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UTAH GEOLOGICAL SURVEY

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August 1, 2003

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125 South State Street
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RE: Preliminary post-fire debris-flow and flood hazard assessment for the July 2003 Farmington fire, Farmington, Utah

Dear Paul:

This letter provides my preliminary fire-related debris-flow and flood hazard assessment for the July 2003 Farmington fire. I believe the conditions created by the Farmington fire heighten the hazard from debris flows and floods, and recommend implementing watershed and other protective measures where necessary.

Based on my field reconnaissance and review of information for the July 2003 Farmington fire, I conclude the following:

- Post-fire debris flows and floods may be generated in the drainages within the burn area due to the loss of vegetation, erodible soils on steep hillslopes, and erodible sediment stored in steep channels.

- The Farmington fire burned small areas of the Shepard Creek and Steed Canyon (Hornet Creek tributary) drainage basins. Because the percentage of areas burned compared to the size of the drainage basins is small, I believe the fire has not significantly changed the debris-flow and flood potential of these drainages.

- Farmington Canyon and Rudd Creek are two large drainage basins partially within the burn area that already contain debris basins (shown on the attached maps). Likely volumes of post-fire debris flows and floods will need to be estimated to judge the adequacy of the debris basins.

- The small mountain-front drainage basins east of Farmington between Shepard and Steed Creeks are completely or partially burned, and flows from the mouths of these drainages (shown on the attached maps) can travel into the developed residential areas of Farmington.

- During my field reconnaissance I observed several locations where sediment fences were recently installed within or below the small drainages along the mountain front. These sediment fences should help reduce the amount of sediment in floods and the potential for debris flows.

- Although the short-term post-fire debris-flow and flood hazards from all drainages within the burn area has been heightened, a long-term non-fire-related debris-flow and flood hazard also exists that will remain after the drainages have revegetated.

Regarding the potential for fire-related debris flows and floods from the Farmington fire burn area, I recommend the following:

- Measures should be taken to rehabilitate and establish vegetation in the burned drainages where necessary.

- Because it takes several years for vegetation in burned watersheds to recover to pre-burn conditions, the short-term debris-flow and flooding hazards will be heightened for several years. In addition, debris-flow and flooding hazards existed before the fire and will remain after the vegetation recovers to pre-burn conditions.

- The U.S. Natural Resources Conservation Service (NRCS) Emergency Watershed Protection (EWP) program should be used to assess hazards to houses and infrastructure below the small fire-impacted drainages. Where necessary, the EWP can provide funding to implement temporary measures to reduce transport of sediment into developed areas and route flows to minimize potential damages.

- The EWP measures are temporary and address only the short-term debris-flow and flood hazards following a wildfire. Houses below these small drainages remain exposed to long-term debris-flow and flood hazards, and Farmington City should consider how to permanently manage these hazards.

For this hazard assessment, I studied the Wasatch-Cache National Forest burn-intensity map, relevant geologic maps, Davis County hazard maps, and aerial photographs. I used aerial photographs (at various scales) dated 1937, 1980, 1985, 1986, and 1989 that covered different portions of the burn area and Farmington City. A substantial amount of information on Farmington debris flows exists and I have attached a list of cited references. I performed a field reconnaissance of the western portion of the burn area and the eastern boundary of Farmington on July 28, 2003.

Debris flows consist of rock, soil, and other debris that mix with water from intense

thunderstorms or spring snowmelt and travel downslope at high speeds. Because of their considerable mass and speed, debris flows are a threat to life and can damage anything in their path, such as buildings, roads, and utility lifelines (water, gas, sewer, and electricity). Debris flows are much more damaging than flash floods, but are generally more restricted in the area they impact.

From an historical perspective, stream-flooding, alluvial-fan-flooding, and debris-flow hazards are the most frequent and destructive geologic hazard affecting Farmington. Davis County has sustained more loss of life and property damage from flash floods and debris flows than any other county along the Wasatch Front (Marsell, 1972). The majority of these floods and debris flows were produced by cloudburst rainfall (Woolley, 1946; Croft, 1967; Butler and Marsell, 1972; Pack, 1985). Debris flows were also triggered by rapid snowmelt in Shepard, Farmington, Rudd, and Steed drainages in 1983 and 1984. The fact that large-volume debris flows have been triggered by thunderstorm rainfall in Farmington Canyon (Croft, 1981; Wieczorek and others, 1983) on unburned watersheds is evidence that large thunderstorms with intense rainfall can occur in the area, and that debris-flow hazards exist even without fires.

Fire-related debris flows have been triggered with small amounts of thunderstorm precipitation. The September 12, 2002, fire-related debris flows from Dry Mountain that damaged Spring Lake and Santaquin in Utah County were triggered by only 0.27 inch of intense thunderstorm rainfall (Giraud and others, 2003) following a period of sustained gentle rainfall. Cannon and others (2003) state that storms with recurrence intervals of between 2 and 5 years have produced fire-related debris flows in Colorado. In Utah, post-fire debris flows and debris floods have recently occurred in or near:

- Lake Point on August 23, 2000 (Big Canyon debris flow, Borrow Pit fire);
- Vivian Park/South Fork Provo River on August 31, 2000 (South Fork debris flow, Wasatch fire complex);
- Alpine on August 21, 2001, and September 6, 2002 (Preston Canyon debris flows, Oak Hills fire);
- Nephi on July 15, 2002 (Birch Creek debris flow, Birch Creek fire); and
- Santaquin and Spring Lake on September 12, 2002 (Dry Mountain/Santaquin debris flows, Mollie fire).

The Farmington fire has similarities to the above fires and has the potential to produce fire-related debris flows and floods.

I have attached two maps, one on an orthophoto and another on a topographic base map, showing mapped alluvial fans (compiled from Lowe, 1988a, 1988b, 1988c, 1988d; Nelson and Personius, 1993) in Farmington. These alluvial fans can be used as a general indication of areas at risk because sediment-laden floods and debris flows have occurred here in the past. Flood waters typically extend downslope to areas below the alluvial fan. However, natural flow paths and depositional areas both on and below alluvial fans may have been modified by development. The map also shows the mouths of small, mostly first-order drainage basins along the mountain front where flows enter Farmington and are largely uncontrolled.

Both Farmington Canyon and Rudd Creek have produced historical debris flows (Keaton and Lowe, 1998). As a result, the Farmington Pond and Rudd Creek debris basins (shown on the

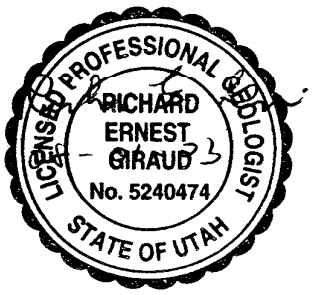
attached maps) were constructed to control debris flows and floods. The ability of these basins to protect Farmington is dependent on basin capacity. The Farmington Pond and Rudd Creek debris basins have capacities of 168,600 and 46,000 cubic yards, respectively (Keaton and Lowe, 1998). Historical debris-flow volumes (non fire-related) listed by Keaton and Lowe (1998) have exceeded the capacities of both of these debris basins. However, if the basin capacity is exceeded, a properly functioning debris basin passing the excess volume through a spillway has still significantly reduced the hazard because the total volume is reduced, and the peak flow, peak velocity, and impacts from coarse sediment are reduced by basin capture. Even though the debris basins provide a level of protection for houses and infrastructure on the associated alluvial fans, debris flows and floods can damage other infrastructure such as roads, bridges, culverts, pipelines, and irrigation diversions within the drainage above the debris basins.

The potential volumes of sediment in debris flows and floods produced by the small drainages east of Farmington are small compared to those produced by Farmington and Rudd Creeks, generally due to less stored sediment in channels, less channel length available to scour, and smaller volumes of runoff. Recent fire-related debris flows indicate that the majority of the sediment volume is scoured from the main channel by progressive sediment bulking (McDonald and Giraud, 2002). A small drainage basin that was burned during the Tank fire (1996) near Orem, similar in size and steepness to those east of Farmington, produced a debris flow/debris flood following thunderstorm rainfall on September 7, 1997 (Solomon and Giraud, 1998). This flow scoured an estimated 2,800 cubic yards of sediment from 3,700 feet of channel. Sediment fences (14 total) installed in the channel by the NRCS trapped much of the sediment from this event, particularly boulders and cobbles, and reduced damages. However, water runoff associated with the flow extended for 5,000 feet along city streets below the drainage mouth in Orem. I believe the small drainages east of Farmington could produce similar or larger volumes of sediment. Evanstad and Rasely (1995) estimate the present condition, low intensity burn, and high intensity burn annual sediment yield for some of the small drainage east of Farmington. However, Evanstad and Rasely (1995) state that their sediment yields cannot be used to estimate potential debris volumes in debris flows because their model does not account for channel sediment bulking.

In summary, the Farmington fire has elevated the hazard from debris flows and floods, and I recommend implementing emergency watershed and other protective measures, particularly below the small drainages east of Farmington, to reduce these hazards. If you have any questions regarding this letter, please contact me (801-537-3351).

Sincerely,

Richard E. Giraud, Senior Geologist
Geologic Hazards Program



Attachments

cc Max Forbush, City Manager, Farmington City
David Adamson, Public Works Director, Davis County
Brian Law, Davis County Sheriff's Office, Emergency Services Coordinator
Bob Rasely, Natural Resources Conservation Service, Salt Lake Office
Nancy Barr, Utah State Division of Emergency Services and Homeland Security
Brain McInerney, National Weather Service, Salt Lake

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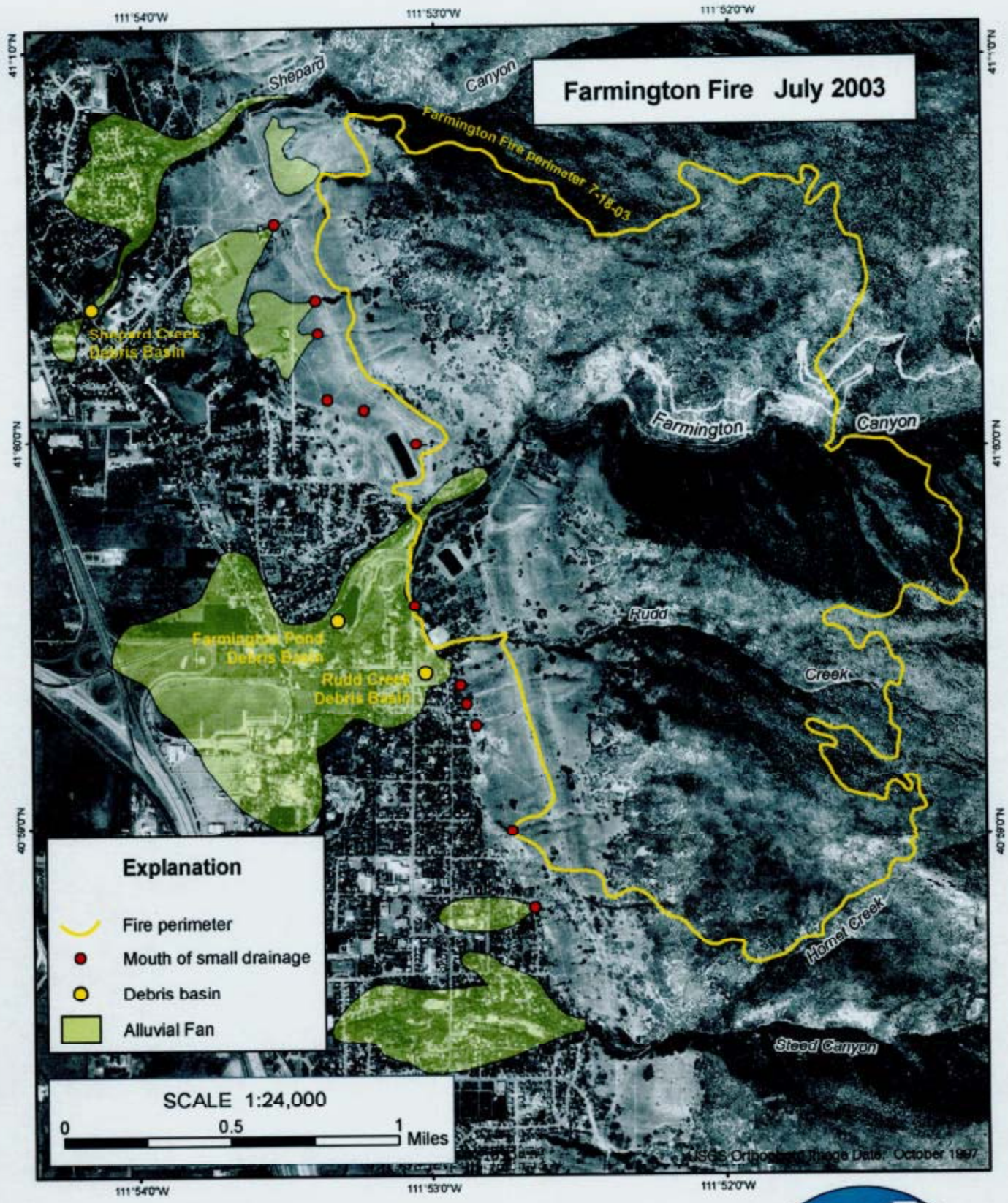

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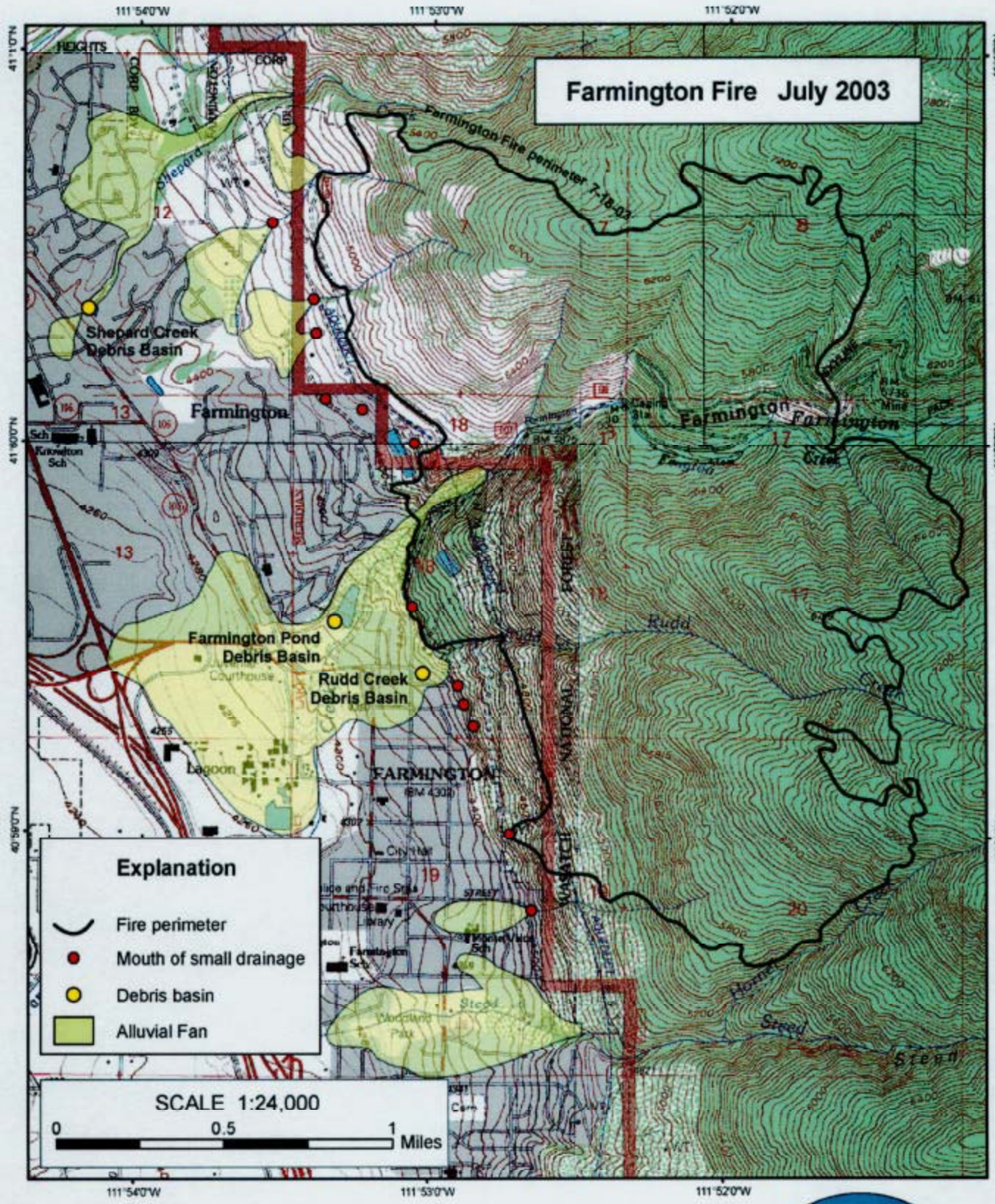

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