AREA C

General Information

Area C is located on Pajarito Road (see Fig. C-1), to the south of TA-50, east of Pecos Drive, and north of Pajarito Road. It is defined by LASL coordinates (beginning with the northeast point and moving in a clockwise direction) N.28+93, E.101+05; N.26+70, E.100+79; N.26+74, E.100+43; N.24+55, E.100+18; N.25+36, E.93+23; N.27+37, E.89+31; N.28+64, E.87+52; and N.30+36, E.88+52. Its location can also be given using township and range as on the mesa in the E 1/2 sec. 22, T. 19 N., R. 6 E.[8] The approximate acreage for Area C is 11.80.[35]

A memo[86] dated seven days after the May 3, 1948, fire in Area B stated

> On May 6, 1948 we forwarded an X priority #153078 to the Zia company...for the construction of a new contaminated dump. The work of digging the ditch commenced Friday morning, May 7th, and was continued through Saturday, May 8th. Work is being resumed this morning, Sunday work having been skipped.
>
> The location for this new contaminated dump has been agreed to by authorized Safety and Health personnel and by CMR Division. Since it is located near the junction of the Alpha Site Road and the Pajarito Road, we are for record purposes considering it as part of the Alpha Site installation.[86]

Selection of the location of Area C is reportedly the first involvement of the USGS in disposal site approval (personal communication, D. D. Meier). There are a total of 6 pits, a chemical pit, and 107 numbered shafts in Area C.

Geology and Hydrology

The mesa at Area C slopes gently eastward. Canyons approximately 304.8 m (1000 ft) north and south of the area are 30.5-45.7 m (100-150 ft) deep.[8] Ten-Site Canyon heads immediately northeast of the area about 45.7 m (150 ft) north of Pit 5. The soil covering is approximately 0.9-1.5 m (3-5 ft) thick above the Tshirege member of the Bandelier tuff.[8] There are two prominent, nearly vertical, joint sets which intersect at approximately 60°.[91] Most major joints are filled with sediments or altered material to a depth of approximately 3.0 m (10 ft)[91] and

spaced 3.0 m (10 ft) apart.[8] All of the pits[91] and probably all of the shafts are dug in the Tshirege member.

The soil cover on the surface of the mesa prevents most of the water on the surface from infiltrating underlying tuff. Where the soil has been removed or disturbed, water might infiltrate the underlying tuff and open joints in the tuff. Beneath the soil there is about 850 feet of the Bandelier tuff which consists of a series of ash fall and ash flows of a friable to welded rhyolite tuff. This tuff is underlain by about 575 feet of volcanic debris of the Puye Conglomerate. The main zone of saturation occurs in the Puye at a depth of about 1300 feet. Perched water may occur above the main zone of saturation, although none was encountered in test well 8 located 1.5 miles northeast of Area C.[92]

Pit and Shaft Description

Background

Pit 1 was put in use June 10, 1948.* ——————————→ June 14, 1949,[12] it was reported "the present dump [Area C] has been in use for one year and during that time we have filled one pit. We are now using the last pit and it should last until June 1950."[12] The "last pit" referred to in the previous quote could be Pit 2, Pit 3, or Pit 4. Pits 2 and 3 show use dates from April 1950 through April 1953.[23] Pit 4 shows a use date from April 1950 through February 1955.[23] Pit 5 shows a use date from April 1953[23] through November or December 1964.[72,73] Pit 6 shows a use date from February 1956 through August 1959.[56] The chemical pit was probably dug in the first part of 1960[87] and closed out in the summer of 1964.[90] In the second quarter of 1957, Area G had been located and Pit 1 of that Area had been dug.[53]

Twelve shafts were dug from February 29, 1958 through October 29, 1959.* The first shafts were for the use of the CMB-DOGS (known as the CMB dogs). These first 12 shafts are numbered 56-67.** By the third quarter of 1959 an additional 55 shafts were ordered dug.[56] These shafts are numbered 1-55. Twenty new shafts, numbered 68-87, were dug the last half of 1962.[65] During the first quarter of 1964 an additional 20 shafts, numbered 88-107, were dug.[70] In an April 23, 1965, memo[74] the statement appears: "It is understood that when these new shafts are all filled no new wells will be drilled in this Area." Table C-1 shows the use dates for the 107 shafts in Area C.

T.C-1

The history of Area C extends from May 7, 1948, the date the first pit was started, through April 8, 1974,** the date the last shaft was filled and plugged with concrete. It is sometimes felt that the last routine radioactive contaminated waste placed in Area C, December 1958,[54] marks the closing of Area C and the

---

*Written communication, J. Enders, ~~H-8~~ 1974.

**The shafts were renumbered by S. E. Russo, Eng.-3, November 20, 1962. (Written communication, J. Enders, ~~H-8~~ 1974.)

**written communication, J. Enders, 1974

opening of Area G. Neither idea is true. Area G pits had received nonroutine radioactive waste before that date and Area C pits continued to receive nonroutine radioactive contaminated waste until Pit 6 was filled August 1959[56] and Pit 5 was filled November or December 1964.[72,73] Since quarterly and annual reports on solid radioactive waste disposal fail to mention Area C after 1968, it can be assumed the area was not in regular use past that time. The plugging of the last Area C shaft, 89, on April 8, 1974, marked the formal closing of the area.

Type of Waste

Records of solid radioactive waste going into Area C can be found in LA Notebooks 2587, 3478, 4644, 6030, 7277, 8453, 9293, 9593, and 12442.[23] These notebooks are used to log information on type, date, location, and volume of waste placed in the disposal area. "...records prior to 1954 are incomplete."[8]

During the pit history of Area C hazardous chemicals and noncontaminated classified materials were buried with radioactive contaminated materials. Routine radioactive contaminated trash for the period consisted of cardboard boxes 33 cm x 33 cm x 61 cm (13 in. x 13 in. x 24 in.), and 5 mil plastic bags, 33 cm x 61 cm (13 in. x 24 in.) and 256 cm x 61 cm (40 in. x 24 in.) of material generated in the chem labs; and 0.20 m^3 (55 gal) barrels of sludge from the waste treatment plants at Bldg. 35, DP West, and at TA-45. Nonroutine contaminated waste included debris from the demolition of Bayo Site and TA-1, classified materials, and TU chips from the shops.

The following preliminary values are decay corrected from original magnitude to that as of January 1, 1973. In the disposal pits of Area C there are 25 Ci of uranium which includes isotopes 234, 235, 236, and 238; 26 Ci of ^{239}Pu; and 149 Ci of ^{241}Am.(Ref 32) In the shafts of Area C there are 49 136 Ci of ^{3}H,(Ref. 280) 40 Ci of ^{22}Na, 20 Ci of ^{60}Co, 31 Ci of $^{90}Sr/^{90}Y$, 1 Ci of ^{226}Ra,* 5 Ci ^{233}U, <0.1 Ci of uranium (including isotopes 234, 235, 236, and 238), 50 Ci of fission products, and 200 Ci of induced activity.(Ref 32) Total number of curies for the pits is 196 and total number of curies for the shafts is 49 482.

* (personal communication M. [illegible])

An earlier report[134] listed the following figures for Area C: D-38, 34 445 lbs; ^{238}U, 0.0 g; ^{235}U, 13 853 g; ^{239}Pu, 2 063 g; ^{233}U, 1467 g; and ^{3}H, 10 g (for Areas C and G, based on estimated curies and 9 600 Ci ≅ 1 g ^{3}H).

It seems appropriate to comment on the establishment of the Hazardous Chemical Area in Area C. As pit use was phasing out in Area C and beginning in Area G, the idea of separate disposal for hazardous nonradioactive chemicals (which were responsible through the years for many* fires in the disposal areas) was accepted. There is no indication[54,56,87] that Pit 6 of Area C was, at any time during its history, dedicated to the exclusive disposal of hazardous nonradioactive chemicals. A memo[87] dated November 12, 1959, suggests it was proposed that part of Pit 6 be used for the "permanent chemical disposal area," but another memo dated September 2, 1959, states covering of Pit 6 to ground level began September 24th and finished October 2nd. Apparently, the chemical pit south of Pit 6 was dug in early 1960.[87]

> A brief review of the use of this pit shows that a variety of chemicals, pyrophoric metals, hydrides and powders, sealed vessels containing sodium-potassium alloy or compressed gases, and equipment not suitable for salvage, public dump or the contaminated dump have been placed in the pit. No high explosives have ever been disposed of in this pit. Normal uranium powders and hydrides have been disposed of in this pit. Inadvertently, some plutonium contaminated objects were placed in the pit but have long since been covered. Because of the uranium disposed it should be assumed that the pit is mildly alpha contaminated.[90]

The hazardous chemical disposal area was fenced off from the rest of Area C, ~~and is currently in place~~. When the hazardous chemical disposal area was closed out in Area C it moved to Area L, Mesita del Buey.

Another disposal practice, disposing of nonradioactive classified waste with contaminated waste, was under discussion about the same time as separate disposal for nonradioactive hazardous chemicals.

> It was rather disappointing to learn during the course of our inquiries on this matter that, despite the general agreement some two years ago [1957], burial in contaminated pits would essentially be a last resort method of disposing of classified waste, nevertheless, a substantial part of the capacity of the existing pit

* (personal communication, J. Enders)

[probably Pit 6] in Area C has been taken up with materials which are not contaminated, not of obvious security interest, and which it would seem could be disposed of by some other method, For example, I [P. F. Belcher, Assistant Director for Classification and Security] am informed that something more than seventy yards has been taken up by Security Branch, LAAO, for the dumping of technical area badges.

~~area badges.~~ It would seem to me that badges can be chopped up and disposed of in some other manner. I will concede that it perhaps is a tedious job, but in view of the fact that we have only a limited amount of real estate for disposal of classified waste it does not seem to me proper to dispose of badges by burial simply because it is easiest.

By the same token it appears that there have been large quantities of safety film from various Laboratory operations placed in the contaminated pits at Area C. Again, it would seem that there must be alternate methods of disposing of safety film which would not involve using up the limited space available in contaminated waste disposal dumps. 185

Eventually, Area H, Mesita del Buey, was designated as the nonradioactive classified waste disposal area.

Originally the shafts in Area C were dug for the disposal of beta-gamma active waste by the CMB-DO-GS at Ten-Site. Shafts were to be used by many other groups for disposal and storage. Appendix A lists the contents of the 107 shafts in Area C.

Mode of Disposal

Pits 1-4 are located in the southwest quarter of the area. (See Fig. C-1.) These pits are 185.9 m (610 ft) long by 12.2 m (40 ft) wide. On Engineering Drawing ENG-R 1264 these are shown as scaled dimensions. Apparently, the Engineering Department was neither asked to stake these pits before dug nor asked to survey these pits while open as there is no record of it being done. Pit 5, located to the north of Pits 1-4, is 33.5 m (110 ft) wide by 214.9 m (705 ft) long and has a maximum depth of approximately 5.5 m (18 ft). Pit 6, in the northwest quarter of Area C is 30.5 m (100 ft) wide by 153.9 m (505 ft) long with a maximum depth of approximately 7.0 m (23 ft). The chemical pit is 7.6 m

(25 ft) wide by approximately 54.9 m (180 ft) long and may be 3.7 m (12 ft) deep.[87]

Numbers on the 107 disposal shafts in Area C do not reflect their excavation or use dates. The first shafts, 56-67, are located between Pit 4 and Pit 5; they are numbered from west to east. The next shafts, 1-55, are between Pit 1 and Pit3; they are numbered from east to west. They were followed by Shafts 68-107 which run south to north immediately past the western ends of Pits 1-4. Shafts 98-107 parallel shafts 68-97; they are numbered from south to north. Shafts 68 and 98 are 6.1 m (20 ft) from the southwest fence of Area C.

The shafts are located on 2.3 m (7-ft 6-in.) centers. Like the pits, they vary in size and depth. Shafts 56-67 are 0.3 m (2 ft) in diam by 3.0 m (10 ft) deep.[54] Shafts 1-55 are 0.3 m (2 ft) in diam by 4.6 m (15 ft) deep.[56] Shafts 68-107 include both 0.9-m (3-ft) diam, 30.5-cm (12-in.) thick, concrete-lined 0.3-m (2-ft) shafts and 0.3-m (2-ft) diam shafts. Ten of the last 20 shafts are concrete lined. In shafts 68-107 the depth may vary from 6.1 m (20 ft) to m (25 ft).(Ref. 8)

A ^{90}Sr disposal shaft, no number, is located a few feet from the south fence corner designated by LASL coordinates N.25+36, E.93+23.

The fence, which runs north-northeast across the western half of Area C, was erected to end confusion over which part of Area C was used for radioactive contaminated waste disposal and which part was used for hazardous chemical disposal (personal communication, J. Enders, H-8). At the time the fence was erected it was common practice for hazardous chemicals to be placed in the chemical disposal pit and then burned. People frequently reported the contaminated dump to be on fire. Therefore, the fence was erected to end the confusion of what was on fire.

> A meeting was held on December 28, 1950, concerning contaminated dump. It was decided at that time that H-1 Monitoring would be responsible for Rad-Safety of all persons entering the dump commencing January 5, 1951.

Our responsibilities are as follows:

1. Furnish full protective clothing including respirator to George Yates, Zia Co., who covers the trash every Friday. Yates has to be monitored after each job and nose swipes taken. He is scheduled for routine Health Pass test. By copy of this memo I'm [Carl Buckland] requesting that Glenn Vogt write monthly work orders to cover the bulldozer work. The maintenance man of D-Bldg. formerly took care of this detail.
2. H-1 Monitoring will be notified, upon arrival of highly active beta-gamma contaminates requiring a knowledge of tolerance times. We will also be notified upon arrival of hot filters from D.P. Site. This advance information will assist us in case of fire for which we are responsible.
3. Film badges and pocket chambers should be issued in cases of high beta-gamma activity.

CMR - Safety and CMR-12 will continue to dump chemicals in the proper place and contaminated items in another. Dean Meyer has stated that if at any time we feel that things are not dumped where we think they should, to contact him.[186]

Numbered reference posts for waste record purposes were used for the first time July 19, 1951 (written communication, J. Enders, H-8).

A February 5, 1957, memo[110] entitled, "Covering Contaminated Trash at Contaminated Dump," reflects some operational changes as follows:

> It is my [John Enders] understanding that the dump [referring to a single pit] was formerly covered once per week. This was done at a time when trash was piled into the dump and covering once per week was a means of reducing the danger of fire.

At present, it seems that the Dump is covered whenever: (a) requested by Eng-4, (b) when there is a slack period for Zia Roads Section. After talking to Mr. Anglin and Mr. Raper of the Zia Roads Section, I find that they point out that the more frequent the covering, more fill dirt is used.

At present, the trash is placed into the Dump in single layers of boxes, etc., which cover about one half of the width of the Dump. The fire hazard is reduced because the fire department's efforts to extinguish a fire in a single layer should be successful.

Therefore, I am suggesting that the routine dump covering operation should be done only after a single layer of trash is placed into the Dump - the width of the layer to be about one-half the width of the Dump.[110]

In 1956[52] collection of trash from laboratories was done in the following way. Zia janitors removed trash from lab hot-waste cans and put the trash into cardboard boxes. The boxes were then sealed and set outside the building for pickup by truck. June 27, 1957,[53] Dempster Dumpster boxes were delivered to Wings 2 and 4 of the CMR Building. "It is planned to put boxed contaminated trash in these boxes and deliver the filled boxes to the Dump."[53] (See Fig. C-2.) By the end of 1957[95] Dempster Dumpster boxes were also placed at TA-2 (Omega Site) and TA-35 (Ten Site). At the start of the third quarter of 1958[98] Dempster Dumpster boxes were put into service at nearly all Laboratory Sites where radioactive trash was picked up. All Dempster Dumpster boxes were painted on the interior and the doors marked FOR RADIOACTIVE TRASH ONLY. "A yellow band was painted around the top of the box with black wording designating the site location of the box."[97]

During the third quarter of 1957[94] a trial use of 5-mil thick plastic bags began. The bags were not placed[21] into cardboard boxes before being taken to the burial ground. Waste during this time was not covered weekly. To demonstrate differences in weathering a cardboard box and a plastic bag containing laboratory waste were marked with the date and left exposed in the burial pit for approximately 3 months (Fig C-3).

The cardboard box weathered considerably and broke open. The plastic bag was still intact.

The following excerpt is from the Annual Report for 1958 on Disposal of Contaminated Solid Waste."[54]

> At the CMR-Bldg. and at Sigma Bldg. loose office and change room trash is now being packaged in plastic bags. Seven six-bushel capacity trash dollies have been purchased for this operation. 5 mil (thickness) 40" x 24" plastic bags are used as liners for the trash dollies. When these bags are filled they are sealed with masking tape and placed into the Dempster Dumpster containers. It is estimated that one plastic bag will hold more trash than four or five 13" x 13" x 24" cardboard boxes. The time spent by Zia Janitors in preparing the bags, filling and sealing them is about one-half that needed to do the same operation using cardboard boxes. It has been observed that these bags are more easily emptied at the disposal pit from the Dempster Dumpster containers than are the cardboard boxes which have a tendency to hang up inside the containers. At the disposal pit the bags also withstand the effects of weathering much better than the cardboard boxes.
>
> Prior to putting the trash dollies into use, the plastic bags used in the labs for holding contaminated trash were 2 mil thick. The bags were removed, sealed, and placed into cardboard boxes. After the trash dolly system was started, these bags are also being placed into the trash dolly and because of this it was felt that an additional safety factor would be needed so 5 mil thick bags were issued as liners for the trash cans in the laboratories.[54]

Indent and single space as quote

The 1959 Annual Report[57] states:

> Cardboard boxes located in the utility corridors of the CMR Bldg. laboratory wings are being replaced with metal cans provided with a plastic bag liner. The changeover was made in order to provide a more fireproof container for solid radioactive waste.[57]

C-.

Trucks were still in use to haul 0.2 m^3 (55-gal) sludge drums from the waste treatment plants at TA-45 and TA-21 to Area C at the end of 1958.[54] (See Fig. C-4.) In March 1959 Dempster Dumpster trucks using skip-type containers began to haul the sludge drums to the burial ground.[57] Trucks continued to be used to haul nonroutine contaminated waste to the disposal area.

Early shaft disposal was described in the Annual Report for 1958 on Disposal of Contaminated Solid Waste.[54]

At infrequent intervals, CMB-DO-GS group at Ten site has beta-gamma active waste material that must be buried. In the past the material was taken to the Disposal Pit where a hole was dug into the ground and the material thrown into the hole and covered with dirt. In February, 1958, an order was submitted to have a dozen holes drilled measuring 2 feet in diameter and about 10 feet deep. The holes were located between Pits 4 and 5, Area C. These holes are now being used for disposal of the gamma active waste from Ten Site. Space* is available at this location for at least 30 to 50 more holes for future disposal.

The technique used by CMB-DO GS for handling this waste is briefly as follows: (1) the material to be thrown away is evaporated to dryness in a hot cell at Ten Site and then placed inside a Dural container. This container is then sealed and placed inside a steel container which is in turn sealed. (2) The steel container is then removed from the hot cell and placed into a lead transfer case which is thick enough to handle up to 40 curies of material. (3) The transfer case is positioned on the back of a 1½ ton truck and fastened securely with a chain. (4) The truck is then driven to the disposal area and positioned above one of the holes. (5) A tripod with a long boom arm attached is used to transfer the material from the transport case to the hole. The steel container is pulled up out of the case by means of a string to which is attached a rope that runs through a pulley on the end of the boom. When the container is over the hole, the

string is cut and a few shovels of dirt are shoveled on top of the container so as to reduce the gamma radiation at ground level to less than 1 mr/hr.[54]

* More shafts were not drilled because it was not possible to drive any further east along the border between Pits 4 and 5. (Written communication, J. Enders, H-8.)

A modification of the procedure was reported in the Annual Report for 1959 on Disposal of Solid Radioactive Waste.[57]

This year 10-Site personnel modified the equipment used for containing and shielding their waste material during transit to the disposal area. This modification included an improved container and a tuballoy cask that is provided with a trap door in the bottom that permits dropping the waste material (sealed in the canister) from the cask directly into the disposal well through a hole in the truck bed. This design improvement has permitted handling of wastes that range up to 400 curies of activity with very little personnel exposure. CMB 11 (DP West) has plans to use this equipment when possible for their waste disposal from the hot cells.[57]

Indent and single space as quote

Permanent markers, metal stakes with numbered tags, were placed by each shaft in 1959.[57] Deliveries to any shaft were logged.[57] In 1961

> ...metal covers were fabricated and installed over the 'active' disposal wells and wood covers were obtained for use on unused wells. At each corner of the wooden covers metal stakes have been located so as to prevent movement of the covers.[62]

In 1967 Solid Waste Operations personnel proposed that H-1 seal the disposal shafts.[111]

Often it is highly desirable for radiation safety and/or security reasons (or both) to seal items placed in the shafts immediately with concrete. It is now standard practice to seal filled disposal shafts with concrete.

The current procedure of obtaining Ready-Mix cement for the above operations is to (1) write a memo to Eng-4, through H-1 Group office, requesting the work to be done, (2) Eng-4, upon receiving the memo, may or may not issue a work order, apparently depending on whether Eng-4 thinks the request is necessary or not. There have been instances where the H-1 Group office has had to repeat the request and by the time the Ready-Mix finally arrives there has been a time lag of (in some cases) several months.

ditto above

Incident and Single space as above

The simple logistics of the operation are also involved in that the Ready-Mix truck, Eng-4 representative, H-1 representative all need to be at the Area at the same time -- and this has also been difficult at times. In the event of an 'emergency delivery' it would be almost impossible to schedule delivery of Ready-Mix to the disposal shaft. [111]

Return to orig. margins 1½ spacing

The proposal to purchase a small cement mixer, some cement and one wheelbarrow so that H-1 could do the job themselves was accepted. (Written communication, J. Enders, H-8.)

Ditto

While burial of contaminated waste was the method of disposal, it was recognized that other ideas should be investigated. Dr. Jette decided that sea burial should be considered. A number of large steel containers was fabricated with gasketed lids and sea cocks. These were used for a period of time; however, when they were filled, the cost of transportation and fabrication of more boxes was so high that the idea was dropped and the full boxes were placed in pits in Area C. [108]

Return to orig. margins 1½ spacing

In 1961[62] six Standard Operating Procedures were prepared on waste disposal operations. Three additional S.O.P. were written to cover non-routine disposal operations.

Studies and Monitoring

There are reports of five fires at Area C. The first took place at 8:35 a.m., November 7, 1950.[187]

> An air sample was taken with the hand air sampler. Its negative results were reported to headquarters. There was no detectable beta or gamma in the pit or at its edge so two firemen, in full protective clothing and respirators, entered the area with hoses from the tank truck which had just arrived. While steam was rising from the fire, a second air sample was taken in the steam and smoke cloud. It too was found to be negative. The fire was brought under control using two tank trucks full of water.[187]

The second fire was reported June 5, 1952 (written communication, J. Enders, H-8). LA Notebook 4664, p. 70, records: "When boxes were being unloaded, one box caught fire and was immediately put out by T. Gomez."

The third fire occurred at 4:25 pm.m, March 24, 1953.[188] The burial ground had been checked at approximately 3:00 p.m. when the crew left after the last delivery. Later, smoke was seen coming from the burial ground.

> Upon arriving at the dump we [C. D. Blackwell and J. Oakes] discovered a fire that had burned itself out with the exception of several barrels of paraffin which were boiling and burning to a small extent....

NOTE: **Two 5-gallon cans of foam were used to completely blanket the fire, and it was completely out by 5:25 PM. The wind was from the west and brisk, so that smoke was carried east and traveled a path between Ten-Site and Beta Site... The dry box from the Omega Fast Reactor, which had been placed in the dump on March 23, 1953, had been completely burned, leaving only the steel frame. The dump had last been covered on March 20, 1953, so that the results of only 2-days hauling was exposed to the fire. No one could determine the cause of the fire, but it was generally believed to have been caused by chemicals being accidentally placed in the boxes with some of the trash. A survey was made around the dump on the morning of March 25, 1953, to check for possible**

udent single pace as bove.

contamination from the smoke. The area east of the pit and parts of the canyon from Beta Site to Ten Site was checked, but no trace of contamination could be found. Any contamination that may have gotten into the air was well diluted and carried away rather than being deposited in the vicinity.[188]

The fourth fire was reported April 22, 1953 (written communication, J. Enders, H-8). LA Notebook 4644, p. 148, records: "One box from Sigma Building was smoking while being thrown into dump. Was put out with fire extinguisher."

The fifth fire took place November 28, 1958, in Pit 6.[189]

> Two boxes found burning during a covering operation. It is suspected a volatile, flammable chemical was involved, as near the boxes...a flask[was found] that possibly had been used to hold acetone.[189]

The USGS did an infiltration study north of Pecos Drive near Area C (personal communication, W. Purtymun, H-8). Two[51] infiltration pits, Pit A and Pit B, 0.6 m (2 ft) in diam by 0.3 m (1 ft) deep were constructed during September 1956.[190]

The 1958 study, which seems to have been conducted September through October, used Pit A. Pit A had three access tubes spaced 0.6 m (2 ft) apart with access tube No. 2 centered in the pit.[51] "Cores for natural moisture-content determination were collected at the site on Oct. 10, 1958."[51] Water supply was intermittent during the 1958 study.[51] How the 1958 study was conducted It is difficult to determine precisely from the USGS report[51] of it. Data are shown in Fig. C-5.

F. C-5

The 1959-1960 study, September 21, 1959 through September 2, 1960,[190] used Pit B.[51]

> The high moisture content beneath the pit before infiltration started was due in part to heavy rains in August, 1959, and the relatively poor drainage in the sandy surface soil.[51] (see Fig. C-6.)

F. C-6

New ¶ **The soil is similar to that on Frijoles Mesa; it is about 6 feet thick and is underlain by welded tuff. The area is moderately well drained. A test-hole 20 feet deep was drilled in the center of the infiltration pit and a 2-inch plastic pipe was installed so that it projected about 1 foot above the pit. Soil and tuff were packed around**

Ditto above

indent & single space as quote

the casing to prevent seepage down alongside the casing. Moisture measurements were made prior to application of water. Water was introduced into the pit and a constant head maintained at three-quarters of a foot for 99 days.

The wetted front (figure C-6) moved to a depth of about 4½ feet during the first 2 days of infiltration and to a depth of about 6½ feet during the next 97 days, but water did not move through the transition zone into the tuff, except in the lower moisture range. The moisture content decreased with depth from a maximum of about 38 percent in B zone of the soil to less than 4 percent within a foot of the surface of the tuff.

Water apparently was perched on the C zone of the soil and the moisture content within the B zone approached saturation. After the first several days of infiltration, most movement of water probably was lateral, as indicated by measurements in a series of holes around another infiltration pit [Pit A] nearby. Some water undoubtedly was lost by evaporation and transpiration.

Although the quantity of water used during the study was equivalent to almost 50 years of precipitation on the Pajarito Plateau, the moisture content in the A and B zones had returned to nearly normal after 8 months of drainage; the moisture content in the C zone and top 2 feet of tuff was slightly higher than before the experiment, and the moisture content of tuff between 8 and 20 feet was unchanged. However, conditions during this study cannot be considered normal because the clogging or silting of pores probably was greatly accelerated when this volume of water moved into the soil within a period of 99 days without the normal seasonal distribution which involves alternate percolation and drainage. 190

The 1960-1961 study,[51] September 2, 1960 through October 2, 1961, used Pit B. No water infiltrated the pit other than precipitation.

The May 19, 1961, measurements were high because of snowmelt, and the October 2, 1961 measurements were low because of low precipitation. [See Fig. C-6.]

The fact that water did not penetrate the dense transition zone between the soil and tuff during the study, or in the following year [the 1960-61 study] indicates that the soil cover will impede vertical movement into the underlying tuff. Capillary rise, evaporation, and transpiration were perhaps the principal reasons that the water did not penetrate the underlying tuff, rather than the low permeability of the transition zone.[51]

In 1962[92] the question of 18.3-m (60-ft) deep shafts at Area C was considered.

There is no serious objection to the burial of radioactive waste in holes 60 feet deep at Area C, although several precautions should be taken. They are; (1) Solid wastes should be packaged for normal underground burial; (2) Liquids and sludges should be contained so no leakage occurs; (3) The soil zone on the mesa should be disturbed as little as possible near present and future waste disposal areas. After the holes are filled, the surface should be sealed with 2 to 3 feet of packed clayey soil; (4) Adequate erosion and drainage maintenance should be provided; (5) The holes should be drilled at least 100 feet from the edge of the mesa at Area C. The principal concern is to prevent water from carrying the radioactive materials to the underlying bodies of ground water.[92]

A fluid dynamics study was reported in progress in 1966.[29] The study was conducted across Ten-Site Canyon from Area C. The study area was approximately 137.2 m (450 ft) north of the east end of Pit 5. Eight holes were augered to study the behavior of gas injected into the rock; and 12 holes were augered to study the behavior of liquid injected into the rock (see Fig. C-7 and Tables C-2 and C-3).

April 29, 1971,[109] the results of test drilling and penetration tests in the west end of Area C were reported. The purpose of the tests was to help establish the location for the meteorological tower (see Figs. C-8, C-9, and C-10). All cuttings were monitored.

No radioactive contamination was detected. Tests at the 120 SW guy indicated that the location is underlain by a disposal pit, probably the chemical pit. No holes were drilled of the 240 N guy, the 120 N guy or the 120 SE guy.[109]

The Ecology Section of the Environmental Monitoring Studies Group is studying honeybees as a potential environmental contaminant indicator organism.[281] Honeybees do accumulate tritium from the environment.[281] November 1, 1973, vegetation surrounding TA-35 (north and east of Area C) and in Area C was sampled and analyzed for tritium.[282]

> Maximum concentrations (pCi ^{3}H/m/plant moisture) surrounding 10-Site [TA-35] measured about 250 pCi/ml for 10 sampling locations. Maximum concentrations in Area C vegetation measured about 185 500 pCi ^{3}H/ml for eight sampling locations. The ^{3}H concentration in Mortandad Canyon [the major canyon north of Area C] bees on this date measured 2630 pCi/ml. While 10-Site vegetation did not contain sufficient concentrations to account for levels in bees, Area C vegetation did. It seems evident that some of the ^{3}H buried in Area C is available to vegetation and hence honeybees.[282]