

CLUBHOUSE FIRE – FIREFIGHTER ENTRAPMENT & BURNOVER



CHEYENNE RIVER SIOUX INDIAN RESERVATION EAGLE BUTTE, SOUTH DAKOTA GREAT PLAINS REGION – BUREAU OF INDIAN AFFAIRS



AUGUST 30, 2006

Clubhouse Fire Investigation Team

A handwritten signature in dark ink, reading "James H. Steele". The signature is written in a cursive style with a large, looping initial "J".

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Executive Summary

On July 6, 2006 four firefighters were involved in an entrapment and burnover while attempting a frontal assault and backfire operation on the Clubhouse Fire, CRA-118-2006 on the Cheyenne River Agency. A two-vehicle accident occurred after the entrapment involving two of the four firefighters involved in the entrapment. All four firefighters are Bureau of Indian Affairs (BIA) employees from Cheyenne River Agency.

The Clubhouse Fire was reported to the Agency Fire Office at 1230 hours MST, Thursday, July 6th. The reported fire was burning in a wheat field about three miles northeast of Eagle Butte, SD. It was later determined that the fire was ignited by an overheated bearing on a combine harvester working near the south end of the wheat field.

When the call came in, four firefighters responded; the Incident Commander (IC) in an Agency IC Pickup Truck, Firefighter #1 (Engine Boss) with Firefighter #2 (Engine Operator) in E-001 a Type 6 300-gallon engine, and Firefighter #3, (ICT4 qualified Engine Boss) in a 1000-gallon Water Tender.

Environmental conditions were extreme at the time of the fire. According to weather data retrieved from local stations through the National Weather Service Office in Aberdeen, SD, the air temperature was about 90° F, relative humidity about 23%, eye level wind speeds of 25-35 mph with gusts to 40 mph, and fuel moisture was estimated at less than 5% for the 1 Hour Time Lag class, and 12% for the 1000 Hour Time Lag class.

On arrival at the fire, their size-up and initial attack strategy and tactic considered two backfire locations resulting in attempting a backfire on a third location. The first two locations could not be attempted because of rapid-fire spread; the third location caught the firefighters in a relatively narrow, flat, and confined creek bed where they were overrun by the extreme forward spread rate of the fire. All three vehicles were driven through the flaming front to get into the black.

The IC sustained second degree burns to both his ears, his nose, left elbow, and left side of his face. He also sustained substantial smoke inhalation, but no thermal inhalation. He was taken by private vehicle to the local Indian Health Service Hospital for treatment and released the same day.

Damage to the IC Truck was extensive with paint bubbling and melting of plastic molding outside and inside the cab. E-001 and Water Tender suffered no damage.

The IC left the fire, however the other three remained to continue suppression efforts along with supplemental resources that had arrived by that time. By 1400

hours that same day, another fire was reported and all Bureau suppression resources responded and suppressed that fire as well.

The entrapment and burnover was not immediately reported which delayed the investigation process until Great Plains Regional staff heard of it and inquired regarding the validity of the report. Subsequently, Cheyenne River Agency Superintendent requested an independent review of this incident of the Great Plains Regional Office. Based on the facts BIA at NIFC initiated a formal Serious Accident Investigation.

INVESTIGATION AND REPORTING PROCESS

On Sunday, July 9, 2006 Great Plains Regional Office (GPRO) Fire Staff heard rumor of a Cheyenne River Agency firefighter being burned while fighting a local fire. The Regional Assistant Fire Management Officer (RAFMO) and Regional Fuels Specialist (RFS) contacted the Agency FMO and Fuels Specialist to verify the rumor and found out that the incident did occur and that burns were sustained by one firefighter. There was also damage to one firefighting vehicle. The RAFMO and RFS recommended to the RFMO and Natural Resources Division Chief the situation be reviewed. The RFMO called the BIA Safety Officer at the National Interagency Fire Center (NIFC) and relayed what was known of the incident. BIA Safety Officer recommended an independent review.

Additional calls were made to the Agency on Monday, July 10 to verify the incident and discuss the regional recommendation for an independent review. Later that day, GPRO Natural Resource Division Chief received a written request from Cheyenne River Agency Superintendent to conduct an independent review of an incident that occurred during the Club House Fire on July 6, 2006. The request also asked for a Regional fire staff member to conduct the review with emphasis on identifying possible alternative actions for future fires of this nature. The Regional Fuels Specialist was tasked to complete an independent review of the incident, which began on Wednesday, July 12, 2006.

The RFS began the investigation by requesting specific documentation from the Agency regarding personnel and supporting documents such as hospital reports, witness statements, IQCS qualifications, copies of qualifications cards, fire report, dispatch logs, and maps. On Wednesday, July 12, 2006 the RFS met with and interviewed the firefighters, conducted a site visit, and photographed the fire area.

Fire activity increased dramatically in the BIA Great Plains Region from July 14 – 29, 2006 and the fire review was put on hold to assist Agencies with suppression efforts. When the Region's fire activity slowed down near the end of July, the review continued. Based on the facts presented, the BIA-NIFC initiated a formal investigation process.

The Bureau of Indian Affairs (BIA) through the BIA-National Interagency Fire Center, Boise, Idaho initiated the Serious Accident Investigation Team (SAIT) for the Clubhouse Fire, Cheyenne River Indian Reservation. The SAIT was formed the afternoon of August 2, 2006 at the Great Plains Regional Office, Aberdeen, South Dakota. They received their delegation of authority from the Regional Director and then traveled to Eagle Butte, South Dakota this same day.

Three Agency engines were trapped and burned over while doing initial attack at the head of a fast moving wildfire. One firefighter suffered first and second degree burns to his face, nose, ears, and elbow, and received immediate care at a local hospital and was released that same day.

The BIA Regional Fuels Specialist participated as Operations Specialist on the SAIT and also spent several days gathering data and interviews prior to the SAIT arrival.

The procedures outlined in 485 DM, chapter Seven, Incident/ Accident Reporting/Serious Accident Investigations was followed to complete this report.

During the evening of August 2, 2006 the SAIT visited the fire site and reviewed firefighter statements, and reviewed the fire area where the entrapment and burnover occurred.

Due to the time lapse between reporting the accident and forming a SAIT there will not be a 24 hour or 72 hour report. The final Clubhouse Fire Entrapment Report will be completed in 45 days.

The SAIT prepared a draft report and briefed the Agency Superintendent and Land Operations Officer the morning of August 4, 2006. The Deputy Regional Director Indian Services was briefed later that afternoon. BIA-NIFC Operations was briefed the morning of August 7, 2006 via telephone.

FINDINGS AND RECOMMENDATIONS

CHRONOLOGY

Chronology – July 6, 2006

Clubhouse Fire #118 – Cheyenne River Indian Reservation – Cheyenne River Agency

Chronology of events for the Clubhouse Fire #118 on July 6, 2006	
Time	Action
Mid May 2006	Indicators of drought conditions becoming evident; lack of seasonal precipitation, declining water levels, lack of green-up for this period.
Late May, 2006	Discussion of severity request amongst Standing Rock and Cheyenne River Agencies, US Forest Service and Great Plains Region. Severity request includes Standing Rock Agency justifying a SEAT aircraft.
June 28, 2006	Discussion between Cheyenne River Fuels Specialist and BIA Regional Office regarding need for severity resources.
July 3, 2006	SEAT aircraft located at Lemmon, SD approximately 70 miles from Cheyenne River Agency, Eagle Butte, South Dakota.
June 27 – July 5, 2006	Cheyenne River Agency responds to fires caused by fireworks and lightning. Normal annual fire load is 100 fires per year; by July 5 th they have recorded 117 fires. Work rest ratios and days off policy are both ignored due to fire load and short staffing.
July 5, 2006	6 fires occur beginning at 2200 hrs, all started by fireworks. Last firefighters to demob from these fires arrive in Eagle Butte between 0330 – 0400 hr. They sign out and return to duty July 6 th at 1200 hrs.
July 6, 2006 1230 hr	Firefighters arrive at fire hall and prepare for the day. Some on initial attack and others to return to previous night fires to assist with mop-up.
1233 hr	Clubhouse Fire is reported to firefighters.
1235 hr	The IC responds in the IC Vehicle as ICT4; Firefighter #1 and Firefighter #2 respond in E-001; Firefighter #3 responds in 1000-gallon water tender (WT).
Time frames from this point are speculative based on estimates by firefighters.	
1240-1243 hr	The IC arrives and positions himself near the heel of the fire and sees a combine in the wheat field. E-001 with Firefighter #1 arrives second and proceeds to east flank to cut fence and move cows out of pasture. Firefighter #3 arrives and positions at a gate on a two-track road running north and paralleling the fire's west flank.
~1245 hr	Firefighter #3 calls the IC to come to the west and the two-track road. Firefighter #3 also talks to E-001 to come over as well. ICT4 and WT proceed north to end of wheat field to use a wet line and burnout to halt the head fire. E-001 leaves the east flank, notices the combine is continuing to harvest wheat from the heel of the fire, north, along the west flank. Combine operator had the fire mostly out at the heel.
~1249 hr	WT and ICT4 arrive at end of wheat field and decide they do not have time to create wet line and backfire. As they start further north, E-001 arrives and joins the plan.
~1251 hr	All three vehicles arrive at a location where they intended to construct wet line and backfire. This would be connected to E-Brueschke Dam. They decide the fire is traveling too fast; they abandon this site and proceed north to find another.

TIME	ACTION
~1255 hr	All three vehicles leave the two-track road and descend the gentle ridge they were on to reach a flat area next to a dry creek bed. Vegetation was green enough to suggest they could anchor their burn line and backfire going west.
~1257 hr	E-001 begins wet line, IC prepares to ignite backfire line, and WT starts pump and engages the driver side spray nozzle. While swinging into position for the wet line, Firefighter #3 notices the fire front on the closest ridgeline, about 100 yards away.
~1258 hr	Firefighter #3 notifies everyone they need to abandon their positions.
~1302 hr	E-001 ENGB notifies his nozzle operator (Firefighter #2) to get in the truck. Firefighter #2 drops hose line, and dives through the passenger side window and crawls into the seat, closing the window behind him. WT moves to the west, and the IC goes to his vehicle and drives southwest looking for an escape route.
~1303 hr	E-001 drives north to escape, concludes they are trapped, determines they cannot outrun the fire front, turns around, heads south and drives directly through the least of the fire front they could find, noticed flame lengths were 12-20 feet long at points along the front. WT now just west of the passing fire front picks a low spot in the leading edge of the west flank and drives through it into the black. The IC in his pickup stops at the edge of the bank, backs up, turns southwest and heads for the west flank.
~1304 hr	E-001 passes through the fire into the black while dragging their hardline, and continues southeast at the base of the short ridge to get out. Runs into the dry creek bed, backs up, turns south, goes up slope onto the ridge, drives a little ways west and stops in heavy smoke to let the air clear. WT drives through the flank fire, and gains the ridge top, turns west and slowly proceeds until seeing the fence. He drives through a low spot in the fence to exit the fire area. The IC cannot see anything due to smoke and heat. His driver window is down as he drives into an embankment and stalls the truck.
~1305 hr	Fire reaches the pickup and blows hot air and embers into the interior. The IC shields his face and starts the truck engine after looking at his shelter on the pickup seat and deciding he can not outrun the fire by exiting the passenger side door. While smothering fire inside the cab, he backs up the truck, turns south, drives through the remaining head of the fire and slowly drives up on top of the ridge staying in the black. E-001 cannot see anything, their cab full of smoke decides to stop and wait for smoke to clear. As the IC breaks onto the ridge he is sighted by WT.
~1307 hr	The IC hears radio talk between E-001 and WT, but cannot talk due to effects of extreme heat and burns.
~1308 hr	The IC driving very slowly accidentally nudges his vehicle into E-001.
~1309 hr	E-001 is notified by the IC he has been burned. He is taken out of the fire area and transferred by POV to the Indian Health Service Hospital in Eagle Butte.
~1309 – 1600	The next events take place without time estimates from firefighters.
	Additional firefighters respond to the fire area. Water Tender takes hardline off reel and outfits E-001 replacing burned hose. Water Tender returns to the heel of the fire and stages at the gate for the two-track road, E-001 continues on fighting fire by crossing through the fire to the east flank and begins flanking fire going south.

TIME	ACTION
~1300 hr	Firefighter #4 is responding to the fire when he calls the cell phone of one of the engines. He reaches the IC, and is informed that he is burned and to call an ambulance. Firefighter #4 calls Tribal Police and orders an ambulance. He then responds to fire after picking up tools at fire cache.
	Firefighter #4 reaches fire on the east flank and continues north through the wheat field. Reaches the fence and cuts it for others. He meets E-001 and they both proceed to meet WT on the west side, where they meet two more firefighters, #5 and #6.
	Here Firefighter #4 changes vehicles and drives a Type 6 engine with Firefighter #5. Firefighter #3 leaves the WT and gets into a pickup with a slip-on tank and Firefighter #6. With E-001 they all cross the fire area to the eastside, find open fireline and begin a tandem mobile attack going north. The lead engine is on the fuel side, and nozzle operator is one-foot-in-the-black due to fireline intensity.
	Fire is pushed out from behind engines and out flanks them. All engines circle back into the black. Firefighter #5 drops hose and walks into the black, gets disoriented and circles back to the fireline south of current location. He ties in with Rural Fire Department (RFD) and they radio his engine to report his location. Firefighter #5 did not have a radio.
1330-1400 hr	Fire again out flanks their position, engines circle back into the black, Firefighter #5 walks up and climbs onto driver side running board. Driver grabs his arm and holds him while putting vehicle into reverse. Entering the black without visibility due to smoke, this engine (E-002) backs into E-001 with Firefighter #1 and Firefighter #2. Engine sustains substantial damage to right front quarter panel.
~1600 hr	Firefight continues using motorized equipment and SEAT aircraft along with RFD engines. About 1600-1630 hrs they receive a call of another fire located 60 miles away. Since Clubhouse Fire is contained, they turn it over to RFD and continue to the Four Bear Fire, which they contain at 2,093 acres.
July 10, 2006	Great Plains Regional Office learns of the entrapment and burnover. Cheyenne River Agency requests and independent review.
July 11, 2006	Great Plains Regional Office initiates an investigation.
Mid – July	Fire activity within the Great Plains Region intensifies and all personnel are committed. 3 engines are ordered to assist CRA on severity.
August 1, 2006	Investigation Team ordered by BIA – National Interagency Fire Center.

**Clubhouse Fire #118
Cheyenne River Indian Reservation
Wildland Fire Entrapment and Burnover
Serious Accident Report**

During the period of mid to late May 2006, the Cheyenne River Agency (CRA) Fuels Management Specialist began collecting wildland fuels samples and corresponding with the Great Plains Regional Fuels Specialist regarding fuel moistures and general signs of drought. Discussions with the National Weather Service revealed the South Dakota Rangeland Fire Index was indicating drought effects consistent with lack of precipitation and suppressed green-up of vegetation that normally occurs this time of year. By late May, talk of severity assistance between Standing Rock Indian Reservation and the US Forest Service, Little Missouri National Grasslands included Cheyenne River to help justify funding a Single Engine Air Tanker (SEAT) in Lemmon, SD. This was funded, as was a SEAT for Pine Ridge Indian Reservation. SEAT bases were established in Lemmon and Pine Ridge (BIA funded), and Mobridge, Pierre, and Custer (South Dakota State funded) by early July.

The drought and approaching 4th of July celebration with fireworks prompted the Cheyenne River Fuels Management Specialist to begin serious discussions with the Great Plains Regional Office about additional resources. By June 22nd, fires began and continued through July. Many days were multiple fire days and Agency staff pursued fire suppression as needed, often overlooking 2:1 work rest ratio and days off. By the 4th of July fires from fireworks were common and Tribal Law Enforcement was actively engaged to deter fireworks use.

Cheyenne River Indian Reservation encompasses more than 2.7 million acres within the exterior boundaries; of this, approximately 1.4 million acres is Trust property and 1.3 million acres is fee lands. Intermingled ownership creates a widespread mutual aid system, which the BIA shares with twelve rural fire districts. Each fire district responds as fires occur regardless of land ownership. The 2003 Fire Management Planning Analysis (FMPA) calculated CRA could be adequately covered using 3-Type 6 engines for an average fire load of 100 fires. The current preparedness budget funds 2-Type 6 Engines and CRA has supplemented with two slip-on units for the 2006 fire season. By July 6th, CRA logged in 116 fires and their August through October fire season had not yet begun. By July 6th the CRA fire crew had initial attacked 67 fires since June 27th. Most had been kept to Class A, B, or C size, nearly all occurring in grass.

On July 5th CRA responded to six fires, all started by fireworks, beginning at 2200 hours. The largest fire was the Bobcat Fire for 12 acres. Firefighters returned to Eagle Butte between 0300 – 0400 hours on July 6th. They went home and reported to the fire station by 1200-1230 hours.

Normal operating procedure at CRA is to conduct a morning briefing where weather and fire information is discussed. On the morning of July 6th the CRA Fuels Management Specialist, who normally conducts the briefings, checked the crew accountability board at the CRA fire station and determined that the crew was going to report late that morning since they'd been out on fires until 4 a.m. He took this opportunity to conduct other fire program business in Pierre, SD, which is 90 miles southeast of Eagle Butte. The National Weather Service issued a Red Flag Warning for July 6th due to low humidity and high winds up to 40 miles per hour. The fuels management specialist was aware of the red flag warning and notified the fire crew by calling them at the fire station when they came on duty late that morning.

Regular shifted firefighters broke for lunch and those coming in readied for the operational period. At 1233 hours they received a telephone call via the mutual aid fire-notification phone line at the fire station. The call reported a fire in a wheat field about 3 miles northeast of Eagle Butte. Responding was The IC, in a pickup designated as the Incident Commander Vehicle, Engine- 001 with Engine Boss Firefighter #1 (ENGB) and firefighter Firefighter #2 and a 1000-gallon water tender (WT) operated by Firefighter #3 (ENGB). The IC reached the fire area first and positioned himself near the heel of the fire while ordering additional suppression resources. He noticed the combine still harvesting wheat and the fire was producing 20 feet flame lengths. Arriving next was E-001, which drove to the east flank. Here Firefighter #1 drove to the fence line and cut it, then he and Firefighter #2 chased cows from the pasture next to the wheat field. Next to arrive was the WT. Firefighter #3 drove the WT toward the west flank and opened a gate to gain entrance to a two-track road that paralleled the wheat field.

The initial attack team saw the combine continuing to be operated, cutting the wheat. Firefighter #3 called the IC and told him of the two-track road and access down the west flank. The IC drove over to that position while Firefighter #3 radioed E-001 for them to come over to the west flank also. While E-001 passed by the combine, Firefighter #1 noticed the operator had harvested the heel of the fire and was working up the west flank. He also noticed the fire was controlled at the heel of the main fire. At this time, the IC and the WT are now driving north on the two-track road past the head of the fire where they plan to put down a wet line and backfire ahead of the fire. Their plan was to stop it as the fire entered the grass at the end of the wheat field.

Interviews with all firefighters described this practice as normal for these conditions. Wet line is anchored; they burn against it on the fireside then patrol it out from the anchor point. As they burn it, they leave their position ahead of the fire along the backfire line. If trouble develops they have access to the black they have created, and if successful it catches the head of the fire and they can patrol it back in for spots. When that is complete they begin flanking the fire back towards the heel using the black for safety. Interview statements were consistent that this fire was no different than any other, with the exception of the strong south wind.

Interview questions asking why anchoring at the heel and flanking using an inside-out tactic, or mobile tandem attack from the fireside was not used were answered by referring the interviewers to past lessons the fire crew has learned under similar circumstances. The structure of cured unharvested wheat produces very high intensities that do not allow firefighters to get close enough to put water on the active front. The next reason describes a problem related to mobile attack from the fuel side, or an outside-in attack. Here the attack vehicle drives in the unburned, unharvested wheat, plowing it down as the firefighter operating the nozzle walks with one-foot-in-the-black. Wheat chaff collects in the truck motor, and eventually stalls the truck. CRA lost a vehicle to a wheat field fire in 2003 because of this.

There were interview questions why the tactical plan was not talked about and briefed. Firefighters answered that when you fight fire together as long as they have, you know what is going to happen, and depending on what order you arrive at the fire, you know what your job is. None of them felt lacking for information and were “game for it”, as was expressed by one of the crew.

As the IC and the WT reached the fence line defining the north end of the wheat field, they realized the head of the fire was too close and they would not have enough time to establish the wet line. When E-001 arrived they all agreed the E. Brueske Dam would be the next logical location for the backfire. They drove the two-track north to the dam but agreed the fire was moving too fast to allow them enough time to lay a wet line and backfire. Here they agreed to move further north and scout the terrain for a backfire opportunity.

All three drove north beyond where the two-track road turned west and descended a small ridge onto a flat that was bordered by a dry creek bed. The green vegetation in the creek bed suggested it might be a good anchor point for the wet line. Firefighter #4 got out of his pickup and prepared the drip torch for the ignition. Firefighter #2, the nozzle-man on E-001, moved the IC-truck a little to the west to get it out of the way, then returned to E-001 and began operating the nozzle to start the wet line. Firefighter #3 started the pump on the tender, engaged the spray nozzle on the driver side, and swung an arc to the north and east in behind E-001 to take over the wet line. As he came into position he looked due south and saw the head of the fire cresting the small ridge they had

just descended. He radioed everyone to abandon the line and get out of the area quickly. He then proceeded west to the base of the ridge, and turned southwest toward the west flank of the oncoming fire. He watched as the head of the fire passed his location, picked a spot in the flank and drove his truck through it into the black. He then ascended a gentle slope to the top of the ridge, turned west and drove through a low spot in an adjacent barbed wire fence into the unburned area along the west flank.

Firefighter #1 hollered to Firefighter #2 to get in the engine, who then dropped the hose and dove in through the passenger side window and pulled himself into the cab, closing the window behind him. Firefighter #4 ran to his IC-truck and drove west looking for a way to escape.

As the head of the fire approached, Firefighter #1 drove E-001 northwest to the edge of the creek bank, noticed a steep embankment and a sinkhole and decided he would get stuck if he attempted a north/northwesterly escape. He then backed up, turned south and picked a spot where he and Firefighter #2 both felt the flame lengths and intensity were the least. With the head-wall of flames only 10-20 feet in front of the truck, Firefighter #1 drove through the flaming front at a place where the flame lengths were about nine feet long, into the black. He traveled approximately 300 feet before the loose hard-line, previously discarded by Firefighter #2, burned off his truck. Because vision was obscured by dense smoke both inside and outside the E-001 cab, Firefighter #1 drove slowly southeast along the base of the ridge until he could see he was going to run into the creek bed that the backfire attempt was anchored to. He then backed up, turned south, ascended the ridge further into the black to the flat on top of the ridge, drove west along the ridge top and parked in the black on top of the ridge to wait for the smoke to clear out.

While Firefighter #1 and Firefighter #2 were finding their way out, Firefighter #4 drove his IC-truck through dense smoke directly in front of the fire looking for an escape route. With poor visibility, he ran his truck into an embankment along a spur drainage on the west side of the fire, stalling the truck. This was shortly after Firefighter #3 had driven the WT through the west flank into the black. The head of the fire was on top of Firefighter #4's IC-truck before he could get it restarted. His driver-side window was down and the driver's side was going to take a direct hit from the oncoming fire front. He tried to get the window up but it would not respond. He felt heat and embers from the fire entering the cab, so he jumped to the passenger side and thought about leaving the vehicle and running. He noticed his fire shelter on the seat beside him, but decided he didn't have enough time to deploy the shelter or run. He knew he would never be able to out run the fire. He took a deep breath, held it, jumped back into the driver's seat and raised his arm to shield his face as he tried to restart the truck. The truck started, so he put it in reverse and backed away from the embankment. Intense heat and embers entered the cab burning his face, ears, nose, and elbow where his arm was crooked to shield his face. He then drove up the slope through the rest of

the fire front and reached the top of the same short ridge that E-001 had parked on moments before. As Firefighter #3 turned the WT to face the fire, he saw the IC-truck top the ridge and turn southwest moving deeper into the black.

At this time Firefighter #1 and Firefighter #2 in E-001, which was still parked on top of the ridge, heard Firefighter #3 on the WT radio talking about The IC. Firefighter #4 heard Firefighter #3, but couldn't respond due to the heat, smoke, and injuries he had sustained. Firefighter #4 proceeded slowly southeasterly in his IC-truck, through the dense smoke along the ridge top and bumped into E-001 head on. He backed up, pulled up along side E-001 and told Firefighter #1 and Firefighter #2 that he'd been burned. Firefighter #4 and Firefighter #1 then drove their trucks over to the west side of the fire, tied in with Firefighter #3 and relayed to him that Firefighter #4 had been burned.

Before leaving the fire area, The IC received a call on his cell phone from another CRA firefighter, Firefighter #4, asking Brady what he needed to bring out to the fire. Brady informed Firefighter #2 that he had been burned and told him to order an ambulance. Before Firefighter #2 arrived on the fire, another private pickup truck arrived, driven by Michael Walters. The Tribal Police Chief, Festus Fischer, was riding with Mr. Walters. Brady asked Mr. Walters if he had any burn ointment. After looking for some ointment, Mr. Walters transported Brady to the IHS Hospital in Eagle Butte in his pickup truck. Chief Fischer jumped in another truck with Larry Fiddler, another citizen that had driven out to the fire. Brady was diagnosed at the hospital with first and second degree burns to his face, ears and nose, with smoke inhalation but no thermal inhalation. He was medicated and released the same afternoon.

Firefighter #1 had to remove remnants of his reel line as it was wrapped around the right side dual wheels of E-001. He called the CRA Model 52 Engine Program and requested additional hose be brought out to the fire to repair his reel. After doing that he drove to the WT and got 50 feet of hose to replace his to hold them over until his order arrived. He and Firefighter #2 helped knock down flames along the west flank until they broke a foam line on the pump head. They drove to the southwest side of the fire and met Firefighter #2 Anderson and Elvis Handboy of the Model 52 Engine Program for hose and foam line repair. After the repairs were complete, they continued to suppress the fire going north along the west flank until they reached a point where they could drive across to the east flank of the fire where they began a mobile attack working their way south.

Firefighter #4 drove to the CRA fire cache, loaded a rack of swatters and drove back to the fire. In route he called one of the fire truck cell phone numbers and got The IC. This is when the IC advised Firefighter #2 that he had been burned and to call for an ambulance. Firefighter #2 called the CRA Law Enforcement Department and requested an ambulance go out to the fire because one of the firefighters had been burned. Firefighter #2 then entered the fire on the east flank and continued to the fence at the end of the wheat field where he cut the fence

for others to have access. He met up with E-001 with Firefighter #1 and Firefighter #2 and went back over to the fire's west flank and tied in with the WT. There, Firefighter #2 located another grass truck that had two other firefighters in it. He advised one of the firefighters to drive his truck while he took over the grass truck, E-002, with Firefighter #5. Firefighter #3 also proceeded along the west flank with the WT, but switched out to an Engine with Firefighter #6, another CRA firefighter. Firefighter #7, yet another CRA firefighter, took over the WT. At this point they all crossed through the black to assist on the east side of the fire.

Heavy equipment had contained the west flank and caught the head. A Single Engine Air Tanker had dropped on the Walter Berndt residence ahead of the fire. The fire burned around the ranch with no damage to the residence. The only physical loss from the fire was a round hay bale and some diesel tank support beams.

The ENGBs decided that a tandem direct attack was best along the east flank, so they began operations to tie into the open fireline and begin direct attack going north. The fireline intensity would not allow them to get very close, so they positioned their engines on the fuel side while the nozzle operator walked up the flank with one-foot-in-the-black. Winds that had been shifting all day caused the fire to flare out behind them and extend into the grass to the east. It then made a sweeping arc as the wind shifted again from the south to the southwest. They saw this and turned their engines into the black. Firefighter #5 was outside E-002 running the hose when this happened. He dropped his hose and walked into the black where he was engulfed in smoke. He was separated from the engine group, and walked south swinging back to the east line.

Safe in the black, Firefighter #4 rolled the hose that Firefighter #5 had dropped back onto the engine. He notified the other engines that he had lost Firefighter #5 in the smoke and couldn't find him. Since Firefighter #5 did not have a radio, the other engines used their public address system to give him directions, hoping he could hear them. They also turned on their overhead emergency lights. Firefighter #5 found his way out of the smoke and met a VFD engine at the fence line to the south. He asked the VFD to contact Firefighter #4, relay his position and tell him that he was okay. After rejoining his engine they continued on with the flanking attack along the east flank.

Within a few minutes, another wind shift occurred, this time strong out of the west. This caused another escape south of the engines along the fire's eastern flank. This escape ran to the east, then turned and swung to the north "like a big door opening from the southwest to northeast" when the wind shifted back to the south. Firefighter #3 and Firefighter #1 moved their engines back and, being totally engulfed in smoke, stopped. Firefighter #5, who was once again outside the truck and engulfed in smoke, ran and jumped up onto the driver-side running board of E-002. Firefighter #4, driving E-002, grabbed Firefighter #5's arm, held him to the truck, put the engine in reverse and backed quickly to the west, into

the smoke and safety of the black, slamming into the passenger side of E-001 causing substantial damage. Both engines were still functional, so they proceeded back onto the fireline to complete their attack. The fire was soon totally contained. They spent the next hour or so patrolling and hot spotting along the perimeter. At 1600 hours they receive notice of another fire located about 45 miles east of Eagle Butte. They responded and spent the next six hours on the Four Bear Fire, catching it at 2,093 acres.

DIRECT CAUSE AND RECOMMENDATIONS

Direct cause of the entrapment, burnover, and damage to the Incident Commander Vehicle was the failed frontal assault due to underestimating forward rates of spread, and responding with an inadequate number of firefighters and equipment.

1. Although drought conditions existed, firefighters felt this fire was not extraordinary other than the presence of sustained high winds. Winds coupled with drought conditions misled firefighters estimate of forward spread that ultimately contributed to a life-threatening situation.
 - a. Firefighters at CRA are experienced firefighters that have ample opportunity to see fires burn under different conditions during prescribed fire operations and fire suppression. They have developed over time the perception that certain tactics will *usually* be successful. Usually being the key word, firefighters must look at alternative tactics and what the warning signs are that their primary tactic may fail.
 - i. CRA must spend more time analyzing and discussing fuel types, weather, and fire behavior as they relate to tactics. They just defined one set of conditions where frontal assault was a failure; they must learn from this and investigate where other failures can happen.
 - ii. Firefighters need more training and experience using the risk management system presented in the Incident Response Pocket Guide, NFES #1077.
2. Firefighters were continually moving ahead of the fire front looking for a point to anchor an indirect control line for a backfire and did not have additional firefighters on-site to watch the fire and relay important situational information.
 - a. They were constantly looking ahead for a backfire location and did not have on-site resources to establish a mobile lookout that could keep pace with the fire front and report situational information. There is speculation that even if this did happen, the lookout would have experienced continual problems trying to broadcast information to the firefighters because of a dysfunctional radio system.

- i. Part of indirect tactics risk mitigations is having functional and adequately placed lookouts for the sole purpose of keeping firefighters ahead of the front informed with current information. CRA needs to adopt operational procedures regarding use of lookouts and make it a management action to abandon indirect attack methods when a lookout cannot be provided.
 - ii. The inadequate radio system has been in place for years for the sole purpose of Civil Defense. It now is key to many other functions as well as rural fire districts. CRA and GPRO must coordinate an interim mitigation to the radio system failure. This is only part of the total communications problem here but is pivotal to keeping a successful first response program safe and effective. It solves only part of the equation if we provide situational awareness but cannot communicate it.
- 3. Firefighters eventually selected a location for the backfire that was lower in elevation than the fire front, and blinded by a small ridge system and tree vegetation near the creek.
 - a. This by itself is not a major contributor, however it was part of the indirect tactic and the effects of it were personified because nobody was looking out for the fire until too late. Additionally, the ICT4 was short crewed on arrival and had to participate tactically as usually happens in Type 4 incidents. Since this was now a complex situation, it demanded oversight that was not available.
 - i. Complete management of complex fires is needed from start to finish and CRA must begin by completing training and qualifying their firefighters for managing fires at this level of complexity.
 - ii. See 2i above.
- 4. The National Weather Service (NWS) predicted high winds that were later measured to speeds of 40 mph during peak gusts. Interviews with firefighters described the winds as strong (20+ mph) and gusty that shifted directions.
 - a. Range fuel types are some of the most reactive in the world. Wind is the key component that accelerates change and intensifies burning.
 - i. CRA firefighters must be serious about learning more about fire behavior and how tactics are implemented according to observed and predicted fire behavior.
 - ii. CRA management must support increasing training and workshop style learning of fire behavior and advanced tactics use.
 - iii. Morning briefings must occur and include the risks for the operational period based on expected winds and fuel types.

5. The harvesting wheat combine changed the wheat field fuel type from tall grass to short grass and was observed to have contained the heel of the fire. Firefighters did not feel they had enough engines on scene to catch the head fire using a tandem mobile attack from the heel of the fire.
 - a. This was an opportunity to advance through the wheat field and be successful while mitigating all of the risk from a frontal assault. The frontal assault plan was decided upon and everyone supported it without considering other options.
 - i. CRA should train firefighters in the use of Tactical Decision Games (TDGS) and Sand Table Exercises (STEX) to game out real or fantasy fires that test knowledge of tactics and how to implement new strategies. This proves to be worthwhile by exposing how assumptions guide our critical thinking and cloud reality without situational awareness or risk management.
6. Lessons learned from past fires in wheat fields led them to consider a frontal assault.
 - a. Hard lessons were learned by CRA by attempting to fight fires inside wheat fields. Their solutions to the problems are logical and well thought out, and have provided guidance to be successful on many fires. However it did not on this one, and accepting a plan at face value without critical thinking can lead to management failures.
 - a. See #1, 2, 4, and 5.
7. Firefighters knew the family and ranch that was ahead of the fire, and this admittedly influenced their decision in favor of a frontal assault. Some of the toughest decisions made on the fire ground will involve people we know. Dealing with this aspect of the job is not conducive to good decisions when done at the height of excitement.
 - a. The human aspect of this job must be confronted and discussed in a learning environment such as TDGS and STEX that helps firefighters identify actual locations or common situations they will encounter and how to possibly handle them before they occur.
 - b. Coordination with the fuels management and prevention programs is needed to create defensible areas for isolated home sites and communities, as well as homeowner awareness and responsibility to provide a tactically defensible structure. This is currently happening in several areas of the reservation and the program needs to expand as well as address maintenance costs and schedules of these areas. This information then becomes available for pre-attack planning and dispatching suppression resources.
8. There was no contingency plan to address escape, or consideration that the plan would fail the way it did. Engine Bosses and Incident Commander made independent decisions from the group and acted quickly using experience and training to guide their decisions and actions. The plan to backfire ahead of the advancing fire front was made and remained viable even when it failed twice previous because of rates of spread. Everyone

- was so busy implementing this plan; no one had the time to consider another, or what contingency operations should be.
- a. Standard training needs to include developing alternatives to the primary plan.
 - b. Training and workshops must include risk management for decision-making.
 - c. See #1, 2, 3, 4, 5, and 6.
9. The notion of the lone individual in a life threatening situation having to make all decisions without second party oversight contributed to the IC Vehicle being burned inside the cab, and the IC receiving 1st and 2nd degree burns.
- a. The ICT4 and WT operator had no help when they began making life critical decisions. It was experience that guided them through this situation, however the ICT4 had a system failure with the operator window down and reportedly stuck in that position.
 - b. See #8
 - c. Review *Surviving Fire Entrapments Comparing Conditions Inside Vehicles and Fire Shelters. September 1997. 9751-2817-MTDC. 7E62P87-Vehicle Entrapment.* All 4 parts located at http://www.fs.fed.us/t-d/php/library_card.
 - d. An operational plan or Job Hazard Analysis can address how their vehicles will function and be setup when implementing tactics to assure firefighter safety.

FINDINGS THAT CONTRIBUTED TO THE EVENT AND RECOMMENDATIONS

1. Drought conditions were being monitored well before this fire occurred and conditions were presented to firefighters during briefings.
 - a. Tracking fuel moistures and green up conditions is a unit wide or regional program function. The indicators of drought are indicators of potential fire behavior. Fire behavior interpretations should continue to come from qualified people at the regional or geographic area level. FBAN qualified or similar can provide invaluable interpretations for firefighters preparing for initial and extended attack.
2. The Fire Management Officer position is a collateral duty attached to the Land Operations Officer. The Assistant Fire Management Officer in charge of operations was reassigned during this period and not available for pre-incident planning or operations oversight before the incident occurred that day. The Fuels Specialist was providing the services of both plus additional duties of getting clothing and gear to be cleaned.
 - a. This is not a new situation for agencies in the Great Plains Region. It is difficult to get qualified individuals willing to locate in the Dakotas. However the fire loads at these reservations are large and demands a full time professional guiding these fire programs. It is also too much responsibility to expect a Land Operations Officer to shoulder when the range programs are so large. CRA with support from the GPRO

advertised for a full time FMO in 2004/2005 and received 3 applications, none of which qualified for the job. This situation is currently being addressed by CRA and GPRO.

3. Many range fires during this fire season have exceeded the Type 4 command level at CRA. The highest command level qualified for CRA is ICT4 with one person in the process of completing a Position Task Book for ICT3.
 - a. Type 3 incidents are defined as intermediate complexity. However, with range fires growing so fast, complexity is relative to the amount of time to make the right decisions. Command positions that are fully tactical will not be able to direct operations and evaluate opportunity as conditions change. CRA needs to better understand response organizations and decide how they will function at the Type 3 level and what their organization will be.
 - b. Its important CRA prioritize candidates to qualify as ICT3 and that a sufficient cadre be available to manage incidents of a complex nature. Decisions involving great risk such as on this incident require critical thinking and understanding of consequences and values at risk throughout all of the suppression activities.
4. Firefighters were routinely exceeding the 2:1 work rest ratio and the 14 and 2 days off requirement.
 - a. CRA is currently following the national standard, however when in violation it is a warning that the organization cannot meet demands of the fire load. Fatigue is accumulative, and we have repeatedly found fatigue as a contributor to poor decision-making. Supplemental resources to help fire personnel are a management responsibility that should be pursued locally within policy direction, or with the GPRO for severity or detail help.
5. The current radio system did not provide reliable communications due to lack of frequency control and radio use etiquette. Simultaneous use of a single frequency by numerous resources made critical communications nearly impossible. Additionally firefighter Romero became separated from his assigned engine and became disoriented. This caused concern to him and his work group as he did not have a hand held radio to communicate with.
 - a. The radio system is in the process of being updated on the priority schedule of Telecom and the contracted communications company. GPRO needs to intervene and make certain that agencies with high fire loads and complex suppression programs receive this service as soon as possible.
 - b. CRA and GPRO need to work together and provide CRA and other agencies adequate handheld radios. The elimination of the third engine crew person to a two-person crew increases the need for reliable communications between the engine driver and the firefighter.

6. Cheyenne River Agency was under-staffed with equipment and personnel for the fire frequency and complexities occurring in June and July 2006.
 - a. Severity funding was addressed early on but not specifically requested for CRA. The agency and GPRO must coordinate severity requests for all agencies in need.
 - b. CRA must monitor fire load and core suppression staff for days off and hours worked as an indicator of need for additional resources. They must consider the need for the organization not just initial response, included in this is equipment (engines and heavy equipment), aircraft, and overhead (ICT3, ICT4, SOF3/2, logistics).
7. Fire Management infrastructure does not allow for a duty officer or other qualified operations oversight when the FMO or both AFMOs are absent.
 - a. The FMO and AFMO-Operations were both absent from the fire program consequently one person was attending to everything. When he left to complete administration duties a critical event occurred. This needs to be addressed operationally so that a person in charge is present in the form of delegated AFMO, FMO, or Duty Officer to provide guidance to crews and priority setting.
8. An After Action Review was conducted on-site following the incident, however there was no mention or attempt at securing a Critical Incident Stress Debriefing (CISD) for the firefighters involved.
 - a. CRA needs to become better versed at CISD awareness and the value of debriefings. The AAR was excellent and reviewed tactical and management operations. The CISD is designed to help firefighters manage the stress of a critical event to avoid accumulating the effects of stress and peer criticisms overtime.

APPENDIX 1

Club House Fire Entrapment and Burn-Over Investigation

FIRE WEATHER AND FIRE BEHAVIOR ANALYSIS

Morgan Beveridge, BIA, Great Plains Region Fuels Manager
Thursday August 17, 2006

The Club House Fire (Fire) occurred at 12:33 hours on Thursday, July 6, 2006 on the Cheyenne River Agency within the BIA's Great Plains Region. The Fire originated in a wheat field from an overheated bearing on a combine that was harvesting wheat. The fire was approximately 3 miles northeast of the Fire Station in Eagle Butte, South Dakota and was ultimately contained at 907 acres the same day. The entrapment and burn-over occurred at approximately 13:00 hours, within ½ hour of initial attack.

The Fire site is within the southern portion of the Rocky Mountain Area National Weather Service Fire Weather Zone 268 (SDZ268-UPPER CHEYENNE) in west central South Dakota. This zone falls within the central and northeast South Dakota coverage area of the Aberdeen National Weather Service (NWS) Office, Aberdeen, SD.

The Aberdeen NWS Office fire weather forecast for the day was a Red Flag Warning for Zones 268 and 269 high winds and low relative humidity. The fire crew was aware of the forecast that morning, prior to their dispatch to the Fire.

Topography:

The Cheyenne River Sioux Indian Reservation consists of steep, rugged and broken river break country along the Missouri River breaks on the east and southeast borders of the Reservation. Steep narrow canyons and slopes in excess of 60% are common along the Missouri River breaks. Less harsh river break country exists along the Cheyenne River at the southern border and the Moreau River within the interior of the Reservation. Other areas include timbered and grassy lowlands, uplands, badlands with bluffs and buttes and long expanses of flat to gently rolling prairie grasslands with intermittent dry and wet streams and farmland.

South to north view of Club House Fire overlooking the south end wheat field - 7/14/06.



The Fire ran for 2 miles from south to the north in a narrow fan shape (see aerial DOQ polygon map). The widest point at the north end of the fan was 1 mile, where multiple resources were able to pinch the fire into a long narrow run for another mile, where the fire was contained. The burned area contains a wheat field at the south end, where the fire originated, with gently rolling grasslands, uplands and a moderately wooded dry creek bed that runs lengthwise through the center part of the fire. The entrapment and burn-over area was at the north end of a bottomland flat that lies between a short shallow side-drainage to the west and the main dry creek bed to the east, roughly one mile north of the fire's point of origin.

Fuels and Vegetation:

The primary carrier of the fire during the first ½ mile run was a fully cured un-harvested wheat field. Fire behavior in wheat at this stage is best modeled using a Fuel Model 3, tall grass. Even so, Fuel Model 3 does not adequately represent the type of fire behavior experienced in fully cured wheat because the bulk density of the wheat stalks and the residual wheat chaff go unrecognized and unaccounted for in the model. Consequently, fire behavior in wheat is usually much more extreme than Fuel Model 3 fire behavior calculations indicate,

particularly when environmental conditions are conducive to extreme fire behavior as was the case at the Club House Fire on July 6, 2006.



After the fire left the wheat field, the remaining vegetation type and primary carrier up to and including the time of the entrapment/burn-over was fully cured grass, best represented by Fuel Model 1, short grass.



The grass consumed in the fire was very dense, contiguous and compacted due to the long period of time the area had gone without a fire disturbance. The average depth of the grass was estimated to be the same as the surrounding unburned grasslands, 17 inches. This is 5 inches greater than the Fuel Model 1 description specifies, contributing to the increased flame lengths and intensity level experienced by the CRA firefighters on July 6.

Although the available fuels in the dry creek bed that was used to anchor from during the failed backfire attempt did not contribute directly to the entrapment, their post-burn condition serves as an indicator of the extremely low fuel moistures on 7/6. The photo below was taken along the dry creek bed immediately adjacent to and east of the entrapment site.



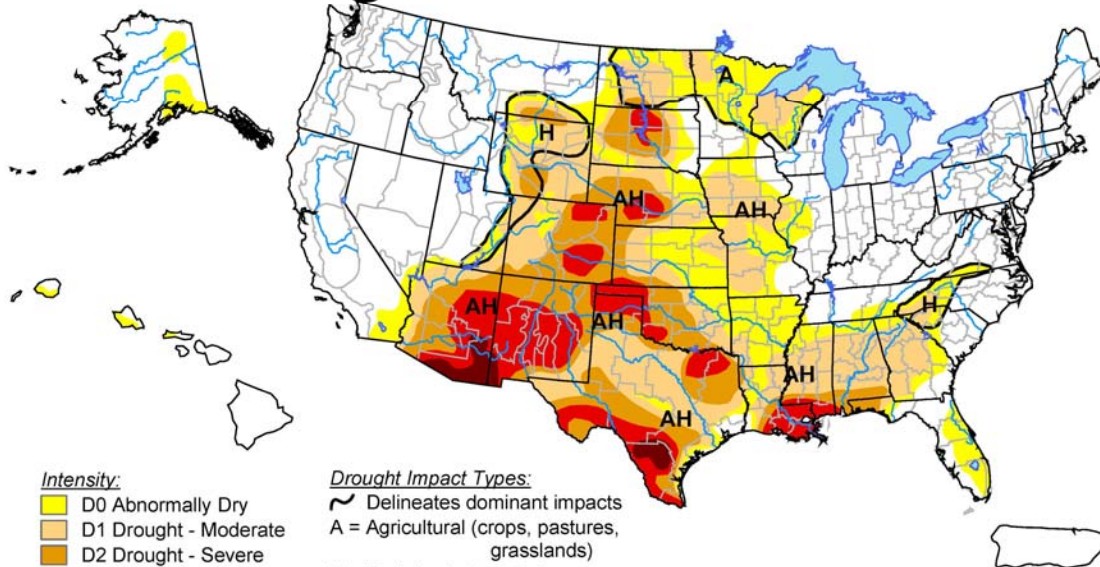
Fire Weather:

The Great Plains Region had been contending with drought levels from Moderate to Exceptional since May. A severity request for additional ground and aviation suppression resources for Standing Rock and Cheyenne River Reservations had been in the planning phase since May, and was funded and implemented in late June. An additional severity request had already been funded and was in operation for the Pine Ridge Reservation, 100 miles southwest of the Cheyenne River Agency.

The following two US Drought Monitor maps show the drought level and the rate at which the drought was progressing outward within the Great Plains Region between July 4 and July 18, 2006. The Cheyenne River Reservation is in the core of the most severe level of drought in South Dakota. The drought has since spread further out from the center to encompass more of the northern Great Plains.

U.S. Drought Monitor

July 4, 2006
Valid 7 a.m. EST



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:

- Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



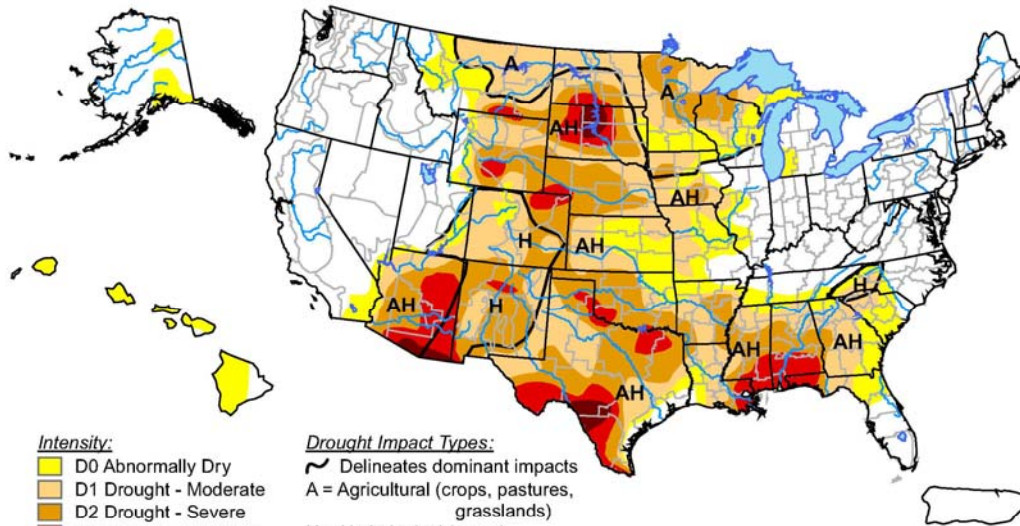
Released Thursday, July 6, 2006

<http://drought.unl.edu/dm>

Author: Doug Le Comte and Tom Heddinghaus, CPC/NOAA

U.S. Drought Monitor

July 18, 2006
Valid 8 a.m. EDT



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:

- ~ Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

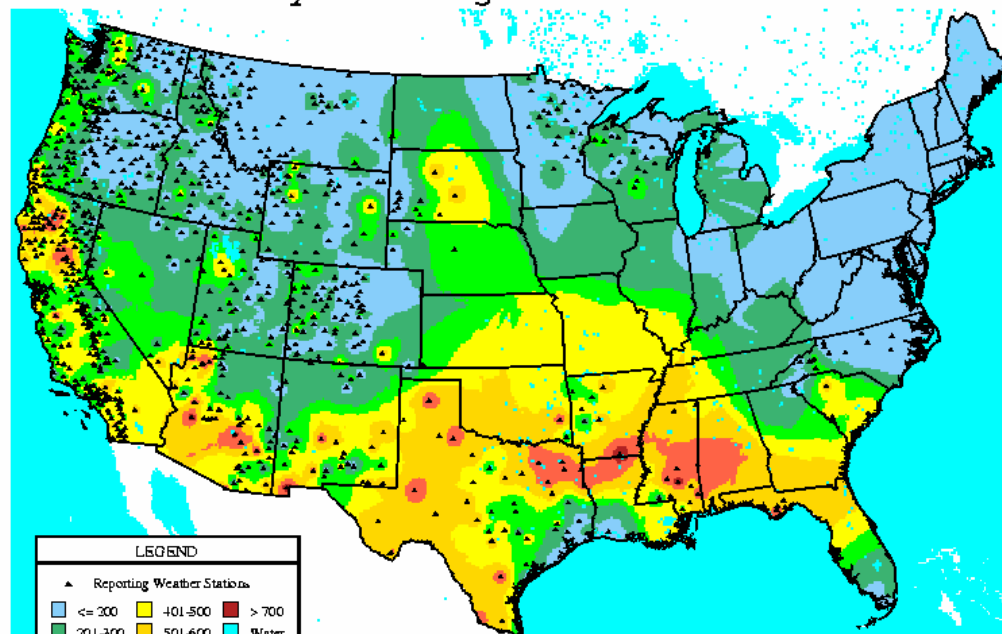


Released Thursday, July 20, 2006

<http://drought.unl.edu/dm>

Author: Richard Heim/Liz Love-Brotak, NOAA/NESDIS/NCDC

Keetch-Byram Drought Index: 09-JUL-06



LEGEND			
▲	Reporting Weather Stations		
≤ 300	401-500	601-700	Water
301-400	501-600		
601-700			

(Inv. Dist.² Interp.)

WFAS-MAPS Graphics FIRE BEHAVIOR RESEARCH - MISSOULA, MT



Weather Predictions for Thursday, July 6, 2006:

The general fire weather forecast for zone 268 (SDZ268-062315-UPPER CHEYENNE) for Thursday, July 6, 2006 called for temperatures of 92-97 degrees, minimum relative humidity of 22-27%, 20-foot winds southeast from 19-24 mph with gusts to around 35 mph, Haines Index of 2 (very low) and no precipitation. This forecast was issued by Cheyenne River Reservation's supporting NWS Office in Aberdeen, SD and is included as Attachment 1. The site-specific weather for the Club House Fire is on page 2/9 and 3/9 of the attachment.

The Aberdeen NWS Office for Zone 268 issued a Red Flag Warning for high winds and low relative humidity from 2 p.m. to 8 p.m. MDT, Thursday, July 6, 2006. The 04:05 Warning stated "Windy and hot today across an area already stricken by dangerously dry conditions", "South winds will increase to 20-30 mph with some higher gusts by early this afternoon...as temperatures increase into the 90s", "The lack of adequate low level moisture across north central South Dakota this afternoon will leave relative humidity at 20% or less". The Red Flag Warning is included as Attachment 2.

The South Dakota Grassland Fire Danger Statement, issued by the Aberdeen NWS Office at 04:07, Thursday, July 6, 2006 called for the "extreme" category to be reached by afternoon that day. The Grassland Fire Danger Statement is included as Attachment 3. The site-specific summary for the area surrounding the Club House Fire is on page 2 of the attachment, under the "Dewey County" listing.

Weather Observations for Thursday, July 6, 2006:

No local weather observations were taken by the fire crew prior to the entrapment/burn-over on 7/6. The CRA fire crew had come back on duty the morning of 7/6 after a very busy night suppressing other local fires. They had been out until 04:00 that morning, went home for some sleep and came back to work at 10:00. The Club House Fire call came in at 12:30.

The Bear Creek Remote Automated Weather Station (RAWS) Station is located 19 miles west of the Fire. Readings from this station at 12:50 on 7/6 indicated a temperature of 90 degrees, relative humidity of 27% and a wind speed of 24 mph with gusts to 43 mph (one of the CRA firefighters on the Club House Fire said that the wind blew his hardhat off his head while he and the other crew members were attempting to backfire).

The weather data from the Beer Creek RAWS was used for the purpose of this review and for the BEHAVE fire behavior calculations. The 7/6/06 Bear Creek RAWS observations are included as Attachment 4.

At-a-glance view of the weather on 7/6 leading up to the entrapment:

BEAR CREEK RAWS STATION, OBSERVATIONS ON 7/6/2006					
Time (MDT)	Temp-F	RH	Wind Speed	Wind Direction	Gusts
08:50	78	47	16	South	23
09:50	81	37	22	South-Southeast	26
10:50	84	31	24	South	29
11:50	88	29	22	South	34
12:50	90	27	24	South	43
13:50	90	26	27	South	38
14:50	91	26	27	South	40

12:50 was approximately 10 minutes prior to the final backfire attempt and entrapment.

As mentioned in the Fire Behavior section below, fuel moistures on 7/6 were estimated to be at or below the recordings taken during the site investigation on Friday, 7/14. Moistures on 7/14, 3 days after 1/4 to 1/2 inch rain fell on the site were:

- Dead and downed 1, 10 and 100 hour fuel moistures were at < 6%
- Core samples of 1,000 hour fuels averaged 12%.
- Live woody fuel moisture was 60% in the scorched oak, >90% in the green oak.
- Live herbaceous moisture in shrubs registered 38-60%.

Fire Behavior:

General:

The Club House Fire originated at the south end of a local wheat field from an overheated bearing on a combine, burned north through the field and out into rolling grassland with a strong southerly wind. The fire behavior was extreme and exceeded anything ever experienced by the firefighters that were trapped and burned over that day. The 4 firefighters involved in the entrapment have 21, 15, 12 and 9 years of wildland fire fighting experience between them.

Observed Fire Behavior:

Interviews with the 4 firefighters involved in the entrapment indicated that backfiring against rapid spreading grass fires has always proven to be an effective method of suppression, with very few fire behavior problems encountered. The fire behavior they experienced on July 6 was different.

The extreme rate of spread and greater than normal flame lengths were the most significant problem on this fire. The firefighters couldn't seem to get far enough ahead of the flaming front to have enough time to set up for a backfire before the fire's width exceeded their black-lining capability. Each time they tried to set up, they would look up and see the fire closing in on them again.

It was noted that wheat field fires at CRA are attacked, as a rule, using indirect attack methods. Experience has taught CRA firefighters that the physical makeup of the wheat stalks and chaff makes it nearly impossible to conduct direct attack without creating a buildup of combustible material up underneath the suppression vehicles. This is a definite hazard for potential ignition underneath the truck.

Usually, wheat field fires subside in flame length, spread rate and intensity once they leave the wheat. On the Club House Fire, the fire actually accelerated in the grass when it left the wheat field. The increase in the fire's forward rate of spread surprised them and caused them to hurry even more.

All of the firefighters interviewed stressed their total surprise that the live "green" fuels in the creek bed carried the fire as if they were dead fuel. They all thought that the green component would serve as a good anchor for their final backfire attempt.

Fire Effects:

The fire effects at the site confirm the extreme fire behavior event.

25-foot tall trees in the dry creek bed were scorched to their tops:



Root cavities were burned completely out to ash:



15-18 inch oak logs (1,000 hr time-lag) were burned down to ash:



Normally in the Northern Great Plains, a grass fire only chars residual limb-wood and logs and root cavities are not even affected.

Fire Behavior Calculations:

The Behave Fire Behavior Prediction Program was used to compute the outputs and verify the firefighter's estimates of fire behavior. Fire Behavior Fuel Model 1 was used for the grass component and Fuel Model 3 for the wheat. Both fuel types were 100% cured. It is very likely that the fire behavior predictions fall short of what actually occurred due to the inadequate fuel modeling for wheat, extremely low fuel moistures and extremely high winds. Wind gusts were recorded to 43 mph during the fire.

Site-specific fuel moistures for 7/6/06 had to be estimated from local weather and moisture level monitoring completed on 6/26 and 6/27 and from fuel moistures taken at the fire site on 7/14.

Prior to the Fire: The area was in D4 (Exceptional) drought for several weeks prior to the Club House Fire. The fire site had not received significant precipitation for over 3 weeks.

Local weather and fuel moisture monitoring recorded on 6/26 and 6/27:

- 1 hour fuel moistures 3%, 4% on 6/26, 9% on 6/27
- 10 hour fuel moistures 4%, 5% on 6/26, 6% on 6/27
- 100 hour fuel moistures 6%, 7% on 6/26, 9% on 6/27
- 1,000 hour fuel moistures 13%, 16% on 6/26, 70% on 6/27 (post-rain)

Local observations have been included as Attachment 5. Note high temperatures, low fuel moistures and low relative humidity in early morning hours on the attachment.

Post-Fire: The Fire site received a wetting rain on Tuesday, 7/11 when 4/10s inch of rain was measured at the NWS Station in Timber Lake, SD 30 miles north of the Fire.

Fuel moistures were measured on-site on Friday, 7/14:

- Grass fully cured at 3% fuel moisture (estimated)
- Dead and downed 1, 10 and 100 hour fuel moistures at < 6%
- Core samples of 1,000 hour fuels averaged 12%
- Live woody fuel moisture was 60% in the scorched oak
- Live woody fuel moisture was >90% in the green oak
- Live herbaceous shrub moisture registered 38-60%

Due to the rain on 7/11 and the long period of time with very little rain on the Reservation prior to the Fire on 7/6, it is estimated that the Fire-site

fuel moistures were at or below the measured moisture levels taken on 7/14.

On July 6, with sustained mid-flame wind speeds of only 10-15 mph across open prairie and pasture land of fully cured short grass (fuel model 1), using the estimated fuel moistures and known wind speeds for the Behave calculation, the fire's rate of spread was greater than or equal to **400 chains per hour**. Four hundred chains per hour equates to **5 miles (26, 400 feet) per hour**, 440 feet per minute or **7.3 feet per second**. Probability of Ignition was calculated up to 90%, spotting distance up to 1.2 miles with a growth rate potential of **8 acres per minute** of sustained spread, all in Fuel Model 1. Flame lengths were calculated at 7-10 feet in Fuel Model 1 and >50 feet in Fuel Model 3, which was verified by the firefighters. Behave outputs for both fuel models indicated that control efforts at the head of the fire would probably be ineffective, the fire is too intense for direct attack by hand crews and that equipment such as dozers and retardant aircraft could be effective.

An actual/comparative rate of spread estimate was derived from personal interviews with the 4 CRA firefighters who attempted the backfires and an on-site (field) investigation to determine fuel type, terrain, relative fuel moistures, distances, timeframes and the distance/time relationship. The "field" estimate lines up with the fire behavior calculation, as follows:

The final backfire attempt was made roughly 8/10s of a mile down-wind (north) of the fire's point of origin. With sustained spread and using the known topography, distances, weather, fuel conditions and the ignition and backfire attempt time, the fire would have reached the final backfire location in approximately 9.6 minutes, the time frame indicated by all those interviewed.

-8/10 mile = 4,224 feet
-Fire moving at 440 feet/minute (5 miles/hour)
-4,224/440 = 9.6 minutes

Fire Weather and Fire Behavior Summary:

Four very experienced and fully qualified plains firefighters were entrapped and burned over while attempting an indirect attack backfire operation on an extremely fast moving range fire.

Extreme drought at the Exceptional Level (D4, U.S. Drought Monitor) from May 2006, extremely low fuel moistures, low relative humidity and very high winds all contributed to the Club House Fire entrapment on July 6, 2006.

Fuels & Weather Factors Contributing to the Extreme Fire Behavior on 7/6/06

1. Extended drought at the Exceptional (D4) Level.
2. Mid-flame wind speeds steady up to 24 mph with gusts to 43 mph.
3. Extremely low fuel moistures.

Grass Fuels: 3% (estimated)

1 Hour Fuels: <6% (Measured 7/14, estimated for 7/6)

10 Hour Fuels: <6% (Measured 7/14, estimated for 7/6)

100 Hour Fuels: <6% (Measured 7/14, estimated for 7/6)

1,000 Hour Fuels: 12% average (Measured 7/14, estimated for 7/6)

Live Woody Moisture: 60% scorched (Measured 7/14, estimated for 7/6)

Live Herbaceous Moisture: 38-60% (Measured 7/14, estimated for 7/6)

4. Low relative humidity of 27%.
5. Fully cured un-harvested wheat field for the first ½ mile of the fire.
6. A thick, fully cured grass fuel bed that had not been disturbed by fire in years.

Aug 01,06 11:40	Text 1: -69:FWFABR	Page 1/9
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FNUS53 KABR 060839
FWFABR

FIRE WEATHER PLANNING FORECAST FOR CENTRAL/NORTHEAST SOUTH DAKOTA
AND WEST CENTRAL MINNESOTA
NATIONAL WEATHER SERVICE ABERDEEN SD
339 AM CDT THU JUL 6 2006

...RED FLAG WARNING FOR ZONES 268 AND 269 FOR HIGH WIND AND LOW RH
THIS AFTERNOON...

.DISCUSSION...AN APPROACHING LOW PRESSURE SYSTEM OVER THE ROCKY
MOUNTAINS WILL GENERATE A PERIOD OF BREEZY TO WINDY CONDITIONS FROM
TODAY THROUGH TONIGHT. A COLD FRONT WILL PASS THROUGH THE NORTHERN
PLAINS TONIGHT AND FRIDAY...TURNING WINDS FROM THE SOUTH TO THE
NORTHWEST...AND THERE SHOULD BE A DROP OFF IN WIND SPEEDS. SCATTERED
SHOWERS AND THUNDERSTORMS WILL BE POSSIBLE THIS EVENING THROUGH LATE
FRIDAY NIGHT ACROSS THE DAKOTAS AS THIS LOW PRESSURE SYSTEM MAKES ITS
WAY ACROSS THE REGION.

SDZ267-062315-
LOWER BAD RIVER-
339 AM CDT THU JUL 6 2006

.TODAY...
SKY/WEATHER.....MOSTLY SUNNY UNTIL 1000...THEN PARTLY SUNNY.
MAX TEMPERATURE.....89-94.
MIN HUMIDITY.....27-32 PERCENT.
20-FOOT WINDS.....SOUTHEAST WINDS 19 TO 24 MPH WITH GUSTS TO
 AROUND 35 MPH.
HAINES INDEX.....2 OR VERY LOW.
HOURS OF SUN.....10 HOURS.
PRECIPITATION.....NONE.
MIXING HEIGHT.....AROUND 8100 FT AGL (AVE 12-6 PM).
TRANSPORT WINDS.....SOUTH AROUND 27 MPH (AVE 12-6 PM).
SMOKE DISPERSAL.....AROUND 229000 OR EXCELLENT (AVE 12-6 PM).
LAL.....1.

.TONIGHT...
SKY/WEATHER.....PARTLY CLOUDY.
MIN TEMPERATURE.....64-69.
MAX HUMIDITY.....65-70 PERCENT.
20-FOOT WINDS.....SOUTH WINDS 18 TO 23 MPH WITH GUSTS TO AROUND
 35 MPH.
PRECIPITATION.....NONE.
LAL.....1.

.FRIDAY...
SKY/WEATHER.....PARTLY SUNNY. SLIGHT CHANCE OF SHOWERS AND
 THUNDERSTORMS AFTER 1500. CHANCE OF RAIN 20
 PERCENT.
MAX TEMPERATURE.....98-103.
MIN HUMIDITY.....28-33 PERCENT.
20-FOOT WINDS.....SOUTH WINDS 10 TO 15 MPH.
HAINES INDEX.....3 OR VERY LOW.
HOURS OF SUN.....9 HOURS.
PRECIPITATION.....ISOLATED TRACE TO 0.05 INCH AMOUNTS.
MIXING HEIGHT.....AROUND 10000 FT AGL (AVE 12-6 PM).
TRANSPORT WINDS.....SOUTHWEST AROUND 7 MPH (AVE 12-6 PM).
SMOKE DISPERSAL.....AROUND 65000 OR EXCELLENT (AVE 12-6 PM).
LAL.....1 UNTIL 1500...THEN 2.

.FORECAST DAYS 3 THROUGH 7...
.FRIDAY NIGHT...PARTLY CLOUDY. SLIGHT CHANCE OF SHOWERS AND
THUNDERSTORMS. LOWS 70 TO 75. SOUTHWEST WINDS 6 TO 11 MPH. CHANCE OF
RAIN 20 PERCENT.
.SATURDAY...PARTLY SUNNY. HIGHS 95 TO 100. NORTHWEST WINDS 5 TO
9 MPH.
.SATURDAY NIGHT...PARTLY CLOUDY. LOWS 65 TO 70. NORTHWEST WINDS 5 TO

Tuesday August 01, 2006

APPENDIX 1

ATTACHMENT 1

Aug 01,06 11:40	Text 1: -69:FWFABR	Page 2/9
6 MPH. .SUNDAY...PARTLY SUNNY. HIGHS 95 TO 100. NORTHWEST WINDS 5 TO 8 MPH. .SUNDAY NIGHT...PARTLY CLOUDY. LOWS 60 TO 65. NORTH WINDS 5 TO 10 MPH. .MONDAY...PARTLY SUNNY. HIGHS 90 TO 95. SOUTH WINDS 5 TO 9 MPH. .MONDAY NIGHT...PARTLY CLOUDY. SLIGHT CHANCE OF SHOWERS AND THUNDERSTORMS. LOWS 65 TO 70. SOUTH WINDS 11 TO 16 MPH. CHANCE OF RAIN 20 PERCENT. .TUESDAY...PARTLY SUNNY. HIGHS 90 TO 95. SOUTH WINDS 13 TO 18 MPH. .TUESDAY NIGHT...PARTLY CLOUDY. LOWS 65 TO 70. SOUTH WINDS 13 TO 18 MPH. .WEDNESDAY...PARTLY SUNNY. HIGHS 95 TO 100. SOUTH WINDS 8 TO 13 MPH. \$\$ SDZ268-062315- UPPER CHEYENNE- 239 AM MDT THU JUL 6 2006 ...RED FLAG WARNING IN EFFECT FROM 2 PM THIS AFTERNOON TO 8 PM MDT THIS EVENING... .TODAY... SKY/WEATHER.....MOSTLY SUNNY UNTIL 1100...THEN PARTLY SUNNY. MAX TEMPERATURE.....92-97. MIN HUMIDITY.....22-27 PERCENT. 20-FOOT WINDS.....SOUTHEAST WINDS 19 TO 24 MPH WITH GUSTS TO AROUND 35 MPH. HAINES INDEX.....2 OR VERY LOW. HOURS OF SUN.....10 HOURS. PRECIPITATION.....NONE. MIXING HEIGHT.....AROUND 8700 FT AGL (AVE 12-6 PM). TRANSPORT WINDS.....SOUTH AROUND 29 MPH (AVE 12-6 PM). SMOKE DISPERSAL.....AROUND 252000 OR EXCELLENT (AVE 12-6 PM). LAL.....1. .TONIGHT... SKY/WEATHER.....PARTLY CLOUDY. SLIGHT CHANCE OF SHOWERS AND THUNDERSTORMS AFTER 1900 UNTIL 0100. CHANCE OF RAIN 20 PERCENT. MIN TEMPERATURE.....64-69. MAX HUMIDITY.....65-70 PERCENT. 20-FOOT WINDS.....SOUTH WINDS 18 TO 23 MPH WITH GUSTS TO AROUND 35 MPH. PRECIPITATION.....ISOLATED TRACE TO 0.05 INCH AMOUNTS. LAL.....1 UNTIL 1900...THEN 2 UNTIL 0100...THEN 1. .FRIDAY... SKY/WEATHER.....PARTLY SUNNY UNTIL 1000...THEN MOSTLY SUNNY UNTIL 1100...THEN PARTLY SUNNY. SLIGHT CHANCE OF SHOWERS AND THUNDERSTORMS AFTER 1500. CHANCE OF RAIN 20 PERCENT. MAX TEMPERATURE.....98-103. MIN HUMIDITY.....25-30 PERCENT. 20-FOOT WINDS.....SOUTHWEST WINDS 11 TO 16 MPH. HAINES INDEX.....3 OR VERY LOW. HOURS OF SUN.....9 HOURS. PRECIPITATION.....ISOLATED TRACE TO 0.05 INCH AMOUNTS. MIXING HEIGHT.....AROUND 11200 FT AGL (AVE 12-6 PM). TRANSPORT WINDS.....WEST AROUND 11 MPH (AVE 12-6 PM). SMOKE DISPERSAL.....AROUND 125000 OR EXCELLENT (AVE 12-6 PM). LAL.....1 UNTIL 1500...THEN 2. .FORECAST DAYS 3 THROUGH 7... .FRIDAY NIGHT...PARTLY CLOUDY. LOWS 65 TO 70. WEST WINDS 5 TO 8 MPH. .SATURDAY...MOSTLY SUNNY. HIGHS 90 TO 95. NORTHWEST WINDS 5 TO 10 MPH. .SATURDAY NIGHT...PARTLY CLOUDY. LOWS 60 TO 65. NORTHWEST WINDS 5 TO 9 MPH.		

*Aug 01,06 11:40	Text 1: -69:FWFABR	Page 3/9
.SUNDAY...PARTLY SUNNY. HIGHS 90 TO 95. NORTH WINDS 5 TO 9 MPH. .SUNDAY NIGHT...PARTLY CLOUDY. LOWS 60 TO 65. SOUTHEAST WINDS 5 TO 7 MPH. .MONDAY...PARTLY SUNNY. HIGHS 85 TO 90. SOUTHEAST WINDS 5 TO 9 MPH. .MONDAY NIGHT...PARTLY CLOUDY. LOWS 60 TO 65. SOUTH WINDS 11 TO 16 MPH. .TUESDAY...PARTLY SUNNY. HIGHS 90 TO 95. SOUTH WINDS 13 TO 18 MPH. .TUESDAY NIGHT...PARTLY CLOUDY. LOWS 60 TO 65. SOUTH WINDS 13 TO 18 MPH. .WEDNESDAY...PARTLY SUNNY. HIGHS 90 TO 95. SOUTH WINDS 11 TO 16 MPH. \$\$ SDZ269-062315- UPPER MISSOURI COTEAU- 339 AM CDT THU JUL 6 2006 ...RED FLAG WARNING IN EFFECT FROM 3 PM THIS AFTERNOON TO 9 PM CDT THIS EVENING... .TODAY... SKY/WEATHER.....MOSTLY SUNNY UNTIL 1600...THEN PARTLY SUNNY. MAX TEMPERATURE.....88-93. MIN HUMIDITY.....25-30 PERCENT. 20-FOOT WINDS.....SOUTH WINDS 18 TO 23 MPH WITH GUSTS TO AROUND 35 MPH. HAINES INDEX.....3 OR VERY LOW. HOURS OF SUN.....12 HOURS. PRECIPITATION.....NONE. MIXING HEIGHT.....AROUND 8300 FT AGL (AVE 12-6 PM). TRANSPORT WINDS.....SOUTH AROUND 26 MPH (AVE 12-6 PM). SMOKE DISPERSAL.....AROUND 214000 OR EXCELLENT (AVE 12-6 PM). LAL.....1. .TONIGHT... SKY/WEATHER.....PARTLY CLOUDY. SLIGHT CHANCE OF SHOWERS AND THUNDERSTORMS AFTER 1900. CHANCE OF RAIN 20 PERCENT. MIN TEMPERATURE.....64-69. MAX HUMIDITY.....65-70 PERCENT. 20-FOOT WINDS.....SOUTH WINDS 18 TO 23 MPH WITH GUSTS TO AROUND 35 MPH. PRECIPITATION.....ISOLATED TRACE TO 0.05 INCH AMOUNTS. LAL.....1 UNTIL 1900...THEN 2. .FRIDAY... SKY/WEATHER.....PARTLY SUNNY. SLIGHT CHANCE OF SHOWERS AND THUNDERSTORMS UNTIL 0700. SLIGHT CHANCE OF SHOWERS AND THUNDERSTORMS AFTER 1500. CHANCE OF RAIN 20 PERCENT. MAX TEMPERATURE.....96-101. MIN HUMIDITY.....30-35 PERCENT. 20-FOOT WINDS.....SOUTHWEST WINDS 11 TO 16 MPH WITH GUSTS TO AROUND 25 MPH. HAINES INDEX.....3 OR VERY LOW. HOURS OF SUN.....8 HOURS. PRECIPITATION.....ISOLATED TRACE TO 0.05 INCH AMOUNTS. MIXING HEIGHT.....AROUND 9900 FT AGL (AVE 12-6 PM). TRANSPORT WINDS.....WEST AROUND 12 MPH (AVE 12-6 PM). SMOKE DISPERSAL.....AROUND 118000 OR EXCELLENT (AVE 12-6 PM). LAL.....2 UNTIL 0700...THEN 1 UNTIL 1500...THEN 2. .FORECAST DAYS 3 THROUGH 7... .FRIDAY NIGHT...PARTLY CLOUDY. SLIGHT CHANCE OF SHOWERS AND THUNDERSTORMS. LOWS 65 TO 70. WEST WINDS 5 TO 10 MPH. CHANCE OF RAIN 20 PERCENT. .SATURDAY...PARTLY SUNNY. HIGHS 90 TO 95. NORTHWEST WINDS 5 TO 7 MPH. .SATURDAY NIGHT...PARTLY CLOUDY. LOWS 65 TO 70. NORTHWEST WINDS 5 TO		
Tuesday August 01, 2006		3/9

APPENDIX 1

ATTACHMENT 2

WWUS83 KABR 060905
RFWABR

RED FLAG WARNING
NATIONAL WEATHER SERVICE ABERDEEN SD
405 AM CDT THU JUL 6 2006

...WINDY AND HOT TODAY ACROSS AN AREA ALREADY STRICKEN BY
DANGEROUSLY DRY CONDITIONS...

.A LOW PRESSURE SYSTEM CHURNING OVER THE ROCKY MOUNTAINS WILL
SPREAD MUCH ABOVE NORMAL TEMPERATURES ACROSS THE WESTERN AND
CENTRAL PORTIONS OF SOUTH DAKOTA TODAY. SOUTH WINDS AHEAD OF THIS
LOW WILL ALSO INCREASE IN SPEED TO BETWEEN 15 AND 30 MPH BY THIS
AFTERNOON. THE COMBINATION OF HOT TEMPERATURES WITH WINDY AND DRY
CONDITIONS RESULTS IN RED FLAG WARNING CRITERIA ACROSS NORTH
CENTRAL SOUTH DAKOTA THIS AFTERNOON AND THIS EVENING.

SDZ268-269-061715-
/O.NEW.KABR.FW.W.0003.060706T2000Z-060707T0200Z/
UPPER CHEYENNE-UPPER MISSOURI COTEAU-
405 AM CDT THU JUL 6 2006 /305 AM MDT THU JUL 6 2006/

...RED FLAG WARNING IN EFFECT FROM 3 PM CDT /2 PM MDT/ THIS
AFTERNOON TO 9 PM CDT /8 PM MDT/ THIS EVENING...

THE NATIONAL WEATHER SERVICE IN ABERDEEN HAS ISSUED A RED FLAG
WARNING...WHICH IS IN EFFECT FROM 3 PM CDT /2 PM MDT/ THIS
AFTERNOON TO 9 PM CDT /8 PM MDT/ THIS EVENING.

SOUTH WINDS WILL INCREASE TO 20 TO 30 MPH WITH SOME HIGHER GUSTS BY
EARLY THIS AFTERNOON...AS TEMPERATURES INCREASE INTO THE 90S. THE
LACK OF ADEQUATE LOW LEVEL MOISTURE ACROSS NORTH CENTRAL SOUTH
DAKOTA THIS AFTERNOON WILL LEAVE RELATIVE HUMIDITIES AT 20
PERCENT OR LESS...WHICH CREATES THE POTENTIAL FOR GRASSLAND FIRES
TO GROW OUT OF CONTROL.

A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE EITHER OCCURRING NOW...OR WILL SHORTLY. A COMBINATION OF
STRONG WINDS...LOW RELATIVE HUMIDITY...AND HOT TEMPERATURES WILL
CREATE EXPLOSIVE FIRE GROWTH POTENTIAL. PLEASE ADVISE THE
APPROPRIATE OFFICIALS OR FIRE CREWS IN THE FIELD.

\$\$

DORN

WWUS83 KABR 062242
RFWABR

RED FLAG WARNING
NATIONAL WEATHER SERVICE ABERDEEN SD
542 PM CDT THU JUL 6 2006

.LOW PRESSURE ALONG THE FRONT RANGE OF THE ROCKIES WILL CONTINUE

APPENDIX 1

ATTACHMENT 2

TO PROMOTE GUSTY WINDS...HOT TEMPERATURES...AND LOW RELATIVE HUMIDITIES INTO THE EVENING HOURS.

SDZ268-269-070200-
/O.CON.KABR.FW.W.0003.000000T0000Z-060707T0200Z/
UPPER CHEYENNE-UPPER MISSOURI COTEAU-
542 PM CDT THU JUL 6 2006 /442 PM MDT THU JUL 6 2006/

...RED FLAG WARNING REMAINS IN EFFECT UNTIL 9 PM CDT /8 PM MDT/
THIS EVENING...

A RED FLAG WARNING REMAINS IN EFFECT UNTIL 9 PM CDT /8 PM MDT/
THIS EVENING.

SOUTH WINDS OF 20 TO 30 MPH...AND EVEN HIGHER GUSTS WILL CONTINUE ACROSS THE REGION INTO THE EARLY EVENING HOURS. THE COMBINATION OF STRONG WINDS...LOW RELATIVE HUMIDITIES AND TEMPERATURES AROUND 90 WILL CONTINUE TO SUPPORT STRONG FIRE GROWTH POTENTIAL. BY MID TO LATE EVENING THE WINDS WILL BEGIN SUBSIDING AND THE RELATIVE HUMIDITY WILL BE ON THE INCREASE AS THE TEMPERATURES FALL.

A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS ARE EITHER OCCURRING NOW...OR WILL SHORTLY. A COMBINATION OF STRONG WINDS...LOW RELATIVE HUMIDITY...AND HOT TEMPERATURES WILL CREATE EXPLOSIVE FIRE GROWTH POTENTIAL. PLEASE ADVISE THE APPROPRIATE OFFICIALS OR FIRE CREWS IN THE FIELD.

\$\$
TDK

APPENDIX 1

ATTACHMENT 3

FNUS63 KABR 060110
RFDABR

GRASSLAND FIRE DANGER STATEMENT
NATIONAL WEATHER SERVICE ABERDEEN SD
810 PM CDT WED JUL 5 2006

..DISCUSSION...HIGH PRESSURE WILL REMAIN ACROSS THE NORTHERN PLAINS FOR ONE MORE DAY TODAY...RESULTING IN SUNNY SKIES AND LIGHT WINDS. BY THURSDAY...A LOW PRESSURE SYSTEM APPROACHING FROM THE CENTRAL ROCKIES WILL CREATE BREEZY TO WINDY SOUTHERLY WINDS. THIS SYSTEM WILL ALSO DRAW MUCH WARMER AIR FROM THE DESERT SOUTHWEST INTO THE DAKOTAS. TEMPERATURES ARE EXPECTED TO BE FLIRTING WITH THE CENTURY MARK BY FRIDAY.

PLEASE HANDLE ALL OPEN FIRES WITH CAUTION DUE TO THE EXTREME FIRE DANGER.

SDZ003-015-060130-
CORSON-DEWEY-
INCLUDING THE CITIES OF...MCINTOSH...TIMBER LAKE...
810 PM CDT WED JUL 5 2006

...VERY HIGH FIRE DANGER TODAY...

THE GRASSLAND FIRE DANGER INDEX WILL REACH THE VERY HIGH CATEGORY THIS AFTERNOON. PARTLY CLOUDY SKIES ARE ANTICIPATED. TEMPERATURES IN THE MIDDLE 80S...AND DEWPOINT TEMPERATURES FROM THE UPPER 40S TO AROUND 50 DEGREES...WILL PRODUCE RELATIVE HUMIDITIES IN THE 25 TO 30 PERCENT RANGE. WINDS WILL BE FROM THE SOUTHEAST TO SOUTH AT 10 MPH.

OUTLOOK FOR TOMORROW...EXTREME.

\$\$

SDZ004-009-016-033>035-045-048-051-060130-
BUFFALO-CAMPBELL-HUGHES-JONES-LYMAN-POTTER-STANLEY-SULLY-WALWORTH-INC
LUDING THE CITIES OF...GANN VALLEY...MOUND
CITY...PIERRE...MURDO...KENNEBEC...GETTYSBURG...FORT
PIERRE...MOBRIDGE...
810 PM CDT WED JUL 5 2006

THE GRASSLAND FIRE DANGER INDEX WILL REACH THE HIGH CATEGORY THIS AFTERNOON. PARTLY CLOUDY SKIES ARE ANTICIPATED. TEMPERATURES FROM 80 TO 85 DEGREES...AND DEWPOINT TEMPERATURES FROM THE UPPER 40S TO THE LOWER 50S...WILL PRODUCE RELATIVE HUMIDITIES IN THE 25 TO 35 PERCENT RANGE. WINDS WILL BE FROM THE SOUTHEAST TO SOUTH AT 10 MPH.

OUTLOOK FOR TOMORROW...VERY HIGH.

\$\$

SDZ005>008-010>011-017>023-036-037-MNZ039-046-060130-
BROWN-CLARK-CODINGTON-DAY-DEUEL-EDMUNDS-FAULK-GRANT-HAMLIN-HAND-HYDE-
MARSHALL-MCPHERSON-ROBERTS-SPINK-BIG STONE-TRAVERSE-
INCLUDING THE CITIES
OF...ABERDEEN...CLARK...WATERTOWN...WEBSTER...CLEAR

APPENDIX 1

ATTACHMENT 3

LAKE...IPSWICH...FAULKTON...MILBANK...HAYTI...MILLER...HIGHMORE...BRI
TON...LEOLA...SISSETON...REDFIELD...ORTONVILLE...WHEATON...
810 PM CDT WED JUL 5 2006

THE GRASSLAND FIRE DANGER INDEX WILL REACH THE LOW CATEGORY THIS
AFTERNOON. CLEAR TO PARTLY CLOUDY SKIES ARE ANTICIPATED. TEMPERATURES
FROM 80 TO 85 DEGREES...AND DEWPOINT TEMPERATURES FROM THE UPPER 40S
TO THE LOWER 50S...WILL PRODUCE RELATIVE HUMIDITIES IN THE 30 TO 35
PERCENT RANGE. WINDS WILL BE FROM THE NORTH AT 5 TO 10 MPH BECOMING
NORTHWEST.

OUTLOOK FOR TOMORROW...MODERATE.

\$\$
TDK

FSDRFDABR
TTAA00 KABR 060907

GRASSLAND FIRE DANGER STATEMENT
NATIONAL WEATHER SERVICE ABERDEEN SD
407 AM CDT THU JUL 6 2006

..DISCUSSION...AN APPROACHING LOW PRESSURE SYSTEM OVER THE ROCKY
MOUNTAINS WILL GENERATE A PERIOD OF BREEZY TO WINDY CONDITIONS FROM
TODAY THROUGH TONIGHT. A COLD FRONT WILL PASS THROUGH THE NORTHERN
PLAINS TONIGHT AND FRIDAY...TURNING WINDS FROM THE SOUTH TO THE
NORTHWEST...AND THERE SHOULD BE A DROP OFF IN WIND SPEEDS. SCATTERED
SHOWERS AND THUNDERSTORMS WILL BE POSSIBLE THIS EVENING THROUGH LATE
FRIDAY NIGHT ACROSS THE DAKOTAS AS THIS LOW PRESSURE SYSTEM MAKES ITS
WAY ACROSS THE REGION.

PLEASE HANDLE ALL OPEN FIRES WITH CAUTION DUE TO THE EXTREME FIRE
DANGER.

SDZ003-004-009-015-016-033>035-045-048-051-062100-
BUFFALO-CAMPBELL-CORSON-DEWEY-HUGHES-JONES-LYMAN-POTTER-STANLEY-SULLY-
WALWORTH-
INCLUDING THE CITIES OF...GANN VALLEY...MOUND CITY...MCINTOSH...TIMBER LAKE...
PIERRE...MURDO...KENNEBEC...GETTYSBURG...FORT PIERRE...
MOBRIDGE...
407 AM CDT THU JUL 6 2006

THE GRASSLAND FIRE DANGER INDEX WILL REACH THE EXTREME CATEGORY THIS
AFTERNOON. PARTLY CLOUDY SKIES ARE ANTICIPATED. TEMPERATURES FROM 85
TO 90 DEGREES...AND DEWPOINT TEMPERATURES FROM THE UPPER 40S TO THE
MIDDLE 50S...WILL PRODUCE RELATIVE HUMIDITIES IN THE 25 TO 30 PERCENT
RANGE. WINDS WILL BE FROM THE SOUTH AT 25 MPH.

OUTLOOK FOR TOMORROW...HIGH.

\$\$

SDZ005-010-017-036-037-062100-
EDMUNDS-FAULK-HAND-HYDE-MCPHERSON-
INCLUDING THE CITIES OF...IPSWICH...FAULKTON...MILLER...HIGHMORE...
LEOLA...
407 AM CDT THU JUL 6 2006

THE GRASSLAND FIRE DANGER INDEX WILL REACH THE VERY HIGH CATEGORY THIS AFTERNOON. PARTLY CLOUDY SKIES ARE ANTICIPATED. TEMPERATURES FROM 85 TO 90 DEGREES...AND DEWPOINT TEMPERATURES FROM THE UPPER 40S TO AROUND 50 DEGREES...WILL PRODUCE RELATIVE HUMIDITIES IN THE 25 TO 30 PERCENT RANGE. WINDS WILL BE FROM THE SOUTH AT 25 MPH.

OUTLOOK FOR TOMORROW...HIGH.

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SDZ006>008-011-018>023-MNZ039-046-062100-
BROWN-CLARK-CODINGTON-DAY-DEUEL-GRANT-HAMLIN-MARSHALL-ROBERTS-SPINK-
BIG STONE-TRAVERSE-
INCLUDING THE CITIES OF...ABERDEEN...CLARK...WATERTOWN...WEBSTER...
CLEAR LAKE...MILBANK...HAYTI...BRITTON...SISSETON...REDFIELD...ORTONVILLE...
WHEATON...
407 AM CDT THU JUL 6 2006

THE GRASSLAND FIRE DANGER INDEX WILL REACH THE LOW CATEGORY THIS AFTERNOON. PARTLY CLOUDY SKIES ARE ANTICIPATED. TEMPERATURES FROM 80 TO 85 DEGREES...AND DEWPOINT TEMPERATURES FROM 50 TO 55 DEGREES ...WILL PRODUCE RELATIVE HUMIDITIES IN THE 30 TO 40 PERCENT RANGE. WINDS WILL BE FROM THE SOUTH AT 20 MPH.

OUTLOOK FOR TOMORROW,,,LOW.

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FNUS63-KABR 060907
RFDABR

GRASSLAND FIRE DANGER STATEMENT
NATIONAL WEATHER SERVICE ABERDEEN SD
407 AM CDT THU JUL 6 2006

...DISCUSSION...AN APPROACHING LOW PRESSURE SYSTEM OVER THE ROCKY MOUNTAINS WILL GENERATE A PERIOD OF BREEZY TO WINDY CONDITIONS FROM TODAY THROUGH TONIGHT. A COLD FRONT WILL PASS THROUGH THE NORTHERN PLAINS TONIGHT AND FRIDAY...TURNING WINDS FROM THE SOUTH TO THE NORTHWEST...AND THERE SHOULD BE A DROP OFF IN WIND SPEEDS. SCATTERED SHOWERS AND THUNDERSTORMS WILL BE POSSIBLE THIS EVENING THROUGH LATE FRIDAY NIGHT ACROSS THE DAKOTAS AS THIS LOW PRESSURE SYSTEM MAKES ITS WAY ACROSS THE REGION.

APPENDIX 1

ATTACHMENT 3

PLEASE HANDLE ALL OPEN FIRES WITH CAUTION DUE TO THE EXTREME FIRE DANGER.

SDZ003-004-009-015-016-033>035-045-048-051-062100-
BUFFALO-CAMPBELL-CORSON-DEWEY-HUGHES-JONES-LYMAN-POTTER-STANLEY-SULLY-
WALWORTH-
INCLUDING THE CITIES OF...GANN VALLEY...MOUND CITY...MCINTOSH...TIMBER LAKE...
PIERRE...MURDO...KENNEBEC...GETTYSBURG...FORT PIERRE...
MOBRIDGE...
407 AM CDT THU JUL 6 2006

THE GRASSLAND FIRE DANGER INDEX WILL REACH THE EXTREME CATEGORY THIS AFTERNOON. PARTLY CLOUDY SKIES ARE ANTICIPATED. TEMPERATURES FROM 85 TO 90 DEGREES...AND DEWPOINT TEMPERATURES FROM THE UPPER 40S TO THE MIDDLE 50S...WILL PRODUCE RELATIVE HUMIDITIES IN THE 25 TO 30 PERCENT RANGE. WINDS WILL BE FROM THE SOUTH AT 25 MPH.

OUTLOOK FOR TOMORROW...HIGH.

\$\$

SDZ005-010-017-036-037-062100-
EDMUNDS-FAULK-HAND-HYDE-MCPHERSON-
INCLUDING THE CITIES OF...IPSWICH...FAULKTON...MILLER...HIGHMORE...
LEOLA...
407 AM CDT THU JUL 6 2006

THE GRASSLAND FIRE DANGER INDEX WILL REACH THE VERY HIGH CATEGORY THIS AFTERNOON. PARTLY CLOUDY SKIES ARE ANTICIPATED. TEMPERATURES FROM 85 TO 90 DEGREES...AND DEWPOINT TEMPERATURES FROM THE UPPER 40S TO AROUND 50 DEGREES...WILL PRODUCE RELATIVE HUMIDITIES IN THE 25 TO 30 PERCENT RANGE. WINDS WILL BE FROM THE SOUTH AT 25 MPH.

OUTLOOK FOR TOMORROW...HIGH.

\$\$

SDZ006>008-011-018>023-MNZ039-046-062100-
BROWN-CLARK-CODINGTON-DAY-DEUEL-GRANT-HAMLIN-MARSHALL-ROBERTS-SPINK-
BIG STONE-TRAVERSE-
INCLUDING THE CITIES OF...ABERDEEN...CLARK...WATERTOWN...WEBSTER...
CLEAR LAKE...MILBANK...HAYTI...BRITTON...SISSETON...REDFIELD...ORTONVILLE...
WHEATON...
407 AM CDT THU JUL 6 2006

THE GRASSLAND FIRE DANGER INDEX WILL REACH THE LOW CATEGORY THIS AFTERNOON. PARTLY CLOUDY SKIES ARE ANTICIPATED. TEMPERATURES FROM 80 TO 85 DEGREES...AND DEWPOINT TEMPERATURES FROM 50 TO 55 DEGREES...WILL PRODUCE RELATIVE HUMIDITIES IN THE 30 TO 40 PERCENT RANGE. WINDS WILL BE FROM THE SOUTH AT 20 MPH.

OUTLOOK FOR TOMORROW,,,LOW.

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FSDRFDABR
TTAA00 KABR 060907

LANS2 Past Conditions

Page 1 of 1

Past Weather Conditions for LANS2

Observations prior to selected time: July 07, 2006 - 00:00 MDT

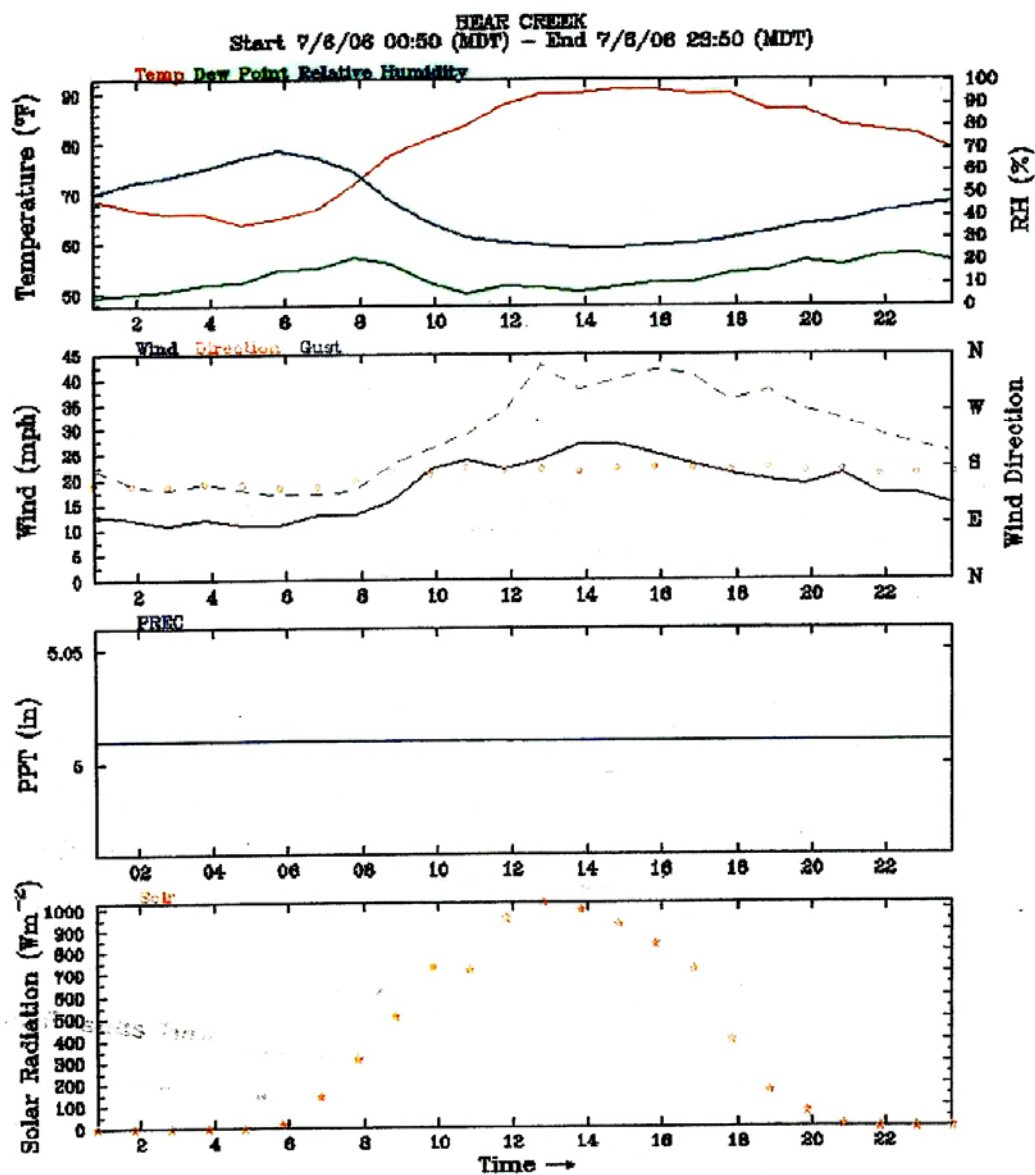
Weather Conditions at July 6, 2006 - 23:50 MDT

	23:50	24 Hour Max	24 Hour Min
Temperature	79.0° F	91.0 at 14:50	64.0 at 4:50
Dew Point	56.4° F	57.9 at 22:50	49.6 at 0:50
Relative Humidity	46%	70 at 5:50	26 at 13:50
Wind Speed	15 mph from S	27 at 13:50	11 at 2:50
Wind Gust	25 mph	43 at 12:50	17 at 5:50
Solar Radiation	0.0 W/m²m	1029.0 at 12:50	0.0 at 0:50
Fuel Temperature	77.0° F	104.0 at 14:50	62.0 at 4:50
Battery voltage	12.70 volt	13.20 at 8:50	12.60 at 0:50

Precipitation accumulated since midnight: 0.00", in 24 hours: 0.00"**Tabular Listing: July 6, 2006 - 0:00 through July 07, 2006 - 00:00 MDT**

Time(MDT)	Temperature °F	Dew Point °F	Relative Humidity %	Wind Speed mph	Wind Gust mph	Wind Direction	Quality check	Solar Radiation W/m²m	Precipitation accumulated in	Fuel Temperature °F	Battery voltage volt
23:50	79.0	56.4	46	15	25	S	N/A	0.0	5.01	77.0	12.70
22:50	82.0	57.9	44	17	27	SSE	N/A	0.0	5.01	79.0	12.70
21:50	83.0	57.5	42	17	29	SSE	N/A	0.0	5.01	82.0	12.70
20:50	84.0	55.6	38	21	32	S	N/A	10.0	5.01	84.0	12.80
19:50	87.0	56.8	36	19	34	S	N/A	70.0	5.01	85.0	12.80
18:50	87.0	54.4	33	20	38	S	OK	165.0	5.01	88.0	13.00
17:50	90.0	54.4	30	21	36	S	OK	395.0	5.01	93.0	13.00
16:50	90.0	52.5	28	23	41	S	OK	719.0	5.01	100.0	13.00
15:50	91.0	52.3	27	25	42	S	OK	837.0	5.01	104.0	13.00
14:50	91.0	51.3	26	27	40	S	OK	932.0	5.01	104.0	13.00
13:50	90.0	50.5	26	27	38	S	OK	996.0	5.01	100.0	13.00
12:50	90.0	51.5	27	24	43	S	OK	1029.0	5.01	102.0	13.00
11:50	88.0	51.7	29	22	34	S	OK	955.0	5.01	99.0	13.00
10:50	84.0	50.1	31	24	29	S	OK	718.0	5.01	95.0	13.10
9:50	81.0	52.2	37	22	26	SSE	OK	732.0	5.01	90.0	13.10
8:50	78.0	56.1	47	16	23	S	OK	505.0	5.01	86.0	13.20
7:50	72.0	57.3	60	13	18	SSE	OK	316.0	5.01	73.0	13.10
6:50	67.0	55.3	66	13	17	SSE	OK	142.0	5.01	70.0	13.00
5:50	65.0	55.0	70	11	17	SSE	OK	18.0	5.01	64.0	12.60
4:50	64.0	52.4	66	11	18	SSE	OK	0.0	5.01	62.0	12.60
3:50	66.0	52.2	61	12	19	SSE	OK	0.0	5.01	66.0	12.60
2:50	66.0	50.8	58	11	18	SSE	OK	0.0	5.01	65.0	12.60
1:50	67.0	50.3	55	12	19	SSE	OK	0.0	5.01	67.0	12.60
0:50	69.0	49.6	50	13	22	SSE	OK	0.0	5.01	69.0	12.60
23:50	70.0	48.8	47	12	23	SE	OK	0.0	5.01	68.0	12.70

[NOAA Cooperative Institute for Regional Prediction](#)For Questions or Comments about this page or MesoWest contact mesowest@met.utah.edu[Privacy Policy](#)http://raws.wrh.noaa.gov/cgi-bin/roman/meso_table_mesowest.cgi?stn=LANS2&unit=0&m... 8/1/2006



ATTACHMENT 5

Cheyenne River Agency Fuels and Weather Monitoring

(Pre-Club House Fire)

Readings for RU332 (35 miles southwest of Club House Fire):

<u>Date</u>	<u>Time</u>	<u>Dry</u>	<u>Wet</u>	<u>RH</u>	<u>1 hr</u>	<u>10 hr</u>	<u>100 hr</u>	<u>1000 hr</u>	<u>Lat.</u>	<u>Long.</u>
6/26/06	0840	88	61	19	3%	4%	6%	13%	44/45/39.2	101/57/59.6

Readings for Iron Lightning (30 miles west of Club House Fire):

<u>Date</u>	<u>Time</u>	<u>Dry</u>	<u>Wet</u>	<u>RH</u>	<u>1 hr</u>	<u>10 hr</u>	<u>100 hr</u>	<u>1000 hr</u>	<u>Lat.</u>	<u>Long.</u>
6/26/06	1213	84	63	21	4%	5%	7%	16%	45/11/19.7	101/50/51.5

Readings for Swiftbird; Old Prison Site (elevation 1,864, 48 miles east of Club House Fire):

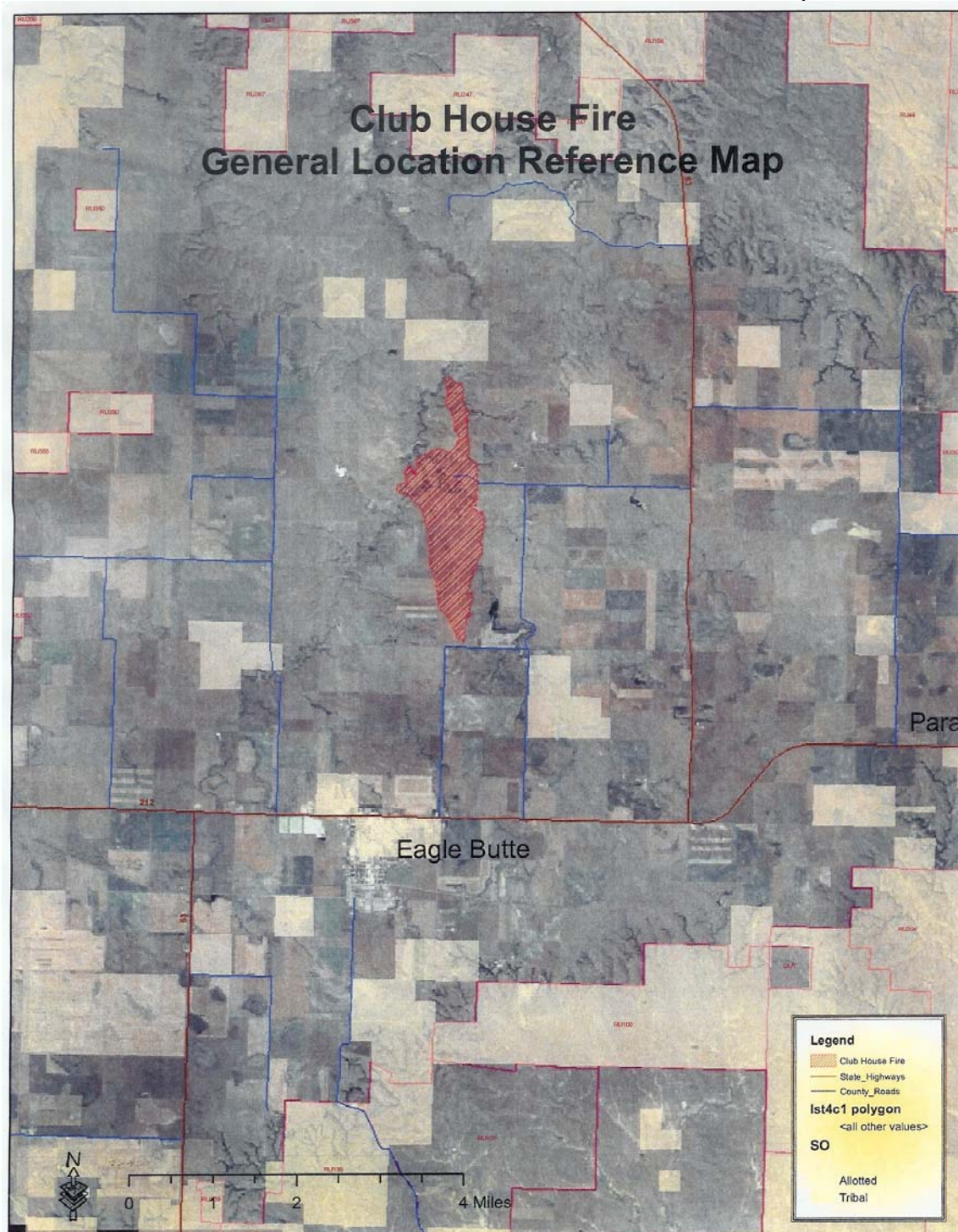
<u>Date</u>	<u>Time</u>	<u>Dry</u>	<u>Wet</u>	<u>RH</u>	<u>1 hr</u>	<u>10 hr</u>	<u>100 hr</u>	<u>1000 hr</u>	<u>Lat.</u>	<u>Long.</u>
6/27/06	0815	74	56	*43	9%	6%	9%	*70%	45/03/22.1	100/20/56.3

* High RH and 1,000 hour fuel moistures due to rain yesterday afternoon/evening.

This map of South Dakota displays its geographical and administrative features. Major cities such as Pierre, Rapid City, and Sioux Falls are marked. The state is crisscrossed by a network of highways, including Interstates 90, 29, and 05. Neighboring states are labeled: Montana to the north, North Dakota to the northeast, Minnesota to the east, Iowa to the southeast, Nebraska to the south, and Wyoming to the southwest. A prominent red arrow points to Pierre, the state capital. The map also shows significant water bodies like Lake Oahe and Lake De Smet, and the Badlands National Park. Latitude and longitude coordinates are provided along the map's borders.

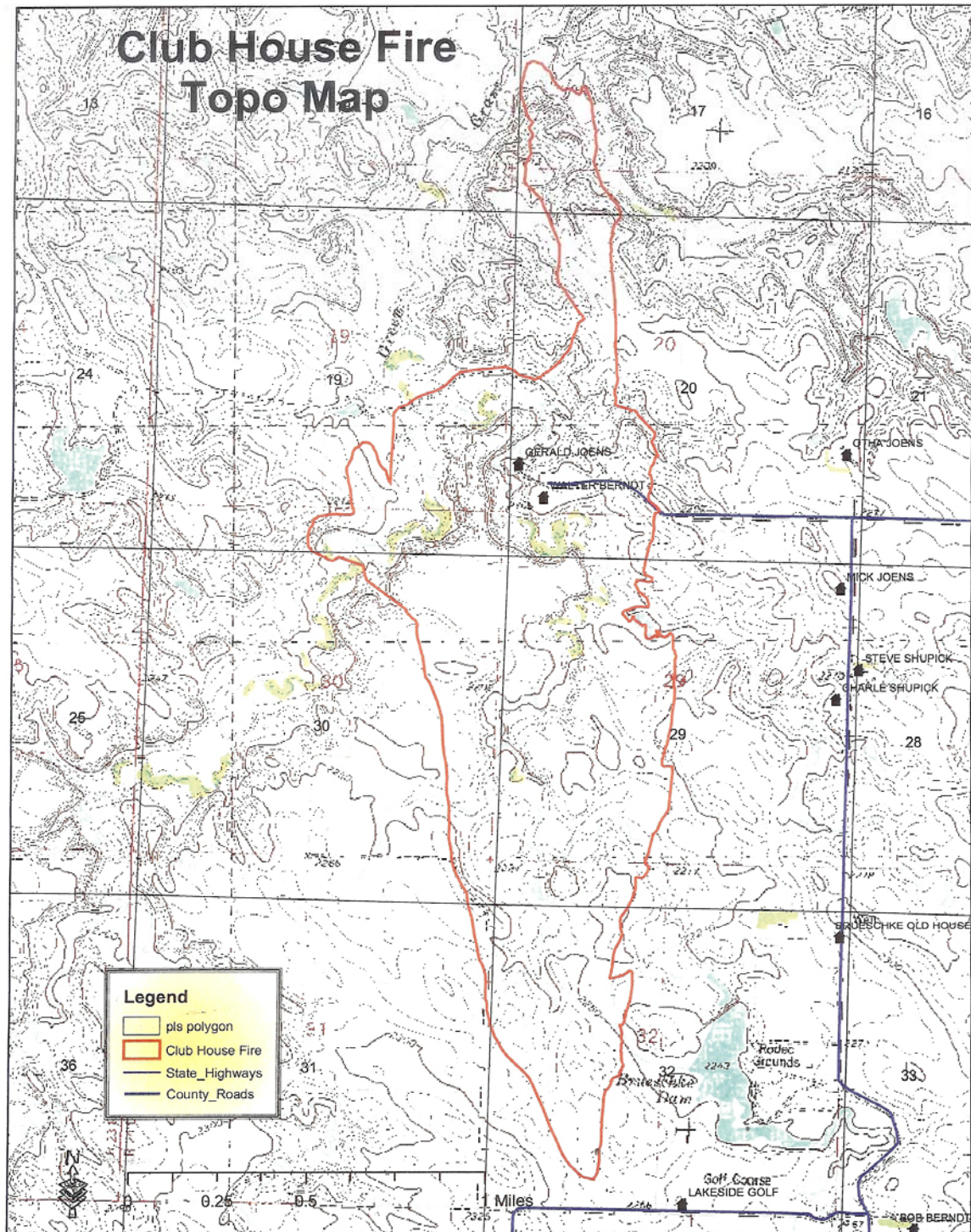
Red arrow locates Eagle Butte, SD where the Clubhouse Fire occurred on July 6, 2006 about three miles northeast of Eagle Butte. Starting in an unharvested wheat field it was pushed by high winds and quickly spread into range grasses.

APENDIX 3: Club House Fire Location Reference Map



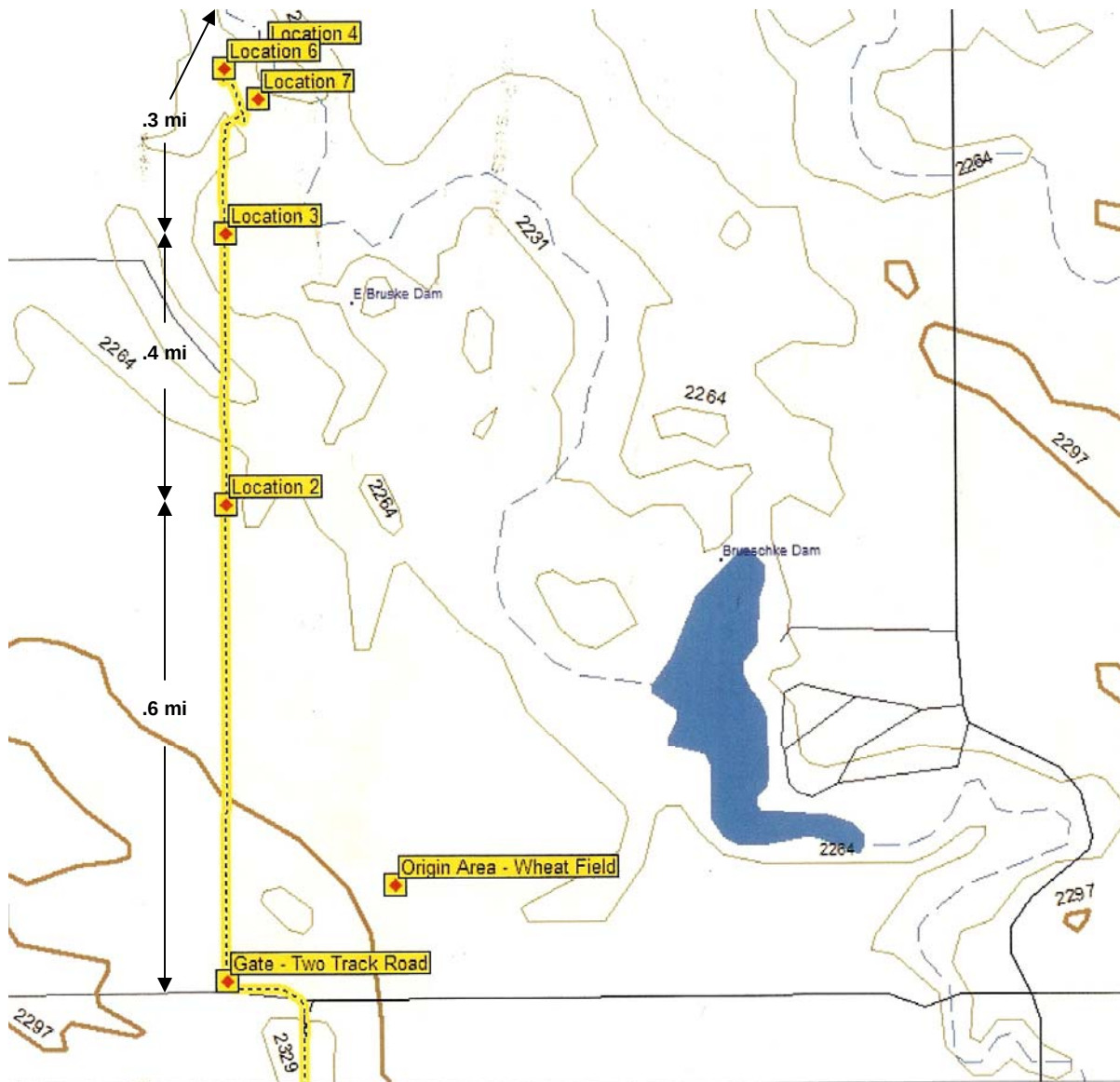
This map is an orthographic photograph with enhancements and overlay of the final Clubhouse Fire final perimeter.

APPENDIX 4: Club House Fire Topographic Map



This topographic map is overlain with the final perimeter of the Clubhouse fire.

APPENDIX 5: GPS Map of Locations of Events



Location 2: End of the wheat field with fence line running west to east and south along the east side of the two track road.

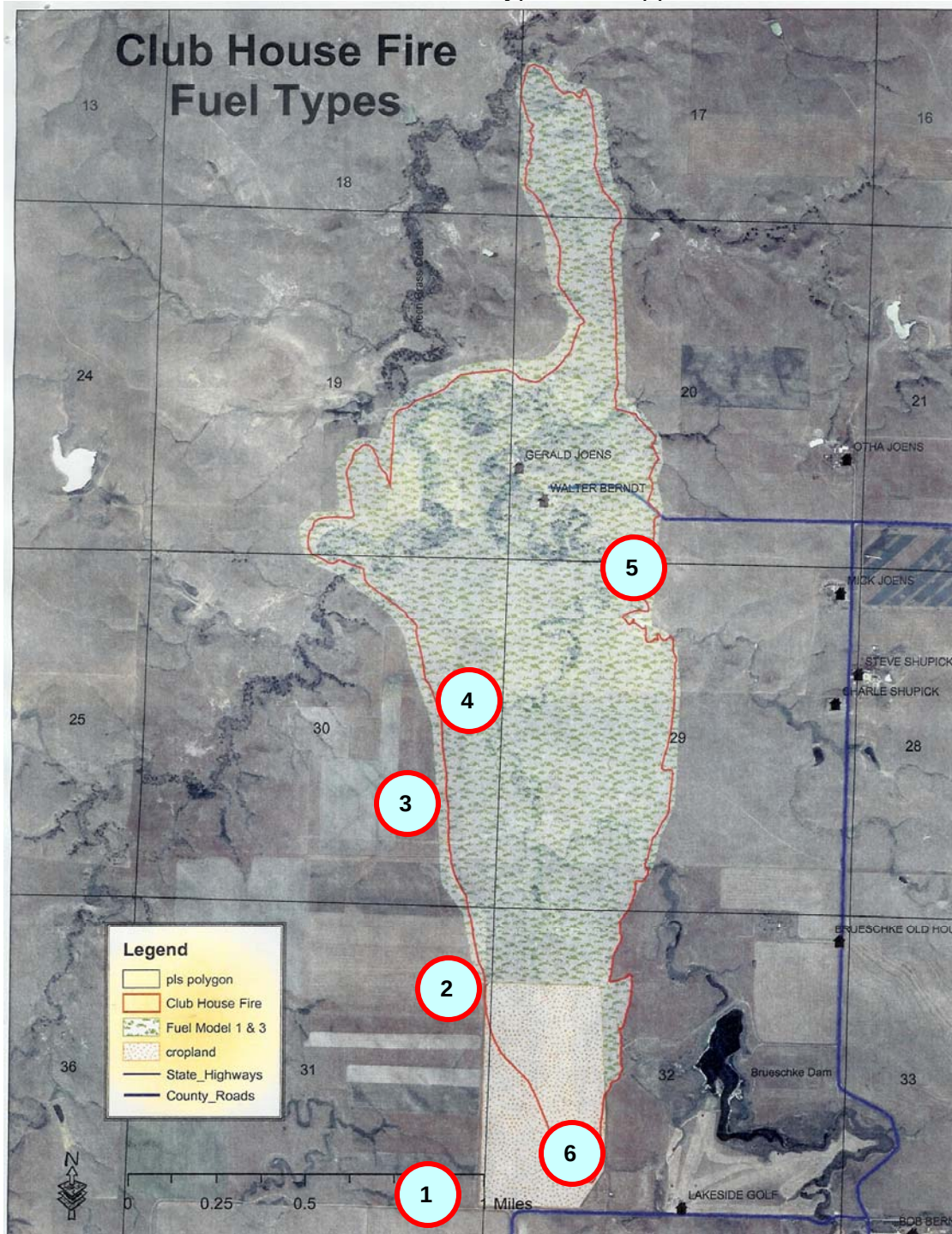
Location 3: Approximate location where the burnout line was considered tying into E Brueschke Dam, which is east of Location 3 marker at the stream course marked with dashed blue line.

Location 4 (5): Where the burnout was to begin and wet line was applied.

Location 6: Where Brady Ward hit the side of a gully and stalled the IC Vehicle and was subsequently burned.

Location 7: Approximate location where Brady Ward drove his IC Vehicle and bumped into E-001 with Brad LeCompte and Firefighter #2 Thompson.

APPENDIX 6: Clubhouse Fire Fuel Types and Approximate Locations



1. Gate that opens two-track road going north.
2. End of wheat field and first consideration for a wet line and burnout.
3. Second consideration for a wet line and backfire that would tie into East Brueschke Dam.
4. Site of the third backfire line consideration and subsequent entrapment and burnover.
5. Approximate site of motor vehicle accident between E-002 and E-001.
6. Fire origin area.

APPENDIX 7: PHOTOGRAHS

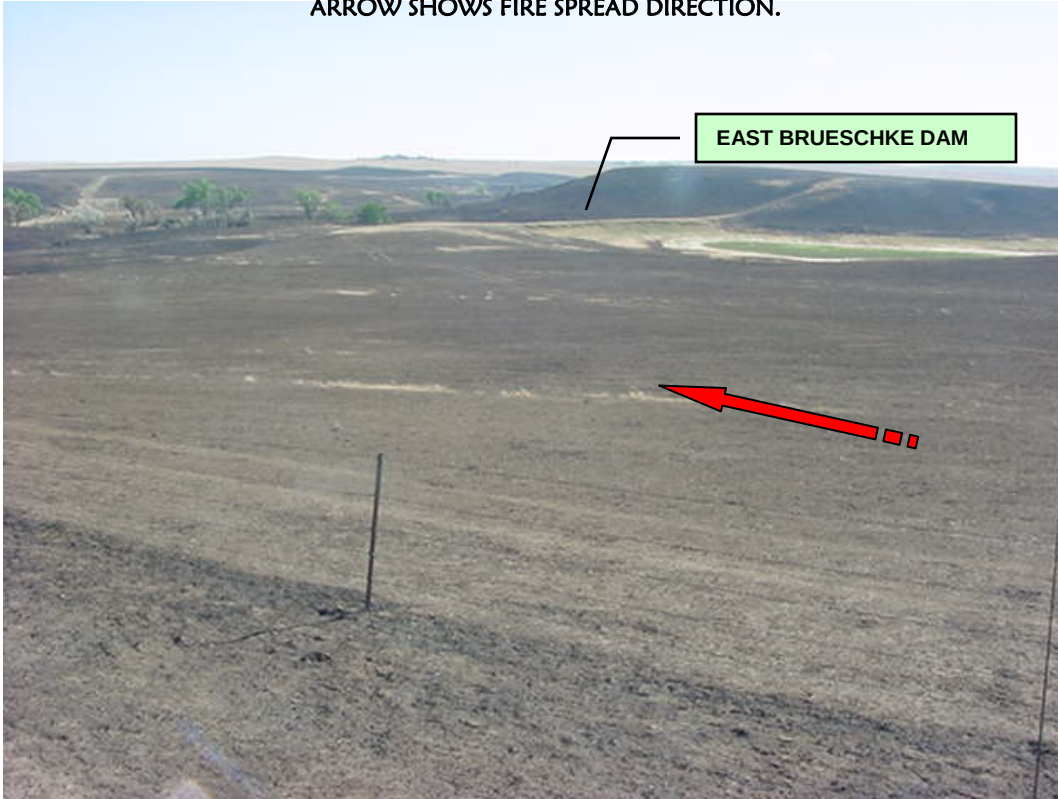
1. SHOWING ORIGIN AREA AND BRUESCHKE DAM: LOOKING NORTHEAST



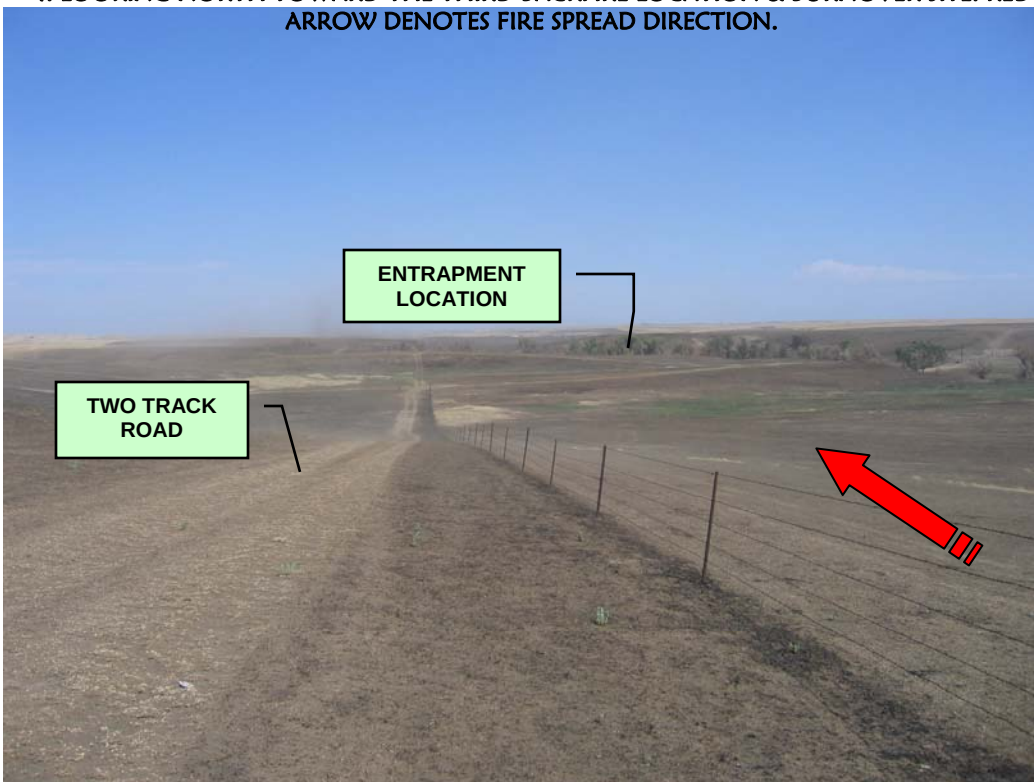
2. LOOKING EAST FROM TWO-TRACK ROAD AT FIRST BACKFIRE LOCATION WHICH WAS IMMEDIATELY ABANDON DUE TO THE APPROACHING FIRE FRONT.



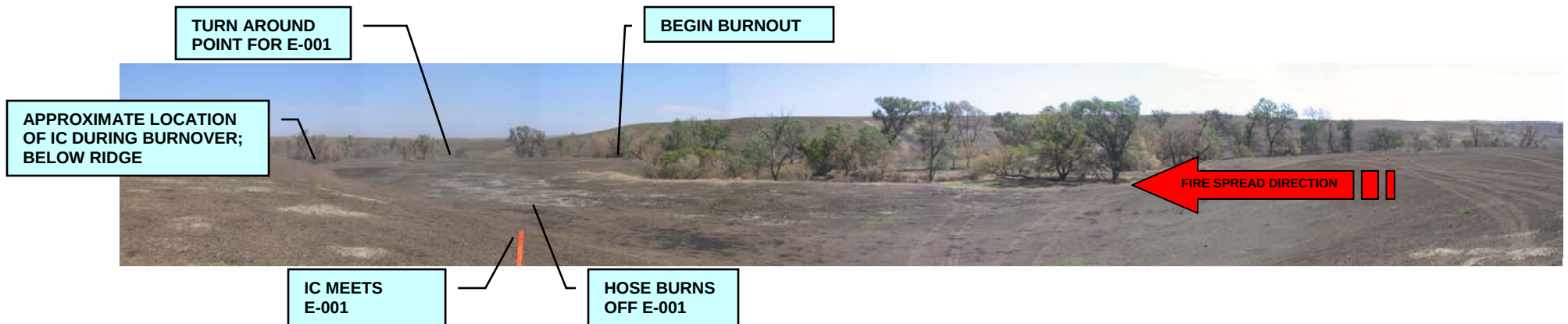
3. SECOND LOCATION FOR BACKFIRE ATTEMPT – E BRUESCHKE DAM NE OF PHOTO SITE. RED ARROW SHOWS FIRE SPREAD DIRECTION.



4. LOOKING NORTH TOWARD THE THIRD BACKFIRE LOCATION & BURNOVER SITE. RED ARROW DENOTES FIRE SPREAD DIRECTION.



5. PANORAMA LOOKING NORTH TOWARD ENTRAPMENT SITE WITH WET LINE ANCHOR IN THE DRAW ALONG THE EAST SIDE OF BURNOUT.



6. PANORAMA LOOKING SOUTH AT DRY CREEK BED NEAR THE ANCHOR POINT OF THE WET LINE. COTTOWOODS OBSCURE A PORTION OF THE ADVACING FIRE FRONT FROM THE SOUTH. INSERT PHOTOGRAPH SHOWS TYPICAL GRASS FUELS OUTSIDE THE WHEAT FIELD.



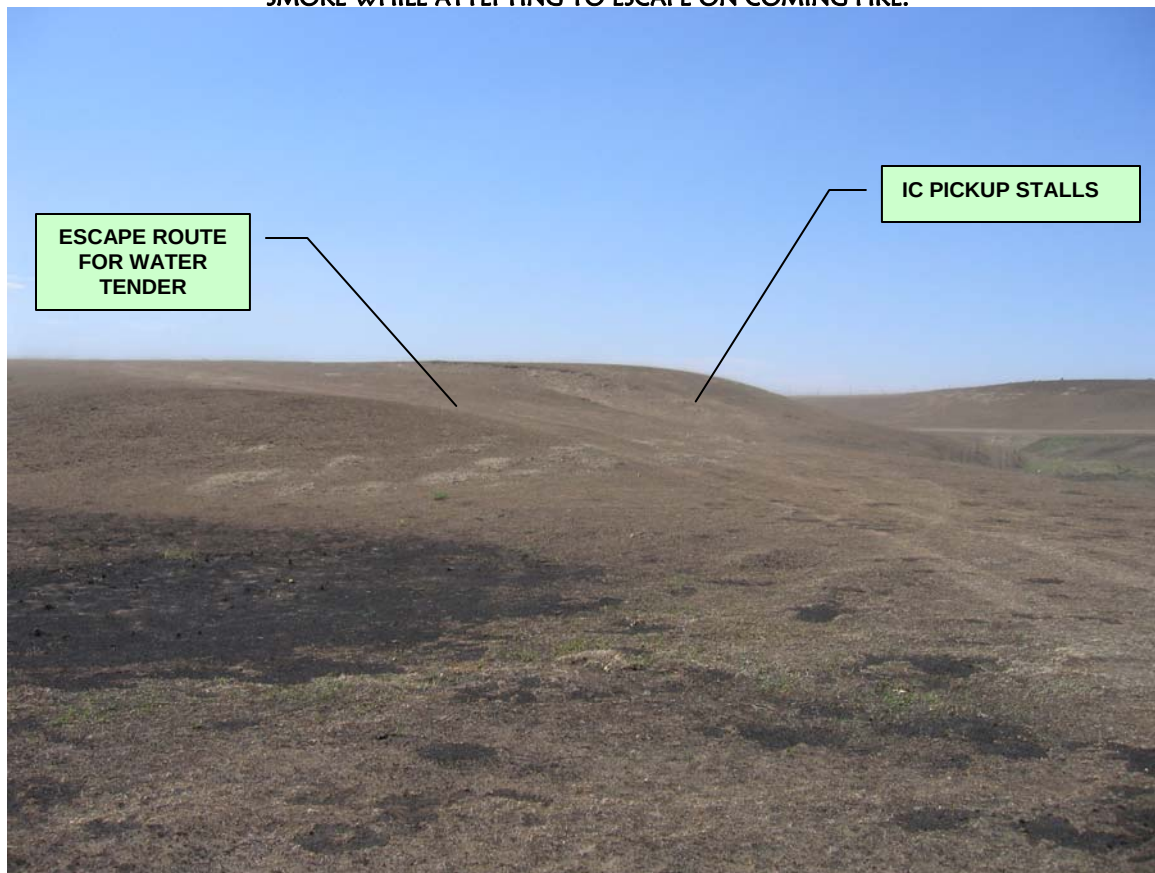
10. LOOKING EAST ALONG THE WET LINE TOWARD DRY CREEK BED ANCHOR POINT. WET LINE IS UNBURNED AREA LOCATED IN PHOTO CENTER. FIRE FRONT MOVED FROM RIGHT TO LEFT.



11. LOOKING EAST FROM THE STALL OUT SPOT OF IC'S TRUCK TOWARD WET LINE WHERE IT TIED INTO THE CREEK BED. PICKUP IS LOCATED ON THE ESCAPE ROUTE OF FIREFIGHTER #3. FIRE FRONT ADVANCED FROM RIGHT TO LEFT.



12. LOOKING WEST TO ESCAPE ROUTE TO RIDGE TOP AND WHERE IC STALLS PICKUP IN HEAVY SMOKE WHILE ATTEMPTING TO ESCAPE ON COMING FIRE.



13. MARKS AT THE POINT WHERE IC PICKUP STALLS JUST BEFORE IMPACT OF THE FIRE FRONT WHICH IS MOVING LEFT TO RIGHT.



14. WALTER BERNDT RANCH THAT LAY AHEAD OF THE FIRE FRONT. PHOTO LOOKING NORTH.



15. ACCIDENT SITE INVOLVING E-002 AND E-001.



16. PHOTOGRAPHS OF DAMAGE TO E-001 (TOP) AND IC VEHICLE (BOTTOM). DENTS – SCRAPES –
PAINT BLISTERS – MELTED EXPOSED PLASTIC

