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The attached Mortandad Canyon Well Abandonment Project Report, LA-UR-00-5975, summarizes work done by Science Applications International Corporation for ESH-18 to abandon 43 wells and moisture access tubes in Mortandad Canyon. Michelle Benak and Richard Koch of SAIC and I wrote the report.

The abandonment work was carried out during August and September of 2000. Many of these wells were damaged by the Cerro Grande fire of May 2000. Other wells and moisture tubes were no longer used by ESH-18.

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Title:

**Mortandad Canyon Well Abandonment Project
Report**

Author(s):

Michelle Benak
Science Applications International Corporation
Richard Koch
Science Applications International Corporation
David B. Rogers
Water Quality and Hydrology Group, ESH-18

Submitted to:

November 22, 2000

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Mortandad Canyon Well Abandonment Project Report

By

Michelle Benak, Richard Koch, and David Rogers

November 2000

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Mortandad Canyon Well Abandonment Project Report

Introduction

The monitor well abandonment project for Mortandad Canyon was performed in response to the Cerro Grande Fire that burned through Mortandad Canyon in May 2000. The fire burned through the entire extent of Mortandad Canyon on Laboratory Property east of TA-59 and onto San Ildefonso Pueblo land.

Mortandad Canyon is located in the middle part of Los Alamos National Laboratory and heads at TA-3 on the west and passes on the north side of TA-59, TA-48, TA-55, and TA-35. The canyon extends through TA-5 and across the eastern Laboratory boundary onto San Ildefonso Pueblo land. The wells and moisture access tubes that were abandoned by the project were located in the upper, middle and lower part of the canyon.

Since 1960 over one hundred observation wells and moisture access tubes have been installed in Mortandad Canyon to monitor the shallow alluvial groundwater. Many of the wells and moisture access tubes were severely affected by the fire. In many cases, PVC or plastic tubing that extended above the surface was partially or entirely melted by the fire. The wells and moisture tubes that were affected by the fire and older monitor wells and moisture access tubes that are no longer usable by the Laboratory were plugged and abandoned.

Science Applications International Corporation (SAIC) personnel were contracted by the Laboratory Water Quality and Hydrology Group (ESH-18) through Johnson Controls Northern New Mexico (JCNNM) to abandon the wells and moisture tubes in Mortandad Canyon. Stewart Brothers Drilling Company provided equipment and field support for the project through the Laboratory Geoengineering Group (EES-4). JCNNM Health and Safety (H&S) personnel provided general H&S oversight for the project and for SAIC personnel. Laboratory H&S Oversight Group (ESH-5) provided H&S oversight for the drilling company.

Prior to conducting field operations required plans and permits were obtained. A Site Specific Health and Safety Plan (SSHASP) was prepared and approved by all required Laboratory groups on August 15, 2000. Other permits that were obtained through Laboratory oversight groups included a Spark/Flame Permit and an Excavation Permit.

Well Survey Activities

Fieldwork for the well abandonment project began on August 22, 2000 with a survey of the wells that were to be abandoned. Measurements were obtained for each well to be abandoned, including total depth, water level (if present), length of the stickup, surface casing diameter and length, cement pad dimensions (if present) and the presence of fire damage. Information that was obtained from the well survey is shown in Table 1.

Well Abandonment Activities

A total of 43 wells and moisture access tubes were abandoned in Mortandad Canyon. The wells that were abandoned and information for each well are shown in Table 1. Waste that was generated from the abandonment of the wells and moisture tubes is listed in Table 2. Figures 1 through 3 show the locations of the wells and moisture access tubes that were abandoned. Photos 1 through 7 depict the abandonment activities in Mortandad Canyon.

Abandonment of the wells and moisture tubes began on August 30, 2000. Abandonment activities began in the upper part of Mortandad Canyon. A drill rig was unable to access the wells in upper Mortandad so these wells were abandoned manually. Where possible the tubing in the wells was removed from the well. Where the tubing could not be retrieved from the well, the tubing was cut off just below ground surface

prior to plugging. Wells MCM-2A, MCM-2B, MCM-2.2, MCM-3A, MCM-3B, MCM-2.8 were plugged with bentonite and a cement cap was placed at the surface using Quickcrete® concrete. The waste pieces of tubing were swipe sampled by ESH-1 for radiological hazards and the samples were found to be below detection levels. The waste materials were removed from the site and transported to the Los Alamos County landfill for disposal.

On September 14, 2000, the drill rig and crew commenced abandonment activities in lower Mortandad Canyon. Abandonment began with pulling any surface casing, casing cap, or "t" posts out of the ground with the drill rig. Cement pads were also pulled from the ground, broken into manageable-sized pieces and removed from the well area.

The tubing for each well was then over-drilled with a hollow stem auger to a depth of 5 feet below ground surface. At each site an attempt was made to pull the tubing from the well. Where possible, the tubing was removed from the hole, however, depending on the age and brittleness of the tubing, the tubing often parted a few feet below the surface. At wells where the tubing parted below surface, the tubing was left in the hole. Each well was then grouted with a mixture of Type I & II Portland cement with 3% bentonite gel added. The drilling company used a trailer-mounted cement mixer to mix the cement, water, and bentonite. The grout mixture was poured into the hole using the tubing remaining in the hole and a hose that connected to the cement mixer. The entire length of the open hole to surface was grouted. The grouted wells were subsequently checked within 24 hours for any settling of the grout. If the grout had settled, extra grout was added to make the grouted holes flush with the surface.

A total of seventy-six 94-pound bags of Type I & II cement were used in grouting the holes to the surface. Each bag of cement required seven gallons of water to make the cement grout. A total of 3 bags of bentonite gel were used to mix with the cement for the grout mixture. A total of seven 50-pound bags of 3/8" diameter Holeplug® bentonite chips were used to abandon holes that were not accessible with the drill rig.

At MCM-4.5 and MCO-6.5B, the drill rig could not pull the surface casing from the well. These casings were cut to just below ground surface with a welder. The holes were then grouted as described above.

Wells MCO-4 and MCM-4B were located in middle Mortandad Canyon at sites that were not accessible to the drill rig. We found that MCO-4 had been previously plugged with bentonite and that MCM-4B was partially plugged with soil. MCM-4B was opened, bentonite chips were poured onto the hole, and water was added to hydrate the chips for abandonment.

The site of MCM-5B was not found, however two 4 in-diameter, 2 ft-long pieces of badly burnt PVC tubing were found in the vicinity. The area around MCM-5B was probed in an effort to locate the borehole but no hole or additional tubing were located. We assume that this moisture access tube is buried and plugged with soil and debris. The pieces of PVC were swipe sampled by ESH-1 personnel and disposed of as waste.

On September 21, 2000 ESH-1 personnel collected swipe samples of the drill rig to check for potential radiological contamination. The samples were determined to be below detection levels and the drill rig and equipment were released from Mortandad Canyon. The drill rig and associated equipment were demobilized and removed from the canyon on September 22, 2000.

Waste Management Activities

On September 25, 2000, ESH-1 personnel collected swipe samples of the waste and debris that resulted from the well abandonment project, to detect possible radiological contamination. ESH-1 personnel used an ESP-1 beta/gamma meter and Ludlum Model 139 alpha meter to check the waste at the sites for radiological contamination. All swipe samples were determined to be below detection levels.

The waste and debris generated by past well construction activities and from the well abandonment project were removed from the canyon on October 2, 2000. The amount and type of waste generated from the well abandonment project is shown in Table 2. The waste and debris consisted of the broken remains of cement pads, waste grout materials, steel surface casings, plastic and PVC tubing, mushroom caps, and miscellaneous well construction debris. Some waste materials were recycled; steel surface casings and mushroom caps that could be reused were transported to the EES-4 equipment yard at TA-3-271 for storage and reuse. The waste and debris that was of no use for recycling were transported to the Los Alamos County Landfill. A total of 3180 pounds of waste materials were transported to the landfill.

Acknowledgments

The authors would like to acknowledge those who contributed to the success of the Mortandad Canyon Well Abandonment Project. The management of the Water Quality and Hydrology Group (ESH-18), Steve Rae and Ken Mullen, recognized the need to provide for the proper abandonment of wells and boreholes in Mortandad Canyon and arranged funding for the project. Mr. Joe Skalski of the Geoengineering Group (EES-4) provided abandonment supplies and field support equipment and personnel. Jim Carothers and Terry Weisgerber of the Industrial Hygiene and Safety Group (ESH-5) and Mr. Clint Daymon of JCNNM provided H&S oversight for the field operations. Tim Zimmerly, Vince Rodriguez, and Suzanne Moore of JCNNM assisted with permitting for the project. Darril Stafford and Greta Williams of the Health Physics Operations Group (ESH-1) performed the swipe sampling. Joe Sena and Jon Marin (SAIC) helped with well abandonment activities and disposal of waste materials.

Table 1. Wells and Moisture Access Tubes Abandoned in Mortandad Canyon

| Hole ID | Survey Date | Survey Time | Tubing Type | Surface Casing | Height of Tubing (Ft from GL) | Sounded Depth (Ft from GL) | Water Depth (Ft from GL) | Comments |
|-----------|-------------|-------------|----------------------------------|----------------------------------|---------------------------------------|----------------------------|--------------------------|--|
| MCM-10 | 08/22/2000 | 3:55:00 P | 2" diameter black plastic | None | 0 | 60.6 | 55.3 | Fire damaged, tubing burned to ground surface |
| MCM-10-1 | 08/22/2000 | 3:50:00 PM | 2" diameter PVC tubing | None | .75' | 119.05 | 118.85 | |
| MCM-10-2 | 08/22/2000 | 3:37:00 PM | 2" diameter PVC tubing | Steel cover, 6.25" ID, 6.625" OD | 1.6' | 43.6 | Dry | |
| MCM-10-3A | 08/22/2000 | 3:10:00 PM | 2" diameter white plastic tubing | None | 1.5' | 30.4 | 29.85 | |
| MCM-10-3B | 08/22/2000 | 3:11:00 PM | 2" diameter white plastic tubing | None | 1.9' | 43.6 | 40.75 | |
| MCM-12A | 08/22/2000 | 3:27:00 PM | 2" diameter black plastic tubing | None | 0 | 98.5 | Dry | Fire damaged, tubing burned and measurements obtained from ground surface. |
| MCM-12B | 08/22/2000 | 3:18:00 PM | 2" diameter black plastic | None | .75' | 79.25 | Dry | |
| MCM-2.2 | 08/22/2000 | 12:40:00 PM | 2" diameter black plastic | None | 2.3' | 86.5 | Dry | Angle hole, tubing slanted |
| MCM-2.8 | 08/22/2000 | 12:05:00 PM | 2" diameter black plastic tubing | None | 4.6' | 59.9 | Dry | Angle hole, tubing slanted and on a side slope. |
| MCM-2A | 08/22/2000 | 11:50:00 AM | 2" diameter black plastic | None | 0 | 5.2 | 0.08 | Tubing fire damaged, melted to ground level |
| MCM-2B | 08/22/2000 | 11:55:00 AM | 2" diameter black plastic | None | 0 | 1 | 0.67 | Fire damaged - tubing melted and broken. |
| MCM-3A | 08/22/2000 | 12:25:00 PM | 2" diameter plastic tubing | None | 2' | 13.6 | Dry | |
| MCM-3B | 08/22/2000 | 12:30:00 PM | 2" diameter black plastic tubing | None | 1.8' | 5 | 3.7 | |
| MCM-4.5 | 08/25/2000 | 12:25:00 PM | 2" diameter black plastic tubing | 4.5" OD steel round | 1.63' stick up for tubing and casing. | 21.47 | 20.37 | |

Table 1 (Continued). Wells and Moisture Access Tubes Abandoned in Mortandad Canyon

| Hole ID | Survey Date | Survey Time | Tubing Type | Surface Casing | Height of Tubing (Ft from GL) | Sounded Depth (Ft from GL) | Water Depth (Ft from GL)** | Comments |
|----------|-------------|-------------|----------------------------------|---|-------------------------------|----------------------------|----------------------------|--|
| MCM-4B | 08/25/2000 | 12:35:00 PM | 2" diameter black plastic | None | * | * | * | Fire damaged. Tubing not located |
| MCM-5.1 | 08/25/2000 | 11:55:00 AM | 2" diameter PVC, white | 10.5" OD steel casing | .63' | 112.07 | Dry | |
| MCM-5.9A | 08/25/2000 | 11:40:00 AM | 2" diameter PVC | 8 3/4" OD round steel casing | 1.0' | * | * | Fire damaged, PVC melted inward 2 ft BGS at time of installation, causing constriction |
| MCM-5A | 08/25/2000 | 12:10:00 PM | 2" diameter black plastic | 6.5" OD steel casing | .75' | 26.35 | Dry | |
| MCM-5B | * | * | 4" diameter PVC | None | 0 | * | * | Fire damaged, PVC badly burned and laying on the ground |
| MCM-5C | 08/25/2000 | 12:05:00 PM | 2" diameter black plastic | None | 2' | 38 | 0 | |
| MCM-6.5 | 08/25/2000 | 11:05:00 AM | 2" diameter black plastic | None | 0 | 96.3 | 93.7 | Fire damaged, burned to ground surface |
| MCM-6.5A | 08/25/2000 | 10:55:00 AM | 2" diameter stainless steel pipe | 6.5" OD steel casing with mushroom cap | 1.5' | 22.65 | 21.7 | |
| MCM-6A | 08/25/2000 | 11:45:00 AM | 2" diameter black plastic | 6.5" OD steel round casing | 1.16' | 17.69 | Dry | |
| MCM-6E | 08/25/2000 | 11:50:00 AM | 2" diameter black plastic | None | 0 | 21 | Dry | Fire damaged, tubing leaning at angle |
| MCM-7.5 | 08/25/2000 | 10:40:00 AM | 2" diameter black plastic | None | 1.1' | 94.6 | 93.6 | |
| MCM-8B | 08/25/2000 | 9:55:00 AM | 2" diameter black plastic tubing | 6.5" OD round steel casing | 1.0' | 31.4 | 30.9 | |
| MCM-8C | 08/25/2000 | 10:05:00 AM | 2" diameter black plastic | None | 0 | 0.58 | 0.25 | Fire damaged, tubing broken at surface and partly filled with obstruction. |
| MCM-8D | 08/25/2000 | 10:10:00 AM | 2" diameter black plastic | 6.5" OD steel casing, 2.2 ft long | 1.5' | 86.8 | Dry | |
| MCM-8E | 08/25/2000 | 10:15:00 AM | 2" diameter black plastic | 6.5" OD steel casing, 2.5' above ground level | 1.7' | 52.35 | Dry | |

Table 1 (Continued). Wells and Moisture Access Tubes Abandoned in Mortandad Canyon

| Hole ID | Survey Date | Survey Time | Tubing Type | Surface Casing | Height of Tubing (Ft from GL) | Sounded Depth (Ft from GL)* | Water Depth (Ft from GL)* | Comments |
|----------|-------------|-------------|----------------------------------|---|-------------------------------|-----------------------------|---------------------------|---|
| MCM-8F | 08/25/2000 | 10:15:00 AM | 2" diameter black plastic | None | 0 | 0 | Dry | Fire damaged, tubing burned and melted closed at surface |
| MCO-4 | 08/25/2000 | 12:30:00 PM | 3" diameter PVC tubing | 8.5" OD steel casing with mushroom cap, 3.5' long | 0 | * | * | In drainage, well found grouted with bentonite and flush with the surface |
| MCO-4.9 | 08/25/2000 | 12:15:00 PM | 2" diameter PVC | 6.5" OD steel | 1.25' | 23.45 | Dry | |
| MCO-5.1A | 08/25/2000 | 12:00:00 PM | 2" diameter PVC pipe | None | 0 | 23 | Dry | Fire damaged, PVC bent over and lying on the ground. |
| MCO-6.5A | 08/25/2000 | 11:00:00 AM | 2" diameter black plastic tubing | 6.5" OD steel with mushroom cap | 1.0' | * | * | |
| MCO-6.5B | 08/25/2000 | 11:00:00 AM | 4" diameter aluminum tubing | 6.5" OD steel casing | 1.0' | 35.7 | Dry | |
| MCO-7.1 | 08/25/2000 | 1:00:00 PM | 2" diameter PVC tubing | None | 0 | 49 | * | Fire damaged, tubing burned and leaning at angle |
| MCO-7.1A | 08/25/2000 | 1:00:00 PM | 4" diameter PVC | None | 0 | 55 | * | Fire damaged, tubing burned and leaning at angle |
| MCO-7.1B | 08/25/2000 | 1:00:00 AM | 2" diameter PVC | None | 0 | * | * | 2 pieces of PVC found in well. Both pieces of pipe were plugged. |
| MCO-7.5A | 08/25/2000 | 10:35:00 AM | 3" diameter black plastic | None | 0 | 0 | Dry | Fire damaged, tubing burned to ground level |
| MCO-8 | 08/25/2000 | 10:00:00 AM | 3" diameter black PVC | 8" OD steel casing, 22.5' tall | 1.5' | 2.75 | Dry | Obstruction in well, appears to be plugged with unknown object |
| MCO-8A | 08/25/2000 | 10:20:00 AM | 2" diameter black plastic | None | .79' | 48.41 | 47.01 | |
| MCWW-1 | 08/25/2000 | 12:50:00 PM | 4" diameter PVC | None | .71' | 41.74 | Dry | Fire damaged, PVC badly burned and cracked at surface |
| TSCM-1 | 08/25/2000 | 11:30:00 AM | 2" diameter black plastic | None | 1.2' | 23.1 | 0.9 | |

* - Indicates data missing due to the severe damage of the wells and moisture tubes by fire or other obstruction.

** - GL = Ground Level.

Table 2. Waste Generated from the Abandonment of Wells and Moisture Access Tubes in Mortandad Canyon

| Hole ID | Date Abandoned | Waste Generated | Tubing (Ft) | SFC Casing (Ft) | Concrete (Ft ³) |
|----------|----------------|--|-------------|-----------------|-----------------------------|
| MCM-10 | 09/15/2000 | Black plastic tubing, 1 t-post | 1 | 0 | 0 |
| MCM-10-1 | 09/15/2000 | PVC tubing, 1 t-post | 1 | 0 | 0 |
| MCM-10-2 | 09/15/2000 | PVC tubing, casing, cement pad | 19 | 4 | 0.025 |
| MCM-10- | 09/14/2000 | PVC tubing, 1 t-post | 31 | 0 | 0 |
| MCM-10- | 09/14/2000 | PVC tubing, 1 t-post | 45 | 0 | 0 |
| MCM-12A | 09/14/2000 | Black plastic tubing, 1 t-post | 1 | 0 | 0 |
| MCM-12B | 09/14/2000 | Black plastic tubing, 1 t-post. 20' extra tubing | 21 | 0 | 0 |
| MCM-2.2 | 08/30/2000 | Cut 2' of plastic tubing to ground surface | 2 | 0 | 0 |
| MCM-2.8 | 08/30/2000 | Cut approx. 5' of plastic tubing | 5 | 0 | 0 |
| MCM-2A | 08/30/2000 | approx. 2' long 2" black tubing placed near well | 0 | 0 | 0 |
| MCM-2B | 08/30/2000 | Cut 5" off tubing to make it flush with ground | 0 | 0 | 0 |
| MCM-3A | 08/30/2000 | Cut off tubing stick up | 3 | 0 | 0 |
| MCM-3B | 08/30/2000 | Cut off tubing stick up. | 2 | 0 | 0 |
| MCM-4.5 | 09/20/2000 | Black plastic tubing, surface casing | 2 | 2 | 0 |
| MCM-4B | 09/21/2000 | .5 piece of black plastic tubing | 1 | 0 | 0 |
| MCM-5.1 | 09/19/2000 | Surface casing, cement pad, grout pad, tubing | 4 | 3 | 1.33 |
| MCM-5.9A | 09/19/2000 | Casing, crushed cement, PVC tubing | 1 | 1.8 | 0.75 |
| MCM-5A | 09/20/2000 | Black plastic tubing, surface casing and, cement | 2 | 4 | 0.33 |
| MCM-5B | * | 4" PVC | 4 | 0 | 0 |
| MCM-5C | 09/20/2000 | 1 "t" post, black plastic tubing | 3 | 0 | 0 |
| MCM-6.5 | 09/18/2000 | 1 "t" post, casing, tubing, tin cap | 1 | 5 | 0 |
| MCM-6.5A | 09/18/2000 | Casing and cap, aluminum tubing | 12 | 4 | 0.29 |
| MCM-6A | 09/19/2000 | Surface casing, cement pad, tubing, 2 tin cans | 3 | 4 | 0.33 |
| MCM-6E | 09/19/2000 | Black plastic tubing, 1 "t" post | 1 | 0 | 0 |
| MCM-7.5 | 09/18/2000 | Black plastic 1"t"post, 1 metal bucket, 1 well cap | 1 | 0 | 0 |
| MCM-8B | 09/15/2000 | Black plastic tubing, surface casing, cement pad | 1 | 4 | 0.25 |
| MCM-8C | 09/15/2000 | Black plastic tubing, 1 t-post, 1 tin can | 1 | 0 | 0 |
| MCM-8D | 09/15/2000 | Black plastic tubing, surface casing, cement pad | 1 | 4 | 0.42 |
| MCM-8E | 09/15/2000 | Black plastic tubing, surface casing, cement pad | 33 | 4 | 0.33 |
| MCM-8F | 09/15/2000 | Black plastic tubing, 1 t-post | 1 | 0 | 0 |
| MCO-4 | 09/21/2000 | Surface casing | 0 | 4 | 0 |

Table 2 (Continued). Waste Generated from the Abandonment of Wells and Moisture Access Tubes in Mortandad Canyon

| Hole ID | Date Abandoned | Waste Generated | Tubing (Ft) | SFC Casing (Ft) | Concrete (Ft ³) |
|----------|----------------|--|-------------|-----------------|-----------------------------|
| MCO-4.9 | 09/20/2000 | PVC tubing, surface casing, cement pad | 10 | 4 | 0.33 |
| MCO-5.1A | 09/20/2000 | 1 "t" post, PVC tubing | 2 | 0 | 0 |
| MCO-6.5A | 09/18/2000 | Black plastic tubing, surface casing, cement pad | 4 | 4.5 | 0.25 |
| MCO-6.5B | 09/18/2000 | Casing, cement, tubing | 2 | 4 | 0.33 |
| MCO-7.1 | 09/20/2000 | .5 piece of PVC | 1 | 0 | 0 |
| MCO-7.1A | 09/20/2000 | PVC tubing, concrete | 9 | 0 | 7 |
| MCO-7.1B | 09/20/2000 | .5' piece of PVC | 1 | 0 | 0 |
| MCO-7.5A | 09/18/2000 | 1 "t" post, tubing | 4 | 0 | 0 |
| MCO-8 | 09/15/2000 | Black plastic tubing, surface casing, cement pad | 6 | 1.9 | 1.3 |
| MCO-8A | 09/15/2000 | Black plastic tubing, 1 t-post | 5 | 0 | 0 |
| MCWW-1 | 09/18/2000 | 4.5" OD PVC tubing, 1 tin cap | 2 | 0 | 0 |
| TSCM-1 | 09/18/2000 | Black plastic tubing, 1 "t" post | 4 | 0 | 0 |

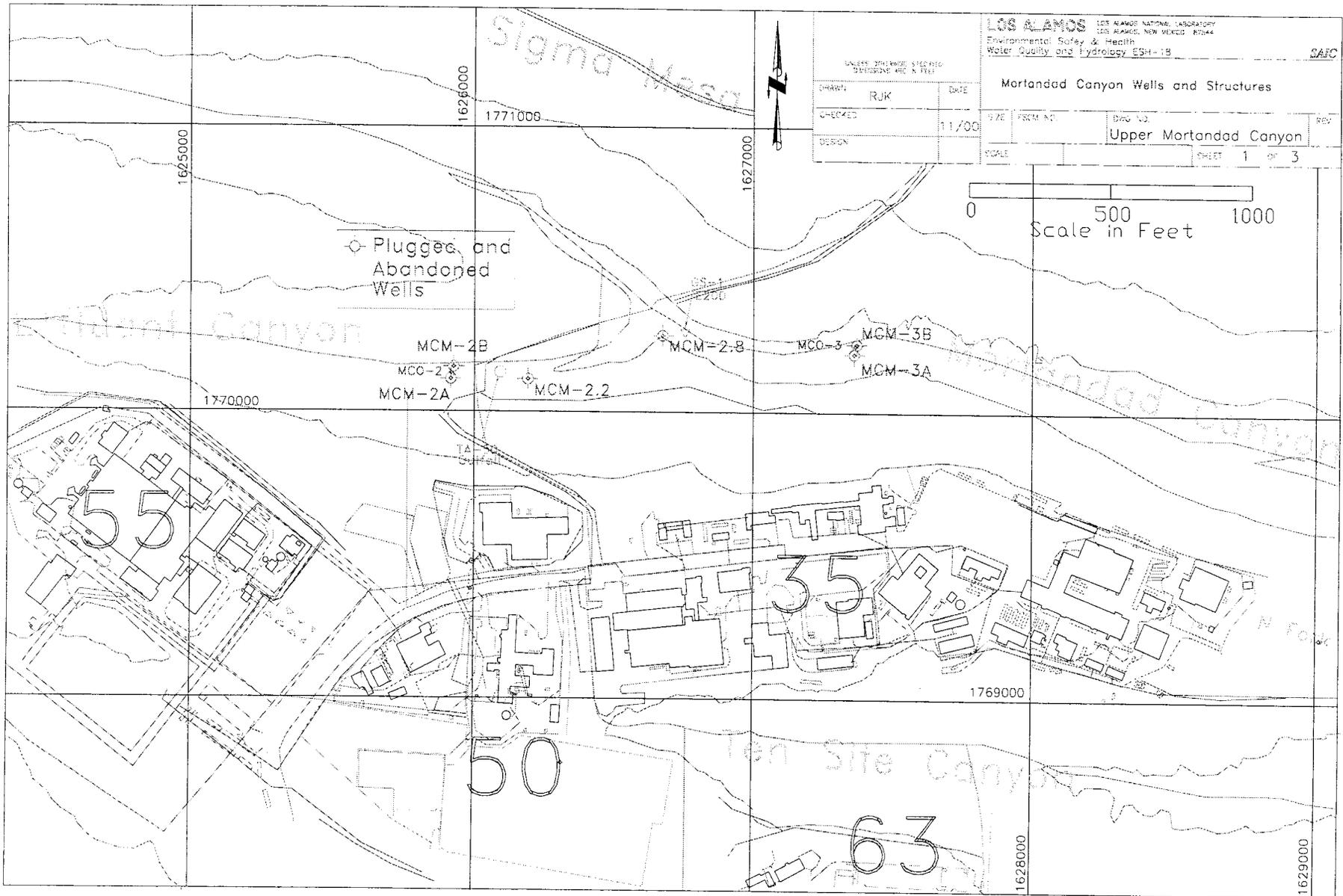
* - Indicates data missing due to the severe damage of the wells and moisture tubes by the fire.

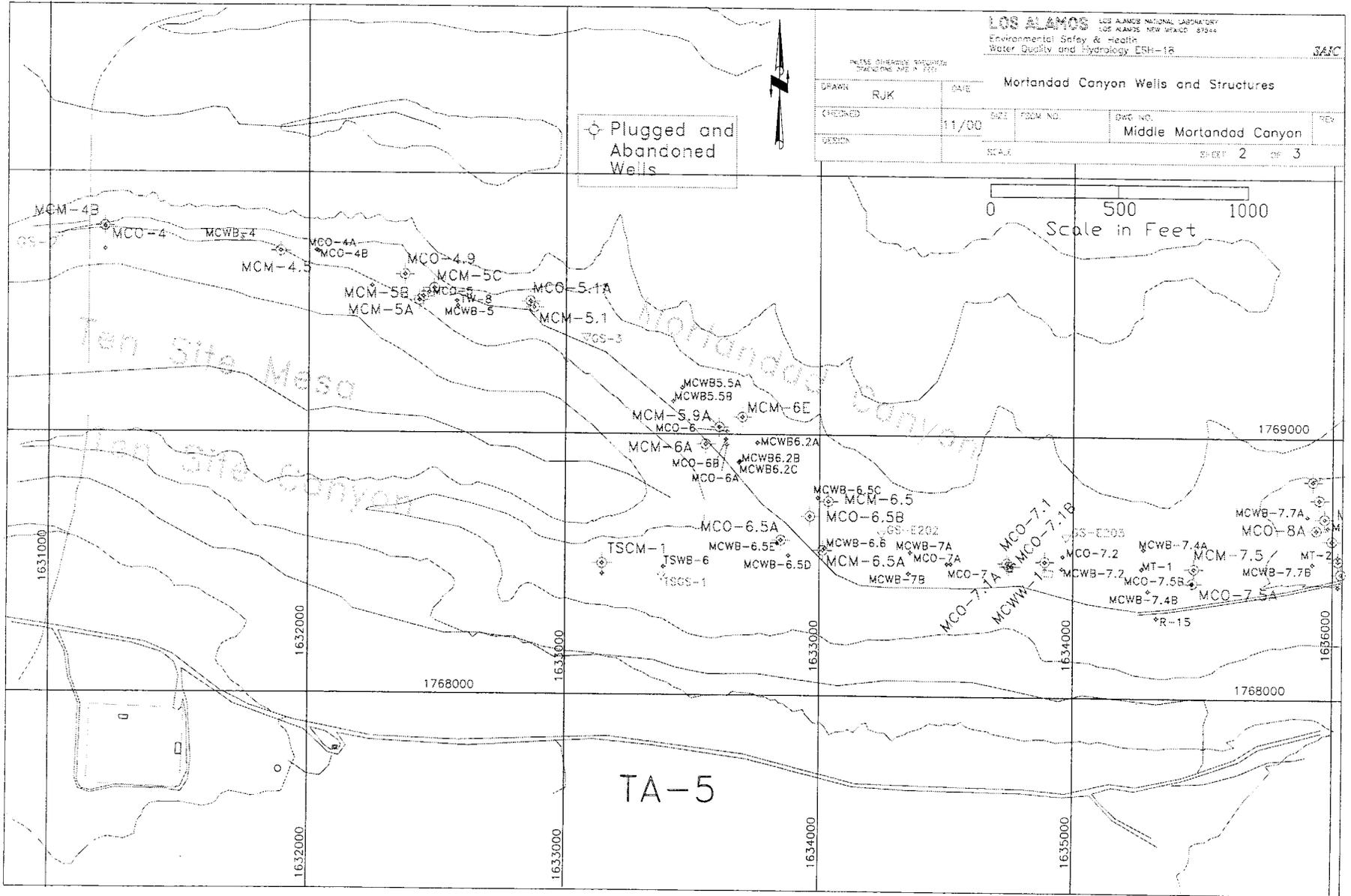
Appendix A. Figures

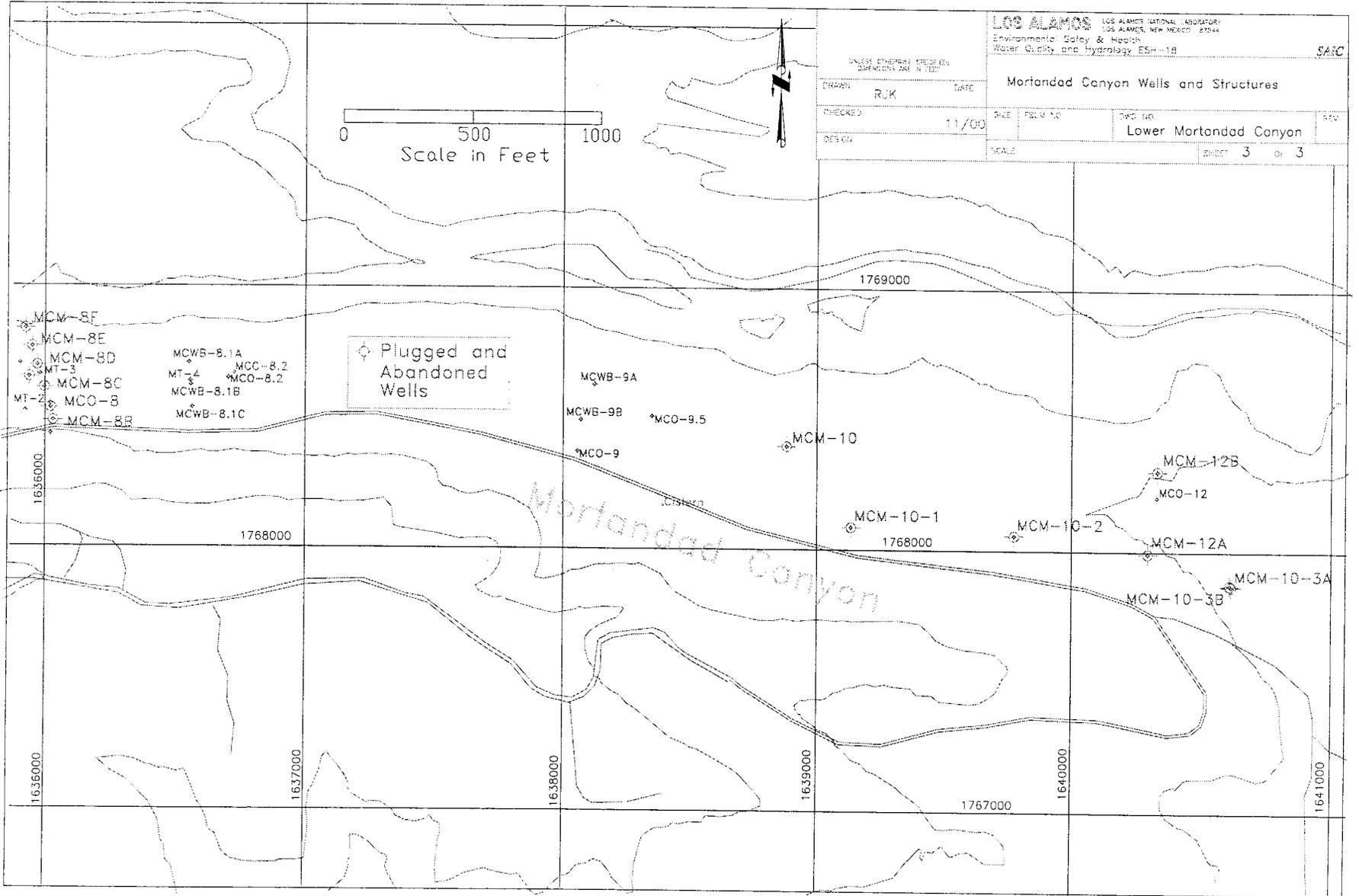
Figure 1. Moisture Access Tubes Abandoned in the Upper Mortandad Canyon – Effluent Canyon area.

Figure 2. Wells and Moisture Access Tubes Abandoned in the Middle Mortandad Canyon – Ten Site Canyon area.

Figure 3. Wells and Moisture Access Tubes abandoned in the Lower Mortandad Canyon area.







Appendix B. Photographs of Well Abandonment Activities



Photo 1 – Drill rig set up to abandon well MCO-7.5A in Mortandad Canyon.



Photo 2 – Drill rig set up to abandon well MCO-7.5A in Mortandad Canyon.



Photo 3 – Grouting up the hole after abandonment of MCO-7.5A.



Photo 4 – Hollow stem auger used to overdrill and grouted hole at MCO-7.5A.



Photo 5. Abandoned moisture access tube MCM-7.5. Hole is grouted and metal ID tag placed in the grout.



Photo 6. Final abandonment of moisture access tube MCM-5C.



Photo 7. Waste materials collected from the well abandonment project.