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September 2013 Storm and Flood Assessment Report

Los Alamos
NATIONAL LABORATORY

Prepared by the Environmental Programs Directorate

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1.0 INTRODUCTION

Between September 10 and 17, 2013, New Mexico and Colorado received a historically large amount of precipitation (Figure 1). This report assesses the damage caused by flooding along with estimated costs to repair the damage at Los Alamos National Laboratory (the Laboratory) on the Pajarito Plateau. Los Alamos County, New Mexico, received between 200% and 600% of the normal precipitation for this time period (Figure 2), and the Laboratory received approximately 450% percent of its average precipitation for September (Figure 3). As a result, the Laboratory was inundated with rain, including the extremely large, greater-than-1000-yr return period event that occurred between September 12 and 13 (Table 1). With saturated antecedent soil conditions from the September 10 storm, when the September 12 to September 13 storm hit, the flooding was disastrous to the Laboratory's environmental infrastructure, including access roads, gage stations, watershed controls, control measures installed under the National Pollutant Discharge Elimination System Permit (hereafter, the Individual Permit), and groundwater monitoring wells (Figures 4 through 21). From September 16 to October 1, 2013, the Laboratory completed field assessments of environmental infrastructure and generated descriptions and estimates of the damage, which are presented in spreadsheets in Attachments 1 to 4 of this report.

Section 2 of this report contains damage assessments by watershed, including access roads, gage stations, watershed controls, and control measures installed under the Individual Permit. Section 3 contains damage assessments of monitoring wells by the groundwater monitoring groups as established in the Interim Facility-Wide Groundwater Monitoring Plan for Monitoring Year 2014. Section 4 addresses damage and loss of automated samplers. Section 5 addresses sediment sampling needs, and Section 6 is the summary of estimated recovery costs from the significant rain and flooding during September 2013.

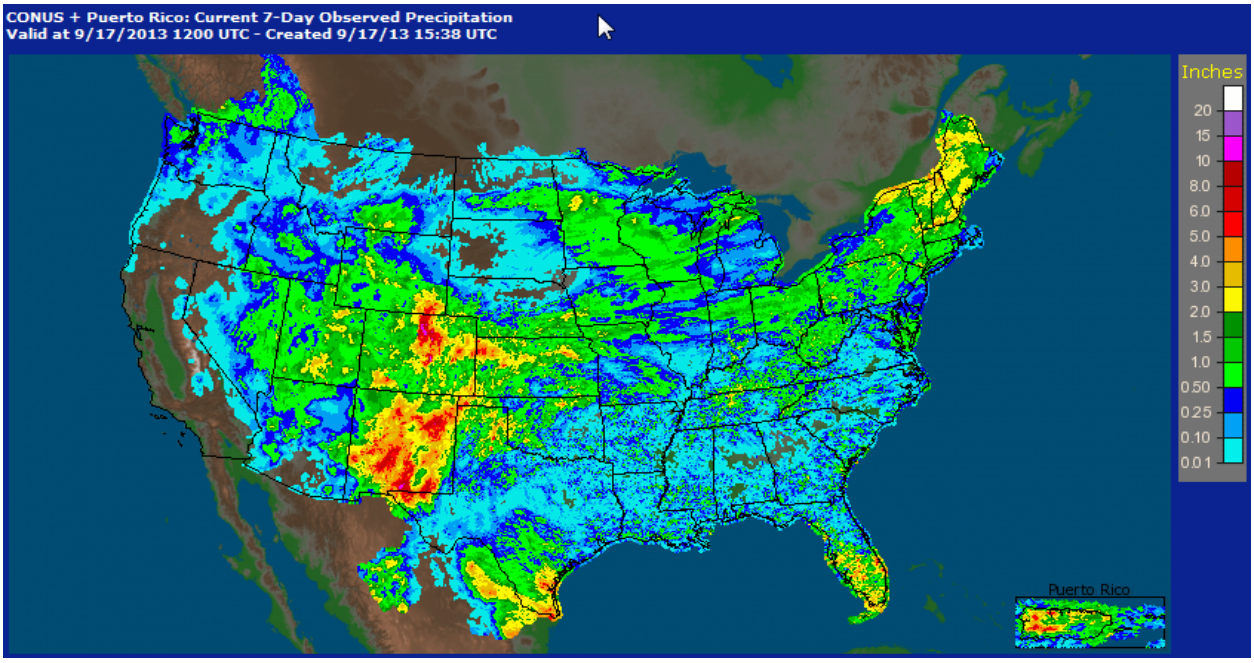

Figure 1 Observed precipitation for the continental U.S. for September 10 to September 17, 2013 (Source: National Oceanic and Atmospheric Administration [NOAA])

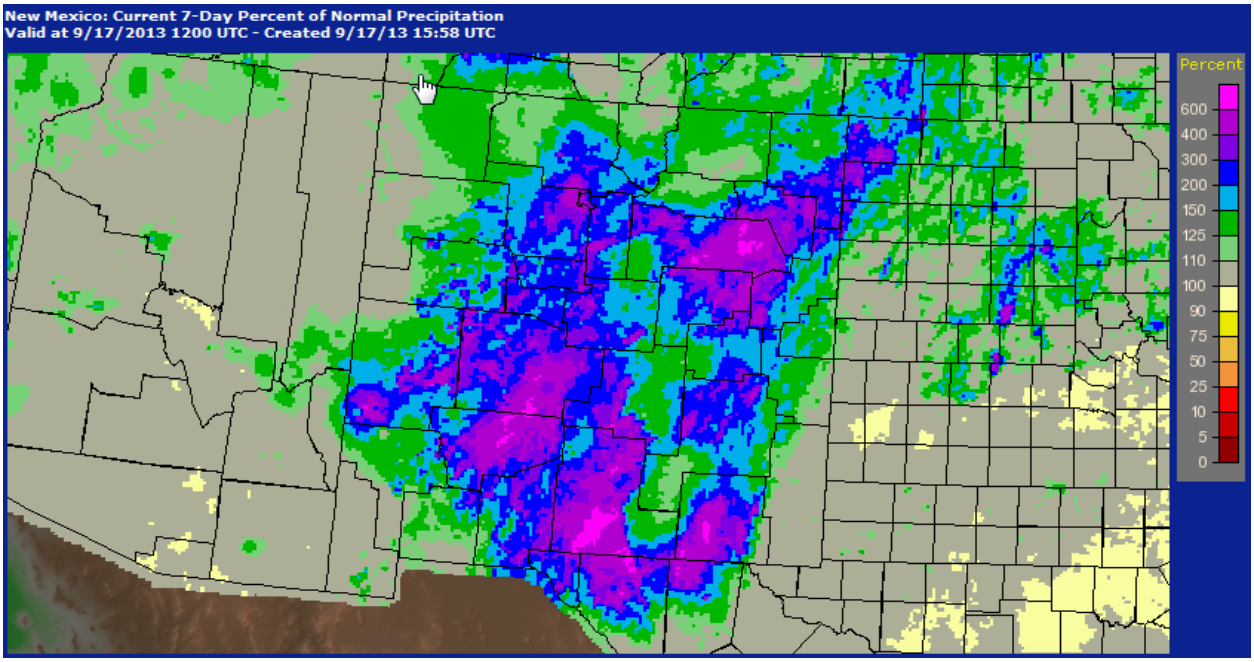

Figure 2 **Percent of precipitation for September 10 to September 17, 2013, for New Mexico (NOAA). Los Alamos County received between 200% to 600% of the normal precipitation for this time period.**

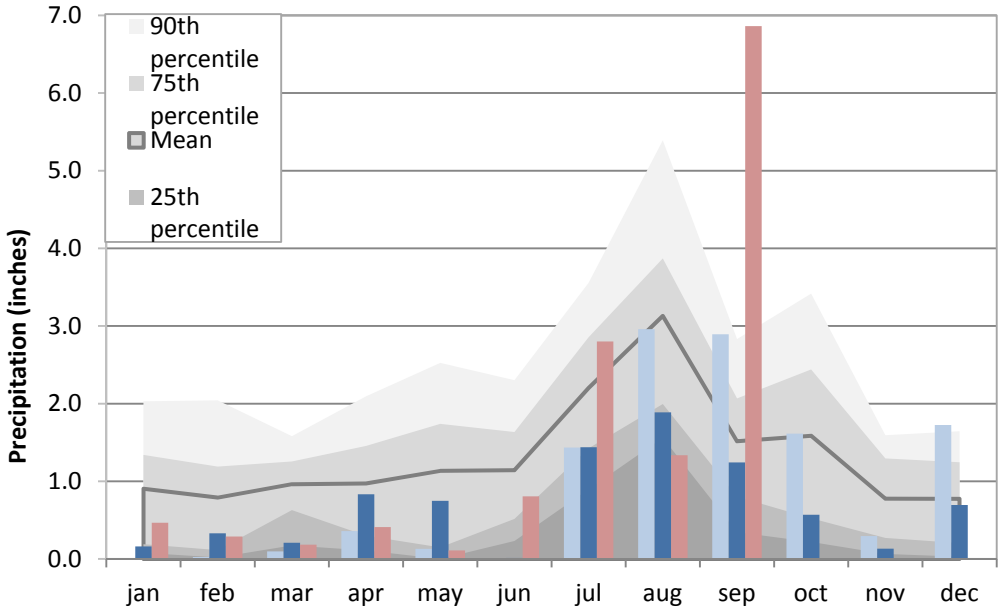

Figure 3 **Total precipitation for each month of 2011, 2012, and up to September 2013 (Laboratory meteorological tower data averaged over the Laboratory). Mean and percentiles are based on data from 1992 to 2010.**

For the storms that occurred from September 10 to September 15, 2013, precipitation at each of the Laboratory meteorological towers is shown in the table below, along with the return period of the storm (24-h periods). The Laboratory was inundated with rain, including the extremely large event that occurred between September 12 and September 13, 2013 (Thursday noon to Friday noon).

Table 1
Total Precipitation at Each of the Laboratory Meteorological Towers

	9/10/2013		9/11/2013		9/12–9/13/2013		9/14–9/15/2013	
Met Tower	**Precip (in.)**	**Return Period (yr)**	**Precip (in.)**	**Return Period (yr)**	**Precip (in.)**	**Return Period (yr)**	**Precip (in.)**	**Return Period (yr)**
TA-06	1.35	3	0.10	<1	5.07	>1000	0.36	<1
TA-49	1.40	2	0.08	<1	3.94	200	1.85	5
TA-53	1.21	3	0.05	<1	3.70	>1000	0.49	<1
TA-54	1.37	4	0.02	<1	4.28	>1000	1.02	1
NCOMM	1.40	2	0.09	<1	4.49	>1000	0.35	<1
Laboratory Average	**1.35**	**3**	**0.07**	**<1**	**4.30**	**>1000**	**0.81**	**1**

Note: Includes the return period of the storm (24-h periods) for the storms that occurred from September 10 to September 15, 2013.

Figure 4 Flood in lower Pueblo Canyon September 13, 2013

Figure 5 Flooding of drainage adjacent to the University House, September 13, 2013

2.0 DAMAGE ASSESSMENTS BY WATERSHED ($6280K)

Damage assessments were completed in five watersheds. Field teams were sent to each of the following watersheds to assess damage to access roads, gage stations, watershed-scale controls, and control measures installed under the Individual Permit.

1. Ancho/Chaquehui
2. Los Alamos/Pueblo (includes Rendija, Bayo, and DP Canyons)
3. Pajarito (includes Twomile, Threemile, and Starmers Gulch Canyons)
4. Sandia/Mortandad (includes Pratt, Ten Site, and Cañada del Buey Canyons)
5. Water/Cañon de Valle (includes Fence and Potrillo Canyons)

The locations of the access roads, gage stations, watershed controls, and control measures under the Individual Permit are presented in Plates 1, through 3.

2.1 Ancho/Chaquehui ($92K)

Canyons Access Roads ($40K)

A site review was completed for one access road within the watershed that is used to access a gage station. Damage generally consisted of a washed-out stream crossing, flood flow down the path of the road with scouring/material deposition and debris on the road bed.

- Ancho Canyon access road is approximately 0.50 mi long from NM 4 to gage station E275 with 1 stream channel crossing. Blade road and reestablish stream channel crossing ($40K).

Gage Stations ($25K)

A site review was completed for 3 gage stations within the watershed. The stations were ranked by estimated repair costs (none, minor, moderate, or severe). Attachment 1 (on CD) presents additional information for the gage station assessment.

Of the 3 gage stations:

- 2 gage stations incurred no damage (E338 and E340)
- 1 gage station was identified with moderate damage
    - ❖ Gage E275: Remove debris around stilling well and staff plate, replace control, and repair asphalt pull-off from NM 4 ($25K)

Watershed Controls ($0)

A site review was completed for watershed controls within the watershed. Attachment 2 (on CD) presents additional information for applicable watersheds.

- No watershed controls installed

Individual Permit Site Monitoring Areas ($27K)

A site review was completed for controls associated with 21 site monitoring areas (SMA) within the watershed. SMAs were ranked by estimated repair costs (none, minor, moderate, or severe). Attachment 3 (on CD) presents additional information for the SMA assessment.

- 15 SMAs incurred no damage
- 5 SMAs were identified with minor damage
    - ❖ A-SMA-2: Replace wattles (11) ($5K)
    - ❖ A-SMA-2.7: Rake out rills, place mulch around 2 berms ($3K)
    - ❖ CHQ-SMA-1.03: Repair rock check dam ($2K)
    - ❖ CHQ-SMA-4.5: Repair rock check dam, replace wattles (3) ($4K)
    - ❖ CHQ-SMA-6: Replace and repair rock check dam (2) ($3K)
- 1 SMA was identified with moderate damage
    - ❖ A-SMA-3: Replace rock check dams (9) ($10K)

2.2 Los Alamos/Pueblo (Includes Rendija, Bayo, and DP Canyons) ($2769K)

Canyons Access Roads ($1726K)

A site review was completed for four access roads within the watershed that are used to access gage stations, groundwater monitoring wells (TA-21 monitoring group and the General Surveillance monitoring group), and Individual Permit monitoring and control locations. Damage generally consisted of washed-out stream crossings, flood flow down the path of roads with scouring/material deposition, debris on the road bed, and base course removal. Because of monitoring well requirements and equipment access needs, all-weather access roads were previously installed and need to be reestablished. The approximate cost to build an all-weather access road with base course 12-ft top crown with low water crossings is $240K per mile and does not include the cost of any required bridges or low-angle cement crossings. Manufactured bridges are approximately $50K ea.

- Pueblo Canyon has two access roads:
  - ❖ The access road on the north side of the canyon is approximately 5 .0 mi long and is maintained by Los Alamos County ($0K).
  - ❖ The access road on the south side of the canyon is approximately 3.25 mi long with 5 stream channel crossings to monitoring well R-2. It is recommended that the road be rerouted to eliminate some of the crossings. Maintain and rebuild all-weather access road as required ($780K).
- Los Alamos Canyon access road is approximately 4.0 mi long from NM 4 to Technical Area 41 (TA-41) with 9 stream channel crossings. Impacted sections of the access road include all stream channel crossings and sections of the road within the flood plain. Four manufactured bridges were knocked off their moorings and damaged. Repair/replace damaged road sections and bridges ($850K).
- DP Canyon access road is approximately 0.60 mi long from DP Road to monitoring well R-6i, with no stream channel crossings. Impacted sections of the access road will require the addition of base course and re-grading ($96K).

Figure 6 Damage to bridge and access road in Los Alamos Canyon

Gage Stations ($485K)

A site review was completed for 15 gage stations within the watershed and ranked by estimated repair costs. Attachment 1 (on CD) presents additional information for the gage station assessment.

Of the 15 gage stations:

- 5 gage stations incurred no damage (E030, E038, E055.5, CO101038, and CO111041)
- 6 gage stations were identified with minor damage
  - ❖ E026: Regrade channel and redirect towards isolated stilling well ($2K)
  - ❖ E039.1: Remove sediment from stilling well ($1K)

- ❖ E040: Remove boulders below ultrasonic probe and in weir ($5K)
- ❖ E050.1: Remove debris in channel above station, remove sediment from stilling well ($2K)
- ❖ E055: Replace datalogger ($5K)
- ❖ E056: Replace datalogger ($5K)

- 1 gage station was identified with moderate damage
  - ❖ E042.1: Replace ISCOs, batteries, and Greenlee box; remove sediment from stilling well ($15K)
- 3 gage stations were identified with severe damage
  - ❖ E059: Replace ISCOs, batteries, and Greenlee box, straighten stilling well, and install control ($50K)
  - ❖ E060.1: Replace ISCOs, batteries, and ultrasonic probe; straighten stilling well and probe arm; install concrete pad for access to Hoffman box and Greenlee box stabilization; install jersey barriers with backfill to protect right bank and redirect high flows towards flume; backfill left downstream bank behind gabion baskets; straighten channel upstream of flume; and install access road ($100K)
  - ❖ E109.9: Remove footprint of gage station ($300K including $75K for equipment removal and $225K for flume removal and site restoration)

Figure 7 September 13, 2013, flood damage to gage station E060.1

Watershed Controls ($230K)

A site review was completed for watershed controls within the watershed. Watershed-scale controls include the Pueblo Canyon grade-control structure, the Los Alamos Canyon ponds, the DP Canyon grade-control structure, and the Los Alamos Canyon weir. Attachment 2 (on CD) presents additional information for applicable watersheds.

- Pueblo Canyon grade-control structure: Minor damage to main structure, riprap repair, debris cleanup ($25K)
- Los Alamos Canyon retention ponds: Moderate damage to lower pond retaining berm, spillway repair ($50K)
- DP Canyon grade-control structure: No damage, debris cleanup ($5K)
- Los Alamos Canyon weir: No damage to structure, debris removal from structure, sediment clean out from ponds ($150K)

Figure 8 Flood debris at the Los Alamos Canyon weir spillway

Individual Permit Site Monitoring Areas ($328K)

A site review was completed for controls associated with 64 SMAs within the watershed and ranked by estimated repair cost. Attachment 3 (on CD) presents additional information for the SMA assessment.

Of the 64 SMAs:

- 30 SMAs incurred no damage
- 16 SMAs were identified with minor damage
    - ❖ B-SMA-1: Repair rock check dam ($3K)
    - ❖ DP-SMA-3: Hand-repair of berm, relocate spillway ($5K)
    - ❖ DP-SMA-4: Repair rock check dam ($3K)

- ❖ LA-SMA-4.1: Repair rock check dam ($3K)
- ❖ LA-SMA-4.2: Hand repair water bars (3) ($3K)
- ❖ LA-SMA-5.02: Replace wattles (3) ($2K)
- ❖ LA-SMA-5.31: Repair rock check dams (2) ($5K)
- ❖ LA-SMA-5.53: Replace wattles (2) ($2K)
- ❖ LA-SMA-5.54: Replace wattles (2) ($2K)
- ❖ LA-SMA-6.25: Replace wattles (3) ($2K)
- ❖ LA-SMA-6.27: Replace wattles (4) ($2K)
- ❖ LA-SMA-6.3: Repair rock check dam ($3K)
- ❖ LA-SMA-6.31: Replace wattles (5) ($3K)
- ❖ LA-SMA-9: Repair berm ($5K)
- ❖ P-SMA-2.15: Repair rock check dam, add extension ($5K)
- ❖ R-SMA-2.3: Replace juniper bales with suitable substitute ($4K)

- 16 SMAs were identified with moderate damage
  - ❖ ACID-SMA-2: Clean out channel and repair, repair berm ($20K)
  - ❖ ACID-SMA-2.1: Clean out channel and repair, repair berm ($20K)
  - ❖ B-SMA-0.5: Repair berm breach, repair rock check dam ($8K)
  - ❖ LA-SMA-0.9: Repair and modify berms (6) ($10K)
  - ❖ LA-SMA-1: Repair multiple berms and rock check dam ($10K)
  - ❖ LA-SMA-1.25: Replace base course berm ($8K)
  - ❖ LA-SMA-2.1: Replace log berm and replace riprap ($8K)
  - ❖ LA-SMA-5.01: Repair rock berm and water bars, replace wattle ($8K)
  - ❖ LA-SMA-5.2: Repair or replace log berm ($6K)
  - ❖ LA-SMA-5.51: Repair berm breaches (2) ($6K)
  - ❖ LA-SMA-5.52: Repair berm, repair and modify rock check dam and riprap ($8K)
  - ❖ LA-SMA-5.91: Repair or replace log check dams (2) ($8K)
  - ❖ LA-SMA-5.92: Rebuild berms (2), add spillway ($10K)
  - ❖ P-SMA-0.3: Rebuild berms (2) ($8K)
  - ❖ P-SMA-2: Repair and replace base course berm, modify rock berm ($15K)
  - ❖ P-SMA-3.05: Repair berms (2) ($8K)
- 1 SMA was identified with moderate to severe damage
  - ❖ R-SMA-1: Repair, replace, or install gabion, and repair channel ($40K)
- 1 SMA was identified with severe damage
  - ❖ P-SMA-1: Failure of engineered slope, repair rock channel, repair small detention ponds (3), repair of multiple areas with rilling ($75K+)

Figure 9 Slope failure at P-SMA-1

2.3 Pajarito (Includes Twomile, Threemile, and Starmers Gulch Canyons) ($951K)

Canyons Access Roads ($660K)

A site review was completed for four access roads within the watershed that are used to access gage stations, groundwater monitoring wells (TA-54 monitoring group and the General Surveillance monitoring group), and Individual Permit monitoring and control locations. Damage generally consisted of washed-out stream crossings, flood flow down the path of roads with scouring/material deposition, debris on the road bed, and base course removal. Because of monitoring well requirements and equipment access needs, all-weather access roads were previously installed and need to be reestablished. The approximate cost to build an all-weather access road with base course 12-ft top crown with low water crossings is $240K per mile and does not include the cost of any required bridges or low-angle cement crossings.

- Pajarito Canyon access road is approximately 1.75 mi long from the TA-18 boat ramp gate to monitoring well R-17 with 1 stream channel crossing. Impacted sections of the access road include the stream channel crossing and sections of the road within the flood plain ($420K).
- Pajarito flood retention structure access road is approximately 0.5 mi long. The lower section of the road to the structure is washed out and impassable. The upcanyon of structure is not accessible because of accumulated logs and debris (cost estimate not available).
- Pajarito Canyon access road from the Pajarito corridor to PCAO-5 is approximately 0.5 mi long with no stream channel crossings. Impacted sections of the access road will require the addition of base course and regrading ($120K).
- Threemile Canyon access road within and above TA-18 is approximately 0.75 mi long with 2 stream channel crossings. Access is through the channel along the Casa and is washed out. Recommend rerouting section of road ($120K).

Figure 10 Damage to Threemile Canyon access road

Gage Stations ($60K)

A site review was completed for 6 gage stations within the watershed and ranked by estimated repair cost. Attachment 1 (on CD) presents additional information for the gage station assessment.

Of the 6 gage stations:

- 2 gage stations were identified with minor damage
  - ❖ E240: Remove sediment from stilling well, regrade channel and redirect towards isolated stilling well ($5K)
  - ❖ E245.5: Regrade channel, redirect towards isolated stilling well ($5K)
- 4 gage stations were identified with moderate damage
  - ❖ E243: Station inaccessible but presumed damaged ($10K)
  - ❖ E244: Station inaccessible but presumed damaged ($10K)
  - ❖ E246: Replace probe mount and probe and shore up eroded area around control ($15K)
  - ❖ E250: Removed debris and sediment around stilling well and shore up eroded area around control ($15K)

Watershed Controls ($0)

A site review was completed for watershed controls within the watershed. Attachment 2 (on CD) presents additional information for applicable watersheds.

- The Pajarito Canyon retention structure was assessed by the Laboratory's Infrastructure and Utilities section and is not included in this assessment.

Individual Permit Site Monitoring Areas ($231K)

A site review was completed for controls associated with 51 SMAs within the watershed and ranked by estimated repair costs. Attachment 3 (on CD) presents additional information for the SMA assessment.

Of the 51 SMAs:

- 25 SMAs incurred no damage
- 13 SMAs were identified with minor damage
    - ❖ 2M-SMA-1: Repair rock check dams (3) ($3K)
    - ❖ 2M-SMA-1.42: Repair rock check dam (1) ($2K)
    - ❖ 2M-SMA-3: Replace wattles (6) ($3K)
    - ❖ 3M-SMA-0.4: Repair berm ($5K)
    - ❖ PJ-SMA-1.05: Repair berm breach ($4K)
    - ❖ PJ-SMA-2: Replace rock check dams (3) ($3K)
    - ❖ PJ-SMA-14: Rake out rills, mulch area ($3K)
    - ❖ PJ-SMA-14.2: Replace rock check dams ($3K)
    - ❖ PJ-SMA-14.3: Replace wattles (2) ($2K)
    - ❖ PJ-SMA-14.8: Replace wattles (2) ($2K)
    - ❖ PJ-SMA-19: Replace rock check dams (3) ($5K)
    - ❖ PJ-SMA-9: Repair rock check dams (2) ($3K)
    - ❖ STRM-SMA-1.05: Repair or replace riprap ($5K)
- 12 SMAs were identified with moderate damage
    - ❖ 2M-SMA-1.8: Replace asphalt sealant ($20K)
    - ❖ 2M-SMA-2: Repair retention pond berm, replace spillway riprap ($15K)
    - ❖ 2M-SMA-2.2: Replace asphalt sealant ($20K)
    - ❖ PJ-SMA-11.1: Install new berms (3) ($10K)
    - ❖ PJ-SMA-17: Repair retention pond berm ($8K)
    - ❖ PJ-SMA-18: Repair retention pond berm, remove sediment ($8K)
    - ❖ PJ-SMA-4.05: Repair berm breach, replace rock check dam ($10K)
    - ❖ PJ-SMA-6: Repair berms (2), rake out rilling, add seed and mulch ($7K)
    - ❖ PJ-SMA-7: Rebuild berm ($10K)
    - ❖ PJ-SMA-8: Rebuild berm and rock check dam ($10K)
    - ❖ STRM-SMA-1. 5: Remove accumulated debris, repair spillways (3) ($10K)
    - ❖ STRM-SMA-5.05: Repair berm breach and rill ($10K)
- 1 SMA was identified with moderate to severe damage
    - ❖ 3M-SMA-4: Install gabions and riprap in damaged channel ($50K)

2.4 Sandia/Mortandad (Includes Pratt, Ten Site, and Cañada del Buey Canyons) ($1230K)

Canyons Access Roads ($592K)

A site review was completed for three access roads within the watershed that are used to access gage stations, groundwater monitoring wells (Chromium Investigation monitoring group and the General Surveillance monitoring group), and Individual Permit monitoring and control locations. Damage generally consisted of washed-out stream crossings, flood flow down the path of roads with scouring/material deposition, debris on the road bed, and base course removal. Because of monitoring well requirements and equipment access needs, all-weather access roads were previously installed and need to be reestablished. The approximate cost to build an all-weather access road with base course 12-ft top crown with low water crossings is $240K per mile and does not include the cost of any required bridges or low-angle cement crossings.

- Sandia Canyon access road is approximately 0.60 mi long from East Jemez Road to the SCI-2 well pad (the road is currently inside the stream channel for approximately 0.26 mi) with 1 stream channel crossing. Reroute road out of the stream channel ($192K).
- Upper Mortandad Canyon access road is approximately 1.25 mi from well R-42 to the R-1 well pad with 3 stream channel crossings. Impacted sections of the access road include the stream channel crossing and sections of the road within the flood plain ($300K).
- Cañada del Buey access road is approximately 3.5 mi long from the Pajarito lay-down yard to monitoring wells CDB-05 and R-53 with one stream channel crossing. The road in good condition with minimal damage but will require grading in some sections ($100K).

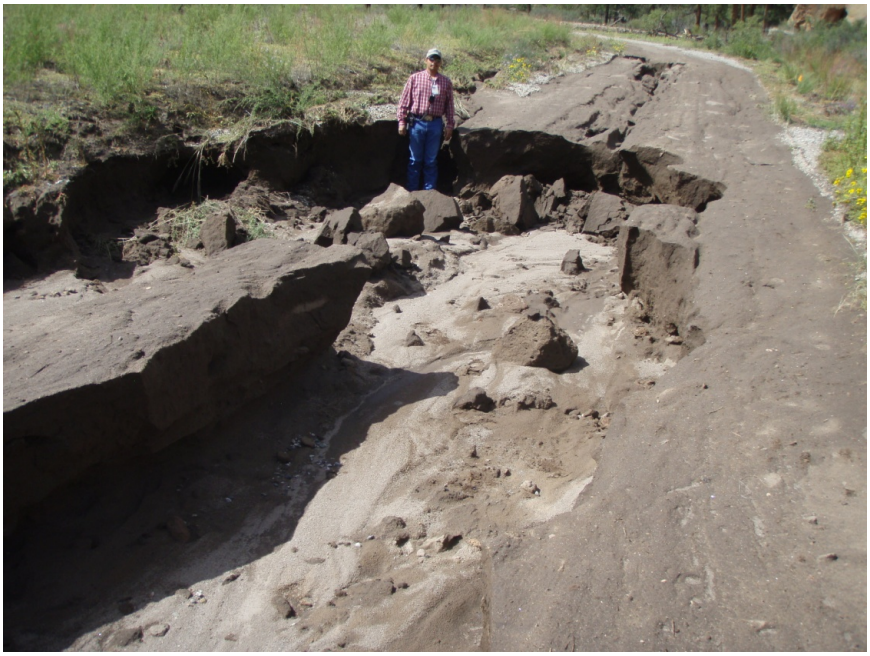

Figure 11 Damaged access road Mortandad Canyon

Figure 12 Damaged access road above sediment traps in Mortandad Canyon

Gage Stations ($57K)

A site review was completed for 11 gage stations within the watershed and ranked by estimated repair costs. Attachment 1 (on CD) presents additional information for the gage station assessment.

Of the 11 gage stations:

- 7 gage stations incurred no damage (E121, E122, E123, E229.3, RG121.9, RG200.5, and RG203)
- 1 gage station was identified with minor damage
    - ❖ E201: Shore up eroded area around control ($7K)
- 3 gage stations were identified with moderate damage
    - ❖ E125: Remove large logs and debris, remove sediment from stilling well, shore up eroded area around control ($15K)
    - ❖ E201.5: Replace staff plate mounting pole, replace or restore ISCO intake tube conduit, shore up eroded area around control ($15K)
    - ❖ E204: Replace ISCOs and batteries, shore up eroded area around control ($20K)

Figure 13 Debris at Sandia Canyon gage E125

Watershed Controls ($200K)

A site review was completed for watershed controls within the watershed. Watershed-scale controls include the Sandia grade-control structure and the Mortandad sediment traps. Attachment 2 (on CD) presents additional information for applicable watersheds.

- Sandia grade-control structure: Currently under construction, no associated costs under the assessment estimate
- Mortandad sediment traps: Major damage to 3 large sediment traps will require sediment cleanout, berm repairs, and channel repairs ($200K)

Figure 14 Damaged equipment at the Mortandad sediment traps

Individual Permit Site Monitoring Areas ($381K)

A site review was completed for controls associated with 64 SMAs within the watershed and ranked by estimated repair costs. Attachment 3 (on CD) presents additional information for the SMA assessment.

Of the 64 SMAs:

- 37 SMAs incurred no damage
- 12 SMAs were identified with minor damage
    - ❖ CDB-SMA-0.15: Repair rilling, back fill erosion gullies ($5K)
    - ❖ CDB-SMA-1: Repair or install additional riprap ($5K)
    - ❖ M-SMA-10.3: Install gravel bags around drop inlets ($2K)
    - ❖ M-SMA-12.6: Hand-repair berm breach ($3K)
    - ❖ M-SMA-3: Repair or install additional riprap ($5K)
    - ❖ S-SMA-3.51: Rebuild rock check dams (2) ($2K)
    - ❖ S-SMA-3.6: Add Ecoblocks, repair or install additional riprap ($5K)
    - ❖ S-SMA-3.95: Replace wattles (4) ($3K)
    - ❖ S-SMA-4.5: Replace wattles (4) ($3K)
    - ❖ S-SMA-5.2: Repair or install rock check dams (2) ($3K)
    - ❖ T-SMA-5: Repair or replace rock berm, check dam ($5K)
    - ❖ T-SMA-6.8: Install wattles (2) and berm ($5K)
- 11 SMAs were identified with moderate damage
    - ❖ M-SMA-6: Modify rock check dams (3), add riprap, install berm ($12K)
    - ❖ M-SMA-7.9: Repair berm breaches (2) ($10K)
    - ❖ PRATT-SMA-1.05: Repair/modify berm and rock check dam ($15K)
    - ❖ S-SMA-1.1: Repair backside of retention basin berm ($30K)
    - ❖ S-SMA-3.53: Reshape channel, extend riprap ($15K)
    - ❖ S-SMA-4.1: Replace wattles (5), repair berm, seed and mulch area ($12K)
    - ❖ S-SMA-5: Remove sediment, repair riprap and spillway ($15K)
    - ❖ T-SMA-1: Repair erosion between culverts, add seed and mulch ($18K)
    - ❖ T-SMA-3: Repair or replace log check dams (2), extend best management practices (BMPs) ($15K)
    - ❖ T-SMA-4: Repair or replace log check dam (1) and extend BMPs ($8K)
    - ❖ T-SMA-7.1: Repair base course ($8K)

- 3 SMAs were identified with moderate to severe damage
  - ❖ M-SMA-1: Hydromulch slope and add riprap ($25K)
  - ❖ CDB-SMA-0.25: Repair or replace heavily damaged berms (3) ($22K)
  - ❖ S-SMA-6: Repair channel, replace coir logs, install rock check dams (5) ($30K)
- 1 SMA was identified with severe damage
  - ❖ M-SMA-12.92: Repair Mortandad sediment traps and remove sediment (see also watershed controls above) ($100K+)

Figure 15 S-SMA-5 Control berm damaged and filled with sediment. ISCO automated sampler and battery found downstream.

2.5 Water/Cañon de Valle (Includes Fence and Potrillo Canyons) ($1203K)

Canyons Access Roads ($900K)

A site review was completed for two access roads within the watershed that are used to access gage stations, groundwater monitoring wells (TA-16 260 monitoring group, MDA AB monitoring group, and the General Surveillance monitoring group), and Individual Permit monitoring and control locations. Damage generally consisted of washed-out stream crossings, flood flow down the path of roads with scouring/material deposition, debris on the road bed, and base course removal. Because of monitoring well requirements and equipment access needs, all-weather access roads were previously installed and need to be reestablished. The approximate cost to build an all-weather access road with base course 12-ft top crown with low water crossings is $240K per mile and does not include the cost of any required bridges or low-angle cement crossings. Manufactured bridges are approximately $50K ea.

- Water Canyon access road is approximately 3.5 mi long from NM 4 to monitoring well CdV-37-1i and has 6 stream channel crossings. Significant damage to the road and stream crossings was observed. It is recommended that an assessment of rerouting the road out of the channel/flood plain and installation of up to three bridges be completed before any road repairs are undertaken. Temporary road repairs are required for access ($840K).

- Cañon de Valle access road is approximately 0.25 mi long from the Burning Ground to stream gage E256 with one stream channel crossing. Impacted sections of the access road will require the addition of base course and regrading ($60K).

Figure 16 Damage to Cañon de Valle access road

Gage Stations ($60K)

A site review was completed for 10 gage stations within the watershed and ranked by estimated repair costs. Attachment 1 (on CD) presents additional information for the gage station assessment.

Of the 10 gage stations:

- 4 gage stations incurred no damage (RG257, RG262.4, RG267.4, and E267)
- 2 gage stations were identified with minor damage
    - ❖ E252: Cut new door on stilling well, regrade channel, redirect towards stilling well ($5K)
    - ❖ E253: Cut new door on stilling well, regrade channel, redirect towards stilling well ($5K)

- 4 gage station was identified with moderate damage
    - ❖ E256: Station inaccessible but presumed damaged ($10K)
    - ❖ E262: Station inaccessible but presumed damaged ($10K)
    - ❖ E262.5: Station inaccessible but presumed damaged ($10K)
    - ❖ E265: Replace or restore the conduit going in and out of the Greenlee box, remove sediment from the stilling well, shore up the eroded concrete pad under Greenlee and Hoffman boxes, replace ISCOs and batteries ($20K)

Figure 17 Damaged gage station in Water Canyon

Watershed Controls ($0)

A site review was completed for watershed controls within the watershed. Attachment 2 (on CD) presents additional information for applicable watersheds.

- No watershed controls installed

Individual Permit Site Monitoring Areas ($243K)

A site review was completed for controls associated with 50 SMAs within the watershed and ranked by estimated repair costs. Attachment 3 (on CD) presents additional information for the SMA assessment.

Of the 50 SMAs:

- 25 SMAs incurred no damage
- 11 SMAs were identified with minor damage
    - ❖ CDV-SMA-1.2: Repair berm breach ($5K)
    - ❖ CDV-SMA-1.4: Install wattles (5) ($3K)
    - ❖ CDV-SMA-2.3: Install wattles (4), replace rock check dams ($5K)

- ❖ CDV-SMA-2.51: Repair or replace rock check dams (2) ($4K)
- ❖ PT-SMA-2: Repair berm breach ($5K)
- ❖ W-SMA-11.7: Repair berm breach ($5K)
- ❖ W-SMA-5: Replace rock check dams (2) ($3K)
- ❖ W-SMA-7: Remove debris and repair rock check dam ($3K)
- ❖ W-SMA-9.05: Repair erosion on backside of berm ($5K)
- ❖ W-SMA-9.7: Install wattles (3) ($2K)
- ❖ W-SMA-9.9: Repair berm breach ($5K)

- 13 SMAs were identified with moderate damage
  - ❖ CDV-SMA-2.42: Repair berm breach ($8K)
  - ❖ CDV-SMA-2.5: Repair berm, replace rock check dams (7), replace wattles (4) ($15K)
  - ❖ CDV-SMA-6.01: Repair berms (2), replace wattles (4) ($15K)
  - ❖ CDV-SMA-6.02: Repair berm breach ($8K)
  - ❖ CDV-SMA-7: Repair berm breach ($8K)
  - ❖ CDV-SMA-8: Reroute channel, remove downed tree, repair berms (2), replace rock check dams (3) ($18K)
  - ❖ CDV-SMA-9.05: Repair berm breaches (3) ($15K)
  - ❖ F-SMA-2: Repair or replace berms (4), remove sediment from other berms ($16K)
  - ❖ PT-SMA-0.5: Repair berm breaches (2) ($10K)
  - ❖ PT-SMA-3: Repair cost estimated will require additional field assessment ($20K)
  - ❖ W-SMA-1: Replace all riprap ($10K)
  - ❖ W-SMA-10: Repair spillway repair ($12K)
  - ❖ W-SMA-8: Repair berm breach ($8K)
- 1 SMA was identified with moderate to severe damage
  - ❖ CDV-SMA-2.41: Repair berm breaches (3), rebuild channel, replace rock check dams ($35K)

Figure 18 Damaged access road in Water Canyon

3.0 DAMAGE ASSESSMENT BY GROUNDWATER MONITORING GROUP ($176K)

Damage assessments were completed for 7 monitoring group surface completions that consist of 106 groundwater monitoring wells (17 alluvial, 28 intermediate, and 61 regional wells), as discussed in the Interim Facility-Wide Groundwater Monitoring Plan for Monitoring Year 2014. Because of multiple screened intervals at a single well location, well surface completion is not equal to sampling locations as presented in the 2014 Interim Plan. Field teams were sent to each well in the following monitoring groups to assess damage to the well and associated pad. Attachment 4 (on CD) presents additional information for the monitoring group assessment.

1. TA-21
2. Chromium Investigation
3. Material Disposal Area (MDA) C
4. TA-54
5. TA-16-260
6. MDA AB
7. General Surveillance

The locations of groundwater monitoring wells are presented in Plate 4.

3.1 TA-21 Monitoring Group ($6K)

A site review was completed for 14 groundwater monitoring wells associated with the TA-21 monitoring group and ranked by estimated repair costs (none, minor, moderate, or severe).

- 11 wells incurred no damage
- 3 wells were identified with minor damage
    - ❖ LA0I(a)-1.1: Clear pad of debris and sediment ($2K)
    - ❖ R-9: Clear pad of debris and sediment ($2K)
    - ❖ R-9i: Clear pad of debris and sediment ($2K)

3.2 Chromium Investigation Monitoring Group ($10K)

A site review was completed for 19 groundwater monitoring wells associated with the Chromium Investigation monitoring group and ranked by estimated repair costs.

- 14 wells incurred no damage
- 5 wells were identified with minor damage
    - ❖ MCOI-6LA0I(a)-1.1: Clear pad of debris and sediment ($2K)
    - ❖ R-1: Clear pad of debris and sediment ($2K)
    - ❖ R-11: Clear pad of debris and sediment ($2K)
    - ❖ R-28: Clear pad of debris and sediment ($2K)
    - ❖ R-42: Clear pad of debris and sediment ($2K)

Figure 19 Flood debris at monitoring well R-11

3.3 MDA C Monitoring Group ($0K)

A site review was completed for 3 groundwater monitoring wells associated with the MDA C monitoring group and ranked by estimated repair costs.

- 3 wells incurred no damage

3.4 TA-54 Monitoring Group ($2K)

A site review was completed for 19 groundwater monitoring wells associated with the TA-54 monitoring group and ranked by estimated repair costs.

- 18 wells incurred no damage
- 1 well was identified with minor damage
    - ❖ R-40: Clear pad of sediment ($2K)

3.5 TA-16-260 Monitoring Group ($7K)

A site review was completed for 19 groundwater monitoring wells associated with the TA-16-260 monitoring group and ranked by estimated repair costs.

- 16 wells incurred no damage
- 3 wells were identified with minor damage
    - ❖ 16-25280: Clear pad of debris ($2K)
    - ❖ CdV-16-1(i): replace and repair base course at pad ($3K)
    - ❖ MSC-16-06295: Clear pad of debris ($2K)

3.6 MDA AB Monitoring Group ($0K)

A site review was completed for 4 groundwater monitoring wells associated with the MDA AB monitoring group and ranked by estimated repair costs.

- 4 wells incurred no damage

3.7 General Surveillance Monitoring Group ($151K)

A site review was completed for 28 groundwater monitoring wells associated with the General Surveillance monitoring group and ranked by estimated repair costs.

- 21 wells incurred no damage
- 5 wells were identified with minor damage
    - ❖ MCO-5: Clear pad of sediment and debris ($2K)
    - ❖ MCO-7: Clear pad of sediment and debris ($2K)
    - ❖ R-33: Clear pad of sediment and debris ($2K)
    - ❖ POI-4: Replace and repair base course within fenced area ($3K)
    - ❖ WCO-1r: Clear pad of debris ($2K)

- 2 wells were identified with major damage
    - ❖ APCO-1: Alluvial monitoring well destroyed, large portion of pad eroded, and fence heavily damaged. Replace with new well, pad, and fence ($80K)
    - ❖ MC0-3: Radioactive liquid waste discharge permit alluvial monitoring well destroyed. Replace with new well and pad ($60K)

Figure 20 Damage to well APCO-1 and pad

4.0 DAMAGE TO AND LOSS OF AUTOMATED SAMPLERS ($35K)

The Laboratory uses ISCO automated samplers at gages, SMAs, and special study locations.

- 15 ISCOs were damaged and require repair ($15K)
- 5 ISCOs were lost in the flooding ($20K)

Figure 21 Damage to the top of an ISCO automated sampler

5.0 PROPOSED SEDIMENT SAMPLING ($600K)

The widespread flooding on September 13, 2013, resulted in stream bank erosion throughout all canyons within the Laboratory. In many of the canyon reaches, the eroded stream bank sediments contained contaminants from past Laboratory operations. The floods left behind extensive floodplain and channel-fill deposits that are likely to have a signature of the eroded contaminated stream-bank sediments. Past surveillance work conducted by the Laboratory to characterize such sediment deposits has demonstrated that concentrations remain within acceptable regulatory risk limits. However, the nature and scale of the floods and erosion from the September event poses unique questions about whether unacceptable contaminant concentrations are present in new floodplain deposits, especially on off-site (San Ildefonso) locations. To appropriately characterize new sediment deposits in affected areas, approximately 200 to 250 samples will be required. Focused analyte suites will be developed on a canyon-by-canyon basis and will be based on existing data for each canyon. In addition, established cross-section locations will be resurveyed to assess sediment transport.

6.0 SUMMARY OF ESTIMATED RECOVERY COSTS

Estimated costs by damage and by watershed are presented in Table 2.

Table 2
Summary of Estimated Costs by Damage and Watershed

Damage	Ancho/ Chaquehui ($K)	Los Alamos/ Pueblo ($K)	Pajarito ($K)	Sandia/ Mortandad ($K)	Water- Cañon de Valle ($K)	Total ($K)
Access Roads	40	1726	660	592	900	3918
Gage Stations	25	485	60	57	60	687
Watershed Controls	0	230	0	200	0	430
SMAs	27	328	231	381	243	1210
ISCOs	0	20	5	5	5	35
Total	**92**	**2789**	**956**	**1235**	**1208**	**6280**

Estimated costs by monitoring group are presented in Table 3.

Table 3
Summary of Estimated Costs by Monitoring Group

Damage	TA-21 ($K)	Chromium Investigation ($K)	MDA C ($K)	TA-54 ($K)	TA-16-260 ($K)	MDA AB ($K)	General Surveillance ($K)	Total ($K)
Pad	6	10	0	2	7	0	11	36
Well	0	0	0	0	0	0	140	140
Total	**6**	**10**	**0**	**2**	**7**	**0**	**91**	**176**

Table 4
Summary of Estimated Total Costs

Damage	Cost ($)
Watersheds	6,280,000
Monitoring Groups	176,000
Sediment	600,000
Total	**7,056,000**

7.0 CURRENT MITIGATION ACTIVITIES

Canyons Access Roads

Temporary access has been provided in lower Los Alamos Canyon to the Los Alamos County production well and in upper Mortandad Canyon for required monitoring well sampling activities under the Consent Order.

Gage Stations

Gages E050 and E060 were immediately put back online to meet Buckman early warning system requirements. Cleaning of debris from gages has been initiated.

Watershed Controls

No activity at this time.

Individual Permit Site Monitoring Areas

Detailed control inspections are currently being completed to meet annual inspection requirements; repair work has begun at sites requiring minor maintenance; and recovery of lost automated samplers and associated batteries is ongoing.

Groundwater Monitoring

Cleanup of sediment and debris at well pads that are easily accessible is underway.

Sediment Sampling

Planning of field activities, submittal of excavation permits and cross-section surveys are underway.