STAFFORD FIRE FIELD REVIEW - OCTOBER 1, 2012
Notes by Juan de la Fuente (Updated 10-3-12)

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Background

The BAER team for the Stafford Fire recently completed their assessment and provided recommendations to Shasta-Trinity National Forest. Two small watersheds burned at high severity, Negro Gulch and a similar sized unnamed watershed immediately to the south (Stafford_Maps_Figures.pdf, Map 1). The District requested further evaluation of the potential for landslides and debris flows in these watersheds. One historic post-fire debris flow is known to have occurred south of the fire in a tributary to Bridge Gulch. This event occurred in 1992, a year after the China Fire which occurred in 1991, which delivered sediment into Natural Bridge Gulch, a tributary to Hayfork Creek (see attachment 1992 Debris Flow_1992 China Fire.pdf).

Bedrock: The bedrock consists mostly of metasediments of the Eastern Hayfork Terrane, including bodies of marble, along with several pockets of ultramafic rock.

Geomorphic Features: The Forest geomorphic layer identifies a number of dormant landslides and inner gorges within the fire boundary (Stafford_Maps_Figures.pdf, Map 1). Several of these features were field verified, along with some additional non-mapped landslides ("Dormant Slumps" on Stafford_Maps_Figures.pdf, Map 2).

Purpose

The purpose of this investigation was to further evaluate the landslide and debris flow potential in two small watersheds which burned at high severity (Stafford_Maps_Figures.pdf, Map 1), and to offer recommendations for treatments if appropriate.

Summary of Findings

General: The potential for landslides and debris flows will be very high for 0-5 years after the fire in the two severely burned watersheds indicated on Stafford_Maps_Figures.pdf, Map 1 (Negro Gulch and the unnamed watershed to the south). This potential will persist even longer (5-15 years) where dormant landslides were significantly affected by the fire. A large increase in sediment from these watersheds can be anticipated, thus having the potential to impact Hayfork Creek. Field sites which present critical watershed issues include the following:

1. **Stream Crossing on Road 31N13-** There is a very high risk of debris flows at this site, and it will likely overwhelm the storage capacity above the culvert.
2. **Active Landslide below Road 31N51A-** The potential for reactivation of this landslide is high, and has the ability to deliver on the order of 10,000 cubic yards of debris to the stream.
3. **Loose Fill at the North End of Road 31N51A-** The fire undermined fill from an abandoned pioneer road which could mobilize on the order of 100 cubic yards of material on the hillslope, and has the potential to reach the stream below.

These sites are described in detail below under *Field observations along Road 31N51A and Field observations on Road 31N13*, along with options for treatments and potential monitoring activities at specific sites. In addition to site level monitoring, installation of at least two tipping bucket rain gage is recommended along road 31N13 and 31N51A.

Limitations: This investigation was a site specific reconnaissance; therefore a very limited proportion of the fire was visited in the field. Consequently, it is possible that some active areas within the dormant slides identified on Stafford_Maps_Figures.pdf, Map 1 were missed. The implication of this uncertainty is that there is the potential for more debris flows initiation sites than what is described here.

Field observations along Road 31N51A

Un-named Stream South of Negro Gulch (Sections 21 &22)

An active slump, approximately 200 feet wide and 800 feet long, was identified below road 31N51A at GPS locations 833-834 (Stafford_Maps_Figures.pdf, Map 2). This slide has the potential to deliver a large volume of sediment into the stream system, particularly under post-fire conditions. The slide exhibits well-defined scarps around the upper margin, approximately 6 feet in height. These scarps supported hardwoods and conifers up to 12 inches in diameter, suggesting that the scarp is at least 50 years old. Since the slide is about 200 feet wide near the top, a wedge of material 150 feet wide, 200 feet long, and 10 feet deep could fail as a debris slide (slopes are about 65%) and would deliver roughly 11,000 cubic yards of sediment into the stream. The distance from the toe of this slide to the crossing of road 31N13 downstream is a little over ¼ mile. There is a landing immediately above the head scarp of the slide with an approximate 7 foot fill. Some of this fill is settling in response to woody material being burned out by the fire. The load of the fill near the head of the landslide has a small destabilizing effect, but the fill is relatively small compared to the landslide itself.

Actions: It would be very costly to stabilize this landslide, well beyond the values at risk. Pulling back the fill near the head of the slide would have a small stabilizing effect, but it is unlikely that this action would prevent the slide from failing. In the longer term, reestablishment of the native vegetation, such as conifers and hardwoods, would increase the stabilization of the slide.

Monitoring: Annual photo point monitoring immediately below the road is recommended for at least 2 years to document changes in the landslide. Additionally, monitoring pins are recommended across the head scarp (for simple tape measurements).

Small Un-named Stream North of Negro Gulch

This watershed is approximately 100 acres and burned at high severity during the Stafford Fire. There is a pioneer road located in the headwaters which has the potential to deliver a considerable amount of sediment into Hayfork Creek (Stafford_Maps_Figures.pdf, Map 3). The road was pioneered with logs and other organic debris buried beneath the fill. The fire burned this out leaving the fill perched on a steep slope with all surrounding vegetation burned (see Photos_2012Stafford.pdf). As such, it could be mobilized by a strong rainfall event.

Actions: The loose fill could be dealt with by re-contouring the road and bringing any excess material back to the landing on the main road (Stafford_Maps_Figures.pdf, Map 4, and GPS 845). The road

segment with the highest risk of shedding sediment is approximately 300 feet long, and contains several pitches of 20% near the south end.
Monitoring: Annual photo point monitoring is recommended for at least 2 years along the pioneer road segment (regardless of whether or not treatments are applied).

Negro Gulch
The Negro Gulch burned at high severity and contains several burned over dormant landslides. A brief drive-by reconnaissance along road 31N51A did not reveal any active areas within these dormant slides. However, due to the limited inventory, it should be assumed that some active areas are present. Also, the steep toe zones of these landslides often develop debris slides following fires, and these in turn generate debris flows.

Field observations on Road 31N13

Crossing on Road 31N13 in Section 22
Due to the burn severity of the Stafford Fire and the unstable lands in the headwaters, there is a very high potential for debris flows to occur in this channel (sediment bulking, high volume flows, and/or landslide generated). The presence of older debris flow deposits in the channel upstream from the crossing (>200 years) reveals a history of this process (see Photos_2012Stafford.pdf). The 48 inch culvert is at high risk of failing, due to it being unable to handle such an event, particularly in light of the large number of logs likely to be incorporated in it. If the culvert were to fail, the debris flow would likely flow over the top of the fill, thus eroding a large proportion of the fill away.

An estimate of the volume of debris, which could accumulate above the road crossing under the current configuration, was made from the following measurements and assumptions (see Stafford_Maps_Figures.pdf, Figure 1). The road is about 12 vertical feet above the culvert inlet, and about 20 feet above the outlet. The fill at the crossing is about 70 feet wide (parallel to the road), and the road itself is about 17 feet wide. Assuming a triangular shaped depositional area with a 70 feet width, 150 feet length with an average depth of 6 feet would yield an area of roughly 1200 cubic yards for debris accumulation above the culvert (Stafford_Maps_Figures.pdf, Map 3). To account for the roughness of the measurements taken in the field, the range of debris volumes which could accumulate above the culvert is estimated at 1,000 to 3,000 cubic yards. It is worth noting that the landslide described above, “active slump at GPS stations 833-834” would deliver approximately 11,000 cubic yards of sediment to the stream. In other words, the storage capacity is only a tiny fraction of what a credible debris flow could deliver to this site.

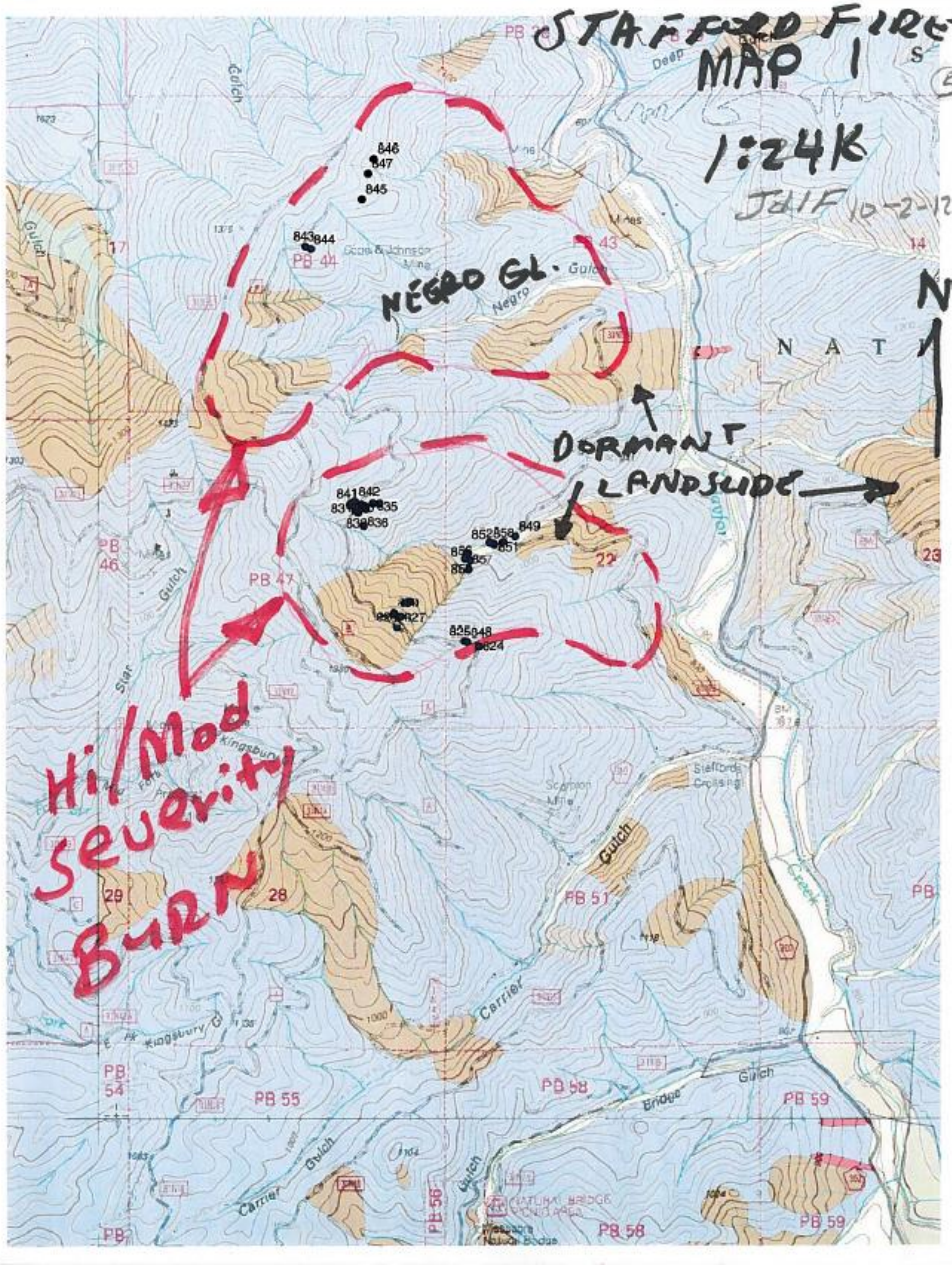
Actions: Since a large debris flow is very likely to occur within the area over the next 5-10 years, the crossing should be configured to handle such an event, and yet be easily re-opened afterwards. This goal can be attained by minimizing fill height, and making it resistant to debris flow scour. A low water ford would accomplish this but it would involve shifting the alignment slightly upstream into the channel and slightly downward, while meeting road standards for vertical and horizontal curves. If it is undesirable for vehicles to drive through the water, a pipe capable of passing low flows could be incorporated into the design. A third option is to pull the culvert and remove the road fill during the wet

season, allowing flows to pass through the drainage unabated. If the road is needed for future management actions, a temporary stream crossing can be engineered to meet the needs of the project as long as it is removed prior to the wet season.

Monitoring: Annual photo point monitoring is recommended for at least 2 years (at minimum one photo upstream and one downstream from the road).

Dormant landslides near the North End of 31N13

Large dormant landslides were observed in Section 15 (these were identified in the GIS data base).


STAFFORD FIRE
MAP 1
1:24K
JAIF 10-2-12
NEGRO GL.
DORMANT LANDSLIDE
Hi/Mod Severity Burn
N
Negro Gulch
Gulch
Deep
Star Gulch
Kingsbury
Carrier
Carrier Gulch
Bridge Gulch
Stafford Crossing
Scorpion Mine
Natural Bridge Picnic Area
PB 43
PB 44
PB 46
PB 47
PB 51
PB 54
PB 55
PB 56
PB 58
PB 59
17
22
23
28
29
14
841
842
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847
835
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849
851
852
857
858
824
825
827
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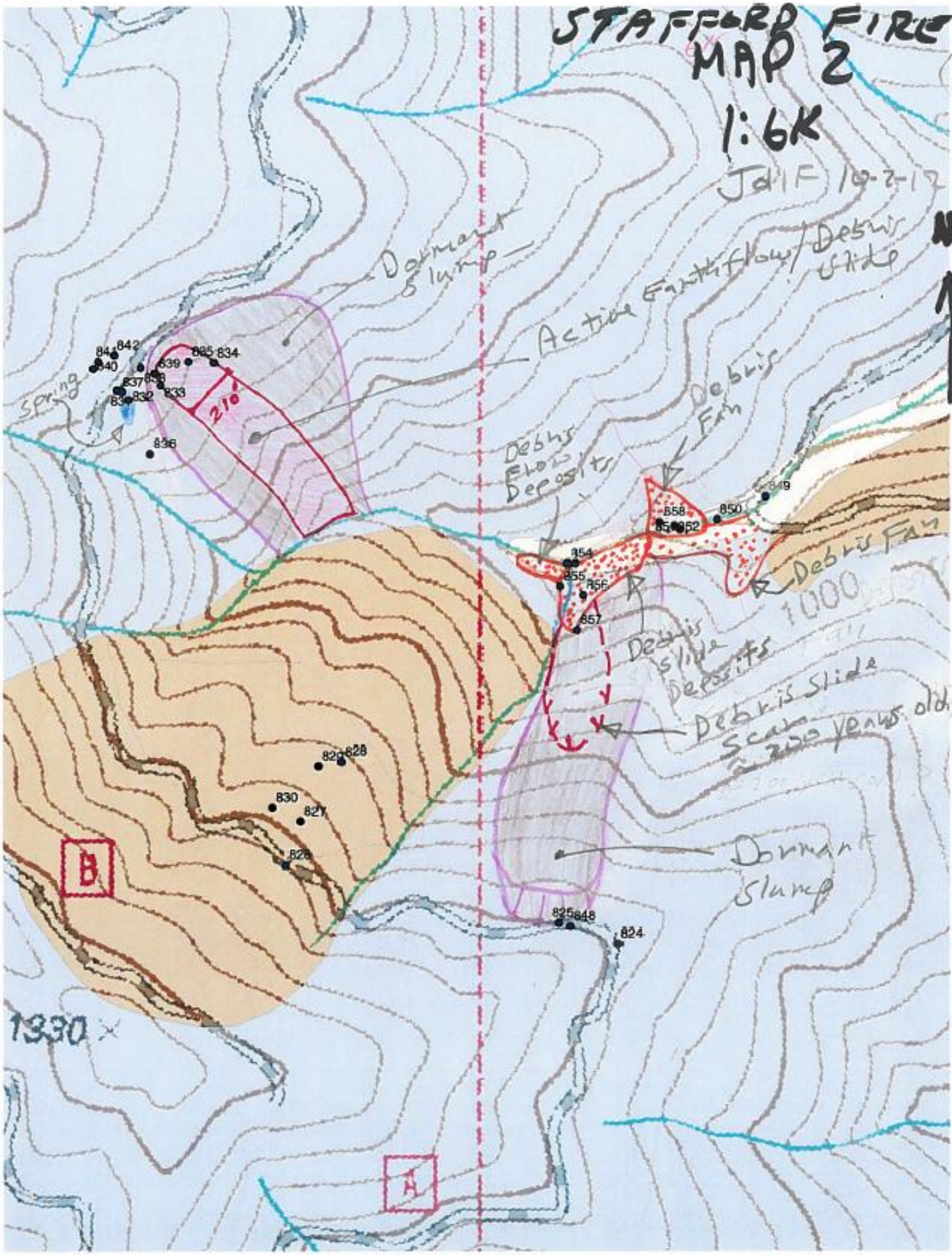
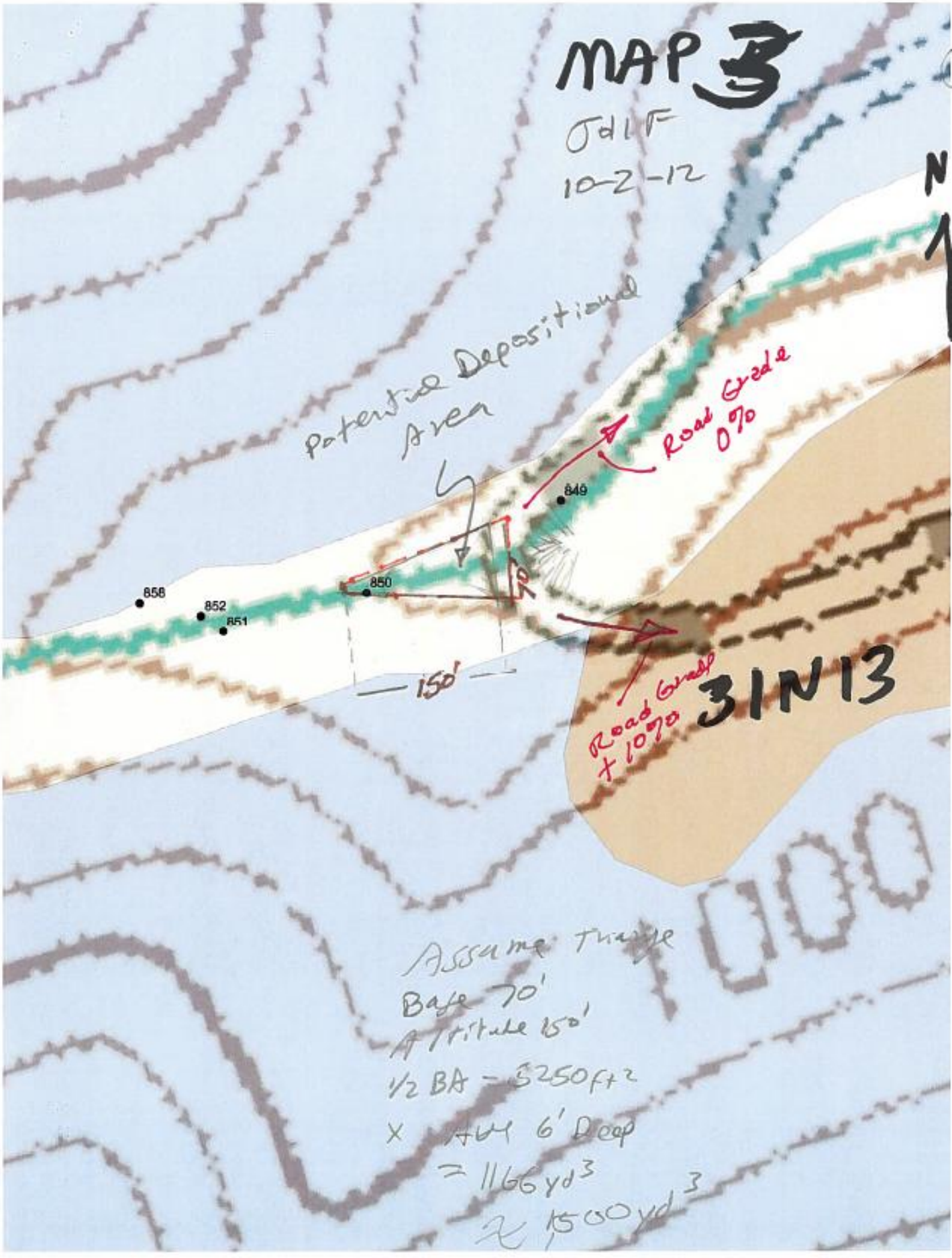
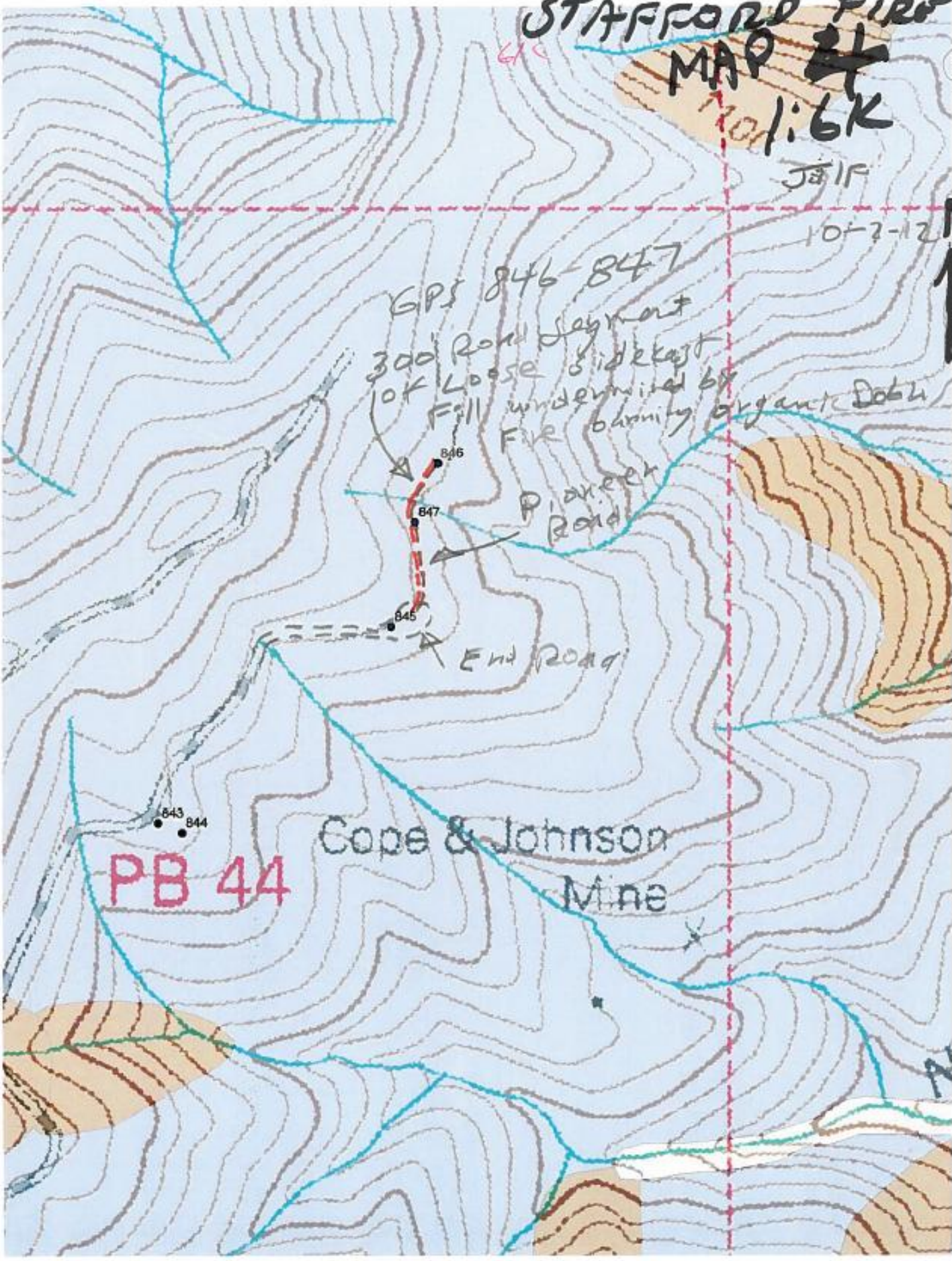

STAFFORD FIRE
MAP 2
1:6K
JdF 10-2-17
Dormant Slump
Active Earthflow/Debris Slide
Debris Flow Deposits
Debris Fan
Debris Slide Deposits
Debris Slide Scar ≈ 200 years old
Dormant Slump
Spring
210'
1000
1330
A
B
834
835
836
837
838
839
840
842
832
833
849
850
852
854
855
856
857
858
824
825
826
827
828
830


MAP 3
JDLF
10-2-12
Potential Depositional Area
Road Grade 0%
849
850
858
852
851
150'
Road Grade +10%
3IN13
Assume Triangle
Base 70'
Altitude 150'
½ BA = 5250ft²
X 4ft 6' Deep
= 1166yd³
≈ 1500yd³


STAFFORD FIRE
MAP #4
1:6K
GPS 846-847
300' Road Segment
OK Loose sidecast
Fill undermined by
Fire Chimney Organic Debris
Pioneer Road
846
847
845
End Road
843
844
PB 44
Cope & Johnson
Mine

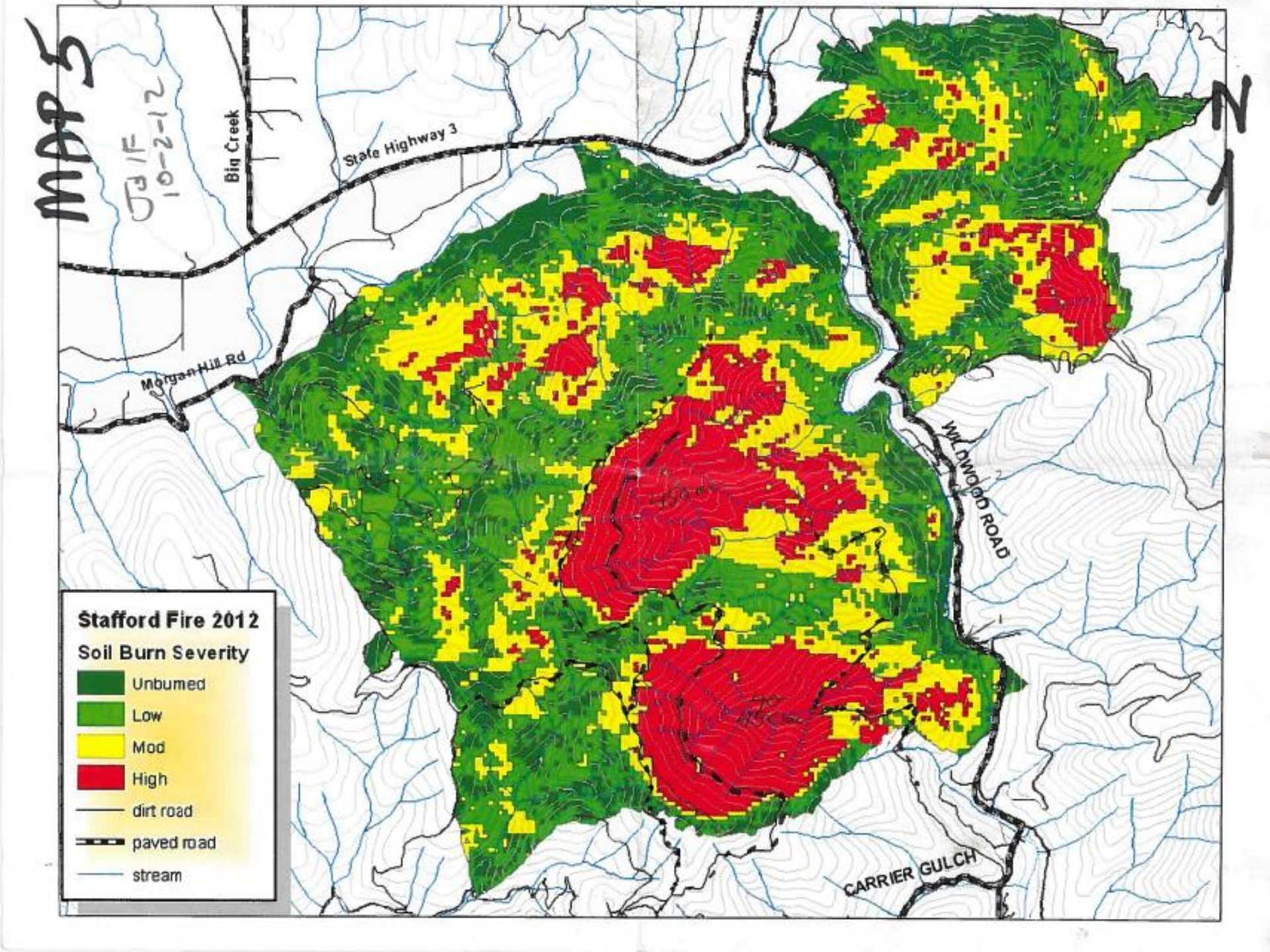
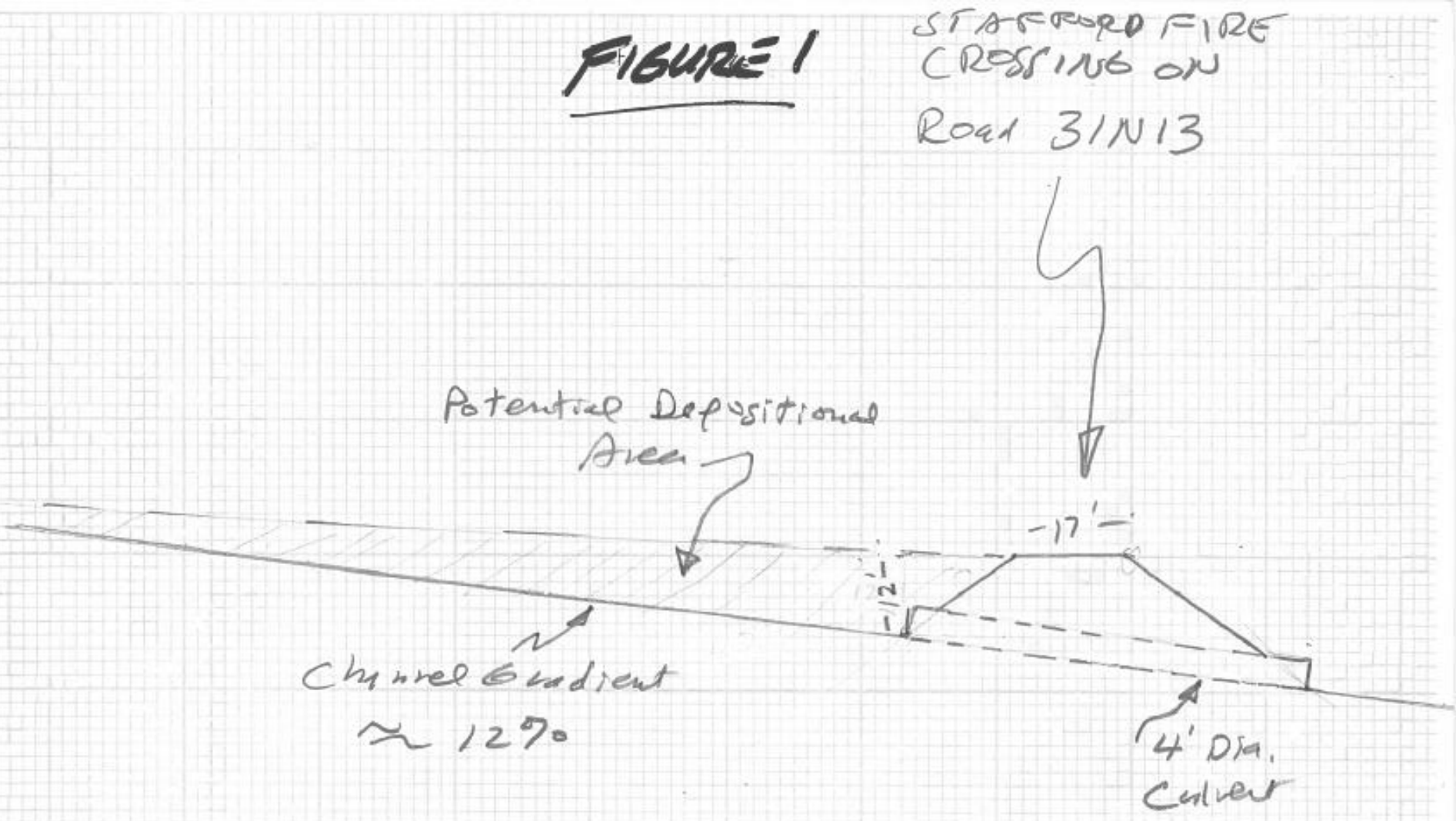

MAP 5
DJF
10-2-12
Big Creek
State Highway 3
Morgan Hill Rd
WILDWOOD ROAD
CARRIER GULCH
N
Stafford Fire 2012
Soil Burn Severity
Unburned
Low
Mod
High
dirt road
paved road
stream

FIGURE 1



Field measurements
paced, rangefinder, clinometer

JAF 10-1-12