015

BACKGROUND

In 2014, The State of Minnesota, Department of Natural Resources (MN DNR), Division of Forestry, tested and evaluated a new generation of fire suppressant gels that are approved by the United States Forest Service Wildland Fire Chemical Systems (WFCS) program.

MN DNR-Forestry experimented with a product called FireIce by Gel Tech Solutions. This product has been evaluated by the United States Forest Service and meets the requirements of USFS Specification 5100-306a for applications from single engine air tankers, individual agency approved large tankers, helicopter buckets and ground engines.

Testing was done in controlled situations. Variables included fuel types, canopy densities, and coverage levels. In late May of 2014, the first load of FireIce was dropped on a wildfire in MN. A complete report on the cost, handling, mixing, loading, storage of FireIce, and findings from 2014 can be found in the 'Minnesota DNR FireIce Field Operational Evaluation, 2014' document.

The conclusion from 2014 was that FireIce would be loaded on MN DNR contracted aircraft whenever possible as the primary suppression product for wildfire operations in MN in 2015.

This was a change to MN operations, which had previously used liquid concentrate retardant.

A series of other changes also occurred between 2014 and 2015 within the MN DNR Aviation Program. The most noteworthy was the sale of two MN DNR owned CL-215 aircraft, which had been the workhorse of the aerial suppression program for 14+ years.

A newer fleet of contracted type three single engine air tankers (wheeled SEATs and Fire Bosses) would be used to replace the CL-215s.

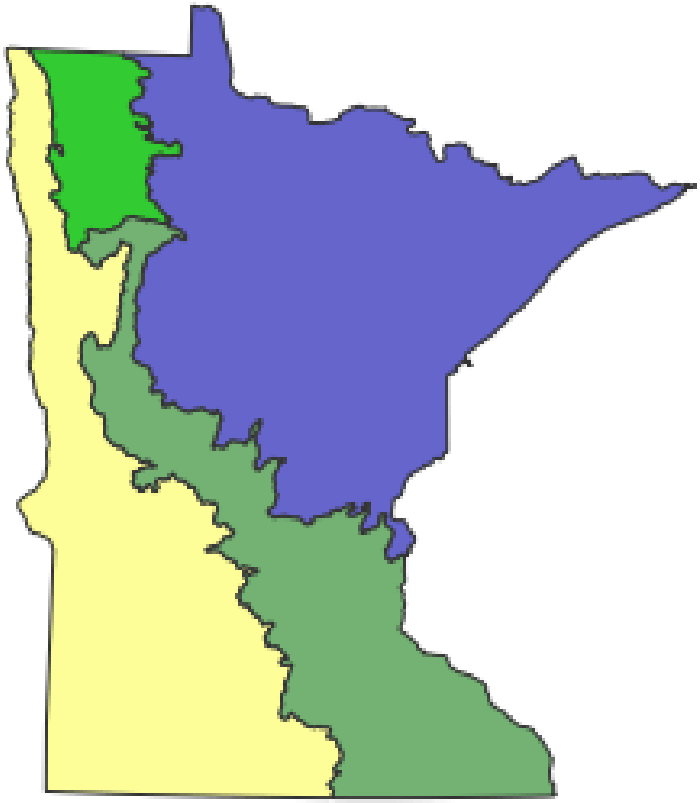
Considerable efforts were made by MN DNR Aviation Personnel over the winter of 2014 and early spring of 2015 to provide training and increased firefighter awareness related to the change in aircraft, FireIce, and their uses independently or in combination on wildfires. Firefighters were also re-trained on the importance of dispatching air resources during the early stages of wildfires.

Training, and good training, is the backbone of a successful wildfire suppression operation. The intensive training provided **prior** to the 2015 spring wildfire season should be considered as a significant factor in the MN DNR's evaluation of FireIce.

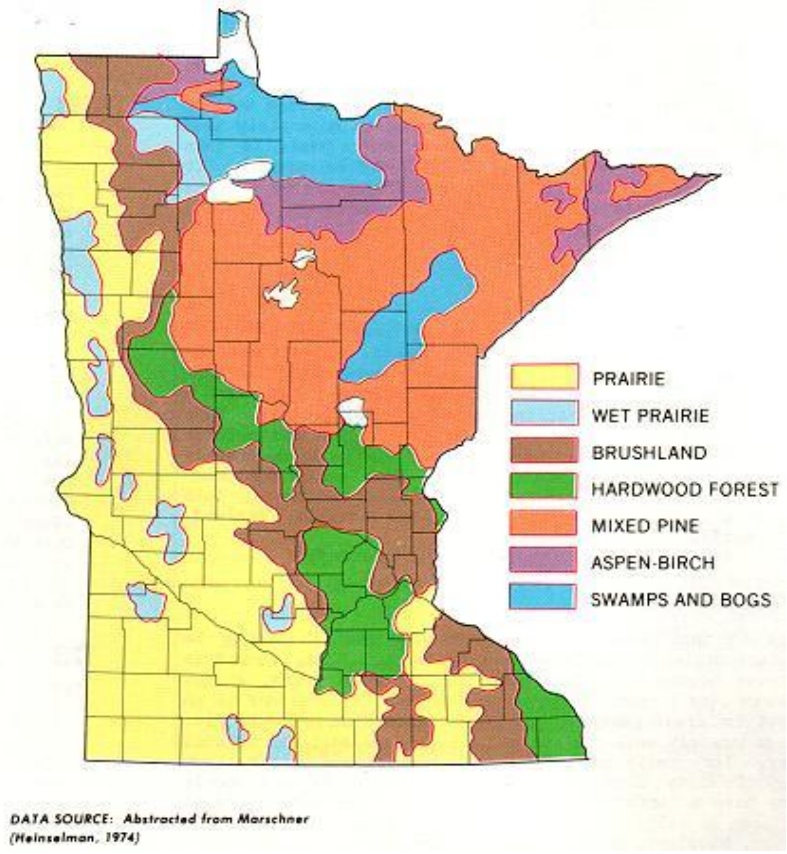
It is also important to understand fuel types across MN, fixed wing base locations, fuel conditions that existed in 2015, snow and ice conditions, and weather patterns experienced in 2015 to systematically understand the MN DNR Aviation Program and its evaluation of FireIce.

Dan Carroll – ATGS – MN DNR

FUEL TYPES and FUEL MODELS



ORIGINAL VEGETATION
OF MINNESOTA



BLUE: **Laurentian Mixed Forest**
Broad areas of conifer forest, mixed hardwood and conifer forests, and conifer bogs and swamps.

GREEN (NW): **Tallgrass Aspen Parklands**
Prairie, wetland swamps, and scattered hardwood woodlands.

YELLOW: **Prairie Parkland**
Historically tallgrass prairie, converted over time to row-crop agriculture.

GREEN (SE): **Eastern Broadleaf Forest**
Transition from forest and woodland to open grassland.

FUEL MODEL COMPARISON

PRAIRIE: FM 1, FM 2, but mostly Ag lands

WET PRAIRIE: FM 2

BRUSHLAND: FM2, FM 3

HARDWOOD FOREST: FM 8

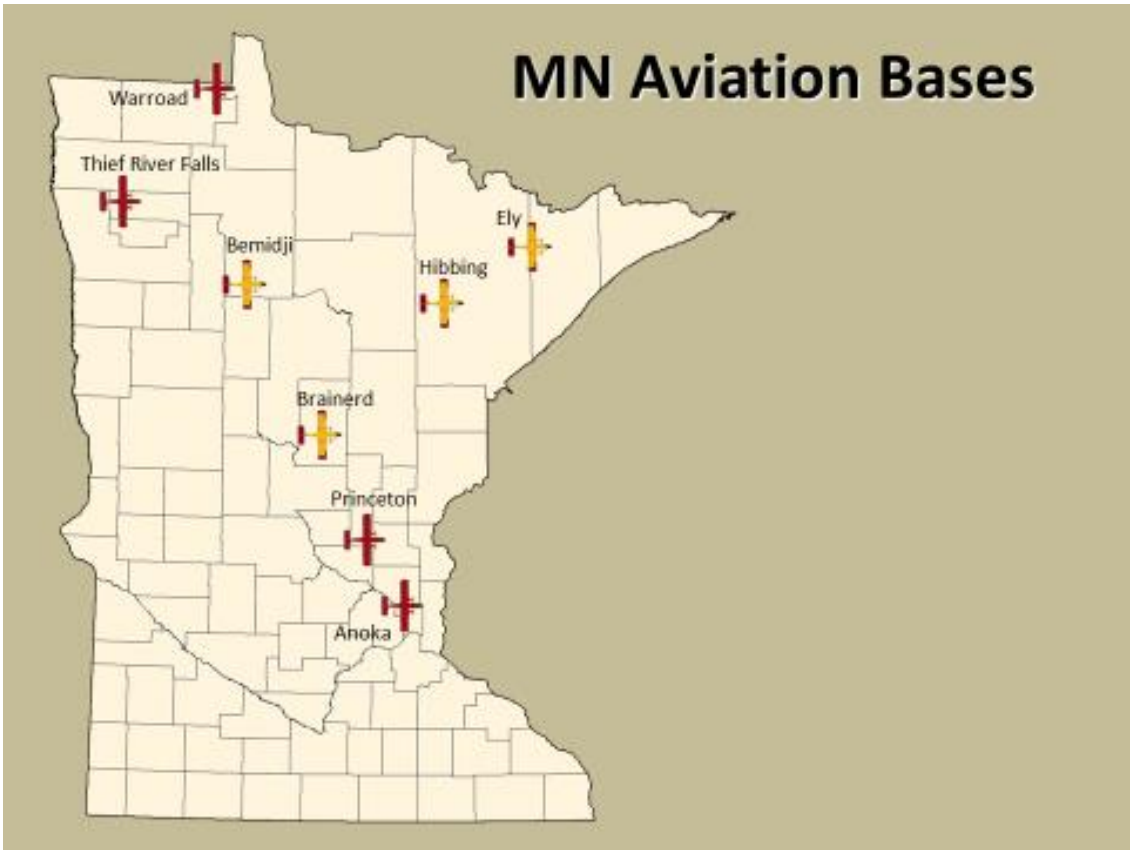
MIXED PINE: FM 2, FM 4, FM 9

ASPEN-BIRCH: FM 10

SWAMPS AND BOGS: FM 3

(These are not exact, simply a comparison)

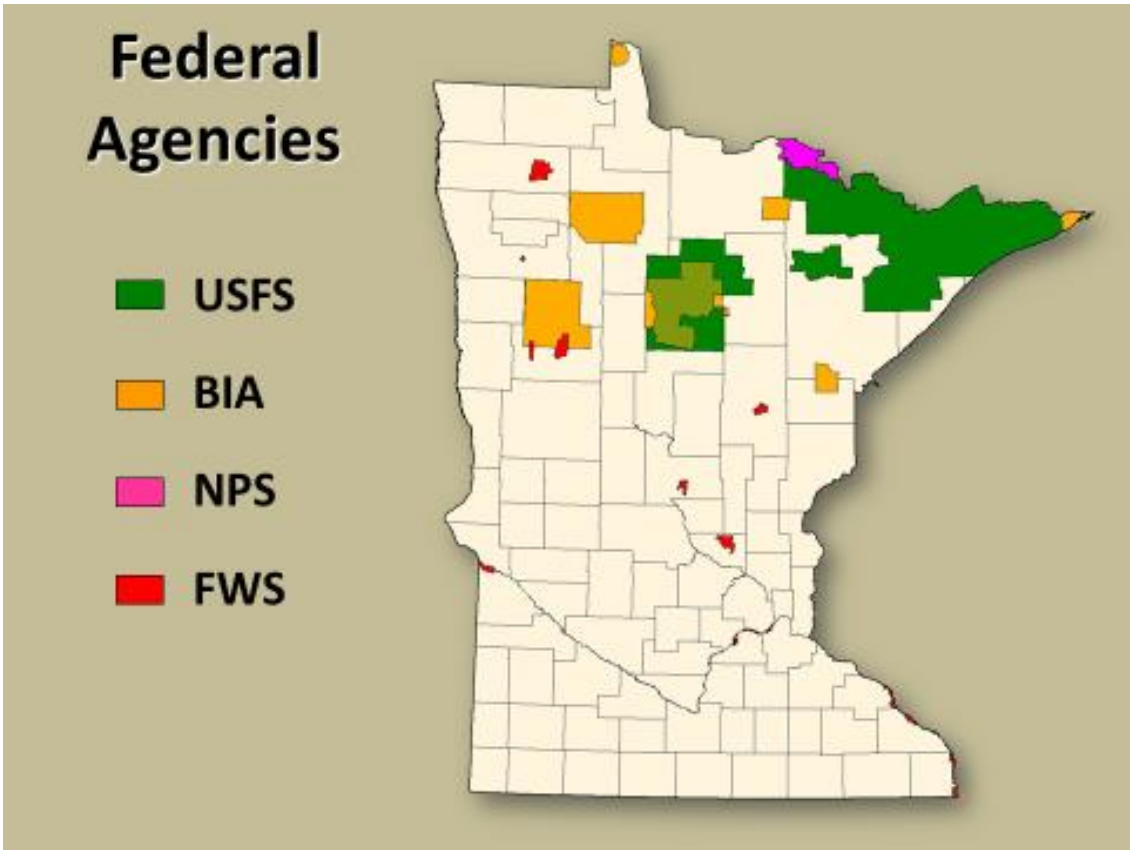
AVIATION SUPPORT



YELLOW: PRIMARY TANKERBASE

RED: SECONDARY FIXED WING BASE

NOTE: ELY IS A USFS BASE



Within the state of MN multiple agencies have jurisdiction for wildfire suppression.

Bases are strategically located across the state to provide coverage.

The MN DNR Aviation Program provides support to all agencies.

These agencies include: MN DNR, United States Forest Service (USFS), Bureau of Indian Affairs (BIA), National Park Service (NPS), and the United States Fish and Wildlife Service (USFWS). **The MN DNR has responsibility on all state lands and all private lands.**

In 2015, all bases except Ely loaded FireIce onto SEATs and/or Fire Bosses.

FLEET OF AIRCRAFT

FireIce was loaded onto SEATs and Fire Bosses upon dispatch to wildfires. SEATs could carry an 800 gallon load, Fire Bosses could carry between 500-600 gallons depending on fuel amount.

Assuming scoop-able water was available, Fire Bosses would drop their FireIce load and then begin scooping operations. SEATs would return to base to re-load or hold.

FIRE BOSS

SEAT

Spring wildfire seasons in MN routinely encounter cold weather. The MN DNR has established 40 degrees Fahrenheit as the temperature tipping point for all mixing and loading operations. At the time of mixing, if the air temperature is below 40 degrees, FireIce will not be mixed.

This standard, coupled with cold weather encountered in 2015, resulted in multiple loads of retardant being mixed instead of FireIce.

WEATHER SYNOPSIS

*References reports generated by St. Cloud State University, St. Cloud MN. Reports are somewhat specific to the St. Cloud area, but due provide a general observation of statewide conditions.

MARCH

The March 2015 average temperature marked a warm-up from a slightly colder than average winter season. The average temperature was 32.4°F (high 43.3°F, low 21.5°F), three degrees milder than average. March 2015 was more than 10 degrees warmer than both March 2013 (21.9°F) and March 2014 (22.5°F).

March 2015 got off to a slow start with three days with lows of zero or colder, including a -16 degree low on March 5th that was one degree short of the record cold. Another cool period occurred March 21st – 27th when the high temperature stayed between 33 and 38 degrees.

Mild periods were more common, including 9 straight days (March 8th – 16th) with temperatures at least 10 degrees warmer than average. The last three days of the month (March 29th – 31st) had highs in the 50's to lower 60's. Record warm high temperatures were set on March 10th and 15th, each at least 5 degrees warmer than the previous record high.

APRIL

A warmer than average March led to a warm April.

The average St. Cloud temperature in 2015, according to the statistics taken at the St. Cloud Regional Airport, was 46.3°F, 1.8°F above average. However, the warmth was concentrated into three warm periods.

On April 1st, St. Cloud came within one degree of a record high temperature (76) and did set a record for warm average temperature. April 2nd had a high temperature of 64 degrees. Between April 11th and April 18th, the high temperature broke 70 degrees four times and another record average temperature was tied on April 12th. (high of 77 degrees, the warmest of the month).

Between April 19th and April 24th, the temperature was never warmer than 54 degrees with five days failing to reach 50 degrees. The final six days of April all had temperatures of at least 60 degrees.

April rainfall of 1.64 inches was 0.93 inches short of the April average. St. Cloud did get occasionally visits of moisture from the Gulf of Mexico. That helped to produce 0.66 inches on April 12th. The April 12th rain was the first daily precipitation of at least a quarter inch in 2015.

*That is the latest occurrence for the first quarter-inch precipitation event in St. Cloud records.

Exactly one inch of the precipitation fell in the form of snow in St. Cloud in April, 1.9 inches less than average. February through April 2015, however, ended up with 8.5 inches of snow, the lowest total since 1987 (1.9 inches). The average February through April snowfall is 18.0 inches.

The dryness resulted in some awfully cool low temperatures, a delayed greening of vegetation, and a heightened fire danger.

MAY
Rain.

Entering the month of May, St. Cloud had received 2.61 inches of measurable precipitation, more than three inches below average. However, May produced 6.03 inches of rain, a little more than three inches above the average.

There were seven days with at least a half an inch of rain. May 16 had the highest rainfall total of the month at 1.48 inches. A 1.41 inch May 17th rainfall broke the daily record, previously 1.10 inches, set in 1910.

Rainfall was even heavier in parts of central, west central, and northwestern Minnesota with 6-8 inches of rain during the month.

The rainy pattern was due to a major change in the steering wind pattern across North America. Instead of the persistent northwest-to-southeast flow that kept conditions relatively dry, a shift to more storms entering the US in Oregon and California and also some northern storms pushing southward across the Rockies led to a much wetter pattern in all of the Plains states.

By the end of May, statewide stream flows in most of Minnesota had drastically improved.

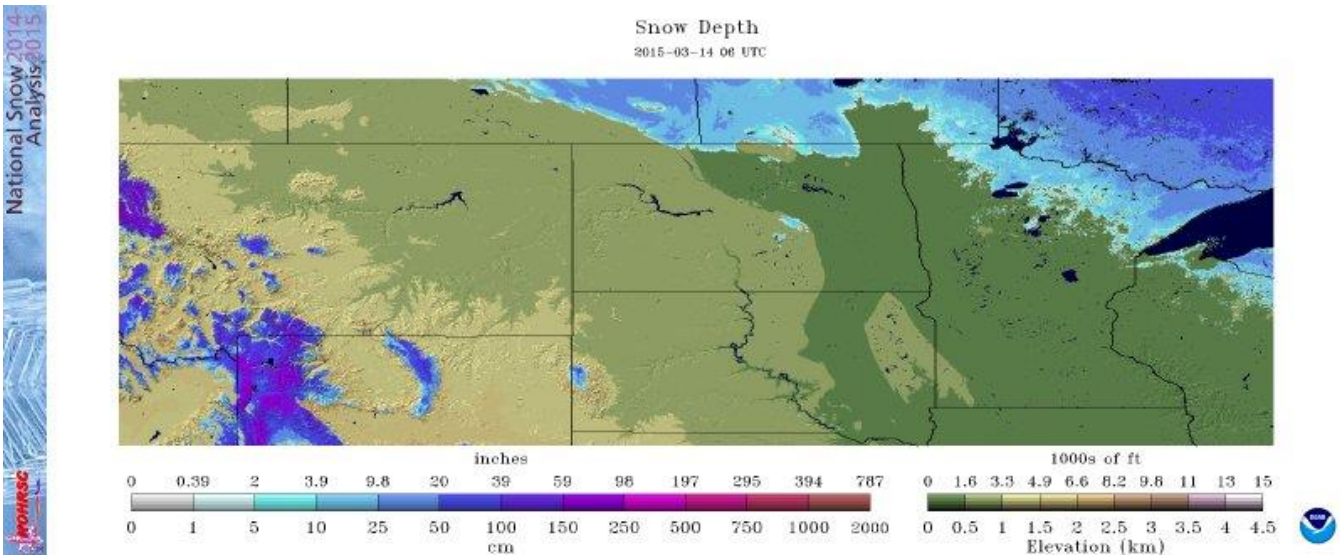
The overall rainy May helped keep a lid on temperatures, thanks to persistent cloud cover. The average high temperature in St. Cloud was 66.3°F, 2.5°F cooler than average. The May average temperature ended up being 55.1°F, 1.4°F cooler than average.

There were twenty days with a high temperature cooler than 70 degrees. The first 80 degree high temperature of the season was delayed until May 27th. That was the latest first 80 degree temperature since 1997 (May 31st) and only the 11th time on record that the first 80 degree high came on May 27th or later.

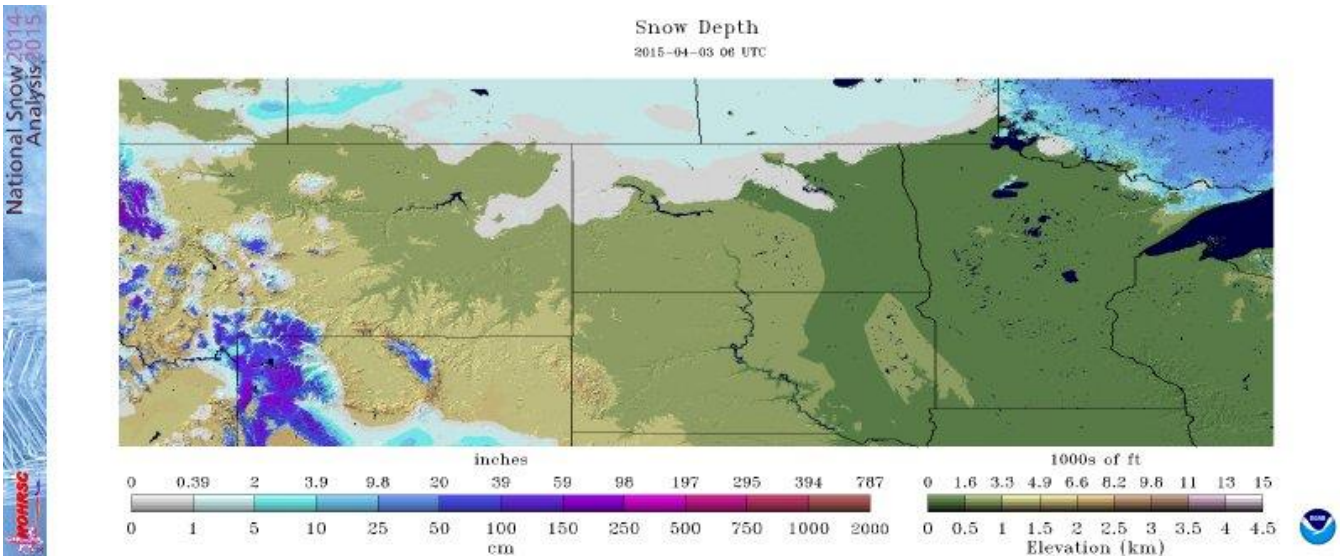
That's in large contrast to the relatively early first 60 degree and first 70 degree high temperatures in the first half of March, mainly due to the lack of snow cover.

SNOW

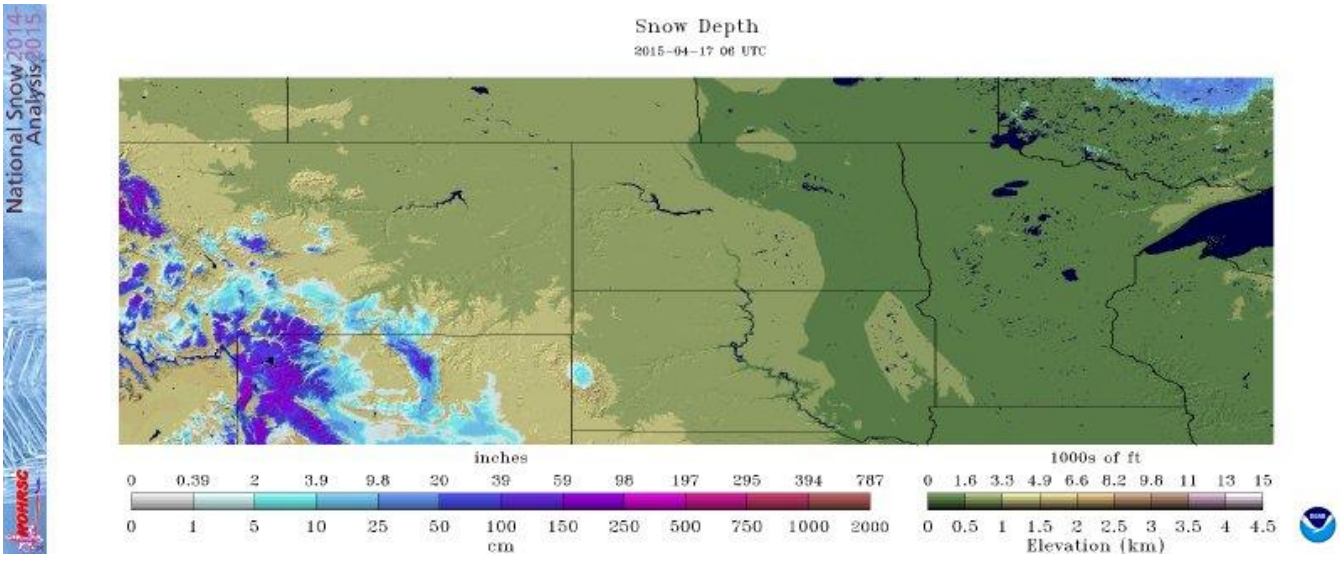
Most of the state was snow free by early March. Snow depth on **March 14th** 2015.



Snow depth on **April 3rd** 2015.

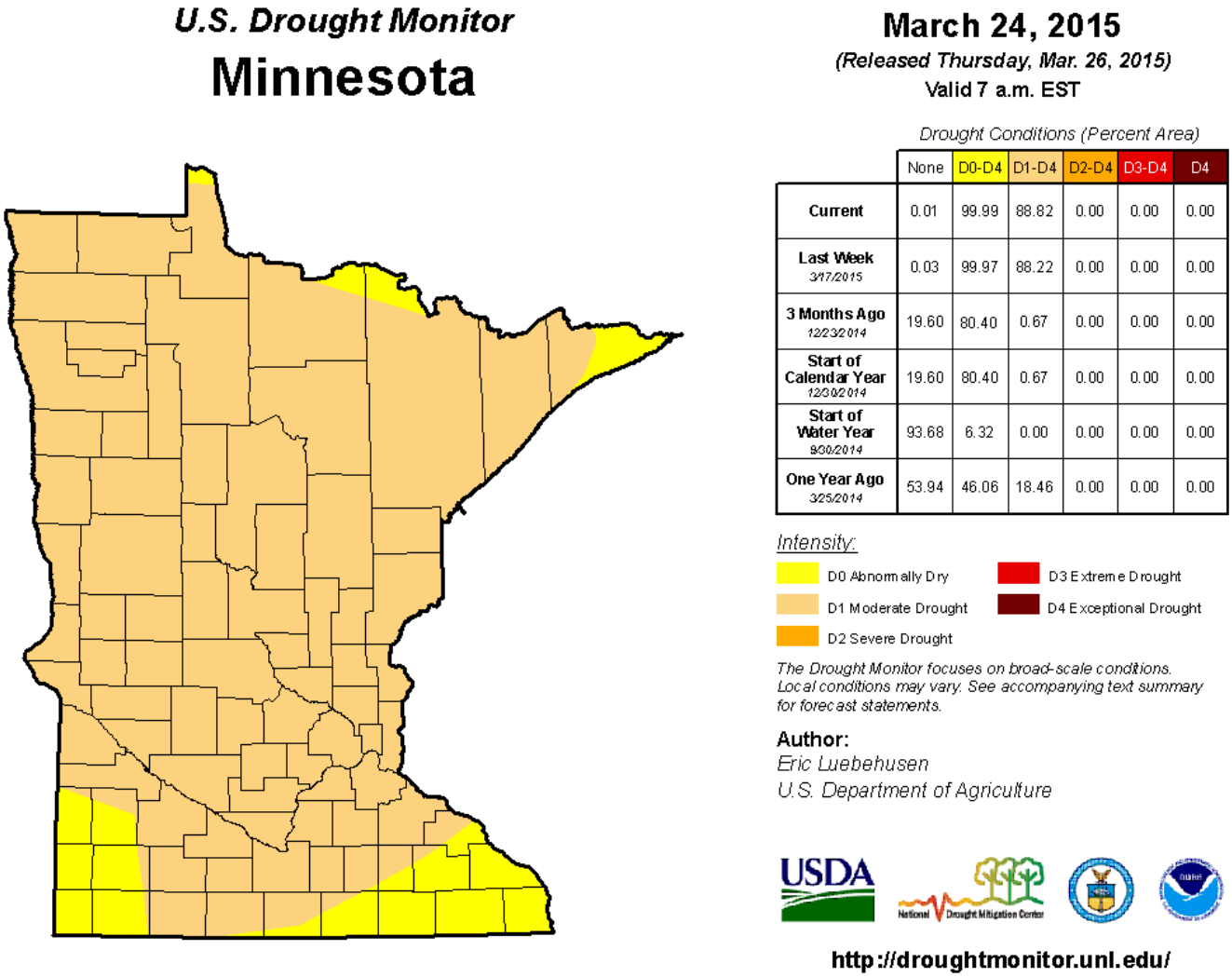


Snow depth on **April 17th** 2015.



CONDITIONS

Entering the 2015 fire season the state of MN was in moderate drought status. Multiple weather factors listed previously, including a 'dry fall' in 2014, below average snow fall over the winter, and a below average moisture content contained in the snowfall, attributed to these conditions.



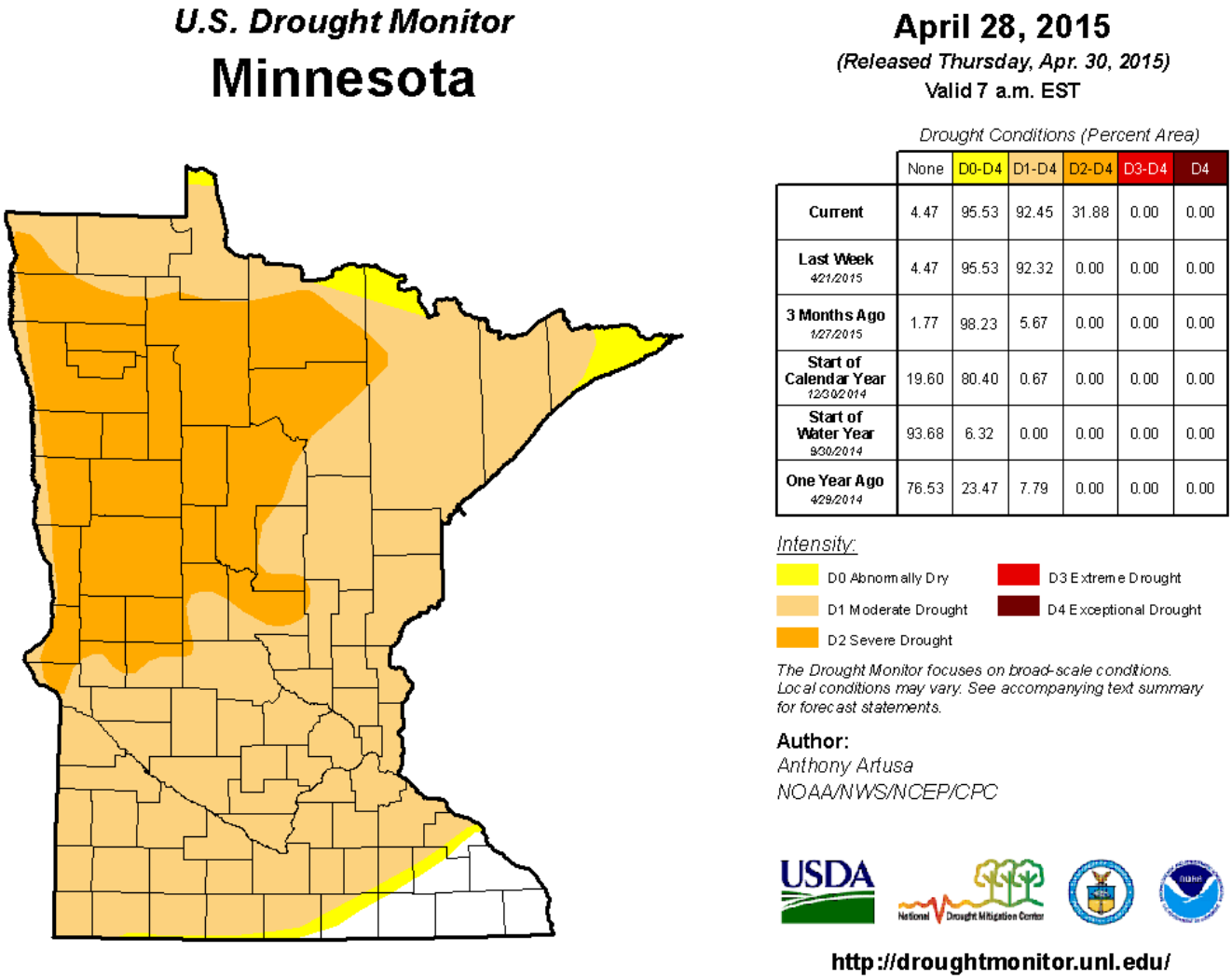
The below average snow fall, and below average moisture content, allowed 1 hour fuels to remain generally upright in nature. This upright fuel arrangement allows for increased fire behavior, but is considered beneficial to aerial suppression operations (fuel coverage is more thorough).

A normal winter snowfall would 'mat' 1 hour fuels, negatively affecting aerial suppression operations (fuel coverage is less thorough, resulting in fires 'burning under' suppression lines).

Other conditions existed because of the drought, including the availability of 100 and 1000 hour fuels, which sustained fire on the surface in timbered fuel types.

Lastly, the lack of snow negatively affected stream flow rates and surface water levels, meaning normal wet areas (ditches, swamps) were too dry to be relied upon for containment.

Conditions continued to worsen as the spring fire season progressed through late April.



Significant moisture events in May put an end to the 2015 spring wildfire season.

The abrupt end to the fire season prevented FireIce to be tested in 'summer fire conditions.'

Summer fire conditions can be described as 100% canopy coverage in timbered and brush fuel types, and intense burning and consumption of all surface fuels.

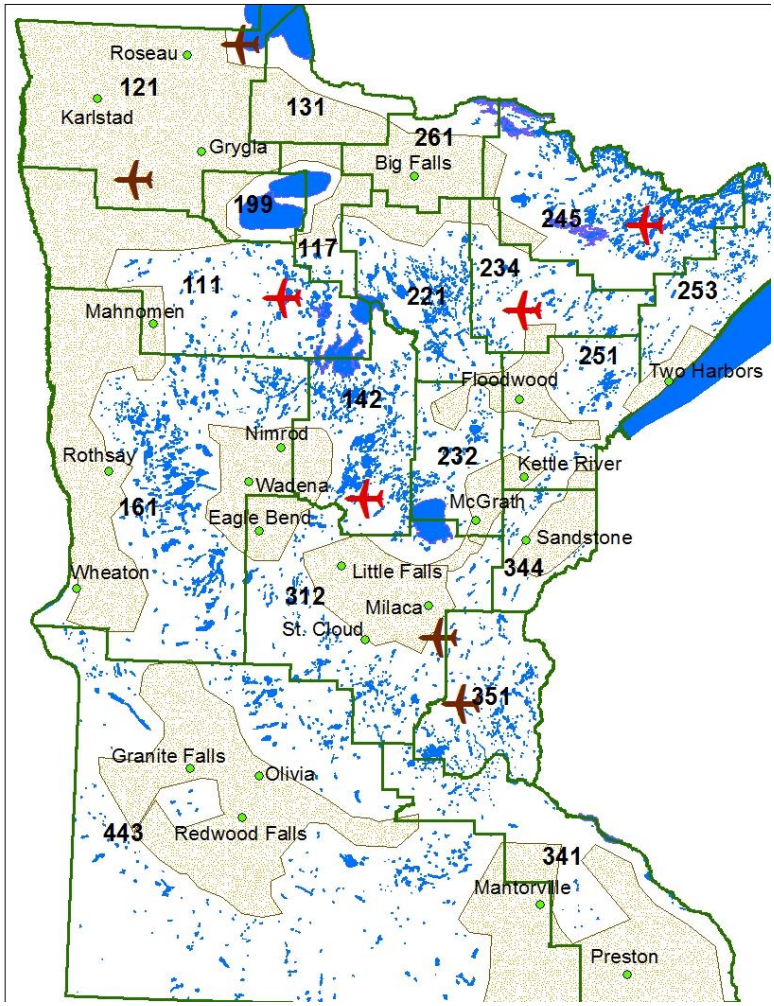
Summer fire conditions were noted by Air Tactical Group Supervisors, but were generally related to the intense burning of surface fuels, not canopy coverage.

Canopy coverage is a significant factor in aerial suppression drops reaching surface fuels.

In the interest of a complete evaluation of FireIce, it is critical to obtain more data regarding its use in full canopy coverage situations.

SCOOPING OPERATIONS

The state of MN is benefited in having a tremendous amount of water available to support wildfire suppression operations. This water availability has historically helped to shape wildfire response, both on the ground and from the air. Specific to fixed wing response, scooping aircraft have been heavily involved since 1993, when CL-215s operations began.



Map: Statewide Scooping Water

Scooping water can be described as a water body roughly 1 mile in length.

Turn-around times are a critical factor in scooping operation success.

The light brown colored areas are zones within the state that do not have 'scooping water' within a 5 NM radius.

This map was used to help train firefighters about the importance of dispatching fixed wing resources in pairs, especially in the brown colored areas.

This map does not factor in weather conditions and lake depth, which are also critical factors in a water body being 'scoopable.'

Water and water availability are two completely different variables. When fire season started in early March of 2015, many of the state's lakes and ponds were ice covered.

Due to the amount of 1 hour fuels across the state, fire season starts immediately after snow melt.

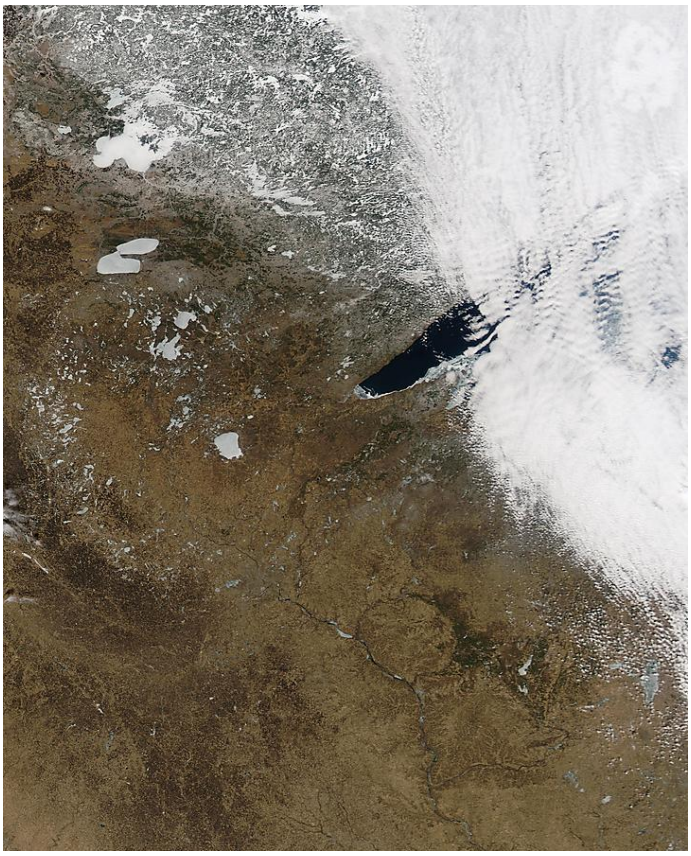
In 2015, early snowmelt started fire season in early March, while ice still covered most lakes.

Ice conditions hindered scooping operations in southern MN until early April. Scooping operations were further delayed in central and northern MN.

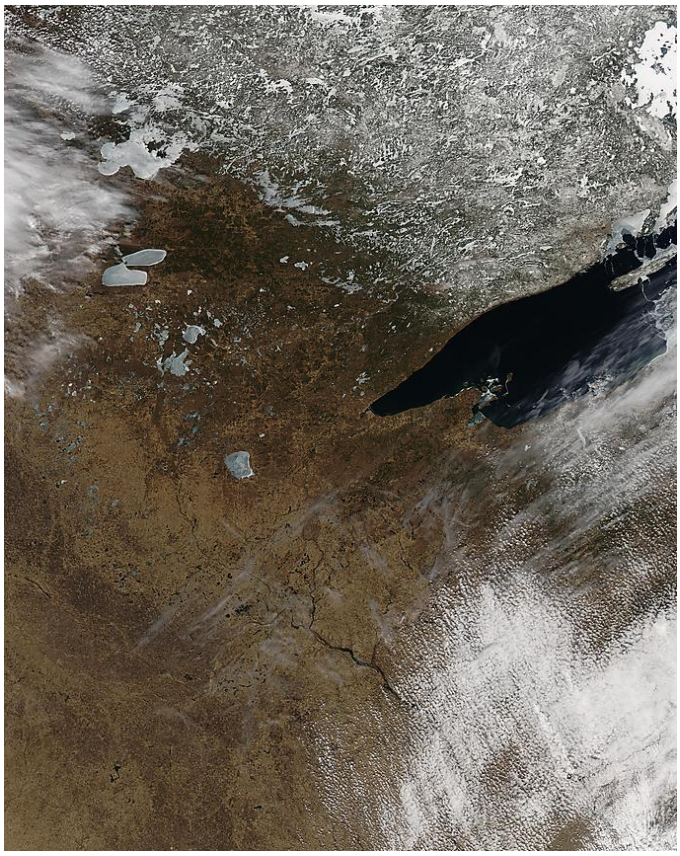
Many fire missions were flown without the support of scooping operations. This should be considered in the evaluation of FireIce.

ICE

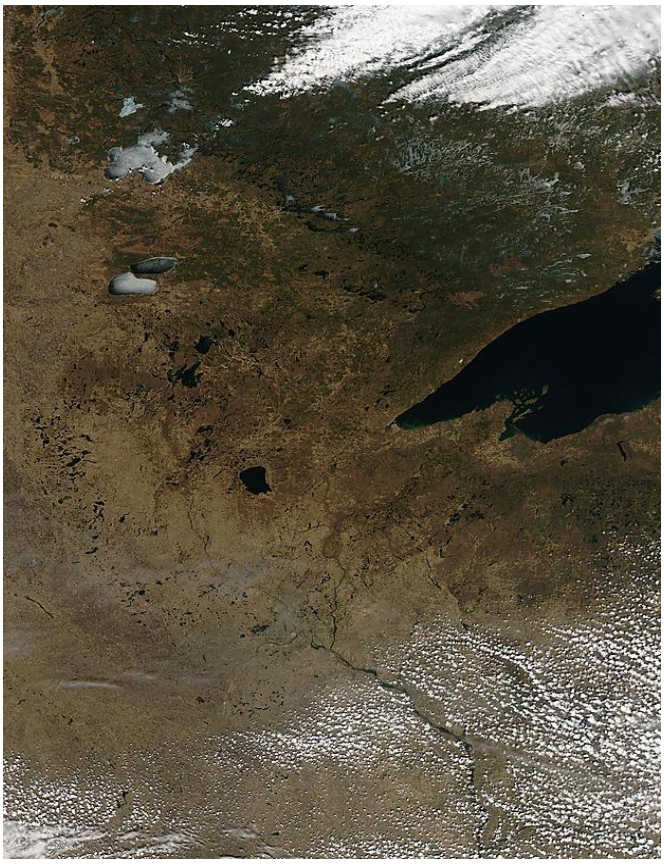
March 14th 2015



April 3rd 2015



April 17th 2015



How Lake Ice Melts

In early March, as the air warms and the sun gets more intense, snow melts, allowing light to penetrate the ice.

The ice acts like glass in a greenhouse, the water beneath it begins to warm, and the ice begins to melt from the bottom. When ice thickness erodes to between four and twelve inches, it transforms into long vertical crystals called "candles." These conduct light, so the ice starts to look black, because it is no longer reflecting sunlight.

Warming continues because light energy is being transferred to the water below the ice. Meltwater fills in between the crystals, which begin breaking the ice apart.

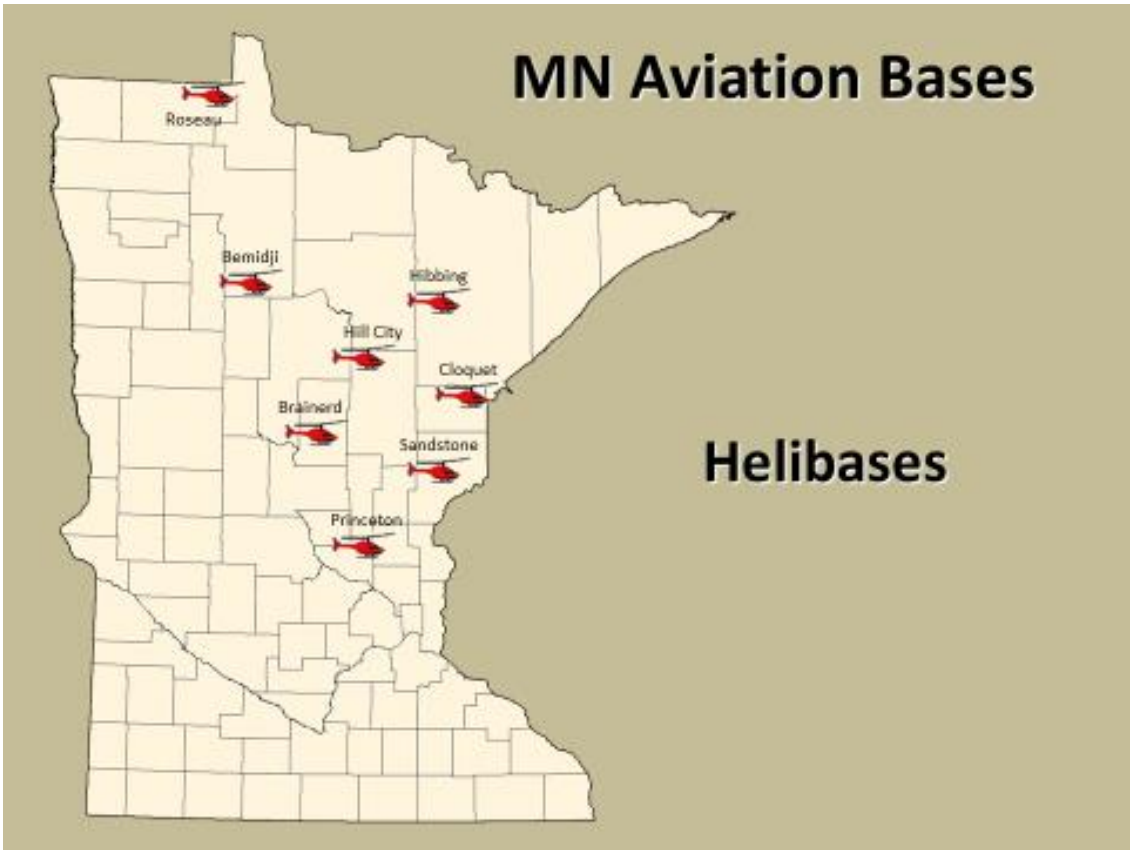
The wind comes up, and breaks the surface apart.

WILDFIRE RESPONSE

As previous information has referenced, understanding a typical wildfire suppression response in MN is important in the evaluation of FireIce.

Because FireIce is a suppressant, not a retardant, it is necessary that drops be followed up by ground resources, and sooner rather than later.

MN is somewhat unique in its elaborate helicopter program, and its use of 'tracked vehicles.' It is typical upon wildfire dispatch that Type 6 Engines, tracked machines, and one helicopter respond. Fixed wing resources (air attack, SEATs, Fire Bosses) are dispatched soon after.



Eight MN DNR helicopter contracts are exclusive use, and 42 days in length.

Start dates are based on anticipated fire danger.

Two CWN helicopters were added in 2015 to support suppression response.

Elaborate training presented by the MN DNR Aviation Program over the winter of 2014 and early spring of 2015 conveyed the importance of dispatching air resources 'early' upon report of a wildfire. It was also suggested by Aviation Personnel, and supported by ground firefighters, that fixed wing suppression resources be dispatched in groups of two whenever possible to increase their effectiveness. It is common knowledge that SEATs work best in groups of two or more.

On a large scale, these messages were received and acted upon.

*Consistently 'early' dispatches of fixed wing resources enabled wildfires to be attacked during the early stages of initial attack. This factor should be considered in the evaluation of FireIce.

AVIATION DISPATCHES

The 2015 spring fire season in MN totaled 1,579 fires for 27,758 acres.

The MN DNR was responsible for 962 fires totaling 23,334 acres.

All other agencies (USFS, BIA, NPS, and USFWS) had a total of 617 fires for 4,424 acres.

The MN DNR Aviation Program received 473 aircraft requests on 192 fires.

The rundown: Helicopter requests = 211, Air Attack requests = 93, Tanker requests = 169.

Aviation resources logged 822 hours of flight time responding to those requests.

Helicopter

Flight hours: 373
Responded to 141 fires.

Missions were flown throughout the spring, and active days occurred throughout late March, April and May.

Air Attack

Flight hours: 214
Responded to 95 fires.

The first mission was flown on March 12th, the last on June 16th. 90% of the missions were flown between March 28th and May 5th.

The most active days were April 2nd, April 11th, April 15th, May 2nd, and May 5th, where a total of 42 fires were responded to.

Fixed Wing Tanker

Flight hours: 235
Responded to 140 fires.

The first mission was flown on March 11th, the last on May 29th. 90% of the missions were flown in the time period between March 28th and May 6th.

The most active days were April 2nd, April 11th, April 15th, May 2nd, and May 5th, where a total of 64 fires were responded to.

65 loads of FireIce were dropped. These drops are the source of the following evaluations.

GROUND FIREFIGHTER EVALUATIONS

Throughout the 2015 spring wildfire season, firefighters and ATGSs discussed and debriefed the use of FireIce soon after fires were controlled. Debrief information is included later in this report. This evaluation sheet was presented to **100 firefighters** from all agencies in MN.

FIRE ICE EVALUATIONS FROM 2015 SPRING FIRE SEASON

Name:
Home Unit/Agency:
Did you see FIRE ICE used on a wildfire or prescribed fire in 2015?

YES / NO IF YES, continue. IF NO, you have completed this sheet

Incident(s)/Event(s) Name(s):

Incident Kind: Wildfire, Prescribed Fire

What resource applied the FIRE ICE? Engine, tracked machine, bladder bag, aircraft

What stages of the fire was FIRE ICE used? Initial attack, extended attack, mop up

To what Fuel Models was FIRE ICE applied?
G = Grass: Light. Moderate. Heavy
B = Brush:
T = Timber: Hardwoods. Conifer.
S = Slash:
O = Other: Structure protection? Infrastructure protection?

Evaluation

Was the use of FIRE ICE a benefit in helping achieve the objectives of the fire(s)?

YES / NO IF NO, please explain:

On a scale from 1 to 10, how effective would you rate FIRE ICE?

1 2 3 4 5 6 7 8 9 10

On a scale from 1 to 10, how effective was FIRE ICE when applied by an aircraft?

1 2 3 4 5 6 7 8 9 10

Do you think FIRE ICE should be used in MN in the future?

YES / NO

Comments:_____

_____

_____

GROUND FIREFIGHTER RATINGS

57% of the firefighters queried had seen FireIce used on a wildfire or prescribed fire in 2015.

82% of the time it was applied to a fire by an aircraft.

87% of the time it was applied during the initial attack phase of the fire.

80% of the time it was applied in a grass fuel type.

95% of the time it helped achieve the objective of the fire.

It was rated at an average of **7.8** on effectiveness. 2 being the low score, 10 the highest.

It was rated at an average of **8.2** on effectiveness when applied by aircraft. 2 being the low score, 10 the highest.

95% of firefighters believe it should be used in MN in the future.

General comments:
On several evaluations it was noted that ground follow up is critical in the success of a FireIce line 'holding.' This is even more important on hot and windy days when spread rates are high, and the probability of ignition is high.

Firefighters also stated that in dense canopy situations FireIce drops did not reach surface fuels 'enough' to contain fire spread. However, in open canopy or broken canopy situations, firefighters were very pleased with FireIce coverage of surface fuels.

Firefighters were also very pleased with FireIce's use in grass fuels, noting that it was more effective than straight water.

Other variables were mentioned if comparing FireIce against retardant. Firefighters were complimentary of the reduced cost, and also that FireIce lacked any long term effects on the land.

Attention was brought to the difficulty deciphering FireIce vs. Retardant drops based on color.

Firefighters also conveyed concern over FireIce drying out, and cited a handful of instances where the fire was able to burn under heavy fuels within a short time period after the drop.

*These comments reflect the fact that FireIce is a water enhancing suppressant, not a retardant.
*These comments reflect the fact that appropriate coverage levels are critical in FireIce success.

ATGS EVALUATIONS

The following evaluation sheet was presented to the MN DNR ATGS Cadre.

FIRE ICE EVALUATIONS FROM 2015 MN SPRING FIRE SEASON

Name:
Years of Air Attack Experience:

Circle all products/applicants/wet stuff that you have observed in your career applied to a wildfire by a fixed wing aircraft:
Water Foam Retardant Gel (Fire Ice) Gel (Other Brand)

Circle all aircraft that applied FIRE ICE on wildfires you were supervising in MN in 2015?
Fire Boss SEAT

How many missions did you supervise in MN in the spring of 2015 where FIRE ICE was applied by aircraft?
0 – 5 6 – 10 11 – 15 16 – 20 21+

What stages of the fire was FIRE ICE applied?
IA (chance of containment > 50%) IA (chance of containment < 50%) Extended attack Mop up

What Fuel Models was FIRE ICE applied on and what coverage level did you select? (circle the fuel model, then list CL)
G = Grass: **Light – CL___ Moderate – CL__ Heavy – CL____**
B = Brush **– CL____**
T = Timber: **Hardwoods (leaf off) – CL__ Hardwoods (leaf on) – CL__ Conifer (dense canopy) – CL__ Conifer (broken canopy) – CL__**
S = Slash **– CL____**
O = Other: **Structure protection – CL__ Infrastructure protection – CL____**

What part(s) of the fire did you apply FIRE ICE?
Head Hot flank Cool flank Shoulder Spot Fire Protection of Structure/Infrastructure

What type of fire behavior did you apply FIRE ICE?
Backing Flanking Running Torching Crowning (short runs) Crowning (sustained)

Did you observe a fire successfully burn through a FIRE ICE line in 2015?
YES NO IF YES – Please explain:

Did you observe 'drift' when FIRE ICE was applied?
YES NO IF YES – Please explain:

Was FIRE ICE visible from the ATGS perspective in all fuel types with all coverage levels?
YES NO IF NO – Please explain:

Did you order a 'load and return' mission and specifically ask for FIRE ICE in 2015?
YES NO

How would you rate feedback from ground firefighters regarding the use of FIRE ICE in aircraft?
Generally Positive Generally Negative IF Negative – Please explain:

How would you rate feedback from tanker pilots regarding the use of FIRE ICE in aircraft?
Generally Positive Generally Negative IF Negative – Please explain:

Was the use of FIRE ICE a benefit in helping achieve the objectives of the fire(s)?
YES / NO IF NO, please explain:

Overall, on a scale from 1 to 10, how effective would you rate FIRE ICE?
1 2 3 4 5 6 7 8 9 10

Realizing that multiple factors exist, what do you believe is the most critical element in FIRE ICE being effective?
Fuel types Timeliness of Dispatch # of Aircraft assigned Favorable weather conditions Ground follow-up

Rate the following factors in order of most critical. 1 being most critical, 5 being least critical of available choices.
Fuel types Timeliness of Dispatch # of Aircraft assigned Favorable weather conditions Ground follow-up

Are there improvements the Aviation Program can undertake to make the use of FIRE ICE more effective?
YES NO IF YES – Please explain:

Do you think FIRE ICE should be used in MN in the future?
YES / NO

Comments:_____
_____
_____
_____
_____
_____
_____

PLEASE USE THIS SPACE FOR INPUTS / ADDITIONAL COMMENTS / SUGGESTIONS

ATGS RATINGS

The MN DNR ATGS Cadre is made up of six nationally red-carded ATGSs, and one trainee.

Entering the spring of 2015, they have a collective 100+ years of ATGS experience.

All members have worked with water, foam, retardant, and FireIce gel. In June of 2015, some preliminary testing was also done with a suppressant called Blazetamer.

All members except one, supervised fires in 2015 where FireIce was applied by a SEAT **and** a FIREBOSS. The one member saw only FireBoss drops, not a single SEAT drop.

Nearly 100% of the 65 FireIce drops made in the spring of 2015 were made under the supervision of a MN DNR ATGS.

The majority of missions flown with a FireIce drop were during initial attack, both the chance of containment < 50%, and chance of containment > 50%. Extended attack missions were also encountered, but were a much lessor occurrence. The mop-up phase of the fire could be considered if 'jettisoned loads' are counted. In other words, upon arrival to the fire the FireIce load was not needed to suppress the fire, so it was jettisoned. This could be considered mop-up.

Coverage levels ranging from 1 – SALVO were used in varying fuel types.

FireIce was applied to all parts of the fire (head, hot flank, cool flank, shoulder, spot fire, and protection of structure/infrastructure).

FireIce was applied to all types of fire behavior (backing, flanking, running, torching, crowning-short runs) except 'crowning – sustained.'

ATGSs did observe fire burning through FireIce lines in 2015. Explanations included: heavy fuels, heavy matted fuels, inability to penetrate heavy fuels, fires burning during peak burning conditions, CL 1 and 2 in heavy grass with no ground support, no ground support at all, and thin spots in the line (connecting drop areas). None of these are surprises.

Drifting of FireIce loads occurred. The most common culprit being crosswind drops during breezy conditions, i.e. 25+ knots.

FireIce was visible from the ATGS's perspective in all fuel types with all coverage levels.

FireIce was specifically asked for during some load and return missions. Reasons for this vary, but the range included the MN DNR's interest in 'testing the product,' to aquatic invasive species concerns, to scooping lakes being 'iced up.'

Feedback received from ground firefighters regarding the use of FireIce was generally positive.

Feedback from tanker pilots regarding the use of FireIce was generally positive.

In all cases, the cadre felt that FireIce was a benefit in helping achieve the objectives of the fire.

Overall, the ATGS Cadre rated the effectiveness of FireIce at an average of **7.9**. 7 being the low score, 8.5 the high.

Opinions were split regarding the most critical element in FireIce effectiveness. Three ATGSs said **ground follow up** is most critical, three ATGSs said **timeliness of dispatch** is most critical, and one ATGS said **favorable weather conditions** is the most critical consideration.

Author's note: It is common knowledge that ATGSs can be highly independent and opinionated. For these reasons the 'most critical element' question only allowed the choice of 5 options. In fairness to the cadre, and to represent reality, dozens of elements exist in the success of a product or the success of a suppression operation.

When rating (1 through 5) the most critical elements in FireIce effectiveness, none of the ATGS evaluations were the same. In fact, most were considerably different. **See the first sentence of the author's note.* It would be an assumption to draw any tangible conclusions from this question.

The cadre does believe that improvements can be made within the aviation program to make FireIce more effective.

<u>Some of the considerations that were mentioned:</u>
-Confirm environmentally benign status to enable use of FireIce within 300 feet of riparian areas
-Load FireIce off the vendor trailer at KBJI (decision was made not to use trailer by ATBM)
-More tankerbase pits – 'several times FireBoss left empty due to lack of maneuvering space'
-Encourage/require Kevin Vondran's gate on all SEATs and FIREBOSSs
-Keep using product to increase awareness and improvement
-Continue to train ground firefighters about the importance of dispatching air resources early

The entire cadre believes FireIce should be used in MN in the future.

*ATGS ratings/comments include actual missions, and additional de-brief information collected after the fire was controlled. De-briefs involve pilots, the ATGS, and the IC and/or Operations person familiar with the ground firefighting effort and 'how things went' during the operation.

*The effectiveness of FireIce was discussed at great length during most of the de-briefs.

ATGS COMMENTS

- Blazetamer appears to offer advantages that FireIce cannot, further testing with Blazetamer should be considered, especially if the Fireboss injection system is used.

- I did not see a big difference in the effect of FireIce over Retardant as a suppressant. The big issues are environmental, storage, mixing and portability of FireIce. I was never able to lay down a load of FireIce and then drop retardant or water in the exact same fuel type. So to honestly say FireIce is the best would be stretching it. I do like the strong color of FireIce over the poor retardant that we have had in the past. I do believe we would see a very noticeable difference in effectiveness of FireIce if we could get a CL 8 in timber fuel types. As far as drift, I would not rate it better or worse than other products out there.

- FireIce is a product that seems to work well with our tactics and techniques. The coloring is great, making it highly visible. One improvement that could be made is to get the 300' water restriction reduced or removed, if as the testing indicates, it does not pose an environmental threat. It seems to be a much better fit for our Fireboss/SEAT program than LC retardant.

- From the application side of the product, it has great visibility, seems to be very effective although most of the fires I worked were in lighter fuels and cooler temperatures during the early and midway portions of the spring fire season. It did not get thoroughly tested in the later, generally warmer time of May-early June in the heavier conifer stands.

  I found it to be most effective in light fuels when the drop fell partially on the flame front with the rest out in front of the flame (kind of like one third on and two thirds off).

  In heavier canopy (jackpine in a young pole size) at CL 3-4 I heard ground reports of not much penetration although it held long enough for us to apply water to allow for full knockdown.

  We saw that a dispatch in the very early phase of a fire is critical for overall success, but the factors that govern the effectiveness of the FireIce product would be immediate ground support in all situations, and certainly favorable weather (wind speed and RH) and fuel type/density would make a huge difference in an individual FireIce drop.

  I like the product. After the Blazetamer demo I am pretty interested in seeing the effectiveness of that product due to my observations on how well the drop held together and how it coated the fuels. At this time we are looking to replace foam as Blazetamer does not dye their product so not sure if we would want to replace the FireIce with Blazetamer for use in the SEATs.

- The only thing that kind of bugged me this year was the # of jettisoned loads. That is part of the 'order early' change being made. It's cheaper than jettisoning a load of LC.

- Impressed in grass, brush, and broken canopy timber. I support the continued use of FireIce as the 1st load out in SEATs/FireBosses. Best applied 1/3 on 2/3 off. Prefer Kevin V's gate.

EXAMPLES OF A DE-BRIEF (the names have been changed to protect the innocent)

AVIATION OPERATIONS DEBRIEFIING

DATE OF REPORT: 04/28/2015 FIRE NAME: Red Lake #372
DATE OF MISSION: 04/27/2015 FIRE NUMBER: Same as fire name
MISSION LOCATION: West of Lower Red Lake AGENCY: Red Lake BIA
ATGS: Turnin' Circles ATGS HOURS FLOWN: 1.22
Tactical Operations: IC John Doe x Adequate Needs Improvement

Comments: 3BH, engines and 2 tracked machines working the fire when ATK5, 851, and 801 arrived. Red Lake River was checking fire spread at the head, but barely. Helicopter provided sizeup at 1 acre, before he lifted for bucket ops it was 7-10. Fuel driven fire, impressive fire behavior. 40 foot flame lengths reported by ground folks, < 6 mph of sustained wind.

Aircraft Assigned: **3BH, T-801, T-851**

1) Dispatch Information: x Adequate Needs Improvement
Comments: Red Lake 50 requested fixed wing resources, good call on their part. Order was done in a timely fashion, spread potential was 10+ miles of grass. Red Lake 19 provided priorities and ground resource location.

2) Approach / Air – Air Briefing: x Adequate Needs Improvement
Comments: 3BH and Agassiz 1 were in the airspace, both came up on 122.925 immediately. 3BH needed fuel upon ATK5 arrival, and Agassiz 1 departed the airspace to the NW.

3) Target Description: x Adequate Needs Improvement
Comments: Long and hot right flank that occasionally became a head fire with wind switch. Tanker drops were effective and critical to support helicopter and tracked vehicles.

4) Communication: Radio Frequency: x Adequate Needs Improvement
Air-Air Communication: x Adequate Needs Improvement
Air-Ground Communication: x Adequate Needs Improvement
Comments: No issues.

5) Airspace De-confliction: x Adequate Needs Improvement
Comments: No issues.

6) Safety Issues: No issues.

7) Additional Comments: CL 2 was used in heavy grass loading with oak patches in front of tracked machines. Ground resources reported that fire was trying to creep/burn underneath FireIce. Had tracked machines not been close, CL 3 would have been used.

SUMMARY

For this report, it is notable to review the following realities regarding FireIce's evaluation.

-Testing done in 2014 by the MN DNR. See 'Minnesota DNR FireIce Field Operational Evaluation 2014.'

Description: Aviation staff became familiar with FireIce. Mixing, loading, storage, etc… which are critical in the success of a tanker program. Aviation staff recognized the need for more intensive training and identified what hardware/gear/tanks/other stuff/other staff were needed to support the use of FireIce across the state at all base locations.

This was a benefit to the effectiveness of FireIce in 2015.

-Training provided to ground firefighters from multiple agencies regarding FireIce and SEAT use.

Description: Firefighters were provided an overview of the new fleet of aircraft that would be available, and a basic introduction to FireIce, simply 'what is it, how it will be used.'

This was a benefit to the effectiveness of FireIce in 2015.

-Training provided to ground firefighters from multiple agencies regarding dispatching of air resources 'early' during the initial attack phase of wildfires.

Description: Helped re-familiarize firefighters about the importance of using aircraft to prevent problems, not solve them. This was critical in 2015 because the fleet of aircraft had changed, and any previous use of FireIce in MN had been limited and its effectiveness was largely an unknown.

This was a benefit to the effectiveness of FireIce in 2015.

-Fuel conditions entering the spring 2015 wildfire season.

Description: All fuels became available to burn very early on. No benefit was provided by 'wet' fuels in wooded fuel types, which is more common in a 'normal spring.' Also, 1 hour grass fuels were ***generally*** in the upright position. These conditions provided excellent testing.

This was a benefit to the effectiveness of FireIce in 2015.

*Remember to consider however, that you read comments by ground firefighters about FireIce drops being 'burned under' when fuels were heavy. Comments from ATGSs also drew attention to fires burning under FireIce drops in 'matted' grasses.

-Snow and ice conditions entering the spring 2015 wildfire season.

Description: Snowfall was non-existent by early March, however, ice cover remained. This prevented scooping operation support until early April in southern MN. Central and northern MN were negatively affected by ice until the third week of April.

This was not a benefit to the effectiveness of FireIce in 2015 (considering how drops are supported). No scooping water = load-return tankerbase = longer turnaround times.

-Weather conditions experienced during the spring 2015 wildfire season.

Description: Although March, April, and the first week of May provided ample opportunity to test FireIce effectiveness, the chance to test FireIce in closed canopy situations on 'hot' days (most common in May and early June) did not occur on more than a handful of missions. May rains put an end to the spring fire season.

This was a benefit to the effectiveness of FireIce in 2015.

*However, it is common sentiment supported by ground firefighters and ATGSs that a closed canopy situation on a hot day is a critical scenario needed to fully evaluate FireIce effectiveness.

FINAL EVALUATION NUMBERS

EFFECTIVENESS

Ground Firefighters: Overall = **7.8** out of 10, When applied by Aircraft = **8.2** out of 10.
ATGSs: Overall = **7.9** out of 10.

DID IT HELP ACHIEVE THE OBJECTIVES OF THE FIRE?

Ground Firefighters: **95%** of the time
ATGSs: **100%** of the time

SHOULD IT BE USED IN MN IN THE FUTURE?

Ground firefighters: **95%** believe so
ATGSs: **100%** believe so

The Upshot:

The MN DNR's testing of FireIce was quite elaborate. The spring fire season of 2015 provided an excellent opportunity to use the product in multiple fuel types, weather conditions, all stages of a wildfire, and varying types of fire behavior.

As with any product, continued testing allows for fine tuning, and to work through newly encountered situations and problems.

The MN DNR intends to continue the use of FireIce, and also to test other suppression products to find the best fit for MN suppression operations.

This report was written and the information complied by:
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07/09/15

PHOTOS/VIDEOS

LEFSA PLANT FIRE

4/15/15

FIRE BOSS

GRASS: FM 3

CL 2

Fire burned through and around FireIce.

No ground support for ½ hour.

ATGS @ 2500 MSL

Photo: Ernie Schmitt

RED LAKE 372

4/27/15

Working left to right in frame:

FIRE BOSS drop started in timber: FM 10.

SEAT drop extended into grass: FM 3.

CL 2

CLOSE GROUND RESOURCES

Fire burned into, but not through drops

ATGS @ 3000 MSL

Photo: Dan Carroll

QUEENS FIRE

4/13/15

FIRE BOSS and SEAT

Drops supported by scooping operation

Open canopy hardwoods w/ heavy surface fuels: FM 9

CL 4

Fire did not chew through drops

ATGS @ 3000 MSL

Photo: Dan Carroll

ROOSEVELT FIRE

4/28/15

FIRE BOSS and SEAT

Blowdown: FM 10, with Balsam Fir understory

CL SALVO

Fire did not chew through drops

ATGS @ 3000 MSL

Photo: Dan Carroll

PALSBURG FIRE

4/15/15

Furthest left drop is retardant from P2V

Drops (2) nearest black are SEAT drops w/ FireIce

Slash: FM 12. Dense Pine: FM 4

CL 4 (knocked fire out of crown back to surface)

Drops did not reach surface fuels

ATGS @ 2500 MSL

Photo: Dan Carroll

WHITE OAK FIRE

3/28/15

FIRE BOSS and SEAT

Grass: FM 3, and Slash: FM 12.

CL?

ATGS @ 2500 MSL

Photo: Jody Leidholm

LUCKY 13 FIRE

04/17/15

FIRE BOSS and SEAT

Young dense Pine: FM 4.

CL 3

Fire jumped over line at the head.

ATGS @ 2500 MSL

Photos: Ernie Schmitt

RED LAKE 334

4/18/15

SEAT

GRASS and BRUSH: FM 3

CL 2 (split load)

Late in the day

Fire did not chew through drops

ATGS @ 2500 MSL

Photo: Dan Carroll

RIVER FIRE

05/02/15

SEATS (FireIce) and P2V (Retardant)

SLASH and SURFACE PEAT: FM 10

CL 4

Fire chewed under drops that evening but were contained by dozer line.

ATGS @ 2500 MSL

Photo and Videos – Dan Carroll

http://youtu.be/UnvQ7h9GfLA (CL 4)

http://youtu.be/gg0CHkGsgbA (CL 3)

Other Videos:
http://youtu.be/SSYBCdeuYWg (CL 3)

Mixing and Loading

FireIce Mixing and Loading Issues and Solutions

2015

1.) When educting FireIce into the water column the pump must be operating at full throttle.

2.) A maximum of (1) 90 degree elbow before the FireIce Eductor is acceptable, any more than that and the FireIce won't siphon up the pickup tube properly.

3.) Be sure to only open the pickup tube valve when the pump is running at full throttle and the same goes when shutting off the valve, the pump must be at full throttle. If you don't water will get in the pickup tube which will result in a plug.

4.) When plumbing the system into the mix tank hands down the best way to do it is going into the side of the mix tank at the top of the tank directly after the FireIce eductor. Try to use the least amount of hose possible to make this connection.

5.) The fitting at the top of the tank should include a 45 or 20 degree elbow on the inside of the tank pointing along the tank edge or down into the tank.

6.) One possible fix to poor siphon is a smaller cone in the FireIce eductor.

7.) A pump in good condition is needed to generate maximum flow past the FireIce eductor.

8.) Dust masks and eye protection should be worn when mixing.

9.) Mixing in high winds is an issue that doesn't have an answer. Try keeping the pail covered as much as possible to keep the product from blowing around.

10.) Roll pails around on their sides, top and bottom to loosen the FireIce before educting.