Memo

Water & Earth Technologies, Inc.
Water Resources and Environmental Consulting

Date: December 13, 2010
To: Kevin Stewart
From: Markus Ritsch
Subject: **Fourmile Creek Burn Area Rainfall Intensity-Duration-Frequency Analysis**

I. ALERT Data Source

Raw ALERT data records extracted from the Urban Drainage and Flood Control District's Nova Star 5.0 base station were analyzed for the period 1990 through 2010. Erroneous data points within the extracted data series were corrected using a quality assurance process prior to the rainfall analysis.

II. Rainfall Analysis Summary

Rain gage data was available for 18 gages located within a 5 mile radius of the centroid of the Fourmile Creek (FMC) burn area (Figure 1 and Figure 2). A peak intensity analysis was completed on 21 years of data from these gages to determine maximum rainfall intensities in each year for time periods including 10 minute, 30 minute, 1 hour and 6 hour intervals. These data were reduced to annual maximum rainfall depth data that were used for the recurrence interval analysis.

The annual maximum rainfall depths were fit to the Fisher-Tippett Type 1 Extreme Value Distribution (Gumble Distribution) using methodology described in the National Oceanic and Atmospheric Science Administration (NOAA) Atlas 2. The Fisher-Tippett Type 1 Extreme Value Distribution (Gumble Distribution) has the following form:

$$x = A + B\{-ln[-lnP]\} \qquad \text{(Equation 1)}$$

x = Recurrence Interval Rainfall Depth
A = Location Parameter
B = Scale Parameter
$P = 1 - \frac{1}{T}$
T = Return Interval Period

The location and scale parameters are functions of the population mean and variance. These are given by:

$$\mu = A + \gamma B \qquad \text{(Equation 2)}$$
$$\gamma = 0.5772\ldots$$
$$\sigma^2 = \frac{\pi^2 B^2}{6}$$

μ = Population Mean
σ^2 = Population Variance

The location and scale parameters are estimated using the Method of Moments. Moment estimators of A and B are given by A* and B*. These are estimated by equating the sample mean and variance to the population values.

$$B^* = \sqrt{\frac{6\,\Sigma(x_i - \bar{x})^2}{\pi^2(n-1)}}$$
$$A^* = \bar{x} - \gamma B^*$$

(Equation 3)

$\bar{x}$ = Sample Mean
n = Sample Size

The Urban Drainage and Flood Control District provided Depth-Duration-Frequency curves for an area adjacent to the area of interest. These curves were used as a calibration check on the distribution fit to the gage data. Results for the 100 year-6 hour and 100 year-1 hour were compared and fell within the expected range, providing confidence that the 10 minute and 30 minute -100 year depths could be determined using the same method. The final results are provided:

Table 1. Rainfall Depths (Inches) – FMC Burn Area

Return Interval (years)	10 Minute	30 Minute	1 Hour	6 Hour
100	1.17	1.91	2.35	3.32
50	1.07	1.72	2.15	3.10
25	0.96	1.54	1.82	2.70
10	0.83	1.28	1.50	2.10
2	0.56	0.78	0.85	1.35

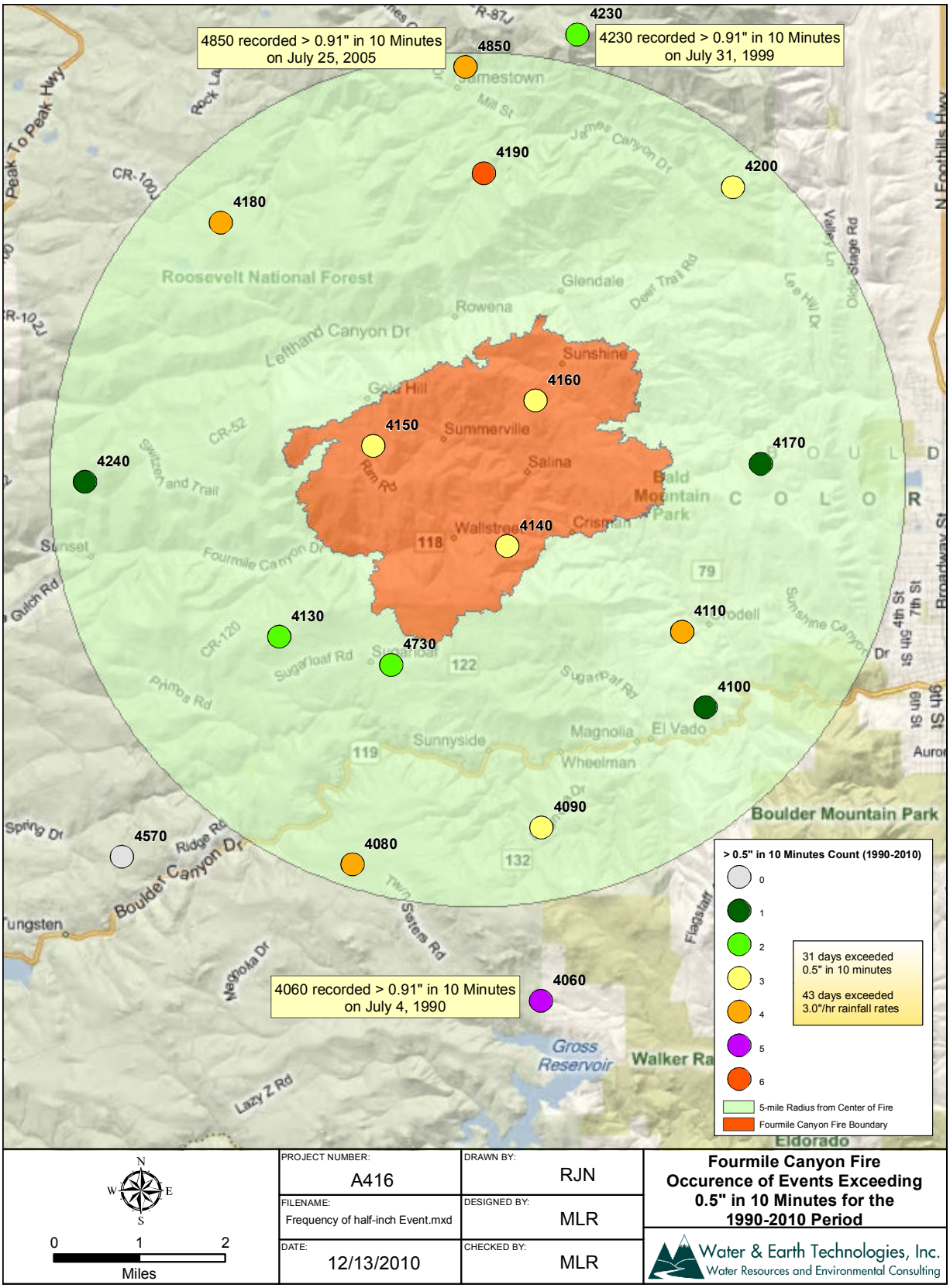

Figure 1. Occurrence of Storms Exceeding 0.5 inches in 10 minutes

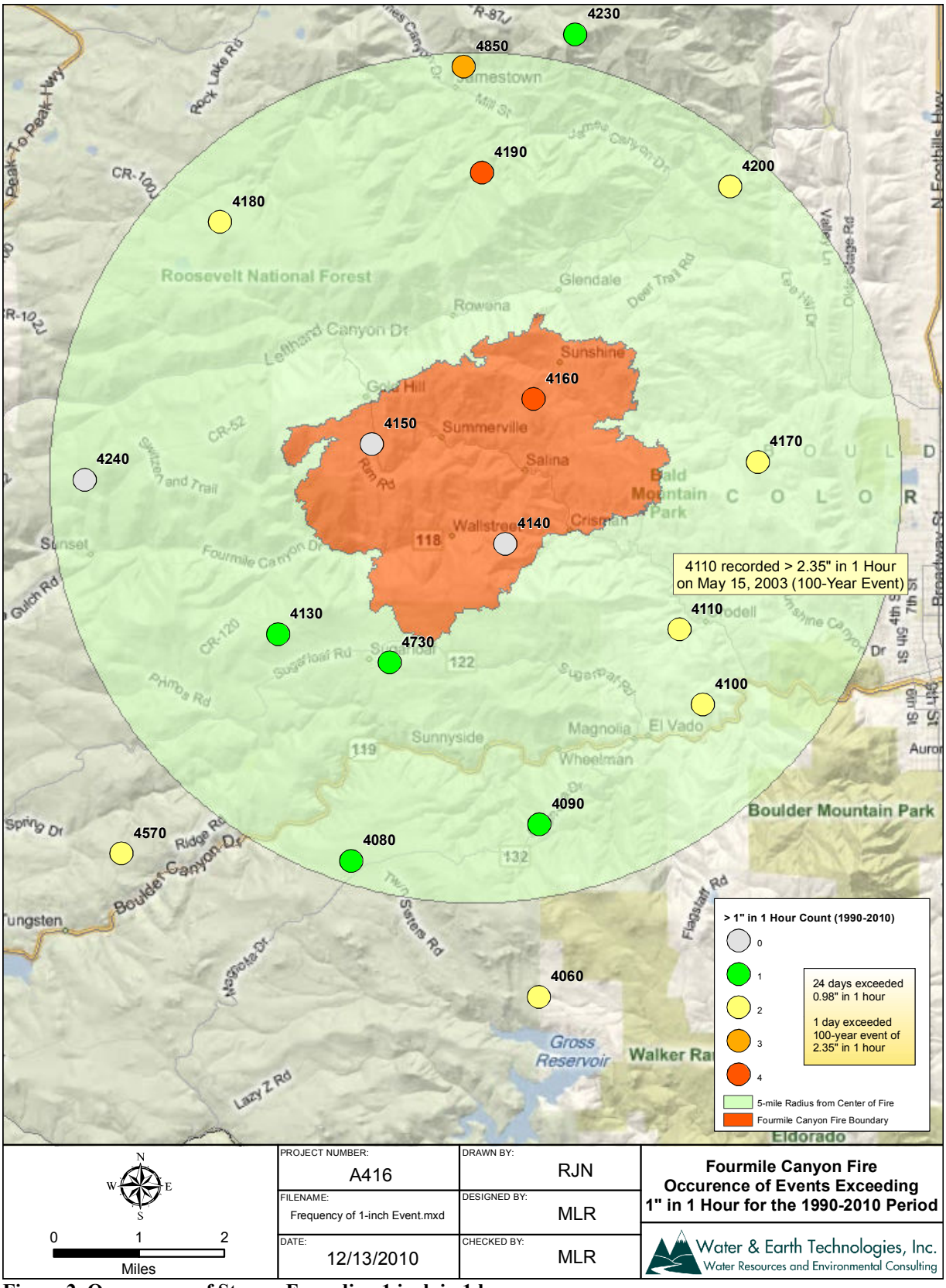

Figure 2. Occurrence of Storms Exceeding 1 inch in 1 hour