LA-10256-MS

まへろ

Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36.



Radiological Survey and Evaluation of the Fallout Area from the Trinity Test:



_OS Alamos National Laboratory Los Alamos, New Mexico 87545 An Affirmative Action/Equal Opportunity Employer

Prepared by Kathy Derouin, Group HSE-8

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

LA-10256-MS

UC-11 Issued: June 1985

Badiological Survey and Evaluation of the Fallout Area from the Trinity Test:

Chupadera Mesa and White Sands Missile Range, New Mexico

Wayne R. Hansen John C. Rodgers



CONTENTS

ABST	TRACT	1
CHA	PTER 1—SUMMARY	2
CHA	PTER 2—INTRODUCTION AND BACKGROUND	5
I.	THE DOE RESURVEY PROGRAM	5
II.	THE TRINITY TEST	5
III.	THE TRINITY FALLOUT ZONE	5
IV.	THE RESURVEY OBJECTIVES	10
CHAI	PTER 3—METHODS AND APPROACH	11
I.	APPROACH	11
II.	METHODS	11 11 12
CHAI	PTER 4—RESULTS	14
I.	TOTAL AREA.A. Trinity Data Analysis: 137Cs in Soil .B. Trinity Data Analysis: 239,240 Pu in Soil .C. Other Fission and Activation Products in Soils .D. Natural Radioactivity in Soils .	14 14 18 20 23
II.	DATA SUMMARY FOR SOILSA. Plutonium in SoilsB. Cesium-137 in SoilsC. Strontium-90 in Soils	24 24 25 27
III.	AIRBORNE RADIOACTIVE MATERIALS.	27
IV.	EXTERNAL PENETRATING RADIATION	29
CHAF	PTER 5—POTENTIAL DOSE EVALUATION AND INTERPRETATION.	40
I.	BASES OF DOSE ESTIMATES AND COMPARISONS	40
II.	POTENTIAL DOSES FROM THE CURRENT CONDITIONS IN THE TRINITY TEST FALLOUT DEPOSITION AREAS	43
III.	SPECIAL CONSIDERATIONS	43

REFERENCES	45 48
JNITS	49
GLOSSARY	50
APPENDIX A—DATA BASE TRINDAT	52
APPENDIX B—LOG OF FIELD OPERATIONS FOR SURVEY OF	
TRINITY, 1977	82
APPENDIX C—IN SITU INSTRUMENT CALIBRATION.	86
APPENDIX D—INTERPRETATION OF DATA.	91
APPENDIX E—SOURCES AND EVALUATION OF RADIATION	
EXPOSURES	10

FIGURES

1.	Central New Mexico. The site of the Trinity Test is noted on the left part of the map
2.	Trinity test tower. Oscura Mountains in the background
3.	Range after test
4.	Diagram of Trinity GZ fences
5.	. The fallout zone from the Trinity test as determined by a 1945
	beta-gamma survey
6.	Outline map of the contaminated area as determined by 1947 and 1948
	survey. A transect was established with numbered laterals
7.	General map of the Trinity fallout area and the measurement locations
8.	Comparison of <i>in situ</i> and soil sample estimates of total ¹³⁷ Cs inventory
9.	White Sands Missile Range, Bingham, and Chupadera Mesa sample locations
10.	Sample locations for the San Antonio area
11.	External radiation dose rates measured at Trinity Site, June 9, 1983 to June 23, 1983
C- 2	1. N_f/ϕ as a function of α
C-2	2. $N_{f}/s = N_{f}/\phi \cdot \phi/s$ as a function of α
D-	1. Location of June 1983 sampling

.

TABLES

I.	ESTIMATES OF RISK BASED ON EXPOSURES ATTRIBUTABLE	
	TO RESIDUAL CONTAMINATION IN AREAS OF FALLOUT	
	FROM THE TRINITY TEST	3
II.	RISK COMPARISON DATA	4
III	¹³⁷ SOIL CONCENTRATION DATA	16
IV	CHUPADERA MESA ¹³⁷ Cs PROFILE DATA	17
v.	GROUND ZERO TO CHUPA DEDA MESA ¹³⁷ C PROFILE DATA	10
v. VI	137C INVENTORVESTIMATES	10
		10
v 11.	COMPARISON OF IN SITUAND SOIL SAMPLE ESTIMATES	•••
3/111		19
V 111.	TRINITY SOIL CONCENTRATION OF 25,240 Pu	21
IX.	GZ ENVIRONS AND CHUPADERA MESA 259270 Pu SOIL	
	CONCENTRATION PROFILE ESTIMATES	22
Χ.	SURFACE SOIL CONCENTRATION OF ²³⁸ Pu AND ²³⁸ 2 ³⁹ Pu RATIOS	22
XI.	1977 ESTIMATES OF 1-cm AND TOTAL PLUTONIUM INVENTORY	23
XII.	ACTIVATION AND FISSION PRODUCTS IN BULK SOIL SAMPLES	
	AT TRINITY GZ AREA	23
XIII.	SOIL CONCENTRATIONS OF NATURALLY OCCURRING	
	GAMMA-EMITTERS.	24
XIV.	GROUND ZERO SURFACE MEASUREMENTS	26
XV.	WHITE SANDS MISSILE RANGE FALLOUT ZONE SOIL	
	MEASUREMENTS	28
XVI.	BINGHAM AREA SOIL MEASUREMENTS, US HIGHWAY 380	
	CORRIDOR	29
xvii	CHUPADERA MESA SURFACE SOU MEASUREMENTS	30
XVIII	FAR FALLOUT ZONE SUPEACE SOIL MEASUREMENTS	21
	SAN ANTONIO ADEA SUDEACE SOIL MEASUREMENTS	22
	A DEAL CONCENTRATIONS OF 137C.	32
VVI		33
AAI .	LAND FORM	24
VVII		34
		33
АЛШ.	ADDODNE DADIO ACTIVITIV	• •
3/3/33/		36
XXIV.	EXTERNAL RADIATION EXPOSURE SUMMARY FOR	
		37
XXV.	EXTERNAL PENETRATING RADIATION MEASUREMENTS AND	
	ESTIMATES OF CONTRIBUTIONS FROM TRINITY FALLOUT	38
XXVI.	STANDARDS AND GUIDES FOR RADIATION AND	
	RADIOACTIVITY	41
XXVII.	INCREMENTAL DOSES	- 44
C-I.	COUNT RATE PER UNIT FLUX AT THE DETECTOR, N_f/ϕ , AS A	
	FUNCTION OF MEASURED α .	89
D-I	NORTHERN NEW MEXICO BACKGROUND REFERENCE VALUES	
<i>D</i>	FOR NATURAL OR FALLOUT LEVELS OF RADIOACTIVITY	02
וו-ח	1083 PLUTONIUM DATA FOR SPLIT SPOON CORE SAMPLES	12
<i>D</i> -11,	FROM GROUND 7FRO AREA	۵4
ייים		74
D-111.	CONTINU ZEDO A DEA	٥e
ענים	ΟΚΟΟΝΟ ΔΕΚΟ ΑΚΕΑ	93
D-1V.	JUNE 1703 ΓLUIUNIUM DAIA ΓΚΟΜ ΙΚΙΝΠΙΥ ΟΖΑΚΕΑ	90
D-V.	PARAMETERS FUR ESTIMATION OF RESUSPENSION OF RADIO-	~-
	NUCLIDES USING MASS LUADING	- 97

D-VI.	ENRICHMENT FACTORS FOR RESUSPENDABLE PARTICLES	98
D-VII.	INHALATION DOSE FACTORS USED.	99
D-VIII.	ESTIMATED DOSES FROM INHALATION OF AIRBORNE	
	MATERIALS FROM RESUSPENSION	100
D-IX.	INPUT PARAMETERS FOR DOSE CALCULATIONS	101
D-X.	INGESTION DOSE FACTORS USED	102
D-XI.	INGESTED RADIONUCLIDES	103
D-XII.	ESTIMATED DOSES FROM INGESTION OF FOODS GROWN	
	IN EACH AREA	104
D-XIII.	ESTIMATED AIR CONCENTRATION FOR SOIL PREPARATION	
	FOR HOME GARDEN.	105
D-XIV.	ESTIMATE DOSES FROM SOIL PREPARATION FOR	
	HOME GARDEN	106
E-I.	RADIOACTIVE MATERIALS OF PRIMARY INTEREST IN THE	
	RADIOLOGICAL SURVEY	113
E-II.	UNITS OF RADIOACTIVITY USED IN THE RADIOLOGICAL	
	SURVEY	115
E-III.	STANDARDS AND GUIDES FOR RADIATION AND	
	RADIOACTIVITY	122

Preface

This series of reports results from a program initiated in 1974 by the Atomic Energy Commission (AEC) for determination of the condition of sites formerly utilized by the Manhattan Engineer District (MED) and the AEC for work involving the handling of radioactive materials. Since the early 1940s, the control of over 100 sites that were no longer required for nuclear programs has been returned to private industry or the public for unrestricted use. A search of MED and AEC records indicated that for some of these sites, documentation was insufficient to determine whether or not the decontamination work done at the time nuclear activities ceased is adequate by current guidelines.

This report contains data and information on the resurvey effort and the effect of residual contamination as a result of nuclear weapons development programs conducted in this area. The report documents the present radiological conditions within the realm of today's sophisticated instrumentation and the impact on any future area development.

This report was prepared by the Environmental Surveillance Group (HSE-8), Health, Safety and Environment Division of Los Alamos National Laboratory. This report was compiled and written by Wayne R. Hansen and John C. Rodgers with major contributions from William D. Purtymun, Donald M. Van Etten, John D. Purson and Kenneth H. Rea. Field work in 1977 was directed by Daniel W. Wilson. Field *in situ* measurements and laboratory sample counting were directed by John Kirby and Douglas Sever of Lawrence Livermore National Laboratory. Other Los Alamos personnel involved in measurements were Thomas E. Hakonson, John W. Nyhan, Edward Rahrig, Thomas E. Buhl, and Alan K. Stoker.

Radiological Survey and Evaluation of the Fallout Area from the Trinity Test:

Chupadera Mesa and White Sands Missile Range, New Mexico

by

Wayne R. Hansen and John C. Rodgers

ABSTRACT

Current radiological conditions were evaluated for the site of the first nuclear weapons test, the Trinity test, and the associated fallout zone. The test, located on White Sands Missile Range, was conducted as part of the research with nuclear materials for the World War II Manhattan Engineer District atomic bomb project. Some residual radioactivity attributable to the test was found in the soils of Ground Zero on White Sands Missile Range and the areas that received fallout from the test. The study considered relevant information including historical records, environmental data extending back to the 1940s, and new data acquired by field sampling and measurements. Potential exposures to radiation were evaluated for current land uses. Maximum estimated doses on Chupadera Mesa and other uncontrolled areas are less than 3% of the DOE Radiation Protection Standards (RPSs). Radiation exposures during public visits to the U.S. Army-controlled Ground Zero area are less than 1 mrem per annual visit or less than 0.2% of the RPS for a member of the public. Detailed data and interpretations are provided in appendixes.

This evaluation of current conditions at the site of the first nuclear weapon test (Trinity) and the associated fallout areas is based on extensive field measurements and sampling followed by interpretation of the resulting data. The study was completed as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP) sponsored by the U.S. Department of Energy (DOE).

The Trinity test was part of the research conducted for the World War II Manhattan Engineer District (MED) atomic bomb project. The test was conducted on July 16, 1945. Measurements of radiation levels at Ground Zero (GZ) and in the fallout zone began the same day. The fallout was blown in a northeast direction over White Sands Missile Range, Chupadera Mesa, and other ranching areas. The land uses in the fallout zone remain the same today. White Sands Missile Range extends north of GZ about 17 km (10 miles). Privately owned ranch land extends along the path of the fallout zone to the northeast with Chupadera Mesa areas of interest at about 50 km (30 miles) northeast of GZ. Land use on Chupadera Mesa is for cattle grazing. Areas farther out in the fallout area also are used for cattle grazing with small areas of crop production.

This study considered all available relevant information. Records and reports provided the history of the measurements of radiation and radioactivity at GZ and the fallout zone. Environmental measurements and sample results, some extending back to the 1940s, were reviewed for information on trends and patterns. Data from these and special radioecology research studies were compiled to provide a basis for planning the acquisition of new data. Most of the new data consist of several hundred field measurements and samples of soil and vegetation.

The findings, based on interpretation of the data, are expressed in this summary as maximum increments of risk to hypothetical individuals exposed to the existing conditions. Individual risks of cancer from exposure to radiation were calculated from factors derived from the National Academy of Sciences 1980 study. Potential exposures to radiation for various possible mechanisms were generally calculated as 50-year committed dose equivalents resulting from 1-year exposures to account for cumulative doses from those radioactive materials retained in the body for varying periods after initial exposure. Exposure to natural background results in exactly the same kind of risks. The risk-estimating factors were applied to natural background radiation as measured in north central New Mexico to provide one context for judging the significance of other risks. People living in northern New Mexico incur an estimated incremental risk of cancer mortality of 8 chances in 10 000, or a probability of 8×10^{-4} , from a 50-year exposure to the natural radiation background. The natural radiation background dose, about 150 mrem each year, includes contributions from cosmic radiation, natural terrestrial radioactivity, and natural radioactivity incorporated in the body. A larger perspective is that the overall U.S. population lifetime risk of mortality from cancers induced by all causes is currently about 2 chances in 10, or a probability of 0.2.

The maximum likely incremental risks from all mechanisms of potential exposure in the areas having residual radioactivity attributable to the residual radioactivity range from about 2 chances in 10 000 (2×10^{-4}) in the restricted use area to a minimum of 6 chances in 10 000 000 000 (6×10^{-10}) under current conditions of land use as summarized in Table I. The mechanisms include direct exposure to penetrating radiation and inhalation of resuspended dust.

Table I gives the incremental risks of cancer mortality, bone cancer, and lung cancer, along with the 50-year dose commitments from which they were calculated. All of the dose commitment values are considered overstated to some degree because assumptions used in their derivation were made to maximize estimates of potential effects. All of the dose commitments are small fractions of those permitted above natural background and medical exposure by the DOE Radiation Protection Standards (RPSs). Maximum estimated doses on Chupadera Mesa and other uncontrolled areas are less than 3% of the RPSs.

Another context for judging the significance of these risks associated with exposure to radiation, whether from

natural background or other sources, is a comparison with risks from other activities or hazards encountered in routine experience. Table II presents a sampling of risks for activities that may result in early mortality and annual risks of death from accidents or natural phenomena. Because not all of the risks are directly comparable, the values for mortality risks shown in Table I overlap the range of values for risks shown in Table II. The largest incremental risks from the exposure to the residual

contamination are about the same size as the incremental risk of a 1000-mile automobile trip; most are smaller than the annual risk of death from lightning.

Some differences in future conditions will result from radioactive decay processes. While the total doses from transuranium elements will not change appreciably, the doses from ⁹⁰Sr and ¹³⁷Cs will decrease 50% in about 30 years. At the GZ area the external radiation doses will decrease about 90% in the same 30-year period.

TABLE 1

ESTIMATES OF RISK BASED ON EXPOSURES ATTRIBUTABLE TO RESIDUAL CONTAMINATION IN AREAS OF FALLOUT FROM THE TRINITY TEST[®]

	Incremental Risk				Committed Dose				
		Increased Pr	obability Based	1		n	irem in 50 y	ears	·
	on 50-Year Committed Doses ^c					from 1-Year Occupancy			
Location ^b /Exposure	Overall Cancer	Bone	Lung	Liver	External				
Hypothetical Resident	Mortality	Cancer	Cancer	Cancer	Body	Body	Bone	Lung	Liver
GZ									
Inner fence	2.0 × 10 ⁻⁴	2.2 × 10 ⁻⁷	1.4 × 10 ⁻⁷	1.1 × 10 ⁻⁶	1700	2.5	75	1.5	36
Between fences	1.1 × 10 ⁻⁴	8.7 × 10 ⁻⁹	2.3 x 10 ⁻⁸	4.2 × 10 ⁻⁸	880	0.17	2.9	0.26	1.4
White Sands Missile Range	1.9×10^{-6}	6.3 × 10 ⁻⁸	8.7 × 10 ^{−\$}	1.0×10^{-7}	14	1.8	21	0.97	3.4
Bingham	4.0×10^{-7}	5.7 × 10 ⁻⁸	4.2 × 10 ⁻⁸	7.5 × 10 ⁻⁸	1.7	1.6	19	0.47	2.5
Chupadera Mesa	1.8×10^{-6}	1.2×10^{-7}	1.6×10^{-7}	2.7 × 10 ⁻⁷	13	2.1	39	1.8	9.0
Far Fallout Zone	7.4 × 10 ⁻⁷	4.8 × 10 ⁻⁸	3.1 × 10 ⁻⁸	3.6 × 10 ⁻⁸	5	1.2	16	0.34	1.2
San Antonio	2.2×10^{-7}	6.0 × 10 ⁻¹⁰	1.8 × 10 ⁻⁸	1.5 × 10 ⁻⁹	1.7	0.1	0.2	0.2	0.05
Other Hypothetical Exposures									
40-h of Work in GZ									
inner fenced area	9.6 × 10 ⁻⁷		_	_	8			_	_
Security Patrols	9.0 × 10 ⁻⁸		_•		0.75			_	-
Annual visitor at Open									
House of Trinity Site	1.2×10^{-7}			_	1.0	•	_	_	_
Natural Radiation Exposure, Los Alamos									
1-year occupancy	1.6 × 10 ^{- s}		_	_	134	 .		•	_
50-year occupancy	8.0 × 10 ⁻⁴		_		6700				_
Radiation Protection Standard			_	—	500	500	1500	1500	1500

*All calculations based on current conditions.

^bLocations are described in more detail in Chapter 4.

^cProbabilities are expressed in exponential notation; they can be converted to expressions of chance by taking the numerical value in front of the multiplication sign (x) as "chances" and writing a one (1) followed by the number of zeros given in the exponent. For example, 9.7×10^{-7} becomes 9.7 chances in 10 000 000.

TABLE II

RISK COMPARISON DATA

Individual Increased Chance of Death Caused by Selected Activities

Activity	Increase in Chance of Death
Smoking 1 pack of cigarettes (cancer, heart disease)	1.5 × 10 ⁻⁵
Drinking 1/2 liter of wine (cirrhosis of the liver)	1×10^{-6}
Chest x-ray in good hospital (cancer)	1×10^{-6}
Travelling 10 miles by bicycle (accident)	1×10^{-6}
Travelling 1000 miles by car (accident)	3×10^{-6}
Travelling 3000 miles by jet (accident, cancer)	3.5×10^{-6}
Eating 10 tablespoons of peanut butter (liver cancer)	2×10^{-7}
Eating 10 charcoal broiled steaks (cancer)	1×10^{-7}

U.S. Average Individual Risk of Death in One Year Due to Selected Causes

Cause	Annual Risk of Death		
Motor Vehicle Accident	2.5×10^{-4}		
Accidental Fall	1×10^{-4}		
Fires	4×10^{-5}		
Drowning	3×10^{-5}		
Air Travel	1×10^{-5}		
Electrocution	6×10^{-6}		
Lightning	5×10^{-7}		
Tornadoes	4×10^{-7}		

U.S. Population Lifetime Cancer Risk

Contracting Cancer from All Causes	0.25
Mortality from Cancer	0.20

2. INTRODUCTION AND BACKGROUND

I. THE DOE RESURVEY PROGRAM

The 1977 and 1983 survey of the Trinity Site was carried out as part of the DOE program aimed at formulation of any remedial actions for Manhattan Engineer District (MED) or Atomic Energy Commission (AEC) sites. In the DOE program, files were reviewed to determine if residual radioactive contamination might exist at the sites. If the radiological conditions were uncertain, a survey of the area influenced by the site was performed. The files and special studies in existence for the Trinity Site indicated a survey would be necessary to quantify the radiological condition of the 32-year-old fallout area from the first nuclear explosion at White Sands Missile Range in New Mexico, July 16, 1945.

Several studies of the fallout zone had been carried out before the resurvey. These included surveys immediately after the test in 1945, studies by University of California, Los Angeles (UCLA) in 1948, 1950, and 1951. In 1973 and 1974, the U.S. Environmental Protection Agency (EPA) carried out an extensive soil sampling program for plutonium in the area. The study included air samplers located on Chupadera Mesa and in Socorro, New Mexico. Starting in 1972 and continuing until 1979, Los Alamos Scientific Laboratory, conducted special ecological studies of the movement of ¹³⁷Cs and plutonium isotopes on study plots on Chupadera Mesa and near Ground Zero (GZ) located on White Sands Missile Range. Factors influencing the survey were the history of the Trinity test, previous studies of the fallout zone, and the stated objectives of the Formerly Utilized Sites Remedial Action Program. Each of these factors is discussed in more detail in following paragraphs. Separate chapters are devoted to the resurvey plan, the results, and interpretation of the data. Appendixes are included that contain the historic data base, the raw data from this study, a log containing locations of sample locations, calibration methods for the in situ detector system used, and calculational methods used for estimations of radiation dose equivalents from any residual fallout radionuclides.

II. THE TRINITY TEST

The Trinity test of the first atomic bomb took place on July 16, 1945, on White Sands Missile Range in Central New Mexico. The test resulted in deposition and dispersal of radioactive fallout over a portion of central and northeastern New Mexico. Figure 1 is a map of the general area with Trinity Site marked on the lower lefthand corner of the map. The device was mounted on a 100-foot tower with cables for instruments and timing strung to shelters 9144 m (10 000 yds) away. Figure 2 is a photograph of the tower-mounted device before the test. The Oscura Mountains are in the background of the photograph about 5 miles east of the test area.

Weather on the day of the test started out being cloudy and windy with scattered showers. At 2:00 a.m., the test was rescheduled from 4:00 a.m. to 5:30 a.m. At 4:00 a.m., the rain stopped and at 4:45 a.m., a favorable weather forecast indicated the 5:30 a.m. time was acceptable. Weather remained cloudy after the test, as observed by planes sent to drop sensors during and after the test.¹ After the test, a crater and zone of melted sand were created (Fig. 3). The green fused sand is referred to as Trinitite in many reports. The GZ area has been designated a National Monument. As noted earlier, GZ is located on White Sands Missile Range, and access is controlled throughout the year. Once annually, the public is invited for a controlled visit to the site, usually in the month of October. Figure 4 is a diagram of the GZ fenced area included in the public visits.

III. THE TRINITY FALLOUT ZONE

Following the test, measurements were made to establish the trajectory of the fallout cloud and the deposition pattern over Chupadera Mesa and areas northeast of GZ. Measurements during 1945 were made across the fallout pattern to outermost edges of the fallout zone.

Figure 5 is a depiction of the fallout zone based on beta-gamma surveys of the soil surface following the test. The fallout followed a northeasterly direction paralleling



Fig. 1. Central New Mexico. The site of the Trinity Test is noted on the lower left part of the map.

6



Fig. 2. Trinity test tower. Oscura Mountains in the background.

the west of U.S. Highway 54 (Fig. 1). The cloud passed over Chupadera Mesa, where localized areas of higher levels were observed.

Another beta-gamma survey carried out in 1947 and 1948 confirmed the earlier observations and added detail to the mapping of the area.² Figure 6 is an outline map of the contaminated area taken from the 1947 and 1948 studies.² A primary transect reference line was established in the 1947 study. The transect of 34° 56' started at the Section Marker at GZ. At every 4930 feet, reference points were marked for the first 11 points. At point 12, the reference points were marked every 9000 feet. From this primary transect, reference line laterals were extended 90° right and left. Sampling and study areas were established according to the lateral numbers. For example, an area of special study on Chupadera Mesa at lateral 21 (about 28 miles from GZ) is referred to as area 21. This type of designation is referred to in reports of several studies of the Trinity fallout zone.

Since 1945, radioactive decay has resulted in substantial reductions of the fallout levels so that only the longlived radionuclides ⁹⁰Sr, ¹³⁷Cs, and ²³⁹Pu with traces of europium, remain. In the intervening years, environmental and biological transport processes such as erosion, sedimentation, and biotic uptake have acted on the initial surface deposition to redistribute these long-lived radionuclides. A number of studies were carried out to characterize the radionuclide distribution and redistribution in the years following the test.

The first major studies were carried out between 1947 and 1950. These studies emphasized radionuclide concentrations including plutonium for soils and plants, particularly on Chupadera Mesa, the crater region, and the region north of the crater, but still on White Sands Missile Range,^{3,4} The studies included characterization in the soils and plants of the area.

Plant studies included a study of the revegetation of GZ. Studies were also carried out that involved descriptions of the movement of small mammals, reptiles, and birds in the area surrounding GZ.⁵ The results of these studies have been included in considerations of the design of this study.

In summary, elevated levels of plutonium and fission products were measured in the fallout pattern. The maximum concentrations in soil outside the fenced area of GZ were detected on Chupadera Mesa about 28 miles from GZ. The authors suggest a localized rain shower may have scrubbed a portion of the fallout cloud.⁴ During the study period of 1947 to 1950, there also was observed some downward migration of fission products in the soil. However, wind erosion in the crater area of GZ was relatively more important than water in spreading the contamination.⁶ Plutonium was found in amounts up to 19 pCi per square foot at area 21. No plutonium was found in samples collected 3 miles south of GZ.7 Studies of plant invasion of the crater area through 1964 concluded that, while the area had not returned to climax vegetation, distributional patterns were controlled by water availability, soil conditions, and timing of climatic variants rather than radiation.⁸



Fig. 3. Range after test.

In 1972, a series of special studies of the plutonium distribution were started by Los Alamos Scientific Laboratory. Soil, vegetation, and rodent samples along the fallout transect were obtained at GZ and out to 56.4 km (35 miles).⁹ Soil samples from GZ indicated a relatively uniform vertical distribution of plutonium in the 30-cmdeep soil samples. Increased migration of plutonium into the soil was observed. Concentrations of plutonium in vegetation and rodents were too low to make valid comparisons. From the data taken, four intensive study areas were established at 1.6 km, 16 km, and 44 km, in addition to a control site south of GZ.¹⁰ About half of the ^{239,240}Pu in the Trinity fallout zone soils was found at the 5- to 20-cm depth in 1973 compared with total plutonium inventories being detected only in the upper 5 cm of soil in previous studies (21 to 25 years). Penetration depths of ^{239,240}Pu into the fallout zone soils were related to the presence of subsoil horizons containing carbonate accumulations and to the extent of rainwater penetration into the soil profiles.^{10,11} Studies of plutonium as related to concentrations on vegetation indicate concentration ratios as high as 1.0 for dry weights.¹² The range for forbs was 0.04 to 1.1 and grasses 0.05 to 1.2. Contamination of plant surfaces with soil particles is considered the cause of plant-soil ratios higher than observed in greenhouse studies.

In 1973 and 1974, the EPA sampled and analyzed soils from across the region of the Trinity fallout field for ²³⁹Pu and ²⁴⁰Pu in the top 5 cm of the surface soil.¹³ Before publication, the results of the survey and the field notes from the sampling were forwarded to Los Alamos by the EPA. The highest surface plutonium level was observed on the White Sands Missile Range. The GZ sample contained 1100 nCi of ^{239,240}Pu per square meter of soil surface. A soil sample taken approximately 3.2 km (2 miles) north of GZ contained 100 nCi per square meter, but neighboring sample locations gave plutonium value factors of 4 to 10 times lower.



Fig. 4. Diagram of Trinity GZ fences.



Fig. 5. The fallout zone from the Trinity test as determined by a 1945 beta-gamma survey.

Consistent with earlier findings of the initial fallout distribution, plutonium levels generally decrease with distance from GZ and with lateral distance from the centerline. The increase on Chupadera Mesa, some 20 to 30 miles from GZ, is also observed in the data. The highest level reported by EPA on the mesa at a single location was 86 nCi per square meter. Background values, that is, the minimum values, were reported at less than 1 nCi per square meter.

The EPA study also included carrying out air sampling for airborne plutonium. An air-sampling station was established at Socorro, New Mexico, and another airsampling station was established at Monte Puerto Ranch on Chupadera Mesa. Air samples were collected over a 10-month period. The samples were analyzed for ^{239,240,238}Pu. The Socorro station acted as a control area because it was located out of the fallout zone. The ²³⁸Pu results from both locations were below the detection level



Fig. 6. Outline map of the contaminated area as determined by 1947 and 1948 survey. A transect was established with numbered laterals.

on many of the samples. Often, the results for ^{239,240}Pu also were below detection limits, and only the data pertaining to the detected plutonium were reported. The primary results of the air sampling indicated that the air concentrations were well below the proposed EPA limit for transuranics deposited on soils. The conclusion of the study indicated that, while higher plutonium levels could be found at very localized individual sites, the sampling density used in the study on Chupadera Mesa makes it unlikely that grossly higher levels are present in the area exceeding the EPA proposed guidance.

Because the EPA study limited itself to plutonium, it was decided that the 1977 resurvey of the fallout zone would include fission product and activation product measurements in addition to confirmatory plutonium measurements. Data for the resurvey concentrated in areas in the far fallout zone (the area north of White Sands Missile Range, and in particular, Chupadera Mesa) because, at the time, it was felt this was the most important area.

IV. THE RESURVEY OBJECTIVES

As previously mentioned, a number of studies have taken special views of either the early distribution of fission products, or later, the distribution of plutonium. The special Los Alamos ecology studies concentrated on intensive studies of four relatively small areas, 1 hectare in size. The EPA study concentrated on the characterization of plutonium mainly in the Chupadera Mesa area. These data are included in the data base of this study (Appendix A). The objective of this study, however, was twofold. The first objective, that of the resurvey program, was to design a sampling program that would allow the estimation of radiological dose to people living in the area for current land uses. These land uses are for grazing cattle and small home gardens. It is anticipated that GZ and the White Sands Missile Range will remain in control of the U.S. Army. Second, because a data base existed for a number of years and it is known from the earlier studies that wind and water played a major role in redistribution of the fallout material, it was decided that the study would also make special measurements to investigate redistribution of the materials from the actions of wind and rain. Because high-resolution germanium lithiumdrifted [Ge(Li)] gamma detectors now exist, and are usable under field situations, it was decided to use the Lawrence Livermore Laboratory mobile radiation detection system. Use of the germanium detector with a pulse height analyzer in a mobile unit enabled the measurement of the distribution of fission products in soil in a rapid manner.

Redistribution of the surface-deposited fission products and plutonium was an important consideration of the studies carried out during the UCLA series in 1947 to 1951. A strong redistribution of surface soil by both wind and rain was observed. Flash floods do occur in the area and tend to move soils and sediments in runoff channels in large quantities. Points of deposition for these sediments that are moved by heavy water events are usually low points that are often dug out to collect the water for livestock watering. Therefore, the study included a number of measurements where the ¹³⁷Cs content was measured both upslope and at the final deposition point for redistribution of the fission products and probably of plutonium also.

To evaluate the significance of the residual contamination at the GZ location, a series of core samples was taken in 1983.

3. METHODS AND APPROACH

This study was designed to supplement existing data on the distribution of fallout from the Trinity Test to allow estimation of potential radiation doses based on land use. The sampling program took advantage of previous studies of the fallout area, as well as special studies of small areas of the fallout zone.

I. APPROACH

Previous surveys had determined the extent of the fallout area and general concentrations of surface deposition of fallout. Later studies by Los Alamos National Laboratory concentrated on the mechanisms for redistribution of the fallout in several intensive study areas.¹⁴ In the case of the U.S. Environmental Protection Agency studies, the principal investigator provided field notes so sample locations could be relocated for further sampling.

The sampling programs were carried out during two time periods. In 1977 the far fallout zone, Chupadera Mesa, and areas around GZ on White Sands Missile Range were sampled. Because time and resources were limited, maximum use of previous survey results guided the plan for characterization of the residual fallout radionuclides. Also, the loan of a van with instrumentation and personnel from Lawrence Livermore National Laboratory allowed use of real-time data for decisions about measurement locations in the field. In 1983 a set of measurements and samples was taken at GZ. Analysis of the 1977 survey data had indicated more detailed information on the depth distribution of radionuclides at GZ would be necessary for engineering studies of the area. In both surveys, in situ measurements with a germanium lithium-activated [Ge(Li)] high-resolution gamma-ray spectrometer and special sampling methods were used to obtain information on the concentrations and location of radionuclides.

II. METHODS

A. In Situ Measurement

In planning the Trinity survey effort, it was determined that the utilization of *in situ* Ge(Li) spectrometry would provide a number of advantages over sole reliance on traditional soil-sampling techniques for obtaining an inventory of radionuclides in the soils of a very large Trinity fallout field. The following considerations were taken into account.

- (a) The relatively short counting time required to obtain a satisfactory gamma spectrum for a sample (30 min compared with 1000-2000 min in the laboratory for a 100-g soil sample) allows a potentially larger number of sample locations to be examined. Alternatively, it allows the reallocation of laboratory Ge(Li) analysis time to the necessary soil profile concentration determinations in support of the *in situ* measurements.
- (b) Local inhomogeneities in soil radionuclide concentration (both in depth and in small regions) are automatically averaged because the detector is responding to photons from a very large quantity of soil (several metric tons compared with a few hundred grams in a laboratory system).
- (c) Combining the inherently high resolution of a Ge(Li) spectrometer system with a mobile detector and support system permits immediate feedback in the field of both radioisotope identity and relative activity (cpm), which allows on-site decisions to be made concerning what additional or different measurements might be needed and where.

The methodology and instrumentation for and feasibility of utilizing *in silu* Ge(Li) spectroscopy for identifying and quantifying radionuclides distributed in soil have been investigated and successfully demonstrated at several laboratories over the past several years.¹⁵⁻¹⁹ For the Trinity resurvey, equipment and techniques developed by the Lawrence Livermore National Laboratory (LLNL) were utilized through a cooperative arrangement. An overview of the system and its calibration are found in published reports.¹⁷ The response of a closed-end, cylindrical Ge(Li) detector, placed at a fixed height (1 meter) above the soil, is an energy-dependent function of the angular response of the detector and the flux of unscattered photons incident on the detector per unit of soil radioactivity. Normally, calibration of this response involves laboratory measurements and calculational procedures independent of the geometries of the distributed sources to be evaluated. Radionuclides that have been redistributed through the vertical soil profile from an initial surface deposition (for example, fallout) are usually assumed to be exponentially distributed in this calibration calculation. As a crosscheck of the laboratory calibration and the suitability of the exponential distribution assumption, an empirical calibration factor for 137 Cs was derived as well.

Although detector response to a source does depend on such variables as the mass attenuation coefficients and densities of soil and air under field conditions, the crucial variable is the specification of the relaxation depth of the activity being measured (that is, the inverse of the power of the exponential distribution function). Under certain circumstances this parameter can be readily and reliably estimated, as in the case of fresh fallout of short-lived radionuclides (⁷Be, for instance) or the case of naturally occurring radionuclides such as uranium, which tend to be uniformly distributed in soil. But the case of aged, long-lived fallout radionuclides deposited over as large and varied terrain as is found in the Trinity fallout field presents a more difficult condition to interpret. Concentration profiles for ¹³⁷Cs were determined at reasonably representative locations throughout the field by the technique of soil sampling and laboratory Ge(Li) analysis. As might be expected, these distributions reflect in a complex way the effects of the wide differences in rainfall input, soil properties and depth, and vegetation type and density, which occur over the range of low-elevation, dry desert terrain, through the grass and piñon-juniper habitat of the mesas, to the conifer forests of the mountain slopes. Representative values were selected and assigned by judgment to each sample location. An effort to develop a linear box model of redistribution of ¹³⁷Cs following deposition was made, but the many uncertainties in estimating the relevant parameters in the model led to results judged to be of no more value than making assignments on the basis of proximity to measured profiles, similarity of soil type, vegetation, elevation, and so forth.

B. Sampling and Analysis

Sampling of soils, sediments, and vegetation accompanied most *in situ* measurements throughout the survey area. Of particular importance were soil profile samples taken at the location of the *in situ* measurement. These soil profile samples were used to develop a correction factor for calibration of the Ge(Li) detector system to account for the depth distribution of gamma-ray emitting radionuclides.

The methods used for obtaining samples and subsequent analysis considered the sensitivity of the systems used and the survey design. At locations with changing topographical features, additional soil samples were taken to study plutonium and strontium distribution. These isotopes are not present in sufficient quantity for detection by the *in situ* measurement system used.

Soil samples were obtained using a 12.8-cm- (5-in.-)diameter ring that was pushed or pounded 5 cm (2 in.) into the soil. Soil was removed from around the ring by use of a shovel and hand trowel. An aluminum sheet was pushed under the ring and both soil and ring were lifted out. The soil was collected in plastic bags labeled with the location identification and an indication of the depth and soil horizon sampled. The procedure was repeated for each soil profile sample, taking care to avoid cross contamination. At each *in situ* measurement location, three 5-cm-deep soil profiles or a total of 15-cm- (6-in.-) deep samples were obtained. At selected locations, profile depths to 40 cm (16 in.) were sampled.

Vegetation samples were collected using grass shears to cut the grass or weeds within 1 to 5 cm of the soil surface. For trees, new growth and the last year's growth were collected. Samples were placed in plastic bags with notation of the plant species and the identification number for that location. Notes were made on the vegetative cover, measured slope, and soil characteristics. Topographic features of the surrounding area also were noted. Additional vegetation samples were collected for later verification of species types.

Soil and vegetation samples were transported daily to laboratories at New Mexico Institute of Mining and Technology in Socorro, New Mexico. Samples were placed in drying racks of window screen on wood frames in an unused greenhouse. After initial air drying, heat lamps were used to dry the samples to constant weight. Constant weight was attained in 1 hour under the heat lamps. A drving time of 2 hours for both soils and plants was used as routine practice. After they were dried, soil and plant samples were pulverized using Waring Blendors. Vegetation samples were packed into cans by overfilling above the top of the container. A manual can sealer compressed the sample while the lid was fastened to the can. About 80 g of dried vegetation was sealed in the can for later counting on a laboratory Ge(Li) detector system. At the same time, 10.05 g of sample was weighed into a plastic sample bottle and labeled for transport to Los Alamos National Laboratory, where radiochemical conducted. Soil samples were analyses were homogenized and about 360 g filled the cans. Samples of 10.05 g of each soil or sediment sample were placed in small plastic bottles and labeled for transport to Los Alamos National Laboratory radiochemical laboratories.

Because the soils were anticipated to contain greater quantities of radionuclides than vegetation, a separate

laboratory was used for soil handling. Samples from the GZ area were handled with special precautions because of higher radionuclide contents. Special laboratory cleaning before and after handling these segregated samples minimized cross-contamination potential.

Vegetation and soil samples were counted on a Ge(Li) system at New Mexico Institute of Mining and Technology as an initial screening method for radionuclide identification. Final analysis of the samples for gamma-emitting radionuclides was conducted by LLNL with calibrated laboratory Ge(Li) systems and data reduction accomplished using computer codes.²⁰

Vegetation and soil samples sent to the Los Alamos environmental surveillance radiochemistry laboratories were analyzed for ²³⁸Pu, ^{239,240}Pu, and ⁹⁰Sr.²¹ Plutonium analyses used standard digestion, anion exchange, plating, and alpha spectroscopy methods. Strontium-90 analyses utilized standard ⁹⁰Y ingrowth methods.

4. RESULTS

I. TOTAL AREA

For an overview of the amount of radioactive fallout from the Trinity Test, the data have been reviewed for overall measurement of 137 Cs, 239,240 Pu, and other radionuclides. Figure 7 is a general map of the Trinity fallout area. Data points are designated as small squares. The solid lines divide the data base into areas of general interest for assessment of the radionuclides on more areaspecific bases. The data base was divided into areas designated: Trinity GZ, San Antonio, White Sands Missile Range, Bingham, Chupadera Mesa, and Far Fallout Zone. Section II of the Results presents the mean data by area. Appendix A lists the data from all data bases summarized in the Results section of this report.

A. Trinity Data Analysis: ¹³⁷Cs in Soil

There are three independent modes of measurement of radionuclide content in Trinity soils used: (1) direct, *in situ* gamma spectroscopy, (2) laboratory gamma spectroscopy of canned soil samples, and (3) laboratory radiochemical analysis of soil samples. (See Chapter 2 of this report for details.) There is only limited overlap of determination of specific radionuclides by these approaches. In the case of ¹³⁷Cs, only *in situ* spectroscopy and laboratory spectroscopy of canned samples were applied; one providing inventory estimates and the other soil concentration on ¹³⁷Cs inventory are not totally independent. The *in situ* measurement requires knowledge of



Fig. 7. General map of the Trinity fallout area and the measurement locations.

the vertical distribution pattern in the soils in the vicinity of the detector in order to be translated into an inventory estimate. The soil sampling results can be used to provide this needed distribution estimate. A discussion of the reduction of these data to provide ¹³⁷Cs inventory estimates follows.

Soil samples were collected at a large number of locations throughout the survey area at locations where *in situ* spectroscopy measurements were made (but not at every such location). Usually samples were collected at three consecutive 5-cm depth intervals. However, when these samples were processed, not all samples were prepared and counted. Profiles for which complete or nearly complete ¹³⁷Cs concentration data exist are shown in Table III.

An estimate can be made of the ¹³⁷Cs concentration in those samples that were counted, but for which no cesium data were reported based on the minimum detectable activity (MDA). Using the MDA estimate in those instances where a sample was counted but no ¹³⁷Cs data were reported provides an upper-bound estimate of inventory. One approach to estimating the MDA for ¹³⁷Cs is to examine the trend in uncertainty in the reported data. The MDA can be taken to be the smallest amount of activity that would likely be reported with an error not greater than some acceptable limit, say 33%. At an uncertainty of 33%, the corresponding concentration is approximately 0.1 pCi/g. Another approach based on statistical considerations, described in Appendix E, yields similar estimates.

Replacing MDA everywhere by the estimate of 0.1 pCi/g substantially increases the number of profile estimates. The profile characterization is by means of an exponential fitting function:

$$\mathbf{C} = \mathbf{C}_{o} \exp(-\alpha \mathbf{x}) \tag{1}$$

where C is the concentration at depth x, C_o is the surface concentration, and α is the inverse relaxation depth of the distribution. This relation can be justified theoretically on the basis of a simple box model in which the soil profile is characterized by a sequence of boxes that exchange contaminants over a period of time at a certain flow rate (A. T. Jakubide, *Migration of Plutonium in Natural Soil*, 1977). To incorporate the uncertainties in the concentration determinations into the profile characterization (that is, into the determination of the inverse relaxation depth estimate), a logarithmic transformation of Eq. (1) is made and the method of linear least squares applied with some modification to compensate for the fact that, unadjusted, the least-squares estimate underemphasizes the uncertainties for small values of C. (See Appendix C, least-squares fitting of an exponential function.)

The resulting alpha estimates for the Chupadera Mesa are shown in Table IV and GZ samples in Table V. Evidently, the mesa samples are characterized by a shallower profile (large alpha), and show less variability than the GZ samples do. This reflects, perhaps, the mechanical disturbance of GZ soils but also differences in the original deposition processes over these two areas, the geochemistry of the respective soils, and other environmental factors such as precipitation frequency, intensity, and so forth.

An estimate of the inventory of 137 Cs (nCi/m²) in these soils can be made utilizing the concentration and profile data. Since there can be expected considerable mixing in the topmost layer of soil, the average concentration at the midpoint in the 0- to 5-cm interval will be taken to be representative of the 0- to 2.5-cm interval as well. (This estimation should tend to overestimate the actual inventory because there is most likely a parabolic distribution shape in the near surface layers caused from depletion processes at the surface.) Then the estimate of the inventory in the 0- to 2.5-cm interval is given, for a density of 1.5 g/cm³, by

$$I_{2.5} = C_{2.5} (pCi/g) \times 2.5 \text{ cm} \times 1.5 (g/cm^3)$$
$$\times 10^4 (cm^2/m^2) \times 10^3 (nCi/pCi) = 37.5 C_{2.5} . (2)$$

Then the total inventory can be estimated over the rest of the profile assuming the fitted exponential distribution:

$$= 37.5C_{2.5} + \left(\int_{2.5}^{\infty} e^{-x} dx\right) (1.5) (1.0) (C_{2.5})$$
$$\cong \left(37.5 + \frac{15}{\alpha}\right) C_{2.5} \pm \sqrt{\frac{\sigma_c^2}{C^2} + \frac{\sigma\alpha^2}{\alpha^2}}, \quad (3)$$

where the integral is approximated by one-half.

A comparison of the *in situ* inventory estimates with many of the soil sample estimates is possible and provides some measure of the compatibility of these two approaches to inventory estimation (Table VI). Because of delays in processing of canned soil samples, assignment of the α profile parameter for each sample location had to

15

TABLE III

¹³⁷Cs SOIL CONCENTRATION DATA

Location							
GZ or	LADB			Conce	ntration (pCi/g)	
Mesa	<u>No.</u>	0-5 cm	FSD ^b	<u>5-10 cm</u>	FSD	10-15 cm	FSD
G	1990	13.6	0.011	21.7	0.013	6.98	0.036
G	1991	6.04	0.036	9.26	0.014	^c	
G	1988	0.61	0.486	24.95	0.024		
G	1989	1.75	0.122	0.17	0.179	MDAª	
G	2006	0.35	0.188	0.28	0.185		
G	2005	0.77	0.031	0.52	0.032		
G	2012	0.38	0.227	0.41	0.127	MDA	MDA
G	2016	0.82	0.032	0.26	0.24	0.11	0.164
G	2018	0.26	0.173	0.26	0.058	0.15	0.355
G	2014	0.99	0.033			0.97	0.059
G	2019	0.54	0.057	0.38	0.108	0.14	0.299
Μ	2027	3.19	0.017	0.12	0.135	0.21	0.155
Μ	2026	5.42	0.063	0.48	0.097	MDA	MDA
Μ	2045	1.18	0.034	0.22	0.085	0.08	0.224
Μ	2048	1.08	0.047	0.13	0.274	0.19	0.296
G	1987	1.87	0.11	0.16	0.291	MDA	MDA
Μ	2053	0.71	0.056			0.06	0.204
Μ	2050	0.79	0.025			0.28	0.221
Μ	2057	2.56	0.017			MDA	MDA
Μ	2049	0.83	0.052			MDA	MDA
М	2115	2.95	0.027	0.09	0.192	MDA	MDA
Μ	2116	5.42	0.013	0.48	0.097	MDA	MDA
Μ	2118	2.06	0.03	0.10	0 .162	MDA	MDA
Μ	2081	1.29	0.032			MDA	MDA
Μ	2080	0.32	0.081			0.11	0.163
G	1992	0.10	0.344	0.18	0.282		
Μ	2120	1.75	0.030	1.0	0.040	MDA	MDA
Μ	2071	3.12	0.02			0.14	0.35
Μ	2058	5.14	0.01			0.08	0.34
Μ	2028	5.87	0.01	0.18	0.29	MDA	MDA
Μ	2059	1.04	0.04			MDA	MDA

*LADB - Los Alamos Data Base.

^bFSD - Fractional Standard Deviation.

^c-- means no data taken.

^dMDA - Minimum Detectable Activity.

TABLE IV

CHUPADERA N	MESA ¹³⁷ Cs	PROFILE	DATA
-------------	-------------------------------	---------	------

	С				
	Conc at				
LADB ^a	2.5 cm				
No.	(pCi/g)	FSD (B) ^b	$\alpha(cm^{-1})$	FSD (a)	Sequence
2026	5.42	0.013	0.33	0.64	0.4
2027	3.19	0.017	0.33	0.09	0.2
2028	5.87	0.010	0.53	0.16	0.4
2045	1.18	0.034	0.32	0.10	0.2
2048	1.08	0.047	0.22	0.29	0.4
2049	0.83	0.052	0.22	0.50	0.2
2050	0.79	0.025	0.10	0.40	0.2
2053	0.71	0.056	0.25	0.32	0.2
2057	2.56	0.017	0.33	0.33	0.4
2058	5.14	0.010	0.42	0.29	0.4
2059	1.04	0.040	0.24	0.45	0.4
2071	6.87	0.020	0.39	0.23	0.4
2080	0.32	0.081	0.11	0.48	0.2
2081	0.29	0.032	0.27	0.41	0.4
2115	2.95	0.027	0.49	0.17	0.7
2116	5.42	0.013	0.48	0.06	0.7
2118	2.06	0.030	0.47	0.16	0.7

Note: Mean $\alpha = 0.3235$ and $\sigma = 0.1281$.

^aLADB - Los Alamos Data Base.

^bFSD - Fractional Standard Deviation.

be made on the basis of limited information. Thus, there are a number of significant differences between the assumed α for *in situ* estimation and the fitted α for soil sample estimation (Table VII). However, corrected *in situ* estimates of inventory based on detector efficiencies as a function of α (Chapter II) were made corresponding to fitted α 's and are shown in column 5 of Table VII.

Figure 8, a plot of soil-sample gamma *in situ* inventory estimates, suggests that the two estimation procedures yield similar results. A paired t-test was calculated for both corrected and uncorrected data (excluding sample 2014, which is a GZ sample), with the result that the two

sample means are not significantly different at the 90% confidence limit in either the corrected or uncorrected cases. The α parameter correction appears to make only a small difference in comparability. Possibly the fact that the *in situ* technique is averaging over a considerably larger volume of soil at each sampling location than the corresponding soil samples is a compensating effect to the uncertainties in estimating α .

Thus, it would appear that the *in situ* ¹³⁷Cs total inventory estimates are comparable with soil sampling estimates with an uncertainty on the order of 50%.

TABLE V

GROUND ZERO TO CHUPADERA MESA ¹³⁷Cs PROFILE DATA

	Conc at			
LADB ^a No.	2.5 cm (pCi/g)	FSD (C) ^b	<u>α (cm⁻¹)</u>	FSD (a)
1087	1 87	0.11	0.37	0.24
1988	0.61	0.486	0.12	0.17
1989	1.75	0.122	0.40	0.07
1990	13.60	0.011	0.06	0.01
1991	6.04	0.036	0.08	0.04
1992	0.10	0.344	0.12	2.17
2005	0.77	0.031	0.08	0.14
2006	0.35	0.188	0.04	2.12
2012	0.38	0.227	0.03	2.51
2014	0.99	0.033	0.002	0.006
2016	0.82	0.032	0.21	0.21
2018	0.26	0.173	0.02	4.27
2010	0.54	0.057	0.08	0.43

^{*}LADB - Los Alamos Data Base.

^bFSD - Fractional Standard Deviation.

B. Trinity Data Analysis: 239,240 Pu in Soil

Direct determination of the concentration and inventory of plutonium in Trinity soils was carried out by soil sampling and radiochemical analyses. Preliminary investigation of the possibility of utilizing the determination of ²⁴¹Am inventory as an indirect means of determining 239,240 Pu inventory proved unsuccessful because of an observed very low concentration of ²⁴¹Am in the Trinity soils, even in the vicinity of GZ.

The soil radiochemical results are tabulated in Table VIII. These data indicate a fairly rapid decrease in plutonium concentration with depth in most cases. But there are some significant exceptions such as at sample location 2072, which is a flat, grassy sediment trap on Chupadera Mesa. Here, relatively high concentrations (>1 pCi/g) persist to a depth of 10 to 15 cm. Deep distribution of plutonium might be expected to occur in such sediment traps; however, no systematic attempt was

TABLE VI

¹³⁷Cs INVENTORY ESTIMATES

A. Chupadera Mesa

	1-cm		Total	
LADB ^a	Inventory		Inventory	
No.	(nCi/m ²)	FSD	(nCi/m^2)	FSD
2026	81.3	0.013	449.6	0.64
2027	47.85	0.017	264.6	0.09
2028	88.05	0.010	386.3	0.18
2045	17.70	0.034	99.56	0.11
2048	16.20	0.047	114.1	0.29
2049	. 12.45	0.052	87.7	0.50
2050	11.85	0.025	148.1	0.40
2053	10.65	0.056	69.2	0.32
2057	38.4	0.017	212.4	0.33
2058	177.1	0.01	376.3	0.39
2059	15.6	0.04	104.0	0.45
2071	103.05	0.02	521.9	0.23
2080	4.89	0.081	55.6	0.48
2081	19.35	0.032	120.0	0.41
2115	44.25	0.027	200.9	0.17
2116	81.30	0.013	372.6	0.06
2118	30.90	0.030	142.9	0.16

B. GZ to Chupadera Mesa

1987	28.05	0.11	145.9	0.26
1988	9.15	0.49	99.1	0.51
1989	26.25	0.12	131.25	0.20
1990	204.0	0.01	3710.0	0.01
1991	90.6	0.036	1359.0	0.05
1992	1.5	0.344	16.25	2.17
2005	11.55	0.031	173.25	0.14
2006	5.25	0.188	14 4.4	3.1
2012	5.70	0.227	204.3	0.23
2014	14.85	0.033	7462.1	0.03
2016	12.30	0.032	89.32	0.21
2018	3.90	0.173	204.75	4.2
2019	8.10	0.057	121.5	0.43

*LADB - Los Alamos Data Base.

^bFSD - Fractional Standard Deviation.

TABLE VII

LADB ^a	Assumed	Inventory In Situ		Inventory Corrected ^b	Inventory Soil Sample		Measured
No.	α	Reported	σ	for a	Estimate	FSD ^c	α
2012	0.2	236.6	5.73	701.3	204.3	0.23	0.03
2014	0.03	858.2	25.29	1501.9	7462.1	0.03	0.002
2016	0.20	84.58	4.46	84.6	89.3	0.21	0.21
2018	0.20	90.92	2.96	269.5	204.8	0.17	0.02
2019	0.20	26.43	1.19	99.7	121.5	0.10	0.08
2026	0.40	540.0	49.28	597.9	449.6	0.64	0.33
2027	0.20	314.0	4.74	232.7	264.6	0.09	0.33
2049	0.20	139.6	3.53	139.6	87.7	0.50	0.22
2050	0.20	125.2	3.43	185.6	148.1	0.40	0.10
2053	0.20	189.0	4.01	189.0	69.2	0.32	0.25
2057	0.40	158.7	3.04	175.7	212.4	0.33	0.33
2058	0.40	323.4	4.22	323.4	376.3	0.29	0.42
2059	0.40	211.3	3.40	284.8	104.0	0.45	-0.24
2071	0.40	388.7	5.35	388.7	521.9	0.23	0.39
2080	0.20	81.5	2.9 1	120.8	55.6	0.48	0.11
2081	0.40	135.5	2.74	168.0	120.0	0.41	0.27
2115	0.70	83.7	2.12	98.3	200.9	0.17	0.49
2116	0.70	84.4	2.23	98.7	372.6	0.06	0.48
2118	0.70	100.0	2.23	120.9	142.9	0.16	0.47

COMPARISON OF IN SITU AND SOIL SAMPLE ESTIMATES OF ¹³⁷Cs TOTAL INVENTORY (nCi/m²)

^aLADB - Los Alamos Data Base.

^bThe number of counts in the ¹³⁷Cs photopeak is converted to nCi/m^2 by a detector efficiency term N_f/s , which is a function of α . The ratio of the efficiency values for the assumed α and actual measured α from profile data was used to evaluate a corrected *in situ estimate*.

 $^\circ T\,S\,D$ - Fractional Standard Deviation.

made to fully explore the extent of vertical redistribution of plutonium in soils.

As in the case of ¹³⁷Cs soil concentrations profile data, these plutonium data can be fitted by an exponential distribution model in most cases to provide an estimate of distribution with depth, and thereby, inventory. Leastsquares fitting of these data (where possible) with an exponential fitting function yield the results tabulated in Table IX.

These profile characterizations clearly point to the highly variable or indeterminate distribution conditions of

the GZ area due possibly to mechanical disturbance in the characteristics of the fallout materials, and so forth. The fit of the shapes of the concentration depth profiles to an exponential function is reasonably good on Chupadera Mesa; but there are some notable exceptions. Some of the cases where there is considerable uncertainty in the profile parameter a are probably attributable to very low concentrations, especially at greatest depth, with consequent poor recovery and counting statistics. Others (sample 2080, for example)may reflect other processes at



Fig. 8. Comparison of in situ and soil sample estimates of total 137 Cs inventory.

work affecting vertical redistribution rather than infiltration, such as disturbances by burrowing rodents, cattle, or big game animals.

Concentrations of ²³⁸Pu in these soils are so low as to make reliable estimates of profile distributions, and consequently total inventory, impossible. Table X illustrates the order of magnitude of some surface (0- to 5-cm) concentrations and corresponding ²³⁸Pu/²³⁹Pu ratios. There is apparently about 20 times more ²³⁹Pu than ²³⁹Pu in the surface soils, independent of location.

The 239,240 Pu inventory estimate was made utilizing the same strategy as was used for 137 Cs inventory estimates, that is, by assuming an essentially uniform concentration in the 0- to 2.5cm layer, and a decreasing exponential distribution over the remainder of the profile. On these assumptions, the 0- to 1-cm inventory I, (most readily available for resuspension) and the total inventory I, estimates are given, assuming again a density of 1.5 g/cm³,

 $I_1 \cong 15C_{2.5} \pm \sigma_c$

and

$$I_{T} \cong \left(37.5 + \frac{15}{\alpha}\right) C_{2.5} \pm \sqrt{\frac{C^{2}}{\sigma c^{2}} + \frac{\alpha^{2}}{\sigma_{\alpha}^{2}}}$$
 (4)

These two inventories are tabulated in Table XI for those cases where adequate data exist. Samples for which either the profile estimate could not be made or for which the uncertainty in the surface concentration and/or profile a estimates were too great to provide useful total inventory estimates, still have a surface inventory estimate listed. Evidently in the case of GZ environs samples, only the near surface inventory estimate is usable.

C. Other Fission and Activation Products in Soils

In addition to cesium and plutonium, several fission products and activation products from the Trinity event and more recent Chinese nuclear tests were detected by the Ge(Li) systems used. The activation and fission products from the relatively recent fallout were detectable at most locations by observing the ⁹⁵Zr and ⁹⁵Nb gamma rays in the *in situ* spectra. The average ⁹⁵Zr (half-life, 64 d)²² areal concentration for the approximately 2500 mi² surveyed was 2.4 ± 0.12 nCi/m² and the ⁹⁵Nb (half-life, 35.1 d)²² average concentration was 3.8 ± 0.15 nCi/m². The range of concentrations was from undetectable to 6.6 nCi/m² for ⁹⁵Nb. Of the 116 measurement locations for ¹³⁷Cs, ⁹⁵Zr was detected at 88 locations and ⁹⁵Nb at 92 locations.

Other short-lived radionuclides detected by the *in situ* Ge(Li) system were ⁷Be and ¹⁰³Ru. The relatively short half-lives of 53.4 d²² for ⁷Be and 39.3 d²² for ¹⁰³Ru also identify these radionuclides as being part of fallout from the 4-megaton Chinese nuclear test on November 17, 1976.⁷ The ⁷Be concentration on an areal basis averaged 8.1 \pm 0.7 nCi/m² with a range from undetected to 26 nCi/m². Of the 116 locations monitored for ¹³⁷Cs, 62 locations had detectable ⁷Be. Only 22 out of the 116 locations for the area surveyed averaging 0.21 \pm 0.04 nCi/m². The range was from undetectable quantities to 1.9 nCi/m².

The *in situ* gamma spectra and laboratory analyses of soil indicated the presence of the activation and fission products ⁶⁰Co, ¹⁵²Eu, and ¹⁵⁵Eu. Because of the longer half-lives associated with these radionuclides, the quantities present are considered to be from the Trinity test. The half-life of ⁶⁰Co is 5.27 yr; ¹⁵Eu, 14 yr; and ¹⁵⁵Eu, 5 yr.²² The areal concentration of these radionuclides at two GZ locations as measured by *in situ* methods indicated 5000 nCi/m² and 50 nCi/m² of ⁶⁰Co and 1.1 x 10⁴ nCi/m² and 1.2 x 10³ nCi/m² of ¹⁵⁵Eu. For areas

TABLE VIII

TRINITY SOIL CONCENTRATION OF 239,240 Pu

Lo	cation					Activity	(nCi/a)				
LADB [®]	GZ or					Activity	(hcn.R)			· · · · ·	
No.	Mesa (M)	0-5 cm	FSD ^b	5-10 cm	FSD	10-15 cm	FSD	15-20 cm	FSD	20-25 cm	FSD
1998	GZ	24.3	0.02	57.4	0.02	0.15	0.47	°		 -	
2001	GZ	64.9	0.02	44.4	0.02	201	0.01				
2003	GZ	3.8	0.05	0.05	0.80	-0.06	0.67	_		•	
2009	GZ	0.48	0.04	0.45	0.04	0.47	0.04	_			
2014	М	0.165	0.05	0.71	0.03	0.146	0.86				
2016	GZ	0.122	0.08			-0.68	0.04				
2018	GZ	0.67	0.04	-0.001 ^d	2.0	_	_ `		-		-
2026	М	3.51	0.03	0.118	0.07	0.018	0.22				
2027	М	1.71	0.03	0.204	0.05	0.074	0.08	_			
2028	М	4.07	0.04	0.109	0.06	0.007	0.28			•	
2037	М	1.83	0.03	0.082	0.06					-	-
2047	М	0.98	0.04	0.241	0.06	0.172	0.05	0.013	0.231	0.007	0.29
2052"	М	0.122	0.07	0.004	0.75	0.010	0.0001	0.0017	0.71		-•
2048	М	0.398	0.058	0.019	0.168	0.0059	0.32	_	_		
2049	М	0.246	0.04	•-		0.001	1.55	_		0.002	1.50
2057	М	0.70	0.03	0.383	0.05	0.01	0.0001	_		_	
2059	М	1.21	0.06	0.033	0.15	0.018	0.17	_	-		
2060	М	1.06	0.04	0.302	0.04	0.157	0.08	0.088	0.10	0.053	0.01
2065	М	0.271	0.04	0.002	0.71	-0.001	1.29				_
2071	М	1.54	0.03	-	•	0.061	0.10		-		
2072	М	4.58	0.03	3.88	0.03	1.15	0.03	_	-		
2073	М	6.70	0.03	•							
2076	М	0.435	0.03	0.018	0.17	0.016	0.09				
2080	М	0.027	0.15	0.024	0.17	0.016	0.19		-		
2082	М	0.95	0.04	0.010	0.20	-0.001	1.0	_	•	_	
2084	М	1.23	0.04	0.056	0.11	0.009	0.44				~
2096	М	0.213	0.06	0.002	1.50	-0.003	1.0	-	-		
2097	М	0.61	0.05	0.153	0.04	0.007	0.43		-	0.002	0.94
2115	М	0.25	0.16	0.021	0.19	0.0013	1.15	-	-		
2118	М	0.18	0.07	0.013	0.23	0.001	4.0				
2119	М	0.17	0.06	-0.01	2.0	0.005	1.0	_			
2120	М	0.23	0.13	0.60	0.05	0.037	0.14		_		•
2121	М	0.69	0.04	0.51	0.04				-		

*LADB - Los Alamos Data Base. *FSD is the standard deviation of the measured value divided by the measured value.

"Slanks indicate that sample was not taken or not analyzed. "Additional profiles: 25-30 cm. 0.007 (1.8) pCi/g; 30-35 cm, 0.0023 (0.61) pCi/g; 40-45 cm, 0.0075 (0.25) pCi/g. "Negative values represent observations smaller than chemical blank values.

- - -

TABLE IX

GZ ENVIRONS AND CHUPADERA MESA ^{239,240}Pu SOIL CONCENTRATION PROFILE ESTIMATES

	Surface Concent	Soil ration		
	C - Cone		Inverse F	Relaxation
	c = conc		Depth of	of Profile
No	(nCi/q)	FSD (C) ^b	$\frac{1}{(cm^{-1})}$	FSD (a) ^b
<u> </u>	(bc1/8)	<u>F3D (C)</u>	<u>u (cm)</u>	<u>1'3D (u)</u>
1995	(uniform	ly uncontam	inated at ba	ckground)
1998	(a indete	erminate—di	sturbed soil	at GZ)
2001	(a positi	ve—disturbe	d soil GZ)	
2003	3.8	0.05	0.86	16.5
2009	0.48	0.04	0.001	12.9
2016	(a positi	ive—disturbe	ed soil)	
2018	(a indet	erminate—sı	urface depos	it only)
2026	3.51	0.03	0.67	0.06
2027	1.71	0.03	0.38	0.05
2028	4.07	0.04	0.72	0.05
2037	1.83	0.03	0.62	0.07
2047	0.98	0.04	0.19	0.06
2048	0.39	0.05	0.56	0.36
2049	0.25	0.04	0.28	5.74
2052	0.12	0.07	0.25	0.09
2057	0.70	0.03	0.34	0.03
2059	1.21	0.06	0.53	0.19
2060	1.06	0.04	0.19	0.05
2065	0.27	0.04	1.01	3.38
2071	1.54	0.03	0.32	0.12
2072	4.58	0.03	0.11	0.02
2073	(a indet	erminate—o	nly surface s	ample tested)
2076	0.44	0.03	0.41	0.31
2080	0.03	0.15	0.05	3.53
2082	0.95	0.04	0.91	0.44
2084	1.23	0.04	0.61	0.15
2096	0.21	0.06	0.93	7.19
2097	0.61	0.05	0.28	0.09
2115	0.25	0.16	0.49	0.54
2118	0.18	0.07	0.52	Ø.78
2119	0.17	0.06	0.35	4.03
2120	(a positi	ve—disturbe	ed soils in str	eam channel)
2121	0.69	0.04	0.06	0.24

*LADB - Los Alamos Data Base.

^bFSD - Fractional Standard Deviation.

TABLE X

SURFACE SOIL CONCENTRATION OF ²³⁸Pu AND ^{238,239}Pu RATIOS

	Surface Conc of ²³⁸ Pu		
Location	(pCi/g)	FSD ^a	^{238,239} Pu
2009	0.023	0.17	0.05
2014	0.0059	0.32	0.04
2016	0.004	0.50	0.03
2018	0.204	0.01	0.05
2047	0.045	0.11	0.05
2060	0.048	0.11	0.05
2065	0.012	0.17	0.04
2072	0.224	0.004	0.05
2073	0.323	0.05	0.05
2076	0.016	0.13	0.04
2082	0.046	0.11	0.05
2119	0.008	0.33	0.05
2121	0.041	0.10	0.06

^aFSD - Fractional Standard Deviation.

outside of GZ, ⁶⁰Co was detected at 21 locations, whereas ¹⁵²Eu and ¹⁵⁵Eu were detected at only four locations *in situ*. The average ⁶⁰Co areal concentration area from ground zero areas was 2.5 ± 1.5 nCi/m². The ⁶⁰Co distribution for the fallout area does not correlate with the ¹³⁷Cs area concentrations. Away from ground zero areas, the correlation coefficient for ⁶⁰Co and ¹³⁷Cs is 0.05. There was no correlation between ⁶⁰Co and ⁹⁰Sr in soils.

Laboratory counting of the soil samples in tuna cans provided additional information about the fission products from the Trinity fallout at GZ. The following radionuclides: ⁶⁰Co, ¹³⁷Cs, ¹³³Ba, ¹⁵²Eu, ¹⁵⁴Eu, and ¹⁵⁵Eu were detected in most soil samples. Table XII indicates the range of soil concentrations of the radionuclides detected. The range is wide but not unusual in view of the disturbances of the Trinity GZ area. The area was plowed and bladed in 1945 to remove materials from the surface. In particular, the fused sand and soil called Trinitite was being picked up by visitors as a memento of the event. The surface was bladed and the Trinitite was buried in trenches in the GZ area in 1952. Other

1977 ESTIMATES OF 1.cm AND TOTAL PLUTONIUM INVENTORY (nCi/m²)

LADB [®]	1-cm ²³⁹ Pu	FSD⁵	Total ²³⁹ Pu	FSD⁵
No.	Inventory (I_i)	(Ι _τ)	Inventory (I ₁)	(I _T)
	<u> </u>		<u> </u>	
1995	Bkg (<0.01)			
1998	364.5	0.02	c	
2001	973.5	0.02	c	•
2003	57.0	0.05	۲.	
2009	7.2	0.04	c	
2014	2.5	0.05	c	
2016	1.8	0.08	c	
2018	10.1	0.04	c	
2026	52.7	0.03	210.2	0.08
2027	25.7	0.03	131.6	0.13
2028	61.1	0.04	237.4	0.07
2037	27.5	0.03	112.9	0.11
2047	14.7	0.04	114.1	0.32
2048	5.9	0.05	25.1	0.66
2049	3.7	0.04		••-
2052	1.8	0.07	11.7	0.69
2057	10.5	0.03	57.1	0.09
2059	18.2	0.06	79.6	0.36
2060	15.9	0.04	123.4	0.27
2065	4.1	0.04	•	
2071	23.1	0.03	129.9	0.37
2072	68.7	0.03	796.3	0.18
2073	100.5	0.03	•	
2076	6.6	0.03	32.6	0.76
2082	14.3	0.04	51.3	0.49
2084	18.5	0.04	76.4	0.25
2097	9.2	0.05		-•
2115	3.8	0.16	17.0	1.27
2118	2.7	0.07	11.9	1.55
2119	2.6	0.06	۰.	
2120	3.5	0.13		
2121	10.4	0.04	•	••-

*LADB - Los Alamos Data Base.

^bFSD · Fractional Standard Deviation.

Total inventory not calculated because of inadequate data (FSD > 3).

radionuclides identified with low confidence and expected in fallout gamma-ray spectra were ¹⁴⁴Ce and ¹²⁵Sb. These latter radionuclides are likely from the Chinese nuclear tests.

In selected soil samples from areas off the White Sands Missile Range, the predominant fission products detected were ¹³⁷Cs and ¹⁵⁵Eu. These samples are from a large area including Chupadera Mesa, Gallinas Peak, and the far fallout areas northeast of New Mexico State Highway 14. For laboratory counting, the 0- to 5-cm and 10- to 15-cm samples were selected for counting for *in situ*

TABLE XII

ACTIVATION AND FISSION PRODUCTS IN BULK SOIL SAMPLES AT TRINITY GZ AREA

Isotope	Soil Sample Interval (cm)	Range of Conc (pCi/g)		
60 Co	0.5	12 60		
CU	0-5	12 - 00		
	5 - 10	12		
	10 - 15	0.12 - 18		
¹³⁷ Cs	0 - 5	4.2 - 21		
	5 - 10	0.52 - 48		
	10 - 15	0.79 - 16		
¹³³ Ba	0 - 5	1.6 - 3.8		
	5 - 10	0.58 - 2.9		
	10 - 15	N.D - 1.5ª		
¹⁵² Eu	0 - 5	12 - 1300		
	5 - 10	240 - 270		
	10 - 15	N.D - 340		
	0 - 5	16 - 76		
	5 - 10	10 - 15		
	10 - 15	N.D - 17		

"Not detected.

detector calibration. Selected 5- to 10-cm samples were counted, but they were fewer in number.

The mean values for the ¹⁵⁵Eu activity in soil were 0.17 \pm 0.12 pCi/g for the 0- to 5-cm depth and 0.14 \pm 0.07 pCi/g for the 10- to 15-cm depth. An analysis of variance indicates the means are equal at the 99% level of significance. The same samples have unequal means for ¹³⁷Cs concentration with the greatest amounts in the 0- to 5-cm samples. The equal concentrations of ¹⁵⁵Eu concentrations in the 0- to 5-cm and 10- to 15-cm soil depths indicate possible movement of Eu deeper into the soil with time. For a deeper soil sample of 20 to 25 cm in the same region but for only one location, the ¹⁵⁵Eu concentration was 0.23 pCi/g.

D. Natural Radioactivity in Soils

The *in situ* Ge(Li) detector system detects the gammaemitting primordial radionuclides and these radiations can be used for calibration of the detector for energy. The quantities of 40 K are determined directly. The quantities of ²³⁸U and ²³²Th are determined from the quantities of gamma-emitting daughter products. Use of the daughter products assumes radiological equilibrium between the parents and daughters with minimal or unimportant chemical redistribution in the soils.

The ⁴⁰K concentration, listed in Table XIII, averaged 17.7 ± 0.56 pCi/g for the region surveyed with a range of values from 3.4 to 42 pCi/g. The wide range of values is consistent with the variable geological features of the region surveyed. The NCRP report on natural background radiation in the U.S. summarizes the concentrations of major radionuclides in rock types and soil.²³ The expected range of values would be predicted to be between 2 pCi/g for carbonate rocks and 40 pCi/g for salic rocks. The geological formations of the region are composed of limestones and sandstones with a small area at the top of Gallinas Peak being intrusive rock identified as rhyolite. The highest value, 42 pCi/g, was from a region of volcanic rocks in a canvon area where ⁴⁰K content would be expected to exceed 30 pCi/g. Soils for the total U.S. averaged 12 pCi/g for in situ measurements taken by Lowder et al. in 1964 compared with the average of 18 pCi/g for this study.²⁴

The concentrations of the natural radionuclides ²³²Th and ²³⁸U also varied within the study region. The ²³²Th average concentration for all *in situ* locations was $0.94 \pm$ 0.04 pCi/g with a range from 0.12 pCi/g to 2.8 pCi/g. The ²³⁸U concentrations for *in situ* locations averaged $0.90 \pm 0.03 \text{ pCi/g}$ with a range from 0.32 pCi/g to 2.0 pCi/g. The highest values of ²³²Th were detected at the top of Gallinas Peak where intrusive rocks occur. The highest uranium value was detected in an area that integrates water runoff in a basin area. Areas of exposed limestone where soils were relatively thin contained the

TABLE XIII

SOIL CONCENTRATIONS OF NATURALLY OCCURRING GAMMA-EMITTERS

Radionuclide		Mean Conc. (pCi/g) \pm S.E.	Range (pCi/g)
⁴⁰ K	101	17.7 ± 0.56	3.4 - 42
²³² Th	101	0.94 ± 0.04	0.14 - 2.8
²³⁸ U	101	0.93 ± 0.03	0.32 - 2.0

lowest concentrations of ²³²Th and ²³⁸U, as expected from literature values.^{23,24}

II. DATA SUMMARY FOR SOILS

The separation of the overall data base into smaller locations of measurement of radionuclides generally followed topographic areas of the fallout area from the Trinity test. An artificiality of the boundary selection was the use of roads or a property boundary, which tends to result in a mixture of topographic features. However, directions and distances from GZ and land use all contributed to the choice of boundaries for separate data treatment.

The areas are bounded in Fig. 7 by solid lines. Trinity GZ is illustrated in Figs. 4 and 11. Located within a special fenced area on the White Sands Missile Range, Trinity GZ is the area of ground disturbance left from the initial test. Figure 9 indicates the sampling locations for the White Sands Missile Range, Bingham area, and Chupadera Mesa. Earlier surveys by Larson et al. and special studies by Hakonson et al. indicated localized areas of higher fallout on Chupadera Mesa.^{6,9} Figure 7 includes the sample locations for the far fallout area. Figure 10 indicates the location of samples in the San Antonio area, which is west and out of the fallout path.

The soil data for each area are summarized in Tables XIV through XIX. The results listed in the tables are summaries of statistical treatment of the data by area to determine means and standard errors (standard deviation of the mean).²⁵ The dates associated with the ^{239,249}Pu determinations are the data from studies by Olafson and Larson in 1948 and 1950, Los Alamos in 1972, EPA in 1973 and 1974, and Los Alamos in 1977 and 1983. Also noted is the depth of soil samples taken because the sampling schemes used by different investigators varied.

A. Plutonium in Soils

From Appendix D, the level of $^{239\cdot240}$ Pu in soils from worldwide fallout deposited in northern New Mexico is 0.008 ± 0.01 pCi/g. Of the areas listed in Tables XIV through XIX, only the San Antonio Area contains $^{239\cdot240}$ Pu in soils at concentrations as low as Northern New Mexico fallout levels. The other areas of the fallout zone all contain $^{239\cdot240}$ Pu above worldwide fallout levels.

The no action level proposed by the DOE Remedial Action Programs for 239,240 Pu is 100 pCi/g. The only



Fig. 9. White Sands Missile Range, Bingham, and Chupadera Mesa sample locations.



Fig. 10. Sample locations for the San Antonio area.

area exceeding this level of plutonium is the controlled inner fenced area of GZ. The EPA has proposed a screening level for no action of 200 nCi/m², which is equivalent to about 15 pCi/g in the top 1-cm layer of soil. Measurements of ²³⁹⁻²⁴⁰Pu in controlled areas of GZ exceed this proposed limit. Measurements made in 1972 within 1 km of GZ in the fallout path exceed this limit, but EPA measurements in 1973 and Los Alamos measurements in 1972 do not exceed the limits.

B. Cesium-137 in Soils

The amounts of ¹³⁷Cs in soils of the GZ area exceed the levels found in soils elsewhere in the U.S.^{26,27} However, the amounts detected by *in situ* measurements on the White Sands Missile Range and other fallout areas are within the range of values reported for the areal distributions of worldwide fallout. Table XX lists a range of 19 to 305 nCi/m² from California to Connecticut. If the measurements at San Antonio are assumed to be levels representing worldwide fallout, the White Sands

TABLE XIV

GROUND ZERO SURFACE MEASUREMENTS

Radionuclide	<u>N</u>	Mean ± S.E. ^a	Min	Max
⁶⁰ Co	6	$5554 + 3094 \text{ nCi/m}^2$	0	19 300
¹³⁷ Cs	6	$8104 + 3772 \text{ nCi/m}^2$	488	23 000
¹⁵² Eu	6	$107 \ 200 \pm 54 \ 400 \ nCi/m^2$	842	340 000
Natural gamma	6	$7.9 \pm 0.7 \ \mu R/h$	5.5	10.0
Total gamma	6	$131 \pm 62 \mu R/h$	9.8	397
⁴⁰ K	6	24 ± 4.4 pCi/g	12	43
²³² Th	6	$0.86 \pm 0.03 \text{ pCi/g}$	0.78	0.97
²³⁸ U	6	$0.60 \pm 0.13 \text{ pCi/g}$	0	0.88
^{239,240} Pu			b	
Inner fence, 0-1 cm	1	(1983) $22.8 \pm 0.2 \text{ pCi/g}$	ь	b
1-6 cm	1	(1983) $156 \pm 15 \text{ pCi/g}$	ь	b
0-15 cm	1	(1983) 23.7 ± 0.4 pCi/g	ь	b
15-30 cm	1	(1983) $256 \pm 3 \text{ pCi/g}$	ь	Ь
30.45 cm	1	(1983) 0.4 ± 0.02 pCi/g	ь	b
Between fences, 0-1 cm	11	(1983) 5.8 ± 9.5 pCi/g	0.04	28
1-6 cm	9	(1983) $1.14 \pm 2.9 \text{ pCi/g}$	0.02	8.8
15-30 cm	11	(1983) $0.0053 \pm 0.003 \text{ pCi/g}$	0.002	0.01
Inner fence, 0-2.5 cm	2	(1972) $127 \pm 180 \text{ pCi/g}$	0.04	255
Combined, 0-5 cm	3	(1977) 31 ± 31 pCi/g	3.8	64.8
5-10 cm	3	(1977) $34 \pm 30 \text{ pCi/g}$	0.05	57
10-15 cm	3	$(1977 \ 67 \pm 116 \ pCi/g$	< MDA	201
¹³⁷ Cs				
Inner fence, 0-1 cm	1	$16.5 \pm 3.3 \text{ pCi/g}$	ь	ь
1-6 cm	1	$21.8 \pm 4.4 \text{ pCi/g}$	ь	Ь
0-15 cm	1	$12.6 \pm 2.5 \text{ pCi/g}$	b	ь
15-30 cm	1	$21.5 \pm 4.3 \text{ pCi/g}$	b	ь
30.45 cm	1	0.67 ± 0.19 pCi/g	Ь	ь
Between fences, 0-1 cm	3	$0.54 \pm 0.37 \text{ pCi/g}$	0.17	0.92
1-6 cm	3	$0.64 \pm 0.48 \text{ pCi/g}$	0.29	1.19
4-10 cm	3	$0.33 \pm 0.12 \text{ pCi/g}$	0.22	0.32
10-15 cm	3	0.07 ± 0.41	-0.33	0.49

Radionuclide	N Mean ± S.E.ª		Min	Max
¹⁵² Eu				
Inner fence, 0-1 cm	1	$284 \pm 29 \text{ pCi/g}$	b	b
1-6 cm	1	$245 \pm 25 \text{ pCi/g}$	b	b
0-15 cm	2	$382 \pm 167 \text{ pCi/g}$	264	501
15-30 cm	2	$1013 \pm 79 \text{ pCi/g}$	957	1069
30-45 cm	2	$225 \pm 80 \text{ pCi/g}$	169	282
76-91 cm	2	$12 \pm 16 \text{ pCi/g}$	0.5	24
106-122 cm	2	$2.2 \pm 2.4 \text{ pCi/g}$	0.4	3.9
Between fences, 0-1 cm	8	$20 \pm 18 \text{ pCi/g}$	3.4	59
1-6 cm	8	18 ± 14 pCi/g	3.5	46

TABLE XIV (cont)

^aS.E. - Standard Error.

^bSingle observation.

Missile Range, Chupadera Mesa, and Far Fallout Zone are 2.4, 4.2, and 2.2 times higher than levels expected in central New Mexico.

Cesium also can be used as an indicator of the slow changes in fallout distribution with time. Measurements by the in situ detector on Chupadera Mesa were made for different land forms at several locations. The Chupadera Mesa area has several closed drainage collection points where the water and associated sediments from rainfall runoff collect. Measurements were made on the slopes above a collection point and on the sediment bed in the dry collection areas. Table XXI summarizes the data taken for such drainage systems on Chupadera Mesa. The arithmetic mean values for ¹³⁷Cs on slopes above drainages and their associated collection points are not equal with a 99.5% confidence using Student's t-test for equal means. The data suggest that after 32 years the cesium bound to soils is slowly being transported into water and sediment collection points. However, the process appears to be slow and any increased areal concentration in the collection sediment points will be offset by radioactive decay with half of the activity disappearing every 30.2 years.

C. Strontium-90 in Soils

Measurements of ⁹⁰Sr in soils during the 1977 survey were restricted to relatively few samples because of analytical costs. From the limited data, comparisons of the ⁹⁰Sr in soils of Chupadera Mesa and the Far Fallout Zone with measurements of worldwide fallout in soils at various locations in the U.S. indicate a clear influence from the Trinity test. Table XXII summarizes data for locations in mountain states of the U.S.; ⁹⁰Sr levels in the fallout zone from the Trinity test range from 10 to 40 times those both north and south of central New Mexico.

III. AIRBORNE RADIOACTIVE MATERIALS

Airborne radioactive materials measurements at Trinity site and in the fallout zone are extremely limited. During the 1973 and 1974 survey by the EPA, a 10month air sampling was conducted on Chupadera Mesa and at Socorro, New Mexico, a community out of the influence of the Trinity test.¹³ Air concentrations of plutonium at both locations were equal, but isotopic ratios at Chupadera Mesa indicated the Trinity test plutonium contributed the major activity while worldwide fallout contributed the major activity at Socorro.¹³

Table XXIII includes plutonium concentrations in air samples taken at GZ and at a control site 5.2 km south of GZ in 1983. Also included are the air concentrations calculated for resuspended plutonium (see Appendix D for details).

Comparison of the calculated resuspended plutonium on Chupadera Mesa with the measured values indicates the calculations overestimate the actual amount by a

TABLE XV

		Depth			
Radionuclide	Ν	(cm)	Mean ± S.E. ^a	Min	Max
⁷ Be	22	<u> </u>	$5.7 \pm 1.2 \text{ nCi/m}^2$	<mda< td=""><td>19</td></mda<>	19
⁶⁰ Co	22		27 ± 23 nCi/m ²	<mda< td=""><td>503</td></mda<>	503
¹³⁷ Cs	22		$162 \pm 42 \text{ nCi/m}^2$	2.1	858
¹⁵² Eu	22		77 ± 77 nCi/m	<mda< td=""><td>1696</td></mda<>	1696
¹⁵⁵ Eu	22		$5.5 \pm 4.0 \text{ nCi/m}^2$	<mda< td=""><td>82</td></mda<>	82
⁹⁵ Nb	22		$3.1 \pm 0.26 \text{ nCi/m}^2$	<mda< td=""><td>4.6</td></mda<>	4.6
⁹⁵ Zr	22		$2.5 \pm 0.27 \text{ nCi/m}^2$	<mda< td=""><td>5</td></mda<>	5
¹⁰³ Ru	22		$0.14 \pm 0.08 \text{ nCi/m}^2$	<mda< td=""><td>1.5</td></mda<>	1.5
Natural gamma	23	-	$7.8 \pm 0.65 \ \mu R/h$	1.5	16
Total Gamma	23		$7.9 \pm 0.56 \mu R/h$	1.8	12
40K	22		$19 \pm 1.4 \text{ pCi/g}$	4.4	31
²³⁸ U			$0.88 \pm 0.05 \text{ pCi/g}$	0.48	1.4
²³² Th	22		0.94 ± 0.08 pci/g	0.29	1.8
²³⁸ Pu	7	0 - 5	0.55 ± 0.43 pCi/g	<mda< td=""><td>3</td></mda<>	3
		5 - 10	$0.38 \pm 0.38 \text{ pCi/g}$	<mda< td=""><td>2.3</td></mda<>	2.3
		10 - 15	0.009 ± 0.005 pCi/g	<mda< td=""><td>0.03</td></mda<>	0.03
²³⁹ Pu (1948)	4	0 - 2.5	$1.32 \pm 0.50 \text{ pCi/g}$	0.10	2.5
²³⁹ Pu (1972)	4	0 - 2.5	$63 \pm 63 \text{ pCi/g}$	0.04	255
(1972)	4	2.2 - 10	$65 \pm 65 \text{ pCi/g}$	<mda< td=""><td>263</td></mda<>	263
(1972)	4	10 - 30	$15 \pm 15 \text{ pCi/g}$	<mda< td=""><td>62</td></mda<>	62
(1973)	13	0 - 5	$99 \pm 84 \text{ nCi/m}^2$	0.3	1100
			(1.42 pCi/g)		
(1977)	7	0 - 5	$10 \pm 9 \text{ pCi/g}$	<mda< td=""><td>65</td></mda<>	65
(1977)	6	5 - 10	$7.6 \pm 7.3 \text{ pCi/g}$	<mda< td=""><td>44</td></mda<>	44
(1977)	7	10 - 15	29 ± 29 pCi/g	<mda< td=""><td>201</td></mda<>	201
⁹⁰ Sr	4	0 - 5	$1.8 \pm 1.4 \text{ pCi/g}$	0.3	6
	4	5 - 10	$0.38 \pm 0.08 \text{ pCi/g}$	0.2	0.6
	3	10 - 15	$0.70 \pm 0.46 \text{ pCi/g}$	0.1	1.6
¹³⁷ Cs	12	0 - 5	4.5 ± 2.3 pCi/g	0.22	27
	12	5 - 10	$4.9 \pm 2.6 \text{ pCi/g}$	<mda< td=""><td>25</td></mda<>	25
	10	10 - 15	$0.8 \pm 0.7 \text{ pCi/g}$	<mda< td=""><td>6.3</td></mda<>	6.3

WHITE SANDS MISSILE RANGE FALLOUT ZONE SOIL MEASUREMENTS

^aS.E. - Standard Error.
TABLE XVI

		Depth			
Radionuclide	<u>N</u>	(cm)	Mean ± S.E. ^a	Min	Max
⁷ Be	2		$5.8 \pm 5.8 \text{ nCi/m}^2$	<mda<sup>b</mda<sup>	12
⁶⁰ Co	2	<u> </u>	$0.6 \pm 0.6 \text{ nCi/m}^2$	<mda< td=""><td>1.2</td></mda<>	1.2
¹³⁷ Cs	2		$52 \pm 28 \text{ nCi/m}^2$	34	69
⁹⁵ Nb	2		$11.4 \pm 0.19 \text{ nCi/m}^2$	1.2	1.6
Natural gamma	2		$5.6 \pm 0.2 \ \mu R/h$	5.4	5.7
Total gamma	2		$5.8 \pm 0.1 \ \mu R/h$	5.7	5.9
⁴⁰ K	2		$12 \pm 0.22 \text{ pCi/g}$	12.1	12.6
²³² Th	2		0.68 ± 0.035 pCi/g	0.64	0.71
²³⁸ U	2		$0.80 \pm 0.05 \text{ pCi/g}$	0.75	0.85
^{239,240} Pu (1948)	2	0 - 1.5	$0.9 \pm 0.4 \text{ pCi/g}$	0.5	1.3
(1972)	2	02.5	0.21 ± 0.08 pCi/g	0.13	0.29
(1972)	-	2.5 - 10	0.43 ± 0.32 pCi/g	0.12	0.75
(1972)		10 - 30	$0.085 \pm 0.085 \text{ pCi/g}$	<mda< td=""><td>0.17</td></mda<>	0.17
(1973)	14	0 - 5	$5.0 \pm 3.3 \text{ nCi/m}^2/$	0.56	48
			(0.070 pCi/g) ^c		

BINGHAM AREA SOIL MEASUREMENTS, US HIGHWAY 380 CORRIDOR

^aS.E. - Standard Error.

^b<MDA = less than minimum detectable activity.

^cCalculation of the pCi/g based on 0.0143 (pCi/g)/(nCi/m²).

factor of 3. The calculated resuspended plutonium at GZ overestimates the measured amount by a factor of 2.

Also included in Table XXIII are comparisons with both DOE and EPA air concentration limits for plutonium. The DOE air concentration limit for insoluble plutonium for an uncontrolled area is $1 \times 10^6 \text{ aCi/m}^3$ ($1 \times 10^{-12} \,\mu\text{Ci/m}\ell$).²⁸ The EPA has proposed an air concentration screening limit for no action of 1000 aCi/m³ of transuranics from resuspension sources.²⁹ All measured and calculated air concentrations are well below either limit.

IV. EXTERNAL PENETRATING RADIATION

Two types of external radiation dose measurements were made for this study. The first was use of the *in situ* gamma-ray spectroscope to estimate the dose from specific radionuclides. The natural background gamma-ray spectra were summed for the uranium and thorium daughters and ⁴⁰K. Total external doses were calculated from the gamma-ray spectra. The dose contributions by fission and activation products such as ¹³⁷Cs and ¹⁵²Eu were estimated from their spectra. These estimates are listed in Table XXIV.

The second set of measurements was made with thermoluminescent dosimeters (TLDs) at locations on the inner and outer fences of GZ. A measurement was also made at the point of highest instrumental gamma-ray dose near the center of GZ. The locations and results of these measurements are presented in Fig. 11.

From the two sets of measurements, an estimate of the average external dose rate from the Trinity test was made for each area of the fallout zone. Table XXV lists the total measured external dose rate and the dose rate from fission and activation products. These values were used in Appendix D and Chapter 5 for estimates of the doses and the estimates of risk in the Summary, Chapter 1.

TABLE XVII

CHUPADERA MESA SURFACE SOIL MEASUREMENTS

		Depth			
Radionuclide	Ν	(cm)	Mean ± S.E. [®]	Min	Max
⁷ Be	49	•	$8.8 \pm 1.1 \text{ nCi/m}^2$	<mda<sup>b</mda<sup>	26
⁶⁰ Co	49		$0.58 \pm 0.16 \text{ nCi/m}^2$	<mda< td=""><td>4.2</td></mda<>	4.2
¹³⁷ Cs	49		$280 \pm 30 \text{ nCi/m}^2$	30	947
¹⁵² Eu ^c	49		$0.48 \pm 0.48 \text{ nCi/m}^2$	<mda< td=""><td>24</td></mda<>	24
¹⁵⁵ Eu	49	-•	$4.2 \pm 2.4 \text{ nCi/m}^2$	<mda< td=""><td>86</td></mda<>	86
""Nb	49		$4.65 \pm 0.15 \text{ nCi/m}^2$	<mda< td=""><td>6.6</td></mda<>	6.6
"Zr	49	-•	$2.55 \pm 0.15 \text{ nCi/m}^2$	<mda< td=""><td>4.2</td></mda<>	4.2
¹⁰³ Ru	49	•	$0.28 \pm 0.07 \text{ nCi/m}^2$	<mda< td=""><td>1.9</td></mda<>	1.9
Natural gamma	49		6.7 ± 0.24 μR/h	3.5	10
Total gamma	49	•	$8.2 \pm 0.32 \ \mu R/h$	4.1	13
40K	49		$16 \pm 0.58 \text{ pCi/g}$	6.4	24
232Th	49		$0.85 \pm 0.04 \text{ pCi/g}$	0.36	1.42
238U	49		0.88 ± 0.04 pCi/g	0.34	1.81
²³⁸ Pu	19	0 - 5	0.083 + 0.020 pCi/g	<mda< td=""><td>0.32</td></mda<>	0.32
	15	5 - 10	0.023 + 0.013 pCi/g	<mda< td=""><td>0.19</td></mda<>	0.19
	15	10 - 15	$0.006 \pm 0.004 \text{ pCi/g}$	<mda< td=""><td>0.06</td></mda<>	0.06
	3	15 - 20	0.003 ± 0.003 pCi/g	<mda< td=""><td>0.01</td></mda<>	0.01
239,240Pu (1948)	10	02.5	$3.1 \pm 1.3 \text{ pCi/g}$	<mda< td=""><td>10.8</td></mda<>	10.8
(1950)	9	0 - 2.5	$3.2 \pm 1.2 \text{ pCi/g}$	0.2	11
(1972)	3	0 · 2.5	0.80 ± 0.34 pCi/g	<mda< td=""><td>1.4</td></mda<>	1.4
(1972)	3	2.5 · 10	$0.15 \pm 0.10 \text{ pCi/g}$	0.02	0.34
(1972)		10 - 30	$0.033 \pm 0.015 \text{ pCi/g}$	0.01	0.06
(1973)	••-	0 - 5	$20.6 \pm 4.3 \text{ nCi/m}^2$	0.4	86
			(0.29 pCi/g) ^d		
(1977)	19	0 - 5	$1.7 \pm 0.41 \text{ pCi/g}$	0.03	6.7
(1977)	14	5 · 10	0.38 ± 0.27 pCi/g	<mda< td=""><td>3.9</td></mda<>	3.9
(1977)	16	10 - 15	$0.11 \pm 0.07 \text{ pCi/g}$	<mda< td=""><td>1.2</td></mda<>	1.2
(1977)	3	15 - 20	0.033 ± 0.03 pCi/g	<mda< td=""><td>0.09</td></mda<>	0.09
*°Sr	7	0 - 5	$2.3 \pm 1.0 \text{ pCi/g}$	0.20	6.8
	3	10 · 15	0.76 ± 0.47 pCi/g	0.22	1.7
¹³⁷ Cs	27	0 - 5	2.81 ± 0.52 pCi/g	<mda< td=""><td>10.4</td></mda<>	10.4
	4	5 - 10	$0.16 \pm 0.02 \text{ pCi/g}$	0.12	0.22
	16	10 - 15	$0.04 \pm 0.02 \text{ pCi/g}$	<mda< td=""><td>0.21</td></mda<>	0.21
	1	20 - 25	0.05	_	-

S.E. - Standard Error.

 b < MDA = less than minimum detectable activity.

^cForty-eight observations for ¹⁵²Eu were below MDA.

^dCalculation of the pCi/g based on 0.0143 (pCi/g)/(nCi/m²).

TABLE XVIII

Radionuclide	N	Depth (cm)	Mean + S.E. ^a	Min	Мах
		()			
⁷ Be	27		$12 \pm 1.2 \text{ nCi/m}^2$	<mda<sup>b</mda<sup>	21
⁶⁰ Co	27		$0.82 + 0.61 \text{ nCi/m}^2$	<mda< td=""><td>16</td></mda<>	16
¹³⁷ Cs	27		$152 \pm 34 \text{ nCi/m}^2$	10	765
⁹⁵ Nb	27		$4.5 \pm 0.29 \text{ nCi/m}^2$	<mda< td=""><td>6.4</td></mda<>	6.4
⁹⁵ Zr	27		2.9 ± 0.24 nCi/m ²	<mda< td=""><td>5.8</td></mda<>	5.8
¹⁰³ Ru	27		$0.25 \pm 0.10 \text{ nCi/m}^2$	<mda< td=""><td>1.6</td></mda<>	1.6
Natural gamma	26		$8.3 \pm 0.53 \ \mu R/h$	3.7	15
Total gamma	26		$8.9 \pm 0.55 \ \mu R/h$	4.1	16
⁴⁰ K	27		$19 \pm 1.1 \text{ pCi/g}$	9.9	31
²³² Th	27		$1.20 \pm 0.12 \text{ pCi/g}$	0.31	2.8
²³⁸ U	27	·	$0.94 \pm 0.05 \text{ pCi/g}$	0.43	1.7
²³⁸ Pu	12	0 - 5	$0.018 \pm 0.005 \text{ pCi/g}$	<mda< td=""><td>0.06</td></mda<>	0.06
	8	5 - 10	$0.008 \pm 0.005 \text{ pCi/g}$	<mda< td=""><td>0.03</td></mda<>	0.03
	6	10 -15	<mda< td=""><td></td><td></td></mda<>		
^{239.240} Pu	1	0 - 2.5	0.77 pCi/g		
(1950)	8	0 - 2.5	$0.94 \pm 0.46 \text{ pCi/g}$	<mda< td=""><td>4.1</td></mda<>	4.1
(1973)	24	0 - 5	$3.2 \pm 0.88 \text{ nCi/m}^2$ (0.046 pCi/g) ^c	0.32	21
(1977)	14	0 - 5	0.30 ± 0.009 pCi/g	<mda< td=""><td>1.2</td></mda<>	1.2
	9	5 - 10	0.15 ± 0.08 pCi/g	<mda< td=""><td>1.5</td></mda<>	1.5
	8	10 - 15	0.008 ± 0.005 pCi/g	<mda< td=""><td>0.04</td></mda<>	0.04
⁹⁰ Sr	4	· 0 - 5	1.47 ± 0.68 pCi/g	0.71	3.5
	1	5 - 10	2.16 pCi/g		
	1	10 - 15	0.30 pCi/g		
	1	20 - 25	0.21 pCi/g		
¹³⁷ Cs	10	0 - 5	2.0 ± 0.19 pCi/g	0.95	3
	5	5 - 10	$0.24 \pm 0.19 \text{ pCi/g}$	<mda< td=""><td>1.0</td></mda<>	1.0
	4	10 - 15	<mda< td=""><td></td><td></td></mda<>		

FAR FALLOUT ZONE SURFACE SOIL MEASUREMENTS

^aS.E. - Standard Error.

 b < MDA = less than minimum detectable activity.

^cCalculation of the pCi/g is based on 0.0143 (pCi/g)/(nCi/m²).

TABLE XIX

SAN ANTONIO AREA SURFACE SOIL MEASUREMENTS

		Depth			
Radionuclide	<u>N</u>	(c m)	Mean ± S.E.*	Min	Max
⁷ Be	9		$3.9 \pm 2.0 \text{ nCi/m}^2$	<mda<sup>a</mda<sup>	14.6
⁶⁰ Co	9		$9.7 \pm 6.0 \text{ nCi/m}^2$	<mda< td=""><td>50</td></mda<>	50
¹³⁷ Cs	9		$67 \pm 20 \text{ nCi/m}^2$	<mda< td=""><td>220</td></mda<>	220
⁹⁵ Nb	9		$2.0 \pm 0.3 \text{ nCi/m}^2$	<mda< td=""><td>3.5</td></mda<>	3.5
⁹⁵ Zr	9		1.5 ± 0.33 nCi/m ²	<mda< td=""><td>2.6</td></mda<>	2.6
Natural gamma	9		$7.5 \pm 0.6 \ \mu R/h$	4.5	9.9
Total gamma	9		$7.7 \pm 0.5 \ \mu R/h$	5.1	9.9
40K	9		$15 \pm 1.4 \text{pCi/g}$	7.2	19.7
²³² Th	9		0.83 ± 0.12 pCi/g	0.14	1.32
²³⁸ U	9		$1.2 \pm 0.13 \text{ pCi/g}$	0.67	2.0
^{239, 240} Pu	4	0 - 5	$0.01 \pm 0.004 \text{ pCi/g}$	<mda< td=""><td>0.02</td></mda<>	0.02
^{239,240} Pu	4	5 - 10	$0.003 \pm 0.003 \text{ pCi/g}$	<mda< td=""><td>0.01</td></mda<>	0.01
^{239,240} Pu	4	10 - 15	<mda< td=""><td></td><td></td></mda<>		

*S.E. - Standard Error.

.

 b < MDA = less than minimum detectable activity.

TABLE XX

AREAL CONCENTRATIONS OF ¹³⁷Cs

	Mean		
Location	(nCi/m ²)	Min	Max
Trinity Fallout Areas			
WSMR	8104 ± 3772	488	23 000
Bingham	52 ± 18	34	69
Chupadera Mesa	280 ± 30	30	947
Far Fallout Zone	152 ± 34	10	765
Central NM			
San Antonio	67 ± 20	<mda< td=""><td>220</td></mda<>	220
Other Areas of U.S.			
Amarillo, TX ^a	148 ± 32	ь	Ь
Burlington, IA [*]	105 ± 34	ь	b
Diablo Canyon, CA ^c	105	100	110
Humboldt Bay, CA ^c	32	ь	b
San Clemente, CA ^c	19	8	36
La Crosse, WI ^c	139	114	164
Baxley, GA ^c	60	41	79
Daisey, TN ^c	168	146	190
Waterford, CN ^c	305	Ь	b

*See Reference 28.

^bSingle data point reported.

^cSee Reference 29.

TABLE XXI

CHUPADERA MESA IN SITU ^{137}Cs data for soils by land form ($\mu Ci/m^2)$

	Slope	Closed Drainage	
Location	Above Drainage	Collection Point	
Cuate Tank	388	756	
		547	
Three Peaks Area	261	947	
	314	410	
		590	
Area 21	338	545	
	428	512	
	308		
	428		
High Point on Mesa	602	540	
	$X_{s} = 383$	$X_{D} = 605$	
	S . E . = 38	S .E. = 59	
	H: X _s	$= X_{D}$	
	t = -3.16 True: <0.5% of time		
	False: 99.5	% of time	

.

TABLE XXII

⁹⁰Sr BACKGROUND INFORMATION

Location	Fallout Conc ⁹⁰ Sr (µCi/m ²)	1959-1976 Rainfall (cm)	Latitue Long	de and gitude	Altitude (m)
Denver	41.21	692.73	39°46′	104°53′	1611
Salt Lake City	91.61	801.87	40°46′	110°49′	1516
El Paso	15.55	335.15	31°48′	106°48′	1204
Houston	36.40	2186.86	29°39′	95°17′	22
Dallas	40.24	1300.49	32°51′	96°51′	160
Chupadera Mesa	688	365	33°40′	105°40′	1524
	to	to	to	to	to
Far Fallout Zone	884	914	34°20′	106°30′	2450

TABLE XXIII

POTENTIAL CONTRIBUTIONS OF RESUSPENSION TO ²³⁹Pu AIRBORNE RADIOACTIVITY

	Per Cent		
	²³⁹ Pu	DOE	Per Cent of
	Concentration	Concentration	Proposed EPA
	(aCi/m ³)	Guide	Derived Limit*
Measured Airborne			
²³⁹ Pu Concentrations			
Chupadera Mesa (10 months) ^b	43	0.0043	4.3
Soccorro (10 months) ^b	41	0.0041	4.1
GZ Average			
Center (28.7 h) ^b	63	0.0063	6.3
Mid-radius (29.8 h) ^b	3	0.0003	0.3
Entrance (34.8 h) ^b	1.2	0.00012	0.1
Control Site WSMR (37.9 h) ^b	1.1	0.00011	0.1
Calculated Contributions of			
Resuspension to ²³⁹ Pu			
Airborne Concentrations			
GZ	38	0.0038	3.8
White Sands Fallout Area	22	0.0022	2.2
Bingham	7	0.0007	0.7
Chupadera Mesa	120	0.012	12
Far Fallout Zone	22	0.0022	2.2
Range of ²³⁹ Pu from Worldwide			
Fallout, 1974-1978, at Santa Fe, NM			
Low (1976)	3.8	0.006	0.4
5-Year Average	16	0.03	1.6
High (1978)	24	0.04	2.4

^aSee Table XXVI.

^bSample time.

TABLE XXIV

EXTERNAL RADIATION EXPOSURE SUMMARY FOR IN SITU DATA

White Sands South of GZ		
(Los Alamos National Labora-		
tory Control) 3 Miles South		
•	Due to Natural	$9.3 \pm 0.17 \ \mu R/h$
	Total External	$9.8\pm0.23~\mu R/h$
GZ		
	Due to Natural	$5.6 \pm 0.5 \ \mu R/h$
	Total External	$175 \pm 1.1 \ \mu R/h$
	¹³⁷ Cs	$9.9 \pm 0.15 \ \mu R/h$
	¹⁵² Eu	$137 \pm 0.7 \ \mu R/h$
White Sands Missile Range in Fallout Path		
	Due to Natural	$8.1 + 0.26 \mu R/h$
	Total External	$22 + 0.3 \mu R/h$
	¹³⁷ Cs	$1.8 \pm 0.03 \ \mu R/h$
	Others: ⁶⁰ Co, ¹⁵² Eu, ¹⁵⁴ Eu	13.1 µR/h
Chupadera Mesa, Area 21, Los Alamos		
National Laboratory Study Area 30 miles from GZ)		
	Due to Natural	$6.0 \pm 0.14 \ \mu R/h$
	Total External	$8.1 \pm 0.14 \ \mu R/h$
	¹³⁷ Cs	$2.0 \pm 0.03 \ \mu R/h$
Monte Puerto Ranch		
	Due to Natural	$8.2 \pm 0.13 \ \mu R/h$
	Total External	$9.8 \pm 0.14 \ \mu R/h$
	¹³⁷ Cs	$1.5 \pm 0.02 \ \mu R/h$
Far Fallout Zone (~55 miles NE from GZ)		
	Due to Natural	$6.8 \pm 0.28 \ \mu R/h$
	Total External	$7.5 \pm 0.28 \ \mu R/h$

TABLE XXV

EXTERNAL PENETRATING RADIATION MEASUREMENTS AND ESTIMATES OF CONTRIBUTIONS FROM TRINITY FALLOUT (µrem/h)

Location	Measurement	Estimated Contribution Above Background
GZ		
Center Maximum	485 ± 4	477
Inner Fence	205 ± 61	187
Outer Fence	10.8 ± 2.5	3.1
White Sands Missile Range	7.8 ± 0.6	0.1
Bingham	5.8 ± 0.1	0.2
Chupadera Mesa	8.2 ± 0.32	1.5
Far Fallout Zone	8.9 ± 0.55	0.6



Fig. 11. External radiation dose rates measured at Trinity Site, June 9, 1983 to June 23, 1983.

5. POTENTIAL DOSE EVALUATION AND INTERPRETATION

The significance of the data on concentrations of radioactivity on soils and sediments, radioactivity on airborne particulates, and external penetrating radiation may be evaluated in terms of the doses that can be received by people exposed to the conditions. The doses can be compared with natural background and appropriate standards or guides for one type of perspective. The doses can also be used to estimate risks or probabilities of health effects to an individual, providing another type of perspective more readily compared with other risks encountered. This section summarizes the analysis of potential doses and risk estimates. The detailed analysis is presented in Appendix D. Readers desiring more information on concepts of radioactivity, radiation, and dose interpretation may be helped by Appendix E, Evaluation of Radiation Exposures.

I. BASES OF DOSE ESTIMATES AND COM-PARISONS

Doses were calculated for various pathways that could result in the inhalation or ingestion of radioactivity. The calculations were based on theoretical models or factors from standard references and health physics literature as detailed in Appendix D. The doses are expressed in fractions of rems, where a millirem (mrem) is 1/1000 of a rem, and a microrem (μ rem) is 1/1 000 000 of a rem. They are generally expressed as dose rates, that is, the radiation dose received in a particular time interval. The rem is a unit that permits direct comparison of doses from different sources, such as x rays, gamma rays, and alpha particles, by accounting for the differences in biological effects from the energy absorbed from different radiations and isotope distributions. These doses can be compared with the DOE Radiation Protection Standards shown in Table XXVI, which are expressed as the permissible dose or dose commitment in addition to natural background radiation and medical exposures. First-year doses represent the dose received during the first year that a given radioactive isotope is ingested or inhaled. Because most of the isotopes of concern in this study are retained in various organs in the body for more than a year, 50-year dose commitments were also calculated. The 50-year dose commitments represent the total dose that would be accumulated in the body or specific critical organs over a 50-year period from ingestion or inhalation during the first year. (Alternatively, the numerical values can also be interpreted to represent the annual dose rate during the 50th year given continuous exposure over all 50 years.) The 50-year commitments are always as large or larger than first-year doses. In this summary, only the 50-year commitments are compared with the standards.

Conceptually, this is in agreement with the recommendations of the International Commission on Radiological Protection (ICRP) that in effect charge the entire dose commitment against the year in which exposure occurs for regulatory purposes.³⁰ The use of the 50-year dose commitment also permits making estimates of risk over a lifetime from the given exposure and simplifies comparisons between different exposure situations.

The dose commitments were calculated using published factors (Appendix D). The dose models employed in the derivation of these factors are based primarily upon reports of the ICRP. Other methods of computing doses are available. Additionally, there are conceptually different approaches emphasizing the dose at the time of maximum dose rate following exposure as the basis for comparison with standards.³¹⁻³³ This is significant for isotopes such as plutonium that accumulate in certain parts of the body and can lead to a constantly increasing dose rate under conditions of chronic exposure. One such approach has been proposed by the EPA as guidance for Federal agencies in regard to plutonium.²⁹ These other approaches do not yield dose estimates or comparisons with standards sufficiently different from the methods used in this report to make any significant difference in the conclusions drawn for the radionuclides of concern in this evaluation. For example, under conditions of chronic exposure to airborne ²³⁹Pu, the radiation dose in the year of maximum dose rate (taken to be the 70th year) calculated by the methods of Healy or the EPA would give organ-specific estimates ranging from about 1/4 (for bone) to 2.6 (for lung) times the values given in this

TABLE XXVI

STANDARDS AND GUIDES FOR RADIATION AND RADIOACTIVITY

DOE Radiation Protection Standards for External and Internal Exposures*

Individuals and Population Groups in Uncontrolled Areas				
	Annual Dose Equivalent or Dose Commitment ^b			
Type of Exposure	Based on Dose to Individuals at Points of Maximum Probable Exposure	Based on an Average Dose to a Suitable Sample of the Exposed Population		
Whole body, gonads, or bone marrow	0.5 rem (or 500 mrem)	0.17 rem (or 170 mrem)		
Other organs	1.5 rem (or 1500 mrem)	0.5 mrem (or 500 mrem)		

DOE Concentration Guides for Radioactivity in Air and Water Above Natural Background in Uncontrolled Areas^c

Isotope		Concentration			
	Media	In Units of Original Reference	In Units Used in This Report		
²³⁹ Pu ²³⁹ Pu	Water Air	5×10 ^{−6} µCi/mℓ 6×10 ^{−14} µCi/mℓ	5000 pCi/l 60 000 aCi/m ³		

EPA Maximum Contaminant Levels from Natural Interim Primary Drinking Water Regulations^d

pe Media Concentration	
Water 15 pCi/l	
out ex- 1 uranium)	

TABLE XXVI (cont)

EPA Proposed Guidance on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment^e

Maximum Annual Alpha Radiation Dose Rate as Result of Exposure to Transuranium Elements:

1 mrad/yr to pulmonary lung	(approximately 10 mrem/yr)
3 mrad/yr to bone	(approximatley 150 mrem/yr)

Derived Air Concentration Reasonably Predicted to Result in Dose Rates Less than the Guidance Recommendations:

In Units of Original Reference	In Units Used in This Report
1 fCi/m ³	1000 aCi/m ³

(for alpha emitting transuranium nuclides on an activity median aerodynamic particle diameter not to exceed 0.1 μ m)

*See Reference 29.

^bTo meet the above dose commitment standards, operations must be conducted in such a manner that it would be unlikely that an individual would assimulate in a critical organ, by inhalation, ingestion, or absorption, a quantity of a radionuclide(s) that would commit the individual to an organ dose exceeding the limits specified in the above table.

See Reference 18.

report.^{33,31} These factors are about the same size as other uncertainties in the data (see Chapter 4.I.A) and smaller than some of the intentionally overestimated assumptions incorporated in this evaluation. Thus there would be no significant changes in the relative ranking or order of magnitude of estimated doses and risks if other methodologies were used.

The estimates of radiological risks from doses, presented in Table I of the summary chapter, were based on the risk factors recommended by the National Academy of Sciences.³⁴ Multiplying an estimated dose and the appropriate risk factor yields an estimate of the probability of injury to the individual as a result of that exposure. The risk factors used are

For uniform whole-body dose Cancer mortality	1.2×10^{-4} per rem whole body,
For specific organ doses	
Lung cancer	9×10^{-5} per rem to lung,
Bone cancer	3×10^{-6} per rem to bone,
Liver cancer	3×10^{-5} per rem to liver.

See Reference 29.

^dSee Reference 30.

As an example, a whole-body dose of 10 mrem/yr $(1.2 \times 10^{-2} \text{ rem/yr})$ would be estimated to add a risk of cancer mortality to the exposed individual of 1.2×10^{-6} per year of exposure, or about 1 chance in 1 000 000 per year of exposure.

Such risk estimates must be placed in appropriate contexts to be useful as a decision-making tool. One comparison is with other types of risks encountered in normal life that may result in early mortality. Table II (in Chapter 1) of this report presented a range of selected examples of activities and risks that increase chances of death.^{35,36} A second useful comparison is an estimate of the risk that can be attributed to natural background radiation. Radiation from various natural external and internal sources results in exactly the same types of interactions with body tissues as those from so-called "manmade" radioactivity. Thus, the risks from a given dose are the same regardless of the source.

Natural background radiation for people in the environment consists of the external penetrating dose from cosmic and terrestrial sources, cosmic neutron radiation, and self-irradiation from natural isotopes in the body. The several-year average for external penetrating radiation measured by a group of 12 perimeter stations located mainly in the Los Alamos area of New Mexico is about 117 mrem/yr. Cosmic neutrons contribute about 17 mrem/yr, and average self-irradiation, largely from natural radioactive potassium (40K), is about 24 mrem/yr. These give a combined dose of about 158 mrem/yr. Because of the variations in the terrestrial component with location and time of year, this value is probably valid to about $\pm 25\%$ for most of the Los Alamos population. For purposes of comparison we will use a rounded value of 150 mrem/yr as typical natural background in the area. This can be interpreted, using the risk factors, to represent a contribution to the risk of cancer mortality of 1.8×10^{-5} (18 chances in 1 000 000) for each year of exposure or a risk of 9×10^{-4} (9 chances in 10 000) in 50 years of exposure to natural background radiation. The natural radiation combined dose for external penetrating dose, cosmic neutron dose, and selfirradiation from internally deposited radionuclides is estimated to be 106 mrem/yr for persons living in the Far Fallout Zone. This would represent a contribution to the risk of cancer mortality of 1.3×10^{-5} (18 chances in 1 000 000) for each year of exposure or a risk of 6×10^{-4} (6 chances in 10 000) in 50 years of exposure to natural background in that area. As perspective, estimates of the overall U.S. population lifetime risk of mortality from

cancer induced by all causes are currently about 0.2 (2 chances in 10.)

II. POTENTIAL DOSES FROM THE CURRENT CONDITIONS IN THE TRINITY TEST FALL-OUT DEPOSITION AREAS

The dose calculations made from the summary data in Chapter 4 are detailed in Appendix D. The overall summary of Appendix D dose estimates is presented in Table XXVII along with the DOE Radiation Protection Standards for whole-body and organ exposures. Also listed is the proposed Environmental Protection Agency (EPA) guidance for transuranic elements in the environment, expressed in mrem/yr. Comparison of the estimated inhalation and ingestion doses with the DOE and EPA guidance indicates there is no cause for concern for individuals living full time in the uncontrolled areas of the fallout zone. However, the controlled GZ fenced areas still have enough residual radiation to exceed standards for uncontrolled areas; but the levels are less than the 5000 mrem/yr standard for controlled areas.

The controlled areas of the fenced GZ are within the larger controlled access area of White Sands Missile Range (Fig. 4). The fence around GZ is locked, with access controlled by the Army's Range Safety Officer and by Security. Public access is limited to a 2-h visit in the autumn of each year when the site is opened to visitors. Visitors are escorted to the site and back off the White Sands Missile Range. The dose to any member of the public would be less than 1 mrem during such a visit.

Other possible means of exposure involve Army personnel either as workers preparing for visitors or the daily security patrols that pass the GZ area outside the fence. Assuming personnel spend 1 week in the inner fenced area in preparation for visitors, the estimated dose would be about 8 mrem total dose. Assuming the security patrol spends 1 hour per day all year checking the outer fence, the estimated dose is 0.75 mrem. These doses are 1.6% and 0.2%, respectively, of the radiation protection standard for a member of the public.

III. SPECIAL CONSIDERATIONS

The GZ area of White Sands Missile Range was declared a National Historic Site in 1962. Any actions considered that alter current conditions will require consultation with the U.S. Army and National Historic Preservation Council of the U.S. Department of the Interior.

TABLE XXVII

INCREMENTAL DOSES

	Mean External Whole Body Increment					mrem/yr (50-Year Cor	nmitted Dos	=)				
	above Natural Background	intralation Total from Resuspension ⁸					Ingestion Total from Foods				Inhalation of Dust by Home Gardener		
Location	(mrem/yr)	Whole Body	Bone	Lung	Liver	Whole Body	Bone	Liver	<u> 61-LLI</u>	Whole Body	Bone	Lung	Liver
GZ													
Inner fence ^e	17	0.028	0.29	0.30	0.14	2.4	74	35	1.3	0.11	1.2	1.2	0.59
Between fences'	876	0.0073	0.074	0.077	0.037	0.1	2.7	1.3	0.03	0.017	0.17	0.18	0.086
White Sands Missile Range ^e 102	14	0.016	0.17	0.17	0.083	1.7	20	2.9	1.3	0.073	0.76	0.80	0.38
Bingham	1.7	0.0049	0.051	0.053	0.025	1.6	19	2.3	1.2	0.039	0.40	0.42	0.20
Chupadera Mesa	13	0.088	0.91	0.95	0.45	1.9	37	8.1	1.5	0.083	0.86	0.87	0.42
Far Fallout Zone	5	0.016	0.17	0.17	0.083	1.2	16	1.8	1.0	0.017	0.19	0.17	0.086
San Antonio	1.7	0.00058	0.0056	0.0058	0.0028	0.1	0.2	0.2	0.05	d	d	d	d
Radiation Protection Standard	500	500	1500	1500	1500	500	1500	1 500	1500	500	1500	1500	1500
EPA Proposed Guidance	-		150	10	-	_	-	-	-	•••	150	10	-

*Major dose contributed by transuranics.

^bMajor dose contributed by transuranics and ⁹⁸Sr (see Appendix D, Table D-XII). ^cEqual time spent at high-dose rate and low-dose rate areas. Assumes 168 h/wk, 52 wk occupancy.

"Not calculated because other inhalation doses are small.

REFERENCES

- Los Alamos Scientific Laboratory, Los Alamos: Beginning of an Era 1943-1945, Los Alamos Scientific Laboratory Public Relations Office, 64 p (1965).
- Stafford L. Warren, "The 1948 Radiological Survey of Areas in New Mexico Affected by the First Atomic Bomb Detonation," University of California at Los Angeles report UCLA-32, Part 1 (November 17, 1949).
- 3. R. Overstreet, L. Jacobson, K. Larson, and G. Huntington, "Trinity Survey Program," Atomic Energy Project, University of California at Los Angeles report R3091 (November 1947).
- K. H. Larson, J. L. Leitch, W. F. Dunn, J. W. Neel, J. H. Olafson, E. E. Held, J. Taylor, W. J. Cross, and A. W. Bellamy, "Alpha Activity Due to the 1945 Atomic Bomb Detonation at Trinity, Alamogordo, New Mexico," University of California at Los Angeles report UCLA-108 (February 1951).
- J. L. Leitch, "Summary of the Radiological Findings in Animals from the Biological Surveys of 1947, 1948, 1949, and 1951," University of California at Los Angeles report UCLA-111 (February 1951).
- 6. K. H. Larson, J. H. Olafson, J. W. Neel, W. F. Dunn, S. H. Gordon, and B. Gillooly, "The 1949 and 1950 Radiological Soil Survey of Fission Product Contamination and Some Soil Plant Interrelationships of Areas in New Mexico Affected by the First Atomic Bomb Detonation," University of California at Los Angeles report UCLA-140 (June 1951).
- J. H. Olafson, H. Nishita, and K. H. Larson, "The Distribution of Plutonium in Soils of Central and Northeastern New Mexico as a Result of the Atomic Bomb Test of July 16, 1945," University of California at Los Angeles report UCLA-406 (September 1957).
- 8. D. B. Dunn and D. L. Spellman, "The Revegetation at the New Mexico Atomic Bomb Crater," University of Missouri report COO-1296-1 (February 1965).

- T. E. Hakonson and L. J. Johnson, "Distribution of Environmental Plutonium in the Trinity Site Ecosystem after 27 Years," *Proceedings of the Third International Congress of the International Radiation Protection Association* (IRPA, Washington, D.C., 1973), CONF-730907-P1, pp. 242-247.
- J. W. Nyhan, F. R. Miera, Jr., and R. E. Neher, "Distribution of Plutonium in Trinity Soils after 28 Years," *Journal of Environmental Quality*, Vol. 5, No. 4, pp. 431-437 (1976).
- T. E. Hakonson and J. W. Nyhan, "Temporal Changes in Soil Plutonium Distribution in Trinity Site Environs," in "Biomedical and Environmental Research Program of the LASL Health Division, January-December 1976," Los Alamos Scientific Laboratory report LA-6898-PR (July 1977), pp. 84-85.
- T. E. Hakonson and J. W. Nyhan, "A Comparison of Plutonium Concentration and Inventory Ratios for some Ecosystem Components in the United States," in "Biomedical and Environmental Research Program of the LASL Health Division, January-December, 1977," Los Alamos Scientific Laboratory report LA-7254-PR (July 1978), pp. 3-4.
- R. L. Douglas, "Levels and Distribution of Environmental Plutonium Around the Trinity Site," U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, Nevada report ORP/V-78-3, 42p. (October 1978).
- T. E. Hakonson and J. W. Nyhan, "Ecological Relationships of Plutonium in Southwest Systems," in "Transuranic Elements in the Environment," W. C. Hanson, ed., U.S. Department of Energy report DOE/TIC-22800, pp. 403-419 (1980).
- H. L. Beck, W. T. Condon, and W. M. Lowder, "Spectrometric Techniques for Measuring Environmental Gamma Radiation," U.S. Atomic Energy Commission Health and Safety Laboratory, New York report HASL-150 (1964).
- H. L. Beck, J. de Campo, and C. Gogalak, "In-Situ Ge(Li) and NaI(Tl) Gamma Ray Spectrometry," U.S. Atomic Energy Commission Health and Safety Laboratory, New York report HASL-258 (1972).

- L. R. Anspaugh, P. L. Phelps, P. H. Gudiksen, C. L. Lindeksen, and G. W. Huckaby, "The In-Situ Measurement of Radioisotopes in the Environment with a Ge(Li) Spectrometer," in *The Natural Radiation Environment*, II, J. A. S. Adams, W. M. Lowder, and T. S. Gesell, eds., Energy Research and Development Administration report CONF-72-0805-P1, pp. 279-304 (1972).
- P. L. Phelps, L. R. Anspaugh, S. J. Roth, G. W. Huckaby, and D. L. Sawyer, "Ge(Li) Low Level In-Situ Gamma-Ray Spectrometer Applications," IEEE Trans. on Nucl. Sci. NS-21(1), p. 543 (1974).
- H. L. Ragsdale, B. K. Tanner, R. N. Coleman, J. M. Palms, and R. E. Wood, "In Situ Measurement of Some Gamma-Emitting Radionuclides in Plant Communities of the South Carolina Castac Plain," in *Environmental Chemistry and Cycling Processes*, Savannah River Ecology Laboratory report, Prepublication Copy, p. 1B-27B (1976).
- R. Gunnik and J. B. Niday, "Computerized Quantitative Analysis by Gamma-Ray Spectroscopy, Vol. I, Description of the Gamanal Program," Lawrence Livermore Laboratory report UCRL-51061 (1972).
- 21. Environmental Surveillance Group, "Environmental Surveillance at Los Alamos During 1977," Los Alamos Scientific Laboratory report LA-7263-MS (April 1978).
- Bureau of Radiological Health, Radiological Health Handbook, U.S. Department of Health, Education, and Welfare, Rockville, MD 20852, U.S. Government Printing Office, Washington, D.C. 20402, pp. 72-85 (1970).
- 23. National Council on Radiation Protection and Measurements, "Natural Background Radiation in the United States," NCRP report No. 45, Washington, D.C. 20014 (November 1975).
- W. M. Lowder, W. J. Condon, and H. L. Beck, "Field Spectrometric Investigations of Environmental Radiation in the USA," in *The Natural Radiation Environment*, J. A. S. Adams and W. M. Lowder, eds., University of Chicago Press, Chicago, Illinois, pp. 597-616 (1964).

- N. H. Nie, C. H. Hull, J. G. Jenkins, K. Steinbrenner, and D. H. Bent, SPSS: Statistical Package for the Social Sciences. 2nd ed., McGraw-Hill, New York, NY (1975).
- 26. T. Buhl, J. Dewart, T. Gunderson, D. Talley, J. Wenzel, R. Romero, J. Salazar, and D. Van Etten, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Radiation Monitoring and Radiological Assessment of Routine Releases," Los Alamos National Laboratory report LA-9445-PNTX-C (1982).
- R. A. Mohr and I. A. Franks, "Compilation of ¹³⁷Cs Concentrations at Selected Sites in the Continental United States," EG&G, Santa Barbara, California, EG&G report 1183-2437 (1982).
- U.S. Department of Energy, "Requirements for Radiation Protection: Concentrations in Air and Water Above Natural Background," DOE Order 5480.1, Chapter XI (August 1981).
- U.S. Environmental Protection Agency, "Persons Exposed to Transuranium Elements in the Environment," Proposed Federal Radiation Protection Guidance on Dose Limits, in *Federal Register*, Vol. 42, No. 230, Wednesday, Nov. 30, 1977, pp. 60956-60959 (1977).
- International Commission on Radiological Protection, "Limits for Intake of Radionuclides by Workers," Annals of the ICRP, Vol. 2, No. 3/4, ICRP Publication 30 (1979).
- U.S. Environmental Protection Agency, "Proposed Guidance on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment," U.S. EPA Office of Radiation Programs report EPA 540/4-77-016 (September 1977).
- 32. J. W. Healy, "A Proposed Interim Standard for Plutonium in Soils," Los Alamos Scientific Laboratory report LA-5483-MS (January 1974).
- 33. J. W. Healy, "An Examination of the Pathways from Soil to Man for Plutonium," Los Alamos Scientific Laboratory report LA-6741-MS (April 1977).

- 34. U.S. Department of Energy, "Radiological Guidelines for Application to DOE's Formerly Utilized Sites Remedial Action Program," U.S. DOE, Oak Ridge Operations report ORO-831 (March 1983).
- W. Wilson, "Analyzing the Daily Risks of Life," in Technology Review, Massachusetts Institute of Technology, pp. 41-46 (February 1979).
- 36. U.S. Nuclear Regulatory Commission, "Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes," Docket No. PR-71,73 (40FR23768), Office of Standards Development, USNRC document NUREG-0170, Vol. 1 (December 1977).

ACRONYMS AND ABBREVIATIONS

AEC	Atomic Energy Commission
ALO	Albuquerque Operations Office
с	counts
cpm	counts per minute
CG	concentration guide
DOE	Department of Energy
EPA	Environmental Protection Agency
ERDA	Energy Research and Development Administration
FDA	Food and Drug Administration
FSD	Fractional Standard Deviation
FUSRAP	Formerly Utilized Sites Remedial Action Program
GZ	Ground Zero
ICRP	International Commission on Radiological Protection
LADB	Los Alamos Data Base
MDA	Minimum Detectable Activity
MED	Manhattan Engineer District
NCRP	National Council on Radiation Protection and Measurements
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
QA	quality assurance
RCG	Radioactivity Concentration Guide
rem	roentgen equivalent man
RPS	Radiation Protection Standard
TLD	thermoluminescent dosimeter
TRU	transuranic
TSS	total suspended solids
USGS	United States Geological Survey
WSMR	White Sands Missile Range
α	alpha
β	beta
γ	gamma
S	standard deviation
x	mean

UNITS

Abbreviation	Unit
_	
c - CI	count
aCI	attocurie (10 ⁻¹⁰ curies)
Ci	curie (unit of radioactivity)
cm	centimeter
cpm/l	counts per min per liter
ICI G	femtocurie (10 ⁻¹³ curies)
n	foot
g	gram
h	hour
in.	inch
keV	kiloelectron volt
kg	kilogram
km	kilometer
km²	square kilometer
l	liter
m	meter
m ³	cubic meter
mCi	millicurie (10 ⁻³ curies)
MeV	megaelectron volt
mg	milligram (10 ⁻³ grams)
min	minute
ml	milliliter $(10^{-3} \ell)$
mm	millimeter (10 ⁻³ meter)
mrem	millirem (10 ⁻³ rem)
mS/m	milliSiemens/meter (1 mS/m = 10 μ mho/cm)
MGD	million gallons per day
MT	megaton (10 ⁶ tons)
μCi	microcurie (10 ⁻⁶ curies)
μg	microgram (10 ⁻⁶ grams)
μm	micrometer (10 ⁻⁶ meters)
nCi	nanocurie (10 ⁻⁹ curies)
pCi	picocurie (10 ⁻¹² curies)
R	Roentgen
rad	62.5×10^6 MeV/g (unit of absorbed dose)
rem	roentgen equivalent man (unit of dose equivalence)
S	second
yr	year

GLOSSARY

alpha particle	A charged particle (identical to the helium nucleus) com- posed of two protons and two neutrons that is emitted during decay of certain radioactive atoms. Alpha particles are stopped by several centimeters of air or a sheet of paper.
beta particle	A charged particle (identical to the electron) that is emitted during decay of certain radioactive atoms. Most beta particles are stoppped by 0.6 cm of aluminum or less.
CG (Concentration Guide)	The concentration of radioactivity in air or water that is determined to result in whole-body or organ doses equal to ERDA's Radiation Protection Standards for external and internal exposures if the air is continuously inhaled or the water is the sole source of liquid nourishment throughout the year.
Curie	A special unit of radioactivity. One curie equals 3.70×10^{10} nuclear transformations per second (abbreviated Ci).
gamma radiation (or x radiation)	Short-wavelength electromagnetic radiation of nuclear origin that has no mass or charge. Because of its short wavelength, gamma radiation can cause ionization. Other electromagnetic radiation (microwaves, visible light, radiowaves, etc.) has longer wavelengths (lower energy) and cannot cause ionization.
arithmetic mean	The average of n given numbers obtained by dividing their sum by n.
geometric mean	The average of n given numbers obtained as the nth root of their product.
gross alpha	The total amount of measured alpha activity.
gross beta	The total amount of measured beta activity.
rad	The unit of absorbed radiation dose. It applies to the fraction of energy deposited by ionizing radiation in a unit volume of material exposed. 1 Rad = 1×10^{-2} Joules per kilogram.
roentgen	The unit of radiation exposure (abbreviated R). It applies only to the amount of charge produced by x or gamma radiation in air. $1R = 2.58 \times 10^{-4}$ coulombs per kilogram.

• •

rem	The unit of radiation dose equivalence that takes into account different effects on humans of various kinds of ionizing radiation and permits them to be expressed on a common basis.
RPS (Radiation Protection Standard)	DOE standards for external and internal exposure to radioactivity as defined in DOE Order 5480.
total uranium	Uranium having the isotopic content of uranium in nature (99.27% ²³⁸ U, 0.72% ²³⁵ U, 0.0057% ²³⁴ U).

APPENDIX A

DATA BASE TRINDAT

The following computer printout contains the combined data from the several studies of environmental levels of radioactivity through 1977. The printout contains 10 columns of information regarding each sample. The following provides a key to the information in each column:

- Column 1—Sample number. "Tag Words" are discussed in Appendix B. The sample numbers greater than 1000 are for a given location from the 1977 survey. Appendix B is a field log describing each location.
- Column 2—Radionuclide analyzed for in the sample or type of radiation measured (G-NAT = natural gamma dose).
- Column 3—Date of the determination.

Column 4—Type of Sample.

INSITU—Field in situ gamma-ray spectroscopy by Lawrence Livermore Laboratory system. JP—one-seeded juniper GR—grasses SK—snakeweed TH—Thistle UK—Unknown vegetation SG—mixed snakeweed and grasses SOIL—Soil sample. Column 5 contains information on depth.

- Column 5—Midpoint of depth from surface of soil samples. Examples: 2.5 is for 0- to 5-cm sample; 7.5 is for 5- to 10-cm sample, and 12.5 is for 10- to 15-cm sample.
- Columns 6 and 7—Arbitrary coordinates from a base map of sample locations. Used for computer graphics in Chapter 4.

- Column 8—Value of radionuclide concentration or penetrating radiation dose.
- Column 9—Units for amount of radionuclide or radiation dose.
- Column 10—Laboratory or agency that conducted determination:

LASL77—Now Los Alamos National Laboratory; associated with *in situ* determinations.

LLL GELI—Samples counted at Lawrence Livermore National Laboratory.

LASLCHEM—Sample determination made by Los Alamos National Laboratory Environmental Surveillance Chemistry Section.

CVEG—Vegetation content by same group as LASLCHEM.

EPA—Environmental Protection Agency determination.

UCLA—University of California at Los Angeles studies of 1948 and 1950.

LASL72—Samplings by Los Alamos Scientific Laboratory in 1972.

With the large amount of data present in TRINDAT, much more information than covered by this report can be recovered from the data base. The last item to be identified is the label associated with PU239 as INSITU in Column 4 and PREDICTED in Column 10. Those data were calculated from known amounts of ¹³⁷Cs in situ measurements and ²³⁹⁻²⁴⁰Pu soil samples at a number of locations. Both ¹³⁷Cs and plutonium isotopes are strongly retained in the top few centimeters of soils. If there were a strong correlation between ¹³⁷Cs and ²³⁹⁻²⁴⁰Pu in soils, a few ²³⁹⁻²⁴⁰Pu radiochemical determinations could establish the relationship with ¹³⁷Cs. Determination of ¹³⁷Cs by relatively inexpensive *in situ* measurements could be used for ²³⁹⁻²⁴⁰Pu estimates at other sampling points in large areas. The "predicted" data in TRINDAT were not used for any of the estimates in this report, but the method has enough promise to merit further development in the future.

				TRINDAT				
2018	BE7	1977	GR	6.66	1.76	8.98	PCI/GM	LLL GELI
1990	BE7 BE7	1977	GR GR	11.35	5.86	20.39	PCI/GM PCI/GM	ILL GELI
1988	BE7	1977	GR	6.64	.55	4.98	PCI/GM	LLL GELI
2018	BE7	1977	INSITU	6.66	1.76	9-68	NCI/M2	LASL77
2096	BE7 BF7	1977	INSTIU	14.49	9.24	0.00	NCI/M2 NCI/M2	LASL77
2099	BE7	1977	INSITU	11.12	10.93	12.10	NCI/M2	LASL77
2139	BE7	1977	INSITU	6.58	.55	0.00	NCI/M2	LASL77
2153	BE7 BE7	1977		3.94	4.88	0.00	NCI/M2	
2015	BE7	1977	INSITU	7.37	2.31	6.47	NCI/M2	LASL77
2075	BE7	1977	INSITU	10.85	4.60	14.30	NCI/M2	LASL77
2127	BE7 BE7	1977		13.40	5.21	9.83	NCI/M2	
2121	BE7	1977	INSITU	13.68	6.87	0.00	NCI/M2	LASL77
2031	BE7	1977	INSITU	10.41	4.28	19.40	NCI/M2	LASL77
2072	BE7 BF7	1977	INSITU	14.50	4.42	17.30	NCI/M2	LASL77
2140	BE7	1977	INSITU	6.58	.55	0.00	NCI/M2	LASL77
2147	BE7	1977		7.77	3.07	11.65	NCI/M2	
2155	BE7	1977	INSITU	6.27	.00	9.08	NCI/M2	LASL77
2032	BE7	1977	INSITU	3.17	3.48	9.78	NCI/M2	LASL77
1997	BE7	1977		6.46	1.16	0.00	NCI/M2	
2128	BE7	1977	INSITU	13.77	5.47	9.79	NCI/M2	LASL77
2076	BE7	1977	INSITU	11.09	4.52	14.70	NCI/M2	LASL77
2062	BE7	1977		9.83	5.10	9.90	NCI/M2	
2030	BE7	1977	INSITU	10.39	4.30	0.00	NCI/M2	LASL77
2138	BE7	1977	INSITU	5.81	2.17	11.49	NCI/M2	LASL77
2136	BE7 BE7	1977		6.58 9.74	.55 5 42	16 10	NCT/M2	
2008	BE7	1977	INSITU	7.40	2.10	0.00	NCI/M2	LASL77
2134	BE7	1977	INSITU	6.58	. 55	0.00	NCI/M2	LASL77
2095	BE7 BE7	1977	INSITU	14.49	9.25	0.00	NCI/M2	LASL77
2067	BE7	1977	INSITU	9.31	4.96	0.00	NCI/M2	LASL77
2077	BE7	1977		10.31	4.41	12.12	NCI/M2	
2025	BE7	1977	INSITU	10.12	4.27	0.00	NCI/M2	LASL77
2094	BE7	1977	INSITU	14.49	9.25	14.30	NCI/M2	LASL77
2068	BE7	1977	INSITU	9.30	4.35	16.60	NCI/M2	LASL77
2050	BE7	1977	INSITU	11.11	5.55	0.00	NCI/M2	LASL77
2126	BE7	1977		12.45	4.27	17.70	NCI/M2	
2146	BE7	1977	INSITU	9.82	4.27	12.12	NCI/M2	LASL77
2038	BE7	1977	INSITU	9.60	4.32	12.52	NCI/M2	LASL77
2088	BE7	1977		13.22	7.66	13.90	NCI/M2	
2006	BE7	1977	INSITU	7.07	2.04	0.00	NCI/M2	LASL77
2058	BE7	1977	INSITU	10.00	5.31	14.00	NCI/M2	LASL77
2081	BE7 BE7	1977		11.31	7.21	0.00	NCI/M2	
2097	BE7	1977	INSITU	15.45	9.75	11.49	NCI/M2	LASL77
2125	BE7	1977	INSITU	14.68	4.45	16.07	NCI/M2	
2093	BE7 BE7	1977	INSITU	3.17	3.48	0.00	NCI/M2	LASL77
2053	BE7	1977	INSITU	10.69	5.56	14.20	NCI/M2	LASL77
2024	BE7	1977		8.95	3.88	0.00	NCI/M2	
2083	BE7	1977	INSITU	6.69	2.24	8.53	NCI/M2	LASL77
2135	BE7	1977	INSITU	6.58	. 55	0.00	NCI/M2	LASL77
2052	BE7 BE7	1977		11.11	5.55	10.80	NCI/M2	
2120	BE7	1977	INSITU	14.30	7.16	14.50	NCI/M2	LASL77
2047	BE7	1977	INSITU	11.08	5.74	11.69	NCI/M2	LASL77
2114	BE7	1977	INSITU	10.46	5.01	20.30	NCI/M2 NCI/M2	LASL77
2013	BE7	1977	INSITU	7.43	2.11	0.00	NCI/M2	LASL77
2130	BE7	1977		6.03	.60	0.00	NCI/M2	LASL77
2082	BE7	1977	INSITU	9.86	4.42	0.00	NCI/M2	LASL77
2119	BE7	1977	INSITU	14.34	7.21	14.93	NCI/M2	LASL77
2080	BE7	1977	INSITU	10.91	7.22	13.20	NCI/M2	LASL77
2027	BE7	1977	INSITU	10.28	7.19	14.10	NCI/M2	LASL77
2023	BE7	1977	INSITU	9.54	3.98	11.50	NCI/M2	LASL77

2144	BE7	1977	INSITU	10.46	7.19	9.87	NCI/M2	LASL77
2039	BE7	1977	TNISTTU	9 60	1 33	0 00	NCT /MO	145177
2000	557	1077	INGITU	5.00	4-52	0.00	NOT/M2	
2009	BE /	1977	INSTIU	6.59	1.65	12.20	NC1/M2	LASL77
2148	BE7	1977	INSITU	2.98	3.62	10.39	NCI/M2	LASL77
2033	RF7	1977	TNSTTU	3 14	3 57	0.00	NCT /M2	
2000		1077		3.14	5.57	0.00		LASLIT
2017	BF1	1977	INSTIU	7.25	2.33	0.00	NCI/M2	LASL77
1998	BE7	1977	INSITU	6.63	. 55	0.00	NCI/M2	LASL77
2085	RF7	1077	TNISTTL	12 60	6 59	12 00	NCT /MO	1 4 5 1 7 7
2005		1977	110	12.00	0.50	13.50	NCI/WZ	LASLIT
2118	BE1	1977	INSIIU	14.55	6.45	19.00	NCI/M2	LASL77
2037	BE7	1977	INSITU	9.82	4.27	0.00	NCI/M2	145177
2074	DE7	1077	TNICTTLI	0 02	4 40	17 50	NCT /MO	
2071		1977	INSTIC	9.03	4.40	17.50	NC1/M2	LASL//
2101	BE7	1977	INSITU	16.52	14.74	13.10	NCI/M2	LASL77
2079	BE7	1977	INSITU	10.53	7.20	16.20	NCI/M2	
2115	RF7	1977	TNSTTU	12 57	6 40	12 10	NCT /MO	1 4 51 77
2115		1077	110110	13.37	0.45	13.40	NC1/M2	LASLII
2092	BF1	1977	INSTIU	13.52	9.21	12.70	NCI/M2	LASL77
2042	BE7	1977	INSITU	9.82	4.27	0.00	NCI/M2	LASL77
2066	RF7	1977	TNSTTH	10 60	4 42	0 00	NCT /M2	1 4 51 77
2000	007	4077		10.00		0.00		
2049	DE /	19//	INSTIU	11.11	5.55	0.00	NC1/M2	LASL//
2043	BE7	1977	INSITU	3.91	3.49	0.00	NCI/M2	LASL77
2055	BF7	1977	INSTIL	11 35	5 86	0 00	NCT/M2	1 451 77
2454	057	1077	TNCTTU	0.05	4 67	44.00		
2134		19//	1113110	3.95	4.57	14.60	NC1/M2	LASL//
2022	BE7	1977	INSITU	9.60	4.32	13.60	NCI/M2	LASL77
1996	BE7	1977	INSITU	6.45	.75	7.89	NCI/M2	LASI 77
2006	BE7	1977	INSTIL	10 52	7 10	0.00	NCT /MO	
2000		19/1		10.53	1.19	0.00	NOT/MZ	LA3L//
2028	BF1	1977	INSTIU	10.37	4.33	25.90	NC1/M2	LASL77
2084	BE7	1977	INSITU	12.58	7.17	13.20	NCI/M2	LASL77
2121	RF7	1977	INSTIL	6 62	1 97	7 00	NCT /MO	1 1 2 1 77
2101		1077	110110	0.02	1.07	7.50	101/102	LAJLII
2012	BF /	1977	INSTIU	6.79	1.77	12.10	NCI/M2	LASL77
2010	BE7	1977	INSITU	6.79	1.71	0.00	NCI/M2	LASL77
2060	RF7	1977	INSTIL	9 91	5 07	0 00	NCT/M2	1 451 77
2442	057	4077			0.07	0.00		
2143	BE/	19//	INSTIU	4.81	3.00	0_00	NC1/M2	LASL//
2026	BE7	1977	INSITU	10.05	4.07	20.80	NCI/M2	LASL77
2122	BE7	1977	INSTIL	13 69	6 87	0 00	NCT/M2	1 4 51 77
2010	057	1077		0.60	4 20	0.00	NOT /MO	
2040		19//	1115110	9.60	4.32	0.00	NC1/M2	LASL//
2123	BE7	1977	INSITU	13.68	6.79	0.00	NCI/M2	LASL77
2087	BE7	1977	INSITU	12.92	7.66	14.40	NCT/M2	LASL77
2116	RE7	1077	TNISTTI	12 74	6 10	17 00	NCT /MO	
2110		19//	INSTIC	13.74	0.12	17.90	NC1/M2	LASL//
2041	BE7	1977	INSITU	9.61	4.32	0.00	NCI/M2	LASL77
2057	BE7	1977	INSITU	10.35	5.34	13.40	NCI/M2	LASL77
2007	RF7	1977	TNSTTU	7 10	2 07	0.00	NCT /M2	1 4 51 77
2040	007	4077	50		2.07	0.00		
2049	BE/	1977	SG	11.11	5.55	1.47	PCI/GM	LLL GELI
1991	BE7	1977	SK	6.63	. 55	2.47	PCI/GM	LLL GELI
2007	RF7	1977	SK .	7 10	2 07	10 60	PCT/GM	LIL GELT
2045	057	1077	SIZ SIZ	10 50	E E 4	7 50	DOT / CM	
2045		19//	SK	10.52	5.51	1.20	PCI/GM	LLL GELI
1987	BE7	1977	SK	6.63	. 55	3.54	PCI/GM	LLL GELI
2016	BE7	1977	SK	7.24	2.33	9.23	PCI/GM	LLL GELI
20.28	RF7	1977	ты	10 37	4 33	0.00	PCT/CM	LLL GELT
2020		4077		10.07	7.00	0.00		
2052	BE/	19/7	UK	11-11	5.55	5.//	PC1/GM	LLL GELI
1990	C060	1977	GR	6.64	. 55	0.00	PCI/GM	LLL GELI
1988	CD60	1977	GR	6_64	. 55	.31	PCI/GM	LIL GELT
2055	0060	1077	CP.	11 25	5 06	26	DCT/CM	
2000	0000	1077	OR OR	11.33	3.80	. 30	POT/GM	
2018	000	19//	GR	6.66	1.76	. 33	PCI/GM	LLL GELI
2140	CD60	1977	INSITU	6.58	. 55	6100.00	NCI/M2	LASL77
2039	CD60	1977	INSITU	9.60	4.32	1.70	NCT/M2	145177
2120	0000	1077		6 60	EE	4 4 4 4	NCT /MO	
2135	0000	1377		0.30		11.41	NCI/M2	LASLII
2047	000	1977	INSTIU	11.08	5./4	0.00	NC1/M2	LASL77
2135	C060	1977	INSITU	6.58	. 55	19300.00	NCI/M2	LASL77
2143	CD60	1977	INSITU	4.81	3.00	1.22	NCI/M2	LASI 77
2010	0060	1077	TNISTTU	6 66	1 76		NCT /M2	
2010	0000	1077		10.00	1.70	0.00		LAGL 77
2028	C060	1977	INSTIU	10.37	4.33	2.50	NC1/M2	LASL77
2016	CD60	1977	INSITU	7.24	2.33	0.00	NCI/M2	LASL77
2011	COGO	1977	TNSTTH	6 32	00	0 00	NCT /M2	1 451 77
2011	0000	4077	INCITU	0.02		0.00		
2034	000	19//	INSTIU	3.10	3.70	3.18	NC1/M2	LASL//
2086	CD60	1977	INSITU	10.53	7.19	0.00	NCI/M2	LASL77
2147	CD60	1977	INSITU	7.77	3.07	0.00	NCT/M2	LASI 77
2010	0060	1077	TNETTU	6 60	2 24	0.00	NCT /MO	
2015	0000	19//	INSTIC	0.05	2.24	0.00	NCI/M2	LASLII
2144	CU60	1977	INSTIU	10.46	7.19	0.00	NCI/M2	LASL77
2007	CD60	1977	INSITU	7.10	2.07	0.00	NCI/M2	LASL77
2084	CDGO	1977	INSITU	12.58	7 17	0.00	NCT /M2	1 451 77
2004	0060	1077	TNSTTH	4 4 4 4	5 55	2.00	NOT / MO	
2050	0000	19/1	1113110	11.11	5.55	0.00	NC1/M2	LASL//
2080	CD60	1977	INSITU	10.91	7.22	0.00	NCI/M2	LASL77
2148	CD60	1977	INSITU	2.98	3.62	0.00	NCI/M2	LASL77
2002	0060	1077	TNSTTH	12 44	7 10	Å. ÅÅ	NCT /MO	1 4 51 77
2003	0000	13/1		12.14	1.19	0.00	NOT/M2	LASLII
2059	CU60	1977	INSTIU	9.74	5.42	0.00	NCI/M2	LASL77
2077	CD60	1977	INSITU	10.31	4.41	1.20	NCI/M2	LASL77
2041	0900	1977	INSTIU	9 61	4.32	1 94	NCT /M2	1 451 77
2426	0060	1077	TNISTTU	6 60			NOT /MO	
2130	0000	19/7	TINDITO	86.0	. 55	0.00	NC1/M2	LASL //
2026			TNISTTII		4 07	2 74	NCT/MO	
2020	CD60	1977	INSTIC	10.05	4.07	2./4	NCI/MZ	LASL77
2155	CD60 CD60	1977	INSITU	3.91	3.49	0.00	NCI/M2	LASL77 LASL77
2020	CD60 CD60	1977 1977 1977		3.91	4.07	0.00	NCI/M2	LASL77 LASL77

TU 14.49	9_25 0.0	O NCI/M2 LASL77
TU 9.83	4 48 0.0	O NCT/M2 LASL77
TU 14 20	7 16 0.0	
10 14.30	/.16 0.0	O NCI/M2 LASL//
TU 10.35	4.28 0.0	O NCI/M2 LASL77
TU 10.12	4.27 4.2	3 NCI/M2 LASL77
TU 6 59	55 0.0	O NOT/MO LASI 77
0.58		O NOT/M2 LASE77
TU 14.49	9.25 0.0	O NCI/M2 LASL77
TU 13.57	6.49 0.0	O NCI/M2 LASL77
TII 14 34	7.21 0.0	NO NOT M2 LASE 77
	EE 7042 0	O NOT/MO LASL77
10 0.58	.55 /913.0	NO NCI/MZ LASL//
TU 6.46	1.16 0.0	O NCI/M2 LASL77
TU 13.69	6.87 0.0	O NCI/M2 LASL77
11 09	4 52 0 0	O NCT/M2 LASI 77
	4.52 0.0	
10 11.11	5.55 0.0	NO NCI/MZ LASL//
TU 14.50	12.20 0.0	O NCI/M2 LASL77
TU 6.79	1.77 0.0	O NCI/M2 LASL77
10 41	4 28 0 0	0 NCT/M2 LASI 77
	4.20 0.0	
10 9.60	4.32 0.0	O NCI/M2 LASL//
ITU 6.45	.75 0.0	O NCI/M2 LASL77
TU 9.82	4.27 0.0	O NCI/M2 LASL77
	2 49 4 0	Q NCT/M2 LASI 77
3.17	3.48 1.0	S NOT/M2 LASL77
9.85	4.35 0.0	O NCI/M2 LASE//
ITU 7.37	2.22 503.5	50 NCI/M2 LASL77
TU 12.92	7.66 0.0	O NCI/M2 LASL77
	2 17 76 0	3 NCT/M2 1AST 77
5.81	2.17 /0.5	A NOT MA LASE //
11.62	/.18 0.0	JU NUI/M2 LASL77
[TU 6.03	.60 0.0	O NCI/M2 LASL77
ITU 13 52	9.21 0.0	O NCI/M2 LASI 77
	1 20 0.0	NO NOT /M2 LAST 77
10.39	4.30 0.0	O NCI/M2 LASL//
ITU 12.60	6.58 2.0	D9 NCI/M2 LASL77
[TU 9.60	4.32 1.9	97 NCI/M2 LASL77
ITH 9.82	4.27 1.3	RINCT/M2 LASI 77
		NOT/MO LASI77
9.30	5.02 0.0	O NCI/MZ LASL//
ITU 11.11	5.55 0.0	DO NCI/M2 LASL77
ITU 3.17	3.48 0.0	DO NCI/M2 LASL77
ITU 13.74	6.12 0.0	O NCI/M2 LASL77
	4 60 0.0	
10.85	4.60 0.0	JO NCI/MZ LASL//
ITU 3.14	3.57 30.7	76 NCI/M2 LASL77
ITU 9.60	4.32 1.9	93 NCI/M2 LASL77
ITU 3.94	4.88 0.0	DO NCI/M2 LASL77
	1 97 0 0	NO NOT/MO LASI 77
0.02	1.87 0.0	
9.54	3.98 3.	I NCI/M2 LASL//
ITU 10.69	5.56 0.0	DO NCI/M2 LASL77
ITU 6.63	.55 44.1	76 NCI/M2 LASL77
	4 42 0 0	DO NOT/M2 LASL 77
9.80	4.42 0.0	
110 3.91	3.49 50.3	30 NCI/M2 LASL//
ITU 16.52	14.74 1.3	78 NCI/M2 LASL77
ITU 9.91	5.07 0.0	DO NCI/M2 LASL77
TTU 7 07	2 04 1 9	AT NCT/M2 LASL77
	2.04 1.1	SI NOTINZ LASEIT
110 7.40	2.10 2.0	JI NCI/M2 LASE//
ITU 6.59	1.65 3.6	53 NCI/M2 LASL77
ITU 7.37	2.31 0.0	DO NCI/M2 LASL77
TTU 11 12	10 00 0	
	10.93 07	OO NCT/M2 145177
TTII 0 04	10.93 0.0	DO NCI/M2 LASL77
ITU 9.91	5_07 0.0	DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95	5_07 0.0 4.57 1.0	DO NCI/M2 LASL77 DO NCI/M2 LASL77 56 NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85	5_07 0.0 4.57 1.0 7.69 0.0	DO NCI/M2 LASL77 DO NCI/M2 LASL77 B6 NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00	10.93 0.0 5_07 0.0 4.57 1.0 7.69 0.0 5.31 0.0	DO NCI/M2 LASL77 DO NCI/M2 LASL77 36 NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00	10.93 0.0 5_07 0.0 4.57 1.0 7.69 0.0 5.31 0.0	DO NCI/M2 LASL77 DO NCI/M2 LASL77 G6 NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82	5.07 0.0 4.57 1.0 7.69 0.0 5.31 0.0 4.27 0.0	DO NCI/M2 LASL77 DO NCI/M2 LASL77 56 NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35	10.93 0.0 5_07 0.0 4.57 1.0 7.69 0.0 5.31 0.0 4.27 0.0 5.34 0.0	DO NCI/M2 LASL77 DO NCI/M2 LASL77 56 NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86	5.07 0.0 4.57 1.1 7.69 0.0 5.31 0.0 5.34 0.0 4.42 0.0	DO NCI/M2 LASL77 DO NCI/M2 LASL77 56 NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.82 ITU 9.86 ITU 9.86 ITU 11.09	5.07 0.0 4.57 1.0 7.69 0.0 5.31 0.0 4.27 0.0 5.34 0.0 4.42 0.0 5.87 0.0	DO NCI/M2 LASL77 DO NCI/M2 LASL77 G6 NCI/M2 LASL77 D0 NCI/M2 LASL77 D0 NCI/M2 LASL77 D0 NCI/M2 LASL77 D0 NCI/M2 LASL77 D0 NCI/M2 LASL77 D0 NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 10.35 ITU 9.86 ITU 10.35 ITU 11.09 ITU 15.45	10.93 0.0 5-07 0.0 4.57 1.4 7.69 0.0 5.31 0.0 4.27 0.0 5.34 0.0 4.42 0.0 5.87 0.0 9 75	DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 11.09 ITU 15.45	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 9.82 ITU 10.35 ITU 9.86 ITU 11.09 ITU 15.45 ITU 6.79	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77 DO NCI/M2 LASL77 G6 NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 10.35 ITU 10.35 ITU 15.45 ITU 6.79 ITU 11.35	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 11.09 ITU 15.45 ITU 6.79 ITU 11.35 ITU 13.22	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 11.09 ITU 15.45 ITU 6.79 ITU 11.35 ITU 13.22 ITU 6.77 ITU 13.22 ITU 13.22	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 10.35 ITU 10.35 ITU 15.45 ITU 6.79 ITU 13.22 ITU 6.27 ITU 13.22 ITU 6.27	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 11.09 ITU 15.45 ITU 13.22 ITU 13.22 ITU 6.27 ITU 10.54	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 10.35 ITU 10.35 ITU 11.09 ITU 15.45 ITU 11.35 ITU 13.22 ITU 6.27 ITU 10.54 ITU 10.54 ITU 13.22 ITU 10.54 ITU 13.68	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 10.35 ITU 10.35 ITU 11.09 ITU 15.45 ITU 6.79 ITU 13.22 ITU 13.22 ITU 13.68 ITU 13.68 ITU 9.83	5.07 0.0 4.57 1.1 7.69 0.0 5.31 0.0 4.27 0.0 5.34 0.0 5.87 0.0 5.87 0.0 5.86 0.0 7.66 0.0 7.19 0.0 6.87 0.0 5.10 0.0	DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.82 ITU 10.35 ITU 9.82 ITU 10.35 ITU 11.09 ITU 11.35 ITU 6.79 ITU 13.22 ITU 6.27 ITU 10.54 ITU 10.54 ITU 13.68 ITU 9.83 ITU 7.42	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 10.35 ITU 10.35 ITU 11.09 ITU 15.45 ITU 11.35 ITU 13.22 ITU 6.27 ITU 10.54 ITU 13.22 ITU 10.54 ITU 10.54 ITU 13.68 ITU 13.68 ITU 7.43 ITU 7.43	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77 DO NC
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 11.09 ITU 15.45 ITU 13.22 ITU 13.22 ITU 13.22 ITU 13.23 ITU 13.68 ITU 13.68 ITU 13.68 ITU 13.68 ITU 9.83 ITU 7.43 ITU 8.95	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 9.86 ITU 10.35 ITU 11.09 ITU 11.35 ITU 13.22 ITU 13.22 ITU 10.54 ITU 13.22 ITU 10.54 ITU 13.22 ITU 10.54 ITU 9.83 ITU 8.95 ITU 10.39	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77 DO NCI/M2 LASL77 DO NCI/M2 LASL77 DG NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 10.35 ITU 9.86 ITU 10.35 ITU 11.09 ITU 15.45 ITU 13.22 ITU 13.22 ITU 6.27 ITU 13.68 ITU 13.68 ITU 13.68 ITU 9.83 ITU 7.43 ITU 10.39 ITU 10.39 ITU 13.13	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.82 ITU 10.35 ITU 9.81 ITU 10.35 ITU 11.09 ITU 11.35 ITU 13.22 ITU 10.54 ITU 10.54 ITU 10.54 ITU 13.68 ITU 9.83 ITU 7.43 ITU 10.39 ITU 10.39 ITU 11.31	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 10.35 ITU 9.86 ITU 11.09 ITU 15.45 ITU 13.22 ITU 13.22 ITU 10.54 ITU 13.22 ITU 10.54 ITU 10.39 ITU 10.39 ITU 10.60	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI / M2 LASL77 DO NCI / M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.82 ITU 9.86 ITU 11.09 ITU 15.45 ITU 13.22 ITU 13.22 ITU 13.22 ITU 13.68 ITU 13.68 ITU 10.54 ITU 10.61 ITU 10.39 ITU 10.39 ITU 10.60 ITU 10.28	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.82 ITU 10.35 ITU 9.82 ITU 10.35 ITU 11.09 ITU 11.35 ITU 6.79 ITU 13.22 ITU 10.54 ITU 10.54 ITU 13.68 ITU 9.83 ITU 9.83 ITU 10.54 ITU 10.54 ITU 10.54 ITU 10.54 ITU 10.60 ITU 10.39 ITU 10.28 ITU 10.28 ITU 10.28 ITU 14.60	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 9.86 ITU 10.35 ITU 11.09 ITU 15.45 ITU 11.35 ITU 13.22 ITU 10.54 ITU 10.39 ITU 10.28 ITU 14.60 ITU 13.77	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI / M2 LASL77 DO NCI / M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.82 ITU 10.35 ITU 9.82 ITU 10.35 ITU 11.09 ITU 15.45 ITU 13.22 ITU 13.68 ITU 13.68 ITU 10.54 ITU 10.54 ITU 13.68 ITU 10.54 ITU 10.54 ITU 10.54 ITU 10.54 ITU 10.60 ITU 10.39 ITU 10.40 ITU 10.28 ITU 10.28 ITU 13.77 ITU 13.77	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.82 ITU 10.35 ITU 9.86 ITU 10.35 ITU 11.09 ITU 11.35 ITU 13.22 ITU 13.68 ITU 10.54 ITU 10.68 ITU 10.39 ITU 10.28 ITU 10.28 ITU 14.60 ITU 13.77 ITU 10.46	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77 DO NCI/M2 LASL77
ITU 9.91 ITU 3.95 ITU 13.85 ITU 10.00 ITU 9.82 ITU 10.35 ITU 9.86 ITU 10.35 ITU 9.86 ITU 10.35 ITU 11.09 ITU 15.45 ITU 13.22 ITU 13.22 ITU 10.54 ITU 10.39 ITU 10.28 ITU 10.460 ITU 10.460 ITU 10.460 ITU 10.460 <tr< td=""><td>$\begin{array}{cccccccccccccccccccccccccccccccccccc$</td><td>DO NCI/M2 LASL77 DO NCI/M2 LASL77</td></tr<>	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	DO NCI/M2 LASL77 DO NCI/M2 LASL77
	TU 14.49 TU 9.83 TU 14.30 TU 10.35 TU 10.12 TU 6.58 TU 14.49 TU 13.57 TU 14.34 TU 6.46 TU 11.09 TU 11.11 TU 6.79 TU 10.41 TU 9.82 TU 9.30 TU 12.92 TU 9.30 TU 9.30 TU 9.30 TU 9.30 TU 9.30 TU 9.30 TU 9.60 TU 9.30 TU 9.54 TU 9.54 TU 9.91 TU 7.40 <	TU 14.49 9.25 0.0 TU 9.83 4.48 0.0 TU 10.35 4.28 0.0 TU 10.35 4.28 0.0 TU 10.35 4.28 0.0 TU 10.35 4.28 0.0 TU 10.35 4.27 4.2 TU 6.58 $.55$ 0.0 TU 14.49 9.25 0.0 TU 14.34 7.21 0.0 TU 14.34 7.21 0.0 TU 14.34 7.21 0.0 TU 14.369 6.87 0.0 TU 11.09 4.52 0.0 TU 11.09 4.52 0.0 TU 11.09 4.52 0.0 TU 11.11 5.55 0.0 TU 11.09 4.52 0.0 TU 10.41 4.28 0.0 TU 9.82 4.27 0.0 TU 9.82 4.27 0.0 TU 9.85 4.35 0.0 TU 9.85 4.35 0.0 TU 12.92 7.66 0.0 TU 12.92 7.66 0.0 TU 12.60 6.58 2.0 TU 9.82 4.27 1.6 TU 9.60 4.32 1.6 TU 9.60 4.32 1.6 TU 9.60 4.32 1.6 TU 9.60 4.32 1.6 TU 9.60 <td< td=""></td<>

2126	C060	1977	INSITU	12.45	4.27	0.00 NCI/M2	LASL77
2132	CD60	1977	INSITU	6.70	2.16	0.00 NCI/M2	LASL77
2079	C060	1977	INSITU	10.53	7.20	0.00 NCI/M2	LASL77
2127	C060	1977	INSITU	13.40	5.21	1.87 NCI/M2	LASL77
2123	0000	19//		13.08	6 /5	0.00 NC1/M2	LASL//
2125	CD60	1977	INSITU	14.68	4.45	0.00 NCI/M2	LASL77
2129	CD60	1977	INSITU	6.27	0.00	0.00 NCI/M2	LASL77
2049	CD60	1977	SG	11.11	5.55	0.00 PCI/GM	LLL GELI
2016	CD60	1977	SK	7.24	2.33	0.00 PCI/GM	LLL GELI
1991	CD60	1977	SK	6.63	. 55	.09 PCI/GM	LLL GELI
2045	C060	1977	SK	10.52	5.51	0.00 PCI/GM	LLL GELI
1097	0000	19//	SK	7.10	2.07	.27 PC1/GM	LLL GELI
2028	0000	1977	TH	10 37	4 33	0.00 PCI/GM	LLL GELI
2052	C060	1977	UK	11.11	5.55	.22 PCI/GM	LLL GELI
1988	CS137	1977	GR	6.64	.55	.42 PCI/GM	LLL GELI
2018	CS137	1977	GR	6.66	1.76	.37 PCI/GM	LLL GELI
2055	CS137	1977	GR	11.35	5.86	.41 PCI/GM	LLL GELI
1990	CS137	1977	GR	6.64	.55	.42 PCI/GM	LLL GELI
2154	CS137	19//		3.95	4.5/	288 70 NCI/M2	
2079	CS137	1977	INSTIU	10 53	7 20	51 80 NCI/M2	
2015	CS137	1977	INSITU	7.37	2.31	96.20 NCI/M2	LASL77
2033	CS137	1977	INSITU	3.14	3.57	65.90 NCI/M2	LASL77
2077	CS137	1977	INSITU	10.31	4.41	61.69 NCI/M2	LASL77
2146	CS137	1977	INSITU	9.82	4.27	538.50 NCI/M2	LASL77
2130	CS137	1977	INSITU	6.03	. 60	2_13 NCI/M2	LASL77
2012	CS137	1977		6.79	2 24	230.00 NCI/M2	
2013	CS137	1977	INSTTU	10.37	4.33	947.00 NCI/M2	
2067	CS137	1977	INSITU	9.31	4.96	127.60 NCI/M2	LASL77
2132	CS137	1977	INSITU	6.70	2.16	231.80 NCI/M2	LASL77
2092	CS137	1977	INSITU	13.52	9.21	55.70 NCI/M2	LASL77
2065	CS137	1977	INSITU	10.39	5.01	271.90 NCI/M2	LASL77
2043	05137	1977		3.91	3.49	39.10 NC1/M2	
2097	CS137	1977	INSTIU	9.86	9.75	756 60 NCI/M2	
2052	CS137	1977	INSITU	11.11	5.55	123.10 NCI/M2	LASL77
2061	CS137	1977	INSITU	9.91	5.07	125.10 NCI/M2	LASL77
2148	CS137	1977	INSITU	2.98	3.62	49.90 NCI/M2	LASL77
2087	CS137	1977	INSITU	12.92	7.66	188.50 NCI/M2	LASL77
2131	05137	19//		6.62	1.8/	42.45 NCI/M2	
2101	CS137	1977	INSITU	16.52	14.74	78.68 NCI/M2	LASL77
2064	CS137	1977	INSITU	10.54	7.19	48.20 NCI/M2	LASL77
2090	CS137	1977	INSITU	13.85	7.69	127.80 NCI/M2	LASL77
2022	CS137	1977	INSITU	9.60	4.32	481.80 NCI/M2	LASL77
2155	05137	19//		3.91	3.49	49.30 NCI/M2	
2066	CS137	1977	INSITU	10.60	4.42	338.50 NCI/M2	
2122	CS137	1977	INSITU	13,69	6.87	152.60 NCI/M2	LASL77
2030	CS137	1977	INSITU	10,39	4.30	590.00 NCI/M2	LASL77
2050	CS137	1977	INSITU	11.11	5.55	125.20 NCI/M2	LASL77
2125	CS137	1977	INSITU	14.68	4.45	90.60 NCI/M2	
2082	CS137	1977	INSTIU	3 94	4 88	57 30 NCI/M2	
2076	CS137	1977	INSITU	11.09	4.52	158.80 NCI/M2	LASL77
2038	CS137	1977	INSITU	9.60	4.32	338.80 NCI/M2	LASL77
2037	CS137	1977	INSITU	9.82	4.27	545.10 NCI/M2	LASL77
2073	CS137	1977	INSITU	9.86	4.42	547_90 NCI/M2	LASL77
2016	05137	19//		7.24	2_33	16000 00 NCI/M2	
2093	CS137	1977	INSITU	14.60	8.57	145, 10 NCI/M2	
2053	CS 137	1977	INSITU	10.69	5.56	189.00 NCI/M2	LASL77
2123	CS137	1977	INSITU	13.68	6.79	111.50 NCI/M2	LASL77
2147	CS137	1977	INSITU	7.77	3.07	69.20 NCI/M2	LASL77
1998	CS137	1977		6.63	.55	328_60 NCI/M2	
2088	05137	1977		13.22	9.00	97 80 NCI/M2	
2081	CS137	1977	INSITU	11.31	7.21	135.50 NCI/M2	LASL77
2040	CS137	1977	INSITU	9.60	4.32	308.00 NCI/M2	LASL77
2143	CS137	1977	INSITU	4.81	3.00	33.94 NCI/M2	LASL77
2018	CS137	1977	INSITU	6.66	1.76	90.90 NCI/M2	LASL77
2116	05137	1977		13.74	6.12 5 7/	84.40 NCI/M2	
2047	CS137	1977	INSITU	10 12	4.07	601.70 NCT/M2	
2058	CS137	1977	INSITU	10.00	5.31	323.40 NCI/M2	LASL77
2119	CS 137	1977	INSITU	14.34	7.21	79.51 NCI/M2	LASL77
2068	CS137	1977	INSITU	9.30	5.02	263.30 NCI/M2	LASL77

2094	CS 137	1977	INSITU		14.49	9.25	103.40	NCI/M2	LASL77
1997	CS137	1977	INSTTU		6.46	1.16	223.20	NCI/M2	LASL77
2127	CS137	1977	TNSTTH		13 40	5 21	10 34	NCT/M2	145177
2020	CS 137	1077	TNETTH		9 60	1 33	429 30	NCT/M2	
2035	05407	1077	INCITU		10 50	7 17	141 20	NCT/M2	
2084	05137	19//	INSITU		12.50	0.70	141.20	NCI/M2	
2034	05137	1977	INSTIU		3.16	3.70	219.70	NCI/M2	LASL
2075	CS137	1977	INSITU		10.85	4.60	40_60	NCI/M2	LASL77
2059	CS137	1977	INSITU		9.74	5.42	211.30	NCI/M2	LASL77
2138	CS137	1977	INSITU		5.81	2.17	543.80	NCI/M2	LASL77
2074	CS137	1977	INSTIL		9.85	4.35	260.90	NCI/M2	LASL77
2120	CS137	1977	INSTIL		14 30	7 16	127 90	NCT/M2	1 451 77
2120	05137	1077	INSTIU		0.01	5 07	217 90	NCT/M2	
2000	05/07	19//	INSTIU		3.51	3.07	317.50	NCT/M2	
2144	05137	1977	INSTIU		10.46	1.19	40.70	NCI/M2	LASL//
2042	CS137	1977	INSTIU		9.82	4.27	512.10	NC1/M2	LASL//
2141	CS137	1977	INSITU		6.58	.55	488.30	NCI/M2	LASL77
2032	CS137	1977	INSITU		3.17	3.48	69.90	NCI/M2	LASL77
2013	CS137	1977	INSITU		7.43	2.11	43.60	NCI/M2	LASL77
2129	CS137	1977	INSTIU		6.27	0.00	31.83	NCI/M2	LASL77
2031	CS137	1077	TNSTTU		10 41	4 28	261 00	NCT/M2	1 451 77
2001	CE 107	1077	TNETTU		0 61	4 22	429.00	NCT/M2	
2041	05137	19//	INSTIU		5.01	4.32	428.00	NCT/M2	
2095	05137	1977	INSTIU		14.49	9.25	68.60	NCI/M2	LASL
2115	CS137	1977	INSITU		13.57	6.49	83.70	NC1/M2	LASL//
2017	CS137	1977	INSITU		7.25	2.33	34.60	NCI/M2	LASL77
2024	CS137	1977	INSITU		8.95	3.88	135.30	NCI/M2	LASL77
2085	CS137	1977	INSITU		12_60	6.58	764.90	NCI/M2	LASL77
2139	CS137	1977	INSTIL		6.58	. 55	4179.00	NCI/M2	LASL77
2055	CS 137	1077	TNSTTU		11 35	5 86	29 50	NCT/M2	1 451 77
2000	05107	1077	TNETTU		44 40	10 02	70.20	NCT/M2	
2099	05137	19//	INSTIU		0.70	10.93	72.30		
2010	05137	1977	INSTIU		6.79	1./1	91.70	NC1/M2	LASL//
2011	CS137	1977	INSIIU		6.32	.00	36.90	NC1/M2	LASL //
2121	CS137	1977	INSITU		13.68	6_87	124.40	NCI/M2	LASL77
2128	CS137	1977	INSITU		13.77	5.47	25.37	NCI/M2	LASL77
2057	CS137	1977	INSITU		10.35	5.34	158.70	NCI/M2	LASL77
2020	CS137	1977	INSTIL		3.17	3.48	0.00	NCI/M2	LASL77
2027	CS 137	1077	TNSTTU		10 28	4 20	314 00	NCT/M2	
2027	05107	1077	TNETTH		7 40	2 10	25 26	NCT/M2	
2008	05137	1077	INSTIU		0 54	2.10	23.30	NCT/M2	
2023	65137	19//	INSTIC		9.54	3.90	202.00	NCI/MZ	
2136	CS137	1977	INSTIU		6.58	. 55	23000.00	NC1/M2	LASL//
2006	CS137	1977	INSITU		7.07	2.04	182.20	NCI/M2	LASL77
2142	CS137	1977	INSITU		6.27	.00	30.00	NCI/M2	LASL77
2086	CS137	1977	INSITU		10.53	7.19	48.40	NCI/M2	LASL77
2007	CS137	1977	INSITU		7.10	2.07	183.80	NCI/M2	LASL77
2009	CS137	1977	INSTIU		6.59	1.65	244.60	NCI/M2	LASL77
2080	CS137	1077	TNSTTU		10 91	7 22	81 50	NCT/M2	1 451 77
2440	05137	1077	TNSTTU		6 59	1.55	730 40	NCT/M2	
2140	05107	19/1	INSTIU		40.45		50.40	NCT/M2	
2120	65137	19//	INSITU		12.45	4.21	58.50	NCI/M2	
2026	05137	1977	INSTIU		10.05	4.07	540.00	NCI/M2	LASL//
2014	CS137	1977	INSITU		7.37	2.22	858-20	NC1/M2	LASL77
1996	CS137	1977	INSITU		6.45	. 75	227.60	NCI/M2	LASL77
2029	CS137	1977	INSITU		10.35	4.28	410.70	NCI/M2	LASL77
2114	CS137	1977	INSITU		10.46	7.18	50.55	NCI/M2	LASL77
2134	CS 137	1977	INSTIL		6.58	. 55	4230.00	NCI/M2	LASL77
2118	CS 137	1977	INSTIL		14 55	6.45	100.00	NCT/M2	
2010	CS 107	1077	TNETTI		11 11	5 55	139 60	NCT/M2	
2045	05407	1077	INSITU		11.11	5.55	100.00	NCT/M2	
2062	65137	19//	INSTIU		9.63	5.10	241.00	NCI/M2	
2100	05137	1977	INSTIU		14.50	12.20	80.90	NC1/M2	LASL
2049	CS137	1977	SG		11.11	5.55	0.00	PCI/GM	LLL GELI
199 I	CS137	1977	SK		6.63	.55	.06	PCI/GM	LLL GELI
2016	CS137	1977	SK		7.24	2.33	. 24	PCI/GM	LLL GELI
1987	CS137	1977	SK		6.63	.55	0.00	PCI/GM	LLL GELI
2045	CS137	1977	SK		10.52	5.51	. 38	PCI/GM	LLL GELI
2007	CS 127	1077	SK		7 10	2 07	34	PCT/GM	LLL GELT
2007	05107	4077	SOTI	40 E	10 27	1 22		DCT/GM	LLL GELT
2028	05137	19//	SUIL	12.5	10.37	4.33	0.00	PCI/GM	
2074	CS137	1977	SULL	2.5	9.85	4.35	1.29	PCI/GM	LLL GELI
2059	CS137	1977	SOIL	12.5	9.74	5.42	0.00	PCI/GM	LLL GELI
2014	CS137	1977	SOIL	12.5	7.37	2.22	. 96	PCI/GM	LLL GELI
2048	CS137	1977	SOIL	7.5	11.09	5.87	. 13	PCI/GM	LLL GELI
1991	CS137	1977	SOIL	7.5	6.63	. 55	9.40	PCI/GM	LLL GELI
2120	CS 137	1977	SOTI	2.5	14.30	7.16	1.74	PCI/GM	LLL GELT
2120	00107	1077	SOTI	12 5	14 30	7 16		PCT/GM	LII GELT
2120	0313/	1077	SOL	2.5	7.30	2 22	0.00	PCT/CM	
2014	0013/	19//	301L	2.5	1.3/	2.22	. 33		LLL GELL
2087	CS137	1977	SUIL	2.5	12.92	1.66	2.99	PC1/GM	LLL GELI
2012	CS137	1977	SOIL	7.5	6.79	1.77	0.00	PC1/GM	LLL GELI
2072	CS137	1977	SOIL	2.5	9.86	4.42	7.12	PCI/GM	LLL GELI
2050	CS 137	1977	SOIL	2.5	11.11	5.55	. 78	PCI/GM	LLL GELI
2066	CS137	1977	SOIL	2.5	10.60	4.42	1.51	PCI/GM	LLL GELI
2007	CS 137	1977	SOT	7.5	7.10	2.07	.03	PCI/GM	LLL GELT
2007	CC 127	1077	SOTI	25	7 27	2 24	1 15	PCT/GM	LLI GELT
2013	0010/	1077	SOL	2.5	7 94	2.01	1.15	DCT/OM	
2016	05137	19//	SUIL	/.2	1.24	2.33	. 20		LLL GELI
2080	CS137	1977	SUIL	2.5	10.91	7.22	. 32	PCI/GM	LLL GELI

							A	DOT / 011	
2050	CS137	1977	SUIL	12.5	11.11	5-55	0.00	PCI/GM	LLL GELI
2061	CS137	1977	SOIL	2.5	9.91	5.07	2.84	PCI/GM	LLL GELI
2053	CS137	1977	SOIL	12.5	10.69	5.56	.06	PCI/GM	LLL GELI
2028	CS137	1977	тн		10.37	4.33	. 35	PCI/GM	LLL GELI
2052	CS137	1977			11 11	5 55	.20	PCT/GM	LLL GELT
2032	511452	4077			6 66	4 76	0.20	DCT/CM	
2018	EU152	19//	GR		0.00	1.70	0.00	PCI/GM	LLL GELI
1990	EU152	1977	GR		6.64	. 55	1.02	PCI/GM	LLL GELI
1988	EU152	1977	GR		6.64	.55	2.21	PCI/GM	LLL GELI
2055	EU152	1977	GR		11.35	5.86	0.00	PCI/GM	LLL GELI
2100	EU152	1977	INSITU		14.50	12.20	0.00	NCI/M2	LASL77
2148	FU152	1977	INSTIL		2.98	3 62	0 00	NCT/M2	1 451 77
2444	511152	1077	TNETTH		10.46	7 10	0.00	NCT/M2	
2144	EUIJZ	1077	INSTIU		10.40	0.05	0.00	NOT/M2	
2094	EU 152	19//	INSTIC		14.49	9.25	0.00	NC1/M2	LASL//
2040	EU152	1977	INSTIU		9.60	4.32	0.00	NC1/M2	LASL//
2018	EU152	1977	INSITU		6.66	1.76	0.00	NCI/M2	LASL77
2092	EU152	1977	INSITU		13.52	9.21	0.00	NCI/M2	LASL77
2031	EU152	1977	INSITU		10.41	4.28	0.00	NCI/M2	LASL77
2052	EU152	1977	INSTIL		11 11	5 55	0.00	NCT/M2	
2002	511462	1077	TNSTTU		0 01	5.00	0.00	NCT/M2	
2000	EU152	19//	INSTIU		3.31	5.07	0.00		
2128	EU152	19//	INSTID		13.77	5.4/	0.00	NC1/M2	LASL//
2057	EU152	1977	INSITU		10.35	5.34	0.00	NCI/M2	LASL77
2043	EU152	1977	INSITU		3.91	3.49	0.00	NCI/M2	LASL77
2006	EU152	1977	INSITU		7.07	2.04	0.00	NCI/M2	LASL77
2039	EU152	1977	INSITU		9.60	4.32	0.00	NCI/M2	LASL77
2136	EU152	1977	INSTIL		6 58	55150	000 000	NCT/M2	1 4 51 77
2120	EU152	1077	INSTIL		14 30	7 16		NCT/M2	
2120		4077	INSTIU		14.30	7.10 E 01	0.00	NCT/M2	
2065	EU152	1977	INSTIU		10.39	5.01	0.00	NCI/M2	LASL//
2058	EU152	1977	INSITU		10.00	5.31	0.00	NCI/M2	LASL77
2097	EU152	1977	INSITU		15.45	9.75	0.00	NCI/M2	LASL77
2066	EU152	1977	INSITU		10.60	4.42	0.00	NCI/M2	LASL77
1996	EU152	1977	INSITU		6.45	.75	0.00	NCI/M2	LASL77
1997	EU152	1977	INSTIL		6 46	1 16	0.00	NCT/M2	1 4 51 77
1027	EU152	1077	TNSTTU		0.40	1.10	0.00	NCT/M2	
2037	EUISZ	19/1	INSTIU		5.02	4.27	0.00	NOT/M2	
2088	EU152	19//	INSITU		13.22	1.00	0.00	NCI/M2	LASL
2027	EU152	1977	INSTIU		10.28	4.20	0.00	NC1/M2	LASL//
2064	EU152	1977	INSITU		10.54	7.19	0.00	NCI/M2	LASL77
2022	EU152	1977	INSITU		9.60	4.32	0.00	NCI/M2	LASL77
2059	EU152	1977	INSITU		9.74	5.42	0.00	NCI/M2	LASL77
2017	FU152	1977	INSTIL		7.25	2.33	0.00	NCT/M2	1 451 77
2014	EU152	1077	INSTIL		7 27	2.22	0.00	NCT /M2	
2014	511452	1077	TNETTH		6 22	2.22	0.00	NCT/M2	
2011	EUISZ	19//	1115110		0.32	.00	0.00	NCI/M2	
2122	EU152	1977	INSTIU		13.69	6.87	0.00	NC1/M2	LASL//
2141	EU152	1977	INSITU		6.58	.55	1221.00	NC1/M2	LASL77
2099	EU152	1977	INSITU		11.12	10.93	0.00	NCI/M2	LASL77
2008	EU152	1977	INSITU		7_40	2.10	0.00	NCI/M2	LASL77
2042	EU152	1977	INSITU		9.82	4.27	0.00	NCI/M2	LASL77
2081	FU152	1977	INSITU		11.31	7.21	0.00	NCI/M2	LASL77
2020	EU152	1977	TNSTTH		3 17	3 48	0.00	NCT/M2	
2020	EU152	1077	TNSTTU		7 24	0.70	0.00	NCT /M2	
2010	EUIJZ	19/1	INSTIU		1.24	2.33	0.00	NCI/M2	
2095	E0152	19//	INSITU		14.49	9.25	0.00	NC1/M2	LASL
2067	EU152	1977	INSTIU		9.31	4.96	0.00	NC1/M2	LASL//
2147	EU152	1977	INSITU		7.77	3.07	0.00	NC1/M2	LASL77
2087	EU152	1977	INSITU		12.92	7.66	0.00	NCI/M2	LASL77
2119	EU152	1977	INSITU		14.34	7.21	0.00	NCI/M2	LASL77
2114	EU152	1977	INSITU		10.46	7.18	0.00	NCI/M2	LASL77
2041	FU152	1977	INSTIL		9.61	4.32	0.00	NCT/M2	145177
2012	EU152	1077	INSTIL		6 79	1 77	0.00	NCT/M2	
2012	EINES	1077	TNSTTI		14 40	0 74	0.00	NCT /MO	
2090	EUISZ	19/1	INSTIU		14.49	9.24	0.00	NCI/M2	
2015	EU152	1977	INSTIU		1.3/	2.31	0.00	NC1/M2	LASL//
2142	EU152	1977	INSITU		6.27	.00	0.00	NCI/M2	LASL77
2079	EU152	1977	INSITU		10.53	7.20	0.00	NCI/M2	LASL77
2013	EU152	1977	INSITU		7.43	2.11	0.00	NCI/M2	LASL77
1998	EU152	1977	INSITU		6.63	.55	621.60	NCI/M2	LASL77
2076	EU152	1977	TNSTTU		11 09	4 52	0.00	NCT/M2	
2010	EU152	1077	TNETTH		6 70	4 74	0.00	NCT/M2	
2010	EUISZ	1077	INSITU		0.75	E 10	0.00	NCT/M2	
2062	E0152	1977	INSITU		9.83	5.10	0.00	NC1/M2	LASL
2127	EU152	1977	INSITU		13.40	5.21	0.00	NC1/M2	LASL77
2135	EU152	1977	INSITU		6.58	.5534	0000.00	NCI/M2	LASL77
2019	EU152	1977	INSITU		6.69	2.24	0.00	NCI/M2	LASL77
2074	EU152	1977	INSITU		9.85	4.35	0.00	NCI/M2	LASL77
2009	EU152	1977	INSTTU		6.59	1.65	0.00	NCI/M2	LASL77
2125	FU152	1977	INSTIL		14 68	4.45	0.00	NCT/M2	LASI 77
2120	E11450	1077	TNETTI		0 00	1 27	0.00	NCT /M2	
2140	EU 152	19//	TNOTTO		5.02	4.21	4000	NOT /M2	LAGL//
2139	EU152	19//	11/2110		0.00	. 55 1	1000.00	NOT/M2	LASL//
2024	EU152	1977	INSITU		8.95	3.88	0.00	NCI/M2	LASL77
2032	EU152	1977	INSITU		3.17	3.48	0.00	NCI/M2	LASL77
2129	EU152	1977	INSITU		6.27	0.00	0.00	NCI/M2	LASL77
2049	EU152	1977	INSITU		11.11	5.55	0.00	NCI/M2	LASL77
2085	FU152	1977	INSTIL		12 60	6.58	0.00	NCI/M2	LASI 77
2124	FU150	1077	TNSTTU		6 59	5514	0000.00	NCT /M2	1 451 77
<u>~ 13</u> +					5.00			····	

2126	EU152	1077	TNSTTH	10 45	4 07	0.00	NCT /MO	1 4 51 77
2020	EUIEO	4077	INSTIC	12.45	4.27	0.00	NCI/M2	LASLII
2028	EU 152	1977	105110	10.37	4.33	0.00	NC1/M2	LASL77
2086	EU152	1977	INSITU	10.53	7.19	0.00	NCI/M2	LASL77
2121	EU 152	1977	INSITU	13.68	6.87	0.00	NCI/M2	LASL77
2118	EU 152	1977	INSTTU	14.55	6.45	0 00	NCT/M2	1 451 77
2021	EU152	1077	TNSTTU	0.02	4 40	0.00	NCT/M2	
2000	EUIEO	4077	INCITU	5.03	4.40	0.00	NCI/M2	LASLII
2082	EU 152	1977	105110	11.62	1.18	0.00	NC1/M2	LASL77
2140	EU 152	1977	INSITU	6.58	. 55	842.60	NCI/M2	LASL77
2038	EU152	1977	INSITU	9.60	4.32	0.00	NCI/M2	LASL77
2007	EU152	1977	INSITU	7.10	2 07	0 00	NCT/M2	1 4 51 77
2138	FU152	1077	TNSTTH	5 94	2 17	1606.00	NCT /MO	
2100	EU (EO	4077	INCITU	3.01	2.17	1090.00	NCI/M2	LASLII
2143	EU 152	1977	INSTIU	4.81	3.00	0.00	NC1/M2	LASL77
2132	EU152	1977	INSITU	6.70	2.16	0.00	NCI/M2	LASL77
2034	EU152	1977	INSITU	3.16	3.70	0.00	NCI/M2	LASL77
2155	EU152	1977	INSITU	3.91	3.49	0.00	NCI/M2	145177
2053	EU152	1977	INSTIL	10 69	5 56	0.00	NCT/M2	
2026	511462	1077		10.05	3.30	0.00		
2020	EUISZ	13/1	INSTIC	10.05	4.07	0.00	NC1/M2	LASL//
2154	EU152	1977	INSTIU	3.95	4.57	0.00	NC1/M2	LASL77
2080	EU152	1977	INSITU	10.91	7.22	0.00	NCI/M2	LASL77
2153	EU152	1977	INSITU	3.94	4.88	0.00	NCI/M2	LASL77
2131	EU152	1977	INSITU	6 62	1 87	0 00	NCT/M2	1 4 51 77
2090	EU152	1077	TNSTTU	12 05	7 60	0.00	NCT /MO	
2020	EUICE	4077	INCITU	13.05	1.05	0.00		LASL//
2030	EU 152	1977	105110	10.39	4.30	0.00	NC1/M2	LASL77
2048	EU152	1977	INSITU	11.09	5.87	0.00	NCI/M2	LASL77
2055	EU152	1977	INSITU	11.35	5.86	0.00	NCI/M2	LASL77
2072	EU152	1977	INSITU	9.86	4.42	0.00	NCI/M2	LASL77
2023	EU152	1977	INSITU	9.54	3.98	23.60	NCT/M2	1 451 77
2025	EU152	1077	INSTIL	10 12	1 27	20.00	NCT/M2	
2023	EU (EQ	4077	INCITU	10-12	4.2/	0.00	NCI/MZ	LASLII
2084	EU 152	1977	105110	12.58	1.11	0.00	NC1/M2	LASL77
2116	EU152	1977	INSITU	13.74	6.12	0.00	NCI/M2	LASL77
2101	EU152	1977	INSITU	16.52	14.74	0.00	NCI/M2	LASL77
2115	EU152	1977	INSITU	13.57	6.49	0.00	NCT/M2	1 451 77
2093	FU152	1977	TNSTTU	14 60	9 57	0.00	NCT/MO	
2077	EU 162	1077	INSTIC	14.00	0.57	0.00		
2011	EU 152	19/1	INSTIU	10.31	4.41	0.00	NC1/M2	LASL//
2075	EU152	1977	INSTIU	10.85	4.60	0.00	NC1/M2	LASL77
2130	EU152	1977	INSITU	6.03	. 60	0_00	NCI/M2	LASL77
2073	EU152	1977	INSITU	9.86	4.42	0.00	NCI/M2	LASL77
2033	EU152	1977	INSITU	3.14	3.57	0.00	NCT/M2	1 4 51 77
2047	FU152	1977	INSTIL	11 08	5 74	0.00	NCT/M2	
2050	EU 152	1077	INSTITU	11.00	5.74	0.00	NCT/M2	
2030		1911	INSTIC	11.11	5.55	0.00	NC1/M2	LASL//
2123	EU 152	1977	1N5110	13.68	6.79	0.00	NC1/M2	LASL77
2068	EU152	1977	INSITU	9.30	5.02	0.00	NCI/M2	LASL77
2029	EU152	1977	INSITU	10.35	4.28	0.00	NCI/M2	LASL77
2083	EU152	1977	INSITU	12.14	7.19	0.00	NCI/M2	LASL77
2061	EU152	1977	INSITU	9.91	5.07	0.00	NCT/M2	1 451 77
2049	FU152	1977	56	11 11	5 55	0.00	PCT/GM	
2007	EU152	1077	SU SU	7 10	2.07	0.00	DCT/CM	
4007	EU (EO	1077		7.10	2.07	0.00	PCI/GM	LLL GELI
1987	EUISZ	19//	36	6.63	. 55	1.31	PC1/GM	LLL GELI
1991	EU152	1977	SK	6.63	.55	. 53	PCI/GM	LLL GELI
2045	EU152	1977	SK	10-52	5 51	~ ~ ~ ~	/	
2016	EU152		A 14		0.01	0.00	PCI/GM	LLL GELI
2028		1977	SK	7.24	2.33	0.00	PCI/GM PCI/GM	LLL GELI LLL GELI
	EU152	1977 1977	SK TH	7.24 10.37	2.33	0.00	PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI
2052	EU152 EU152	1977 1977 1977	SK TH UK	7.24 10.37	2.33	0.00	PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LLL GELI
2052	EU152 EU152 EU154	1977 1977 1977 1977		7.24 10.37 11.11	2.33 4.33 5.55	0.00 0.00 0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LLL GELI LLL GELI
2052 1988	EU152 EU152 EU154	1977 1977 1977 1977	SK TH UK GR	7.24 10.37 11.11 6.64	2.33 4.33 5.55 .55	0.00 0.00 0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LLL GELI LLL GELI
2052 1988 2055	EU152 EU152 EU154 EU154	1977 1977 1977 1977 1977	SK TH UK GR GR	7.24 10.37 11.11 6.64 11.35	2.33 4.33 5.55 .55 5.86	0.00 0.00 0.00 0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI
2052 1988 2055 1990	EU152 EU152 EU154 EU154 EU154	1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR	7.24 10.37 11.11 6.64 11.35 6.64	2.33 4.33 5.55 .55 5.86 .55	0.00 0.00 0.00 0.00 0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI
2052 1988 2055 1990 2018	EU152 EU152 EU154 EU154 EU154 EU154	1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR GR	7.24 10.37 11.11 6.64 11.35 6.64 6.66	2.33 4.33 5.55 .55 5.86 .55 1.76	0.00 0.00 0.00 0.00 0.00 0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049	EU152 EU152 EU154 EU154 EU154 EU154 EU154	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR GR SG	7.24 10.37 11.11 6.64 11.35 6.66 11.11	2.33 4.33 5.55 .55 5.86 .55 1.76 5.55	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987	EU152 EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SK	7.24 10.37 11.11 6.64 11.35 6.64 6.66 11.11 6.63	2.33 4.33 5.55 .55 5.86 .55 1.76 5.55	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987 2007	EU152 EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR GR SG SK SK	7.24 10.37 11.11 6.64 11.35 6.64 6.66 11.11 6.63 7.10	2.33 4.33 5.55 5.55 5.86 .55 1.76 5.55 .55 2.07	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987 2007	EU152 EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR GR SS SK SK SK	7.24 10.37 11.11 6.64 11.35 6.64 6.66 11.11 6.63 7.10	2.33 4.33 5.55 5.86 .55 1.76 5.55 .55 2.07	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987 2007 1991	EU152 EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR GR SK SK SK SK	7.24 10.37 11.11 6.64 11.35 6.64 6.66 11.11 6.63 7.10 6.63	2.33 4.33 5.55 .55 5.86 .55 1.76 5.55 2.07 .55	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987 2007 1991 2005	EU152 EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR GR SG SK SK SK SK SK	7.24 10.37 11.11 6.64 11.35 6.64 6.66 11.11 6.63 7.10 6.63 10.52	2.33 4.33 5.55 5.86 5.55 1.76 5.55 2.07 .55 5.51	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987 2007 1991 2045 2016	EU152 EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154	1977 1977 1977 1977 1977 1977 1977 1977	SK TUK GR GR GR GR SSK SK SK SK SK	7.24 10.37 11.11 6.64 11.35 6.64 6.66 11.11 6.63 7.10 6.63 10.52 7.24	2.33 4.33 5.55 5.86 .55 1.76 5.55 2.07 .55 5.51 2.33	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987 2007 1991 2045 2016 2028	EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154	1977 1977 1977 1977 1977 1977 1977 1977	SK T UK G G G R G G G G G G G G G G G G G G G G	7.24 10.37 11.11 6.64 11.35 6.64 6.66 11.11 6.63 7.10 6.63 10.52 7.24 10.37	2.33 4.33 5.55 5.86 5.55 1.76 5.55 2.07 5.55 2.07 5.51 2.33 4.33	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987 2007 1991 2045 2016 2028 2052	EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154	1977 1977 1977 1977 1977 1977 1977 1977	SK T UK G G R G G G G G G G G G G G G G G G G G	7.24 10.37 11.11 6.64 11.35 6.64 6.66 11.11 6.63 7.10 6.63 10.52 7.24 10.37 11.11	2.33 4.33 5.55 5.55 5.55 5.55 5.55 5.55 5	0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987 2007 1991 2045 2045 2045 2028 2052 2100	EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU155	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR GR SG SK SK SK SK SK SK SK SK SK UK UK UNSITU	7.24 10.37 11.11 6.64 11.35 6.64 6.66 11.11 6.63 7.10 6.63 10.52 7.24 10.37 11.11	2.33 4.33 5.55 5.85 1.76 5.55 2.55 2.33 4.33 5.55 2.33 4.33 5.20	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987 2007 1991 2007 1991 2045 2016 2028 2052 2100	EU152 EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU155 EU155	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SK SK SK SK SK SK SK SK TH UK INSITU INSITU	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\end{array}$	2.33 4.33 5.55 5.55 5.55 5.55 5.55 5.55 2.07 5.55 2.33 5.55 2.33 5.55 12.71	0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI
2052 1988 2055 1990 2049 1987 2007 1991 2045 2016 2018 2028 2052 2010 2010	EU152 EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU155 EU155 EU155	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SK SK SK SK SK SK SK SK SK SK SK SK SK	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.64\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 12\\ 57\end{array}$	2.33 4.33 5.55 5.55 5.55 5.55 5.55 5.55 5	0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LASL77 LASL77
2052 1988 2055 1990 2048 2049 2045 2007 1991 2045 2016 2028 2052 2010 2010 2010 2010	EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU155 EU155 EU155	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SK SK SK SK SK SK SK TH UK INSITU INSITU INSITU	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.64\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 13.57\end{array}$	2.33 4.33 5.55 5.85 5.55 5.55 5.55 5.55 5.55 5	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI LLSL77 LASL77 LASL77
2052 1988 2055 1990 2018 2049 1987 2007 1991 2045 2016 2028 2052 2010 2010 2010 2010 2010	EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU155 EU155 EU155 EU155	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SK SK SK SK SK SK SK SK TH UK INSITU INSITU INSITU	7.24 10.37 11.11 6.64 11.35 6.64 6.66 11.11 6.63 10.52 7.24 10.37 11.11 14.50 6.79 13.57 9.82	2.33 4.33 5.55 5.56 1.76 5.557 5.551 2.335 12.355 12.335	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987 2007 1991 2016 2016 2016 2016 2016 2015 2017 2017 2017	EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU155 EU155 EU155 EU155 EU155	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SS SK SK SK SK SK SK SK TH UKSITU INSITU INSITU INSITU	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 13.57\\ 9.82\\ 6.66\end{array}$	2.33 4.33 5.55 5.556 1.765 5.557 2.333 5.555 2.333 5.5513 3.55 1.775 2.333 5.201 6.27 1.719 4.27 1.76	0.00 0.00	PCI/GM PCI/M2 NCI/M2 NCI/M2 NCI/M2	LLL GELI LLL GELI
2052 1988 2055 1990 2049 1987 2007 1991 2045 2016 2018 2052 2010 2010 2010 20115 2003 2018 2032	EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU155 EU155 EU155 EU155 EU155 EU155	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SSK SK SK SK SK SK SK SK TH UK INSITU INSITU INSITU INSITU INSITU INSITU INSITU	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.64\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 13.57\\ 9.82\\ 6.66\\ 3.17\end{array}$	2.33 4.33 5.55 5.556 1.755 2.551 2.333 5.556 5.557 5.557 5.551 2.33355 12.201 6.271 4.276 3.48	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM NCI/M2 NCI/M2 NCI/M2 NCI/M2	LLL GELI LLL GELI LLSL77 LASL77 LASL77 LASL77
2052 1988 2055 1990 2018 2049 1987 2007 1991 2016 2028 2050 2016 2016 2016 2016 2010 2115 2037 2037 2032 2013	$\begin{array}{c} {\sf EU152} \\ {\sf EU152} \\ {\sf EU154} \\ {\sf EU155} \\$	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SK SK SK SK SK SK TH UK INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.64\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 13.57\\ 9.82\\ 6.66\\ 3.17\\ 7.43\\ \end{array}$	2.33 4.33 5.55 5.56 5.55 2.551 2.335 5.551 2.335 12.71 6.427 1.769 4.276 3.41	0.00 0.00	PCI/GM NCI/M2 NCI/M2 NCI/M2 NCI/M2 NCI/M2 NCI/M2	LLL GELI LLL GELI LLSL77 LASL77 LASL77 LASL77 LASL77
2052 1988 2055 1990 2049 1987 2007 1991 2049 2049 2016 2028 2052 2100 2015 2018 2037 2018 2032 2018 2032 2052	$\begin{array}{c} {\sf EU152} \\ {\sf EU152} \\ {\sf EU154} \\ {\sf EU155} \\$	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SK SK SK SK SK SK TH UNSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 13.57\\ 9.82\\ 6.66\\ 3.17\\ 743\\ 11.11\\ \end{array}$	2.333 4.35556 5.556 1.75557 2.5513335 1.55557 2.3335 1.55557 2.3335 1.5552 1.5553335 1.766 1.5552 1.766 1.776 1.555 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.755 1.555 1.776 1.779 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.776 1.755 1.756 1.776 1.776 1.776 1.755 1.756 1.776 1.776 1.756 1.776 1.756 1.776 1.756 1.756 1.776 1.776 1.756 1.756 1.756 1.776 1.7566 1.7566	0.00 0.00	PCI/GM PCI/M2 NC	LLL GELI LLL GELI
2052 1988 2055 1990 2049 1987 2007 1991 2045 2016 2015 2015 2015 2013 2013 2015 2013 2015 2015 2015 2015 2015 2015 2015 2015	$\begin{array}{c} {\sf EU152} \\ {\sf EU152} \\ {\sf EU154} \\ {\sf EU155} \\$	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SSK SK SK SK SK SK SK SK SK SK SK SK SK	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.64\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 13.57\\ 9.82\\ 6.66\\ 3.17\\ 7.43\\ 11.11\\ 4.81\end{array}$	2.33 4.33 5.556 5.556 1.7555 2.55133355 12.771 4.768 12.768 1.768 12.768 1.7	0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM NCI/M2 NCI/M2 NCI/M2 NCI/M2 NCI/M2	LLL GELI LLL GELI LL GELI L
2052 1988 2055 1990 2018 2049 1987 2007 1991 2016 2028 2052 2010 2115 2037 2037 2037 2032 2032 2032 2052 2013 2052 2013 2052 2013	EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU155 EU155 EU155 EU155 EU155 EU155 EU155 EU155 EU155	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SK SK SK SK SK SK TH UK INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.64\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.52\\ 7.24\\ 10.57\\ 9.82\\ 6.66\\ 3.57\\ 9.82\\ 6.66\\ 3.57\\ 9.82\\ 6.66\\ 3.57\\ 9.82\\ 6.66\\ 3.17\\ 7.43\\ 11.11\\ 4.81\\ 3.72\\ 5.72\\ 5.8$	2.33 4.35 5.55 5.55 5.55 5.55 5.55 5.55 5	0.00 0.00	PCI/GM PCI/M2 NC	LLL GELI LLL GELI LLSL77 LASL77 LASL77 LASL77 LASL77 LASL77 LASL77 LASL77 LASL77 LASL77
2052 1988 2055 1990 2019 2019 2019 2019 2019 2019 2016 2016 2016 2016 2016 2016 2016 2017 2018 2013 2013 2012 2013 2012 2018 2022 2019	EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU155 EU155 EU155 EU155 EU155 EU155 EU155 EU155	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SK SK SK SK SK SK SK SK TH UK INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.57\\ 11.11\\ 14.50\\ 6.79\\ 13.57\\ 9.82\\ 6.66\\ 3.17\\ 7.43\\ 11.11\\ 4.81\\ 3.17\end{array}$	2.33 4.33 5.556 5.556 1.765 2.551 3.3550 1.765 2.551 3.3550 1.42768 1.42768 1.42768 1.55008	0.00 0.00	PCI/GM PCI/M2 NCI/M2 PCI/M2 NCI/M2 NCI/M2 PCI/M2 NC	LLL GELI LLL GELI
2052 1988 2055 1990 2049 1987 2007 1991 2046 2052 2010 2015 2015 2018 2032 2013 2013 2013 2013 2013 20143 2055	$\begin{array}{c} \text{EU152} \\ \text{EU152} \\ \text{EU154} \\ \text{EU155} \\ \text{EU1555} \\ $	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SS SK SK SK SK SK SK SK SK SK SK SK SK	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.64\\ 6.66\\ 11.11\\ 6.63\\ 7.24\\ 10.52\\ 7.24\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 9.82\\ 6.66\\ 3.17\\ 7.43\\ 11.11\\ 4.81\\ 3.17\\ 6.63\end{array}$	2.33 4.35 5.55 5.55 1.75 5.55 1.33 5.50 1.35 5.50 1.35 5.50 1.35 5.50 1.35 5.50 1.55 5.50	0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM NCI/M2 NCI/M2 NCI/M2 NCI/M2 NCI/M2 NCI/M2 NCI/M2	LLL GELI LLL GELI
2052 1988 2055 1990 2018 2049 1987 2007 19918 2016 2028 2052 2010 2010 2010 2015 2037 2037 2037 2032 2032 2032 2043 2052 2013 2052 2013 2052 2013 2052 2013 2053	EU152 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU154 EU155 EU155 EU155 EU155 EU155 EU155 EU155 EU155 EU155 EU155 EU155	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SK SK SK SK SK SK SK SK SK TH UK INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.64\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 13.57\\ 9.82\\ 6.66\\ 3.17\\ 7.43\\ 11.11\\ 4.81\\ 3.17\\ 6.63\\ 10.41\\ \end{array}$	2.333 3.35556 5.556 5.557 5.5333550 1.7497 6.277681155008 5.553 3.553 3.552 5.5333550 5.553 5.557 5.5008 5.523 5.523 5.523 5.5333 5.523 5.523 5.5333 5.523 5.5333 5.523 5.5333 5.523 5.5333 5.523 5.5333 5.523 5.5333 5.523 5.5333 5.523 5.53333 5.52333 5.52333 5.52333 5.5233333 5.523333 5.523333 5.52333335 5.5233333 5.52333335 5.52333335 5.5333335 5.52333335 5.5333335 5.52333335 5.5333335 5.52333335 5.5333335 5.5333335 5.533335 5.5333335 5.533335 5.533335 5.533335 5.533335 5.533335 5.533335 5.533335 5.533335 5.533335 5.533335 5.533335 5.533335 5.53335	$\begin{array}{c} 0.00\\$	PCI/GM NCI/M2 NC	LLL GELI LLL GELI LASL77 LASL77 LASL77 LASL77 LASL77 LASL77 LASL77 LASL77 LASL77 LASL77
2052 1988 2055 1990 2019 2049 1987 2007 1991 2016 2016 2016 2016 2016 2016 2016 201	$\begin{array}{c} \text{EU152} \\ \text{EU152} \\ \text{EU154} \\ \text{EU155} \\ EU$	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SK SK SK SK SK SK SK SK TH UK INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU INSITU	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 13.57\\ 9.82\\ 6.66\\ 3.17\\ 7.43\\ 11.11\\ 4.81\\ 3.17\\ 6.63\\ 10.41\\ 7.07\end{array}$	2.33 4.33 5.55 5.556 1.765 2.5513335 1.765 2.5513335 12.719 4.2768 1.553.4115 3.4115 3.4115 3.41558 4.22768 1.553.335 2.53335 2.53335 1.768 1.553.335 1.768 1.553.335 1.553.335 1.768 1.553.335 1.553.335 1.768 1.553.335 1.553.335 1.553.335 1.768 1.553.335 1.553.335 1.553.335 1.553.335 1.553.335 1.553.335 1.553.335 1.553.335 1.553.335 1.553.335 1.553.335 1.768 1.553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.5553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.55553.335 1.555553.335 1.555555555555555555555555555555555555	$\begin{array}{c} 0.00\\$	PCI/GM NCI/M2 NC	LLL GELI LLL GELI LL GELI L
2052 1988 2055 1990 2049 1987 2007 1991 2049 2049 2049 2049 2052 2016 2028 2052 2010 2015 2037 2018 2032 2052 2013 2015 2015 2032 2015 2005 2019 2016 2028 2055 2019 2016 2028 2055 2019 2016 2028 2055 2019 2016 2028 2055 2019 2016 2016 2017 2017 2017 2016 2016 2016 2016 2017 2017 2017 2017 2017 2017 2017 2017	$\begin{array}{c} \text{EU152} \\ \text{EU154} \\ \text{EU155} \\ \text{EU155} \\ \text{EU1555} \\ \ \ \text{EU1555} \\ \ \ \text{EU1555} \\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SS SK SK SK SK SK SK SK TH UNSITU INSITU	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.66\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 9.82\\ 6.66\\ 3.17\\ 7.48\\ 11.11\\ 4.81\\ 3.17\\ 6.63\\ 10.41\\ 7.07\\ 3.16\end{array}$	$\begin{array}{c} 2.33\\ 4.33\\ 5.55\\ 5.55\\ 1.75\\ 5.557\\ 5.557\\ 5.557\\ 2.551\\ 3.335\\ 12.71\\ 6.276\\ 4.76\\ 4.76\\ 4.15\\ 5.50\\ 4.55\\ 3.3\\ 5.50\\ 4.28\\ 4.23\\ 70\end{array}$	0.00 0.00	PCI/GM NCI/M2 NC	LLL GELI LLL GELI LL
2052 1988 2055 19908 2049 1987 2007 12045 2016 2028 2010 2010 2010 2015 2037 20052 2010 2013 2052 2013 2052 2013 2054 2028 2013 2052 2013 2052 2013 2052 2013 2055 2055 2055 2055 2055 2055 2055 205	$\begin{array}{c} \text{EU152} \\ \text{EU152} \\ \text{EU154} \\ \text{EU155} \\ \text{EU155} \\ \text{EU155} \\ \text{EU1555} \\ \ \ \text{EU1555} \\ \ \ \text{EU1555} \\ \ \ \text{EU1555} \\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	1977 1977 1977 1977 1977 1977 1977 1977	SK TH UK GR GR GR SG SS SK SK SK SK SK SK SK SK SK SK SK SK	$\begin{array}{c} 7.24\\ 10.37\\ 11.11\\ 6.64\\ 11.35\\ 6.64\\ 6.66\\ 11.11\\ 6.63\\ 7.10\\ 6.63\\ 10.52\\ 7.24\\ 10.37\\ 11.11\\ 14.50\\ 6.79\\ 13.57\\ 9.82\\ 6.66\\ 3.17\\ 7.43\\ 11.11\\ 4.81\\ 3.17\\ 6.63\\ 10.41\\ 7.07\\ 3.16\\ 13.77\end{array}$	2.333 5.556 5.556 1.7555 2.557 5.557 5.557 5.557 5.557 5.557 5.557 5.557 5.557 12.33355 12.7497 13.497 13.497 13.4550 15.550 12.33350 12.7497 13.497 13.4550 12.5085 3.52085 12.5085 12.	0.00 0.00	PCI/GM PCI/M2 NC	LLL GELI LLL GELI LASL77

2012	EU 155	1977	INSITU	6.79	1.77	81.60 NCI/M2	LASL77
2092	EU 155	1977	INSTITU	13.52	9 21	0 00 NCT/M2	1 451 77
2072	FILLEE	1077		0.06	4 40		
2012	20155	19//	INSTIC	9.80	4.42	0.00 NC1/M2	LASL//
2019	EU155	1977	INSITU	6.69	2.24	0.00 NCI/M2	LASL77
2067	EU 155	1977	INSITU	9.31	4 96	0 00 NCT/M2	1 451 77
2040	SUITEE	1077		4 4 4 4			
2049	20155	19//	INSTIU	11.11	5.55	0.00 NC1/M2	LASL//
2132	EU155	1977	INSITU	6.70	2.16	0.00 NCI/M2	LASL77
2084	EU 155	1977	INSTIL	12 58	7 17	O OO NCT/M2	1 451 77
2004	50155	1077	INGITU	12.00	1.11	0.00 NCI/M2	LASLII
2015	EU155	1977	INSTIU	7.37	2.31	0.00 NCI/M2	LASL77
2141	EU155	1977	INSITU	6.58	. 55	0.00 NCT/M2	145177
2059	FI1155	1077	TNSTTH	0 74	E 40		
2033	20133	1377	110110	3.14	5.42	0.00 NC1/M2	LASL//
2050	EU155	1977	INSITU	11.11	5.55	0.00 NCI/M2	LASL77
2080	EU155	1977	INSITU	10.91	7.22	0.00 NCT/M2	1 4 51 77
2085	FI1155	1077	TNSTTH	12 60	6 60		
2003	20133	1377	10110	12.00	0.58	0.00 NC1/M2	LASL//
2123	EU155	1977	INSITU	13.68	6.79	0.00 NCI/M2	LASL77
2009	EU 155	1977	INSITU	6.59	1.65	0.00 NCT/M2	1 4 51 77
2064	CI14EE	1077	TNETTU	10 54	7 40		
2004	E0155	19//	INSTIU	10.54	1.19	0.00 NC1/M2	LASL//
2155	EU155	1977	INSITU	3.91	3.49	0.00 NCI/M2	LASL77
2118	EU 155	1977	INSITU	14.55	6.45	0 00 NCT/M2	1 4 51 77
2072	ELIKEE	1077	TNETTH	0.00	4 40	0.00 NOT/M2	
2073	20155	1977	110110	9.80	4.42	0.00 NC1/M2	LASL/7
2016	EU155	1977	INSITU	7.24	2.33	0.00 NCI/M2	LASL77
2057	FU 155	1977	INSTIL	10 35	5 34	0 00 NCT/M2	1 451 77
2042	ELIXEE	1077	TNETTH	10.00	4 07		
2042	EU 155	19//	INSTIC	9.82	4.27	0.00 NC1/M2	LASL77
2008	EU155	1977	INSITU	7.40	2.10	0.00 NCI/M2	LASL77
2086	EU 155	1977	INSTIL	10 53	7 19	0 00 NCT/M2	1 451 77
2022	EU 4EE	1077	TNCTTU	10.00	1.15	0.00 NOT/M2	LAGLIT
2022	20133	19//	1113110	9.00	4.32	0.00 NC1/M2	LASL77
2027	EU 155	1977	INSITU	10.28	4.20	0.00 NCI/M2	LASL77
2014	EU 155	1977	INSITU	7 27	2.22	0.00 NOT /M2	1 451 77
2427	FUILEE	1077	TNETTU	40.40	E	0.00 NOT/M2	
2121	EU 155	1977	INSTIU	13.40	5.21	0.00 NC1/M2	LASL77
2038	EU155	1977	INSITU	9.60	4.32	0.00 NCI/M2	LASL77
2122	EU 155	1977	INSTIL	13 69	6 87	0 00 NCT/M2	1 451 77
2052	EUIIEE	1077	TNCITU	10.05	5.57	0.00 NC1/M2	LASLII
2053	E0155	19//	INSTIU	10.69	5.56	0.00 NC1/M2	LASL77
2065	EU155	1977	INSITU	10.39	5.01	0.00 NCI/M2	LASL77
2071	FU155	1977	TNSTTH	0 83	1 19	O OO NCT/MO	1 4 51 77
2047	ELLAGE	1077	THETTH		7.70	0.00 NC1/M2	LAJLII
2047	20155	19//	1115110	11.08	5.74	0.00 NCI/M2	LASL77
2138	EU 155	1977	INSITU	5.81	2.17	0.00 NCI/M2	LASL77
2033	FU155	1977	TNSTTU	3 14	3 57	0 00 NCT/M2	
2000	CUASE	1077	THETTH		5.57	0.00 NC1/M2	LASLII
2026	EU 155	19//	INSTIU	10.05	4.07	55.10 NCI/M2	LASL77
2153	EU155	1977	INSITU	3.94	4.88	0.00 NCI/M2	LASL77
2119	EU 155	1977	INSTIL	14 34	7 21	0 00 NCT/M2	1 451 77
2040	FUILEE	1077	TNCTTU	44.00	/· 5-		
2048	20155	19//	INSTIU	11.09	5.8/	0.00 NC1/M2	LASL77
1997	EU155	1977	INSITU	6.46	1.16	0.00 NCI/M2	LASL77
2039	EU 155	1977	INSTIL	9 60	4 32	0 00 NCT/M2	1 451 77
2064	ELLAGE	4077	TNCTTU	5.00	7.52	0.00 NC1/M2	LASLII
2061	E0155	1977	INSTIU	9.91	5.07	0.00 NC1/M2	LASL77
2041	EU 155	1977	INSITU	9.61	4.32	0.00 NCI/M2	LASL77
2075	FU155	1977	INSTIL	10.85	4 60	0 00 NCT/M2	1 451 77
2004	ELIAEE	1077	TNETTU	10-00	4.00		
2094	EU 155	1977	INSTIU	14.49	9.25	0.00 NC1/M2	LASL77
2024	EU 155	1977	INSITU	8.95	3.88	0.00 NCI/M2	LASL77
1996	EU155	1977	INSITU	6.45	. 75	0 00 NCT/M2	1 451 77
2025	FUILEE	1077	TNETTH	40.40	4 07		
2025	EU 155	19//	1115110	10.12	4.27	0.00 NC1/M2	LASL//
2060	EU 155	1977	INSITU	9.91	5.07	0.00 NCI/M2	LASL77
2077	EU155	1977	INSITU	10.31	4.41	0.00 NCT/M2	1 4 51 77
2066	E11155	1077	TNISTTI	10 60	4 40	EA OO NOT /MO	
2000	20133	1377	1113110	10.00	4.42	64.00 NC1/M2	LASL//
2007	EU155	1977	INSITU	7.10	2.07	0.00 NCI/M2	LASL77
2090	EU 155	1977	INSITU	13.85	7.69	0.00 NCT/M2	
2028	FU155	1977	TNSTTH	10 37	1 22	RE OO NOT/MO	1 4 51 77
2010	ELLISE	1077			7.33		
2043	20133	13//	1143110	3.91	3.49	0.00 NC1/M2	LASL77
2062	EU155	1977	INSITU	9.83	5.10	0.00 NCI/M2	LASL77
2146	EU 155	1977	INSITU	9.82	4.27	0.00 NCT/M2	145177
2140	FI1155	1077	TNSTTU	6 60			
2140	50155	1077		0.38		0.00 NC1/M2	LASL//
2135	EU155	1977	INSTIU	6.58	. 55	0.00 NCI/M2	LASL77
2058	EU 155	1977	INSITU	10.00	5.31	0.00 NCT/M2	LASI 77
2029	FI1155	1077	TNSTTH	10 25	4 20	0.00 NCT /MO	
2023	20133	1077		10.35	4.20	0.00 NC1/M2	LASL//
2079	EU155	1977	TINZTIO	10.53	7.20	0_00 NCI/M2	LASL77
2121	EU 155	1977	INSITU	13.68	6.87	0.00 NCI/M2	LASI 77
2116	FU 155	1977	INSTIL	12 74	6 10		1 4 51 77
2110	50155	4077		13.74	0.12	0.00 NC1/M2	LAGL//
2125	EU155	19/7	TINZTIO	14.68	4.45	0.00 NCI/M2	LASL77
2017	EU 155	1977	INSITU	7.25	2.33	0.00 NCI/M2	LASL77
2129	EU 155	1977	INSITU	6.27	0.00	0 00 NCT/M2	1 451 77
2074	ELLARE	1077		0.27	4.00		
2014	20133	13//	1113110	9.85	4.35	0.00 NC1/M2	LASL77
2083	EU155	1977	INSITU	12.14	7.19	0.00 NCI/M2	LASL77
2131	EU 155	1977	INSITU	6.62	1.87	0.00 NCT/M2	1 451 77
2124	FILLEE	1077	TNSTTU	6 50			
2104	20135	1011		0.58	. 55	0.00 NC1/M2	LASL //
2147	EU155	1977	UITSNI	7.77	3.07	0.00 NCI/M2	LASL77
2097	EU 155	1977	INSITU	15.45	9.75	0.00 NCT/M2	LASI 77
2022	FUISE	1077	TNSTTU	0 = 4	2 00		1 451 77
2023	20133	1011		5.34	3.90	0.00 NC1/M2	LASL//
2088	EU 155	1977	INSITU	13.22	7.66	0.00 NCI/M2	LASL77
2082	EU 155	1977	INSITU	11.62	7,18	0.00 NCT/M2	LASI 77
2130	FI1155	1077	INSTIL	6 60	EE		1 451 77
2103	50133	19/1		0.58		0.00 NC1/M2	LASL//
2087	EU155	1977	INSTIC	12.92	7.66	0.00 NCI/M2	LASL77

2154	EU 155	1977	INSTIU	3.95	4.57	0.00 NCI/M2	LAS1.77
2000	EU 155	1077	INSTIL	11 12	10 93	0 00 NCT/M2	1 451 77
2033	EUISE	1077	TNETTH	10.46	7 14		
2144	EUISS	4077	INSITU	10,40	1. IF		
2076	EU155	19//	INSTIU	11.09	4.52	0.00 NC1/M2	
2095	EU155	1977	INSITU	14.49	9.25	0.00 NC1/M2	LASL//
2093	EU 155	1977	INSITU	14.60	8.57	0.00 NCI/M2	LASL77
2040	EU 155	1977	INSITU	9.60	4.32	0.00 NCI/M2	LASL77
2136	EU 155	1977	INSITU	6.58	. 55	0.00 NCI/M2	LASL77
2120	511455	1077	INSTIL	14 30	7 16	0 00 NCT/M2	
2004	EUIIEE	4077		14,00	7 24	0.00 NCT/M2	
2081	EU 155	19//	INSTIC	11.31	7.21		
2068	EU 155	1977	INSITU	9.30	5.02	0.00 NC1/M2	LASL//
2030	EU 155	1977	INSITU	10.35	4.30	0.00 NCI/M2	LASL77
2096	EU 155	1977	INSITU	14,49	9.24	0.00 NCI/M2	LASL77
2126	EU155	1977	INSITU	12.45	4.27	0.00 NCI/M2	LASL77
2148	FU 155	1977	INSTIL	2.98	3.62	0.00 NCI/M2	LASL77
2011	EU 155	1077	TNSTTI	6 32		40 20 NCT/M2	
2011	EU 155	1077	INSITU	44.25	E 06		
2055	EU 155	19//	INSTIU	11.35	5.80		
2130	EU 155	1977	INSTIU	6.03	.60	0.00 NC1/M2	LASL//
2114	EU 155	1977	INSITU	10.46	7.18	0.00 NCI/M2	LASL77
2101	EU 155	1977	INSITU	16.52	14.74	0.00 NCI/M2	LASL77
2142	EU 155	1977	INSITU	6.27	.00	0.00 NCI/M2	LASL77
2067	G-NAT	1977	INSTIL	9.31	4.96	6.37 UR/HR	LASI 77
2007	G-NAT	1077	TNISTTU	10 52	7 20	5 19 UD/HD	
20/9	G-NAT	19/1	INSTIU	10.53	7-20		
2086	G-NAT	1977	INSTIC	10.53	7.19	4.75 UR/HR	LASL//
2033	G-NAT	1977	INSITU	3.14	3.57	8.05 UR/HR	LASL77
2016	G-NAT	1977	INSITU	7.24	2.33	11.10 UR/HR	LASL77
2121	G-NAT	1977	INSITU	13.68	6.87	15.11 UR/HR	LASL77
2010	G-NAT	1977	INSTIL	6.79	1.71	6.42 UR/HR	LASL77
1000	G-NAT	1077	TNISTTI	6 63	55	9 57 UP/HP	
1990	G-NAT	4077	INSTIU	14.60	0 57		
2093	G-NAT	1977	INSTIU	14.60	8.5/	0.75 UR/HR	
2114	G-NAT	1977	INSITU	10.46	7.18	4.72 UR/HR	LASL//
2129	G-NAT	1977	INSITU	6.27	0.00	7.70 UR/HR	LASL77
2058	G-NAT	1977	INSITU	10.00	5.31	8.21 UR/HR	LASL77
2072	G-NAT	1977	INSITU	9.86	4.42	8.93 UR/HR	LASL77
2080	G-NAT	1977	INSTIL	10 91	7 22	5.30 UR/HR	145177
2440	C-NAT	4077	TNETTH	6 50			
2140	G-NAT	19//	105110	0.56	. 55		
2007	G-NA I	1977	INSTIU	7.10	2.07	6.82 UR/HR	LASL
2018	G-NAT	1977	INSITU	6.66	1.76	6.94 UR/HR	LASL77
2088	G-NAT	1977	INSITU	13.22	7.66	9.01 UR/HR	LASL77
2087	G-NAT	1977	INSITU	12.92	7.66	8.75 UR/HR	LASL77
2019	G-NAT	1977	INSTIL	6.69	2.24	5.38 UR/HR	145177
2012	G-NAT	1077	TNETTH	9.54	2 08	7 89 UP/HP	
2023	G NAT	4077	INSTIC	40.77	5.50		
2128	G-NAT	19//	INSTIU	13.77	5.47		
2134	G-NA I	1977	INSTIU	6.58	. 55	0.40 UK/HK	LASL
2064	G-NAT	1977	INSITU	10.54	7.19	4.76 UR/HR	LASL //
2 100	G-NAT	1977	INSITU	14.50	12.20	8.09 UR/HR	LASL77
2144	G-NAT	1977	INSITU	10.46	7.19	3_87 UR/HR	LASL77
2040	G-NAT	1977	INSTIL	9.60	4.32	5.72 UR/HR	LASL77
2094	G-NAT	1077	TNSTTU	11 31	7 21	6 18 UR/HR	1 451 77
2425	C-NAT	1077	TNISTTU	6 59	55		
2135	G-NAT	19/1	INSTIU	0.58	E 40		
2062	G-NAT	19//	INSTIU	9.83	5.10		
2030	G-NA I	1977	INSTIU	10.39	4.30	8.05 UR/HR	LASL//
2066	G-NAT	1977	INSITU	10.60	4_42	8.82 UR/HR	LASL77
2155	G-NAT	1977	INSITU	3.91	3.49	7,02 UR/HR	LASL77
2120	G-NAT	1977	INSITU	14.30	7.16	8.83 UR/HR	LASL77
2009	G-NAT	1977	INSITU	6.59	1.65	9.11 UR/HR	LASL77
2082	G-NAT	1977	INSTTU	11.62	7.18	8.07 UR/HR	LASL77
2125	G-NAT	1077	INSTIL	14 68	4 45	11.56 UR/HR	LASI 77
2123	C-NAT	4077	TNETTH	0.86	4 40		
2073	GINAT	19//	INSTIU	5.00	4.42 E EE		
2052	G-NAT	1977	INSTIU	11.11	5.55	9.69 UR/HR	
2083	G-NAT	1977	INSITU	12.14	/.19	4,75 UR/HR	LASL//
2017	G-NAT	1977	INSITU	7.25	2.33	11.56 UR/HR	LASL77
2085	G-NAT	1977	INSITU	12.60	6.58	7.03 UR/HR	LASL77
2041	G-NAT	1977	INSITU	9.61	4.32	6.54 UR/HR	LASL77
2097	G-NAT	1977	INSTIL	15.45	9.75	8.55 UR/HR	LASL77
2024	G-NAT	1077	TNSTTU	8 95	3 88	8 31 UR/HR	145177
2024	G NAT	4077	INSITU	0.55	2 70		
2034	G-NAI	19/7	INSTIU	3.10	3.70		
2020	G-NAT	1977	INSTIU	3.17	3.48	3.33 UK/HK	
2068	G-NAT	1977	INSITU	9.30	5.02	8.06 UR/HR	LASL/7
2060	G-NAT	1977	INSITU	9.91	5.07	9.48 UR/HR	LASL77
2092	G-NAT	1977	INSITU	13.52	9.21	3.70 UR/HR	LASL77
2011	G-NAT	1977	INSITU	6.32	. 00	8.96 UR/HR	LASL77
2022	G-NAT	1977	INSTIL		4 32	7.22 LR/HR	LASI 77
2022	G-NAT	1077	TNSTTU	7 43	2 11		1 451 77
2013	G-INAT	1077	TNETTH	7.43	0.04		
2096	G-NA	19//	1115110	14.49	5.24		
2059	G-NAT	1977	INSITU	9.74	5.42	7.68 UR/HR	LASL//
2074	G-NAT	1977	INSITU	9.85	4.35	6.41 UR/HR	LASL77
2049	G-NAT	1977	INSITU	11.11	5.55	5.82 UR/HR	LASL77
2148	G-NAT	1977	INSITU	2.98	3.62	8.38 UR/HR	LASL77
2043	G-NAT	1977	INSTIL	2 0 1	3 49	6.37 UR/HR	LASI 77
	G HANT		1.10110	5.5	0.40		

2116	G-NAT	1977	INSITU	13.74	6.12	9.16 UR/HR	LASL77
2075	G-NAT	1977	INSTIU	10,85	4.60	6.05 UR/HR	LASL77
24/2	G-NAT	1077	INSTITU	6 27		7 68 UR/HR	
2021	G-NAT	1077	INSTIU	10 41	1 20	6 07 UP/HP	
2031	G-NAT	19//	INSTIU	10.41	4.20		
1990	G-NAT	19//	INSTIU	0.45	. /5		
2130	G-NA I	19//	INSTIU	6.03	. 60	9.10 UR/HR	
2136	G-NAT	1977	INSITU	6.58	. 55	5.47 UR/HR	LASL77
2047	G-NAT	1977	INSITU	11.08	5.74	7.17 UR/HR	LASL77
2077	G-NAT	1977	INSITU	10.31	4.41	7.29 UR/HR	LASL77
2008	G-NAT	1977	INSITU	7.40	2.10	15.99 UR/HR	LASL77
2138	G-NAT	1977	INSITU	5.81	2.17	1.55 UR/HR	LASL77
1997	G-NAT	1977	INSITU	6.46	1.16	4.56 UR/HR	LASL77
2037	G-NAT	1977	INSTIL	9 82	4 27	9.27 UR/HR	LASL77
2042	G-NAT	1977	INSTIL	9.82	4 27	9.69 UR/HR	
2042	G-NAT	4077	TNSTTU	14 49	9.27	5 83 UP/HP	
2095	G-NAT	19//	INSTIU	14.45	3.23		
2025	G-NAT	19//	INSTIU	10.12	4.2/		
2027	G-NA I	1977	INSTIU	10.28	4.20	4.36 UR/HR	LASL//
2057	G-NAT	1977	INSITU	10.35	5.34	7.36 UR/HR	LASL77
2127	G-NAT	1977	INSITU	13.40	5.21	7.87 UR/HR	LASL77
2147	G-NAT	1977	INSITU	7.77	3.07	5.42 UR/HR	LASL77
2118	G-NAT	1977	INSITU	14.55	6.45	8.82 UR/HR	LASL77
2026	G-NAT	1977	INSITU	10.05	4.07	8.56 UR/HR	LASL77
2141	G-NAT	1977	INSTTU	6.58	. 55	8.74 UR/HR	LASL77
2143	G-NAT	1977	INSTIL	4 81	3 00	5.72 UR/HR	LASL 77
2140	G-NAT	1077	TNSTTU	9.87	4 27	3 46 UP/HP	
2140	G NAT	4077	INSTIC	5.02	2 16		
2132	G-NAT	19//	INSTIU	6.70	2.10	4.72 UR/HR	
2123	G-NAT	19//	INSITU	13.68	6.79	12.60 UR/HR	
2038	G-NAT	1977	INSITU	9.60	4.32	5.73 UR/HR	LASL//
2061	G-NAT	1977	INSITU	9.91	5.07	9.96 UR/HR	LASL77
2076	G-NAT	1977	INSITU	11.09	4.52	3.85 UR/HR	LASL77
2153	G-NAT	1977	INSITU	3.94	4.88	5.50 UR/HR	LASL77
2039	G-NAT	1977	INSITU	9.60	4.32	5.98 UR/HR	LASL77
2119	G-NAT	1977	INSITU	14.34	7.21	6.71 UR/HR	LASL77
2048	G-NAT	1077	INSTIL	11.09	5 87	6.97 UR/HR	
2040	G-NAT	1077	INSTIU	16 52	14 74	6 87 UD/HD	
2101		19/1	INSTIU	10.52	17./7 EE		
2139	G-NAT	19//	INSTIU	0.38	. 55		
2090	G-NA I	19//	INSITU	13.85	7.69	14.08 UR/HR	LASL//
2154	G-NAT	1977	INSITU	3.95	4.57	4.79 UR/HR	LASL//
2131	G-NAT	1977	INSITU	6.62	1.87	6.77 UR/HR	LASL77
2014	G-NAT	1977	INSITU	7.37	2.22	11.02 UR/HR	LASL77
2126	G-NAT	1977	INSITU	12.45	4.27	7.09 UR/HR	LASL77
2084	G-NAT	1977	INSITU	12.58	7.17	8.11 UR/HR	LASL77
2065	G-NAT	1977	INSITU	10.39	5.01	5.96 UR/HR	LASL77
2006	G-NAT	1977	INSITU	7.07	2.04	5.40 UR/HR	LASL77
2071	G-NAT	1977	INSITU	9.83	4.48	7.56 UR/HR	LASL77
2445	G-NAT	1077	INSTIL	13 57	6 49	8 65 UR/HR	
2000	G NAT	4077	INSTIU	10.35	4 29		
2025	G-NAT	4077	INSITU	10.35	4.20		
2029	GINAT	19//	1115110	10.35	4.20		
2094	G-NA I	1977	INSTIU	14.49	9.25	7.01 UR/HR	LASL
2055	G-NAT	1977	INSITU	11.35	5.86	7.03 UR/HR	LASL//
2050	G-NAT	1977	INSITU	11.11	5.55	5.64 UR/HR	LASL77
2015	G-NAT	1977	INSITU	7.37	2.31	2.87 UR/HR	LASL77
2012	G-NAT	1977	INSITU	6.79	1.77	9.47 UR/HR	LASL77
2099	G-NAT	1977	INSITU	11.12	10.93	3.96 UR/HR	LASL77
2053	G-NAT	1977	INSTTU	10.69	5.56	4.46 UR/HR	LASL77
2138	G-NAT	1977	INSTIL	5.81	2.17	8.15 UR/HR	LASL77
2022	G-NAT	1977	INSTIL	3 17	3.48	8.79 UR/HR	LASL77
2101	G-TOT	1077	TNSTTU	16 52	14 74	7.34 UR/HP	LASI 77
2101	G-TOT	1077	TNETTI	44 60	9 67		
2053		19/1	TNSTTU	14.00	5.57		
2065	G-101	19//	INSTIU	10.39	5.01		
2015	G-101	1977	INSITU	1.37	2.31	3.29 UK/HR	
2096	G-TOT	1977	INSITU	14.49	9.24	7.25 UR/HR	LASL//
2087	G-TOT	1977	INSITU	12.92	7.66	9.75 UR/HR	LASL//
2144	G-TOT	1977	INSITU	10.46	7.19	4.12 UR/HR	LASL77
2027	G-TOT	1977	INSITU	10.28	4.20	5.67 UR/HR	LASL77
2014	G-TOT	1977	INSITU	7.37	2.22	11.47 UR/HR	LASL77
2082	G-TDT	1977	INSITU	11.62	7.18	8.89 UR/HR	LASL77
2011	G-TOT	1977	INSTTU	6.32	.00	9.28 UR/HR	LASL77
2052	G-TOT	1977	INSTIL	11 11	5.55	10.23 UR/HR	LASL77
2002		1077	TNSTTI	6 70	1 77	10 46 UP/HP	1 4 51 77
2012	. G-TOT	1077		0./2	2 47		
2138		19//	TNETTU	5.81	2.1/		
2143	G-101	1977	INSTIU	4.81	3.00	5.89 UK/HK	
1998	G-TOT	1977	INSITU	6.63	.55	10.60 UR/HR	LASL/7
2067	G-TOT	1977	INSITU	9.31	4.96	7.04 UR/HR	LASL77
2136	G-TOT	1977	' INSITU	6.58	.55	174.70 UR/HR	LASL77
2068	G-TOT	1977	/ INSITU	9.30	5.02	9.14 UR/HR	LASL77
2148	G-TOT	1977	INSITU	2.98	3.62	8.62 UR/HR	LASL77
2018	G-TOT	1977	INSITU	6.66	5 1.76	7.36 UR/HR	LASL77
2095	G-TOT	1977	INSTIL	14.49	9.25	6.26 UR/HR	LASL77
2122	. С. ТОТ	1977		6 70	2 16	4,91 UR/HR	LASL77
2132			1110110	0.70			
2058	G-TOT	1977	INSTIL	10.00	5 21	9 95 UD/HD	1 451 77
------	-------	------	--------	-------	-------	--------------	-----------
2028	G-TOT	1077	TNSTTU	10.00	4 22		
2030	C-TOT	4077	INSTIU	9.00	4.32		
2071	0 707	19//	INSTIU	9.83	4.48	9.53 UR/HR	LASL//
2074	G-101	1977	INSITU	9.85	4.35	7.75 UR/HR	LASL77
2024	G-TOT	1977	INSITU	8.95	3.88	8.93 UR/HR	LASL77
2039	G-TOT	1977	INSITU	9.60	4.32	8.14 UR/HR	LASL77
2120	G-TOT	1977	INSITU	14.30	7.16	9.65 UR/HR	LASL77
2141	G-TOT	1977	INSITU	6.58	. 55	10.34 UR/HR	LASL77
2072	G-TOT	1977	INSTIL	9.86	4 42	12 65 110/10	
2033	G-TOT	1077	TNSTTU	3.00	2 57		
2000	G-TOT	1077	INSTIC	3.14	3.57	8.22 UR/HR	
2092	G-101	19//	INSTIU	13.52	9.21	4.07 UR/HR	LASE77
2153	G-101	1977	INSITU	3.94	4.88	5.76 UR/HR	LASL77
2009	G-TOT	1977	INSITU	6.59	1.65	10.15 UR/HR	LASL77
2019	G-TOT	1977	INSITU	6.69	2.24	5.62 UR/HR	LASL77
2017	G-TOT	1977	INSITU	7.25	2.33	11.78 UR/HR	LASL77
2049	G-TOT	1977	INSITU	11.11	5.55	6.44 UR/HR	1 4 51 77
2077	G-TOT	1977	INSTIL	10 31	4 4 1	7 67 UP/HP	
2086	G-TOT	1677	TNSTTU	10.51	7 10		
2000	G-TOT	4077	INSTIU	10.53	1.19	5.06 UR/HR	
2037	G-101	19//	INSTIU	9.82	4.27	12_03 UR/HR	LASL//
2123	G-101	1977	INSTIU	13.68	6.79	13.24 UR/HR	LASL77
2022	G-TOT	1977	INSITU	9.60	4.32	9.70 UR/HR	LASL77
2047	G-TOT	1977	INSITU	11.08	5.74	7.92 UR/HR	LASL77
2130	G-TOT	1977	INSITU	6.03	. 60	9.89 UR/HR	LASL77
2050	G-TOT	1977	INSITU	11.11	5.55	6.17 UR/HR	1 451 77
2025	G-TOT	1977	INSTIL	10 12	4 27	8 59 UP/HP	
2146	G-TOT	1977	INSTIL	9 92	1 27		
2055	G-TOT	4077	INSTIC	5.02	4.27		
2055		19//	INSTIC	11.35	5.80	7.23 UR/HR	LASL//
2147	G-101	1977	INSTIU	7.77	3.07	5.69 UR/HR	LASL77
2007	G-101	1977	INSITU	7.10	2.07	7.57 UR/HR	LASL77
2075	G-TOT	1977	INSITU	10.85	4.60	6.34 UR/HR	LASL77
2114	G-TOT	1977	INSITU	10.46	7.18	5.04 UR/HR	LASL77
2076	G-TOT	1977	INSITU	11.09	4.52	4.52 UR/HR	LASL77
2026	G-TOT	1977	TNSTTU	10.05	4 07	11 23 UR/HR	
2110	G-TOT	1077	TNSTTU	14 24	7 0 4		
2113	C-TOT	1077	INSITU	14.34	/.21		
2134		1977	INSTIU	0.58	. 55	1/1.20 UR/HR	LASL//
2023	G-101	19//	INSTIU	9.54	3.98	9.59 UR/HR	LASL77
2115	G-TOT	1977	INSITU	13.57	6.49	9.25 UR/HR	LASL77
2053	G-TOT	1977	INSITU	10.69	5.56	5.25 UR/HR	LASL77
2129	G-TOT	1977	INSITU	6.27	0.00	7.95 UR/HR	LASL77
2059	G-TOT	1977	INSITU	9.74	5.42	8.81 UR/HR	LASL77
2126	G-TOT	1977	INSTTU	12.45	4 27	7 48 UR/HR	1 451 77
2081	G-TOT	1977	INSTIL	11 31	7 2 1	6 95 UD/HD	
2040	G-TOT	1077	TNSTTU	9.60	1 21		
2040	G-TOT	1077	INSTIU	5.00	4.32	5 70 UD/UD	
2000		1077	INSITU	10.91	1.22	5.72 UR/HR	LASL//
2138	G-101	19//	INSTIU	5.81	2.17	10.34 UR/HR	LASL77
2066	G-101	1977	INSITU	10.60	4.42	10.17 UR/HR	LASL77
2057	G-TOT	1977	INSITU	10.35	5.34	8.24 UR/HR	LASL77
2032	G-TOT	1977	INSITU	3.17	3.48	9.17 UR/HR	LASL77
1996	G-TDT	1977	INSITU	6.45	.75	9.32 UR/HR	LASL77
2094	G-TOT	1977	INSITU	14.49	9.25	7.62 UR/HR	LASL77
2061	G-TOT	1977	INSITU	9,91	5.07	10.66 UR/HR	1 451 77
2030	G-TOT	1977	INSTIU	10.39	4.30	10 98 UR/HR	
2060	G-TOT	1077	INSTIL	0.05	5 07		
2010	G-TOT	1077	TNSTTU	5.51	3.07		
2010	G-TOT	1077	INSTIU	0.79	1.71		
2110		12//	INSTIU	14.55	0.45	9.52 UR/HR	LASL//
2097	G-101	19//	INSITU	15.45	9.75	8.9/ UR/HR	LASL//
2100	G-101	1977	INSTIU	14.50	12.20	8.51 UR/HR	LASL77
2006	G-TOT	1977	INSITU	7.07	2.04	6.20 UR/HR	LASL77
2135	G-TDT	1977	INSITU	6.58	.55	397.00 UR/HR	LASL77
2042	G-TOT	1977	INSITU	9.82	4.27	12.25 UR/HR	LASL77
2121	G-TDT	1977	INSITU	13.68	6.87	15.95 UR/HR	LASL77
2079	G-TOT	1977	INSTIL	10.53	7 20	5 53 UP/HP	
2083	G-TOT	1977	INSTIL	12 14	7 19	5 67 110/110	
2155	G-TOT	1077	INSTIU	2.14	2 40		
2133		4077	INSTIU	3.91	5.45		
212/		19//	INSTIC	13.40	5.21	8.08 UR/HR	LASL//
2099	G-101	19/7	INSTIU	11.12	10.93	4.32 UR/HR	LASL77
2085	G-101	1977	INSITU	12.60	6.58	8.04 UR/HR	LASL77
2013	G-TOT	1977	INSITU	7.43	2.11	9.98 UR/HR	LASL77
2029	G-TOT	1977	INSITU	10.35	4.28	7.89 UR/HR	LASL77
2088	G-TOT	1977	INSITU	13.22	7.66	9.93 UR/HR	LASL77
2116	G-TOT	1977	INSITU	13.74	6.12	9.78 UR/HR	LASL77
2064	G-TOT	1977	INSITU	10.54	7,19	5.08 UR/HR	LASL77
2125	G-TOT	1977	INSTIU	14 68	4 45	12 20 UP/HP	
2121	G-TOT	1977	INSTIT	6 60	1 07	6 97 110/00	
2440	G-TOT	1077	TNETTU	0.02			LAJL//
2000		1077	TNETTU	0.58		9.77 UK/HR	
2008	9-101	19//	INSTIU	7.40	2.10	0.24 UR/HR	LASL77
2031	G-101	1977	INSITU	10.41	4.28	7.44 UR/HR	LASL77
2139	G-TOT	1977	INSITU	6.58	. 55	21.95 UR/HR	LASL77
2128	G-TOT	1977	INSITU	13.77	5.47	9.79 UR/HR	LASL77
2034	G-TDT	1977	INSITU	3.16	3.70	8.89 UR/HR	LASL77

2020	G-TOT	1977	INSITU	3.17	3.48	9.95 UR/HR	LASL77
2154	C-TOT	1977	INSTIL	3 95	4.57	5.16 UR/HR	LASL77
2000		1077	INSTIL	13 85	7 69	14 68 UR/HR	
2090		19//	TNETTU	13.03	5 10		
2062	G-IUI	1977	INSTIU	9.63	5.10		
2041	G-101	1977	INSTIU	9.61	4.32		
2142	G-TOT	1977	INSITU	6.27	. 00	7.90 UR/HR	LASL //
2084	G-TOT	1977	INSITU	12.58	7.17	8.89 UR/HR	LASL77
2043	G-TOT	1977	INSITU	3.91	3.49	6.42 UR/HR	LASL77
2016	G-TOT	1977	INSTIL	7.24	2.33	11.50 UR/HR	LASL77
2048	G-TOT	1077	TNSTTH	11 09	5 87	7 55 UR/HR	LASL77
2040		4077	TNETTU	6.46	1 16		
1997	G-101	19//	INSTIC	0.40	1.10		
2029	G-101	1977	INSTIU	10.35	4.28	11.72 UR/HR	
2073	G-TOT	1977	INSITU	9.86	4.42	12.42 UR/HR	LASL//
2061	K40	1977	INSITU	9.91	5.07	24.10 PCI/GM	LASL77
2115	K40	1977	INSITU	13.57	6.49	21.50 PCI/GM	LASL77
2073	K40	1977	INSITU	9.86	4.42	22.60 PCI/GM	LASL77
2130	K40	1977	INSTIL	6.03	. 60	18.50 PCI/GM	LASL77
2154	KAO	1977	INSTITU	3 95	4 57	11 79 PCT/GM	LASL77
2134		4077	TNETTH	14 55	6 45	19 40 PCT/GM	
2110	K40	19//	INSTIU	14.55	0.45	13.40 PC1/GM	
2011	K40	1977	INSTIU	6.32	00	24.30 PC1/GM	LASL
2127	K40	1977	INSITU	13.40	5.21	15.90 PCI/GM	LASL //
2009	K40	1977	INSITU	6.59	1.65	16.65 PCI/GM	LASL77
2144	K40	1977	INSITU	10.46	7.19	12.40 PCI/GM	LASL77
2083	KAO	1977	TNSTTU	12 14	7 19	9.90 PCI/GM	LASL77
2000		4077	TNICTTH	2 91	3 49	14 29 PCT/GM	1 4 51 77
2043	K40	19/1	INSTIU	3.51	5.45 E 06	16 EO DOT/CM	
2055	K40	1977	INSTIC	11.35	5.80	18.50 FC1/GM	
2029	K40	1977	INSITU	10.35	4_28	18.57 PC1/GM	LASL//
2134	K40	1977	INSITU	6.58	. 55	14.68 PCI/GM	LASL //
2119	K40	1977	INSITU	14.34	7.21	17.32 PCI/GM	LASL77
2077	K40	1977	INSITU	10.31	4.41	17.08 PCI/GM	LASL77
2064	K40	1977	TNSTTU	10 54	7.19	14.56 PCI/GM	LASL77
2004	K40	4077	TNETTH	6 58	55	23 90 PCT/GM	1 451 77
2140	N40	1077	INSTIU	0.50	2 70	10 16 PCT/GM	
2034	K40	1977	INSITU	3.16	3.70	19.16 PCI/GM	
2065	K40	1977	INSTIU	10.39	5.01	13.80 PCI/GM	LASL//
1998	K40	1977	INSITU	6.63	. 55	29.90 PCI/GM	LASL
2128	K40	1977	INSITU	13.77	5.47	18.30 PCI/GM	LASL77
2146	K40	1977	INSITU	9.82	4.27	6.41 PCI/GM	LASL77
2023	K40	1977	INSITU	9.54	3.98	17.30 PCI/GM	LASL77
2101	K40	1977	INSTIL	16.52	14.74	14.90 PCI/GM	LASL77
2402		4077	TNISTTI	13 69	6 79	28 40 PCT/GM	145177
2123	K40	19/1	INSTIC	13.00	5 74	10 00 DCT/CM	
2047	K40	19//	INSTIU	11.08	5.74	12.85 PCI/GM	
2032	K40	1977	INSITU	3.17	3_48	17_10 PCI/GM	LASL//
2116	K40	1977	INSITU	13.74	6.12	19.60 PCI/GM	LASL //
2018	K40	1977	INSITU	6.66	1.76	20.40 PCI/GM	LASL77
2084	K40	1977	INSITU	12.58	7.17	18.30 PCI/GM	LASL77
2008	K40	1977	INSTTU	7,40	2.10	13.28 PCI/GM	LASL77
2086	K40	1977	TNSTTU	10.53	7.19	15.01 PCI/GM	LASL77
2016	KAO	1077	TNSTTU	7 24	2 33	30 94 PCT/GM	1 4 51 77
2010		4077		,	5 10	16 90 PCT/GM	
2002	K40	19//	INSTIU	5.03	3.10	18 10 PCI/CM	
2010	K40	1977	INSTIC	6.79	1.71		
2019	K40	1977	INSITU	6.69	2.24	16.11 PCI/GM	LASL //
2017	K40	1977	INSITU	7.25	2.33	26.60 PCI/GM	LASL77
2020	K40	1977	INSITU	3.17	3.48	19.48 PCI/GM	LASL77
2114	K40	1977	INSITU	10.46	7.18	14.48 PCI/GM	LASL77
2075	K40	1977	INSITU	10.85	4.60	14.80 PCI/GM	LASL77
2071	KAO	1977	INSTIL	9.83	4.48	.16.20 PCI/GM	LASL77
2120	K40	1077	TNSTTU	14 30	7 16	19 70 PCI/GM	145177
2120	×40	1077	TNETTH		1 07	19 80 PCT /CM	
2131	K40	19//	INSTIU	0.02	1.07	13.00 FCI/CM	
2007	K40	1977	INSITU	7.10	2.07	17.43 PCI/GM	
2030	K40	1977	INSTIU	10.39	4.30	18.60 PCI/GM	LASL
2090	K40	1977	INSITU	13.85	7.69	29.60 PCI/GM	LASL77
2099	K40	1977	INSITU	11.12	10.93	10.60 PCI/GM	LASL77
1996	K40	1977	INSITU	6.45	. 75	26.60 PCI/GM	LASL77
2013	K40	1977	INSITU	7.43	2.11	25.20 PCI/GM	LASL77
2022	KAO	1977	TNSTTU	9 60	4.32	16.30 PCI/GM	LASL77
2426	K40	4077	TNETTH	12 45	4 27	16 10 PCT/GM	145177
2120	K40	4077	TNSTTU	7 97	7.27	19 79 PCT/CM	
2014	K40	19//	INSTIC	7.37	2.22	15.75 FCI/GM	
2041	K40	1977	TN2TIO	9.61	4.32	13.10 PC1/GM	LASL//
2042	K40	1977	INSITU	9.82	4.27	22.37 PCI/GM	LASL77
2080	K40	1977	INSITU	10.91	7.22	15.10 PCI/GM	LASL77
2136	K40	1977	INSITU	6.58	. 55	12.55 PCI/GM	LASL77
2082	K40	1977	INSITU	11.62	7.18	18.80 PCI/GM	LASL77
2066	K40	1977	TNSTTI	10.60	4 42	20.80 PCI/GM	LASL77
2000	KAO	1077	TNSTTH	Q 20	4 27	21.90 PCT/GM	LASI 77
2037	N40	4077	TNCTTH	40.02	5 24	17 80 PCT/CM	1 4 51 77
2057	K40	19/7	INSIIU	10.35	3.34		1 101 77
2028	K40	1977	INSTIU	10.37	4.33	10.90 PC1/GM	
1997	K40	1977	INSITU	6.46	1.16	12.84 PC1/GM	LASL //
2025	K40	1977	' INSITU	10.12	4.27	12.81 PCI/GM	LASL77
2094	K40	1977	INSITU	14.49	9.25	18.10 PCI/GM	LASL77
2085	K40	1977	INSITU	12.60	6.58	15.30 PCI/GM	LASL77

2006	K40	1977	INSITU	7.07	2.04	4.66	PCI/GM	LASL77
2093	K40	1977	INSITU	14.60	8.57	:5.20	PCI/GM	LASL77
2067	K40	1977	INSITU	9.31	4.96	14.80	PCI/GM	LASL77
2053	K40	1977	INSITU	10.69	5.56	8.90	PCI/GM	LASL77
2129	K40	1977	INSITU	6.27	0.00	21.66	PCI/GM	LASL77
2122	K40	1977	INSITU	13.69	6.87	30.60	PCI/GM	LASL77
2138	K40	1977	INSITU	5.81	2.17	25.31	PCI/GM	LASL77
2015	K40	1977	INSTIU	7.37	2.31	4.37	PCI/GM	LASL77
2039	K40	1977	INSITU	9.60	4.32	12.10	PCI/GM	LASL77
2049	K40	19//	INSTIU	11.11	5.55	14.10	PCI/GM	LASL77
2068	K40	19//	INSTIU	9.30	5.02	18.20	PCI/GM	LASL77
2097	K40	19//	INSTIU	15.45	9.75	20.74	PCI/GM	LASL77
2038	K40	1977	INSTIU	9.60	4.32	11.20	PCI/GM	LASL77
2081	K40	19//	INSTIU	11.31	7.21	16.60	PCI/GM	LASL77
2060	K40	19//	INSTIU	9.91	5.07	23.90	PCI/GM	LASL77
20/9	K40	1977	INSTIU	10.53	7.20	14.90	PCI/GM	LASL77
2135	K40	19//	INSTIU	0.58	.55	43.00	PCI/GM	LASL77
2040	K40	19//		11.09	5.87	14.50	PCI/GM	LASL //
2033	K40	19//		3.14	3.5/	14.92	PCI/GM	LASL77
2000	K40	4077		13.22	1.00	16.40	PCI/GM	LASL //
2031	K40	19//		10.41	4.28	13.90	PCI/GM	LASL //
2030	K40	19//		11.11	5.55	13.60	PCI/GM	LASL //
2143	K40	19//		4.81	3.00	12.15	PCI/GM	LASL //
2021	K40	19//		10.28	4.20	9.65	PCI/GM	LASL //
2141	K40	19//		0.50	. 55	26.40	PCI/GM	LASL/7
2035	K40	19/1		9.74	5.42	17.50	PCI/GM	LASL //
2040	K40	19//		9.60	4.32	11.32	PCI/GM	LASL //
2139	K40	4077		6.58	.55	24.90	PCI/GM	LASL77
2132	K40	19//	INSTIU	6.70	2.16	12.33	PCI/GM	LASL77
2072	K40	19//	INSITU	9.86	4.42	21.10	PCI/GM	LASL77
2074	K40	19//	INSTIU	9.85	4.35	13.50	PCI/GM	LASL77
2125	K40	19//	INSTIU	14.68	4.45	28.90	PCI/GM	LASL77
2024	K40	19//	INSITU	8.95	3.88	14.95	PCI/GM	LASL 77
2147	K40	19//	INSTIU	7.77	3.07	12.60	PC1/GM	LASL77
2007	K40	19//	INSTIU	12.92	1.66	20.50	PCI/GM	LASL 77
2121	K40	19//	INSTIU	13.68	6.87	28.90	PCI/GM	LASL77
2092	K40	19//	INSITU	13.52	9.21	11.20	PCI/GM	LASL77
2026	K40	19//	INSTIU	10.05	4.07	19.50	PCI/GM	LASL77
2100	K40	19//	INSTIU	14.50	12.20	17.70	PCI/GM	LASL77
2058	K40	19//	INSTIU	10.00	5.31	19.50	PCI/GM	LASL77
2095	K40	1977	INSITU	14.49	9.25	15.50	PCI/GM	LASL77
2096	K40	19//	INSITU	14.49	9.24	15.90	PCI/GM	LASL77
2142	K40	19//	INSTIU	6.27	.00	22.40	PCI/GM	LASL77
2012	K40	19//		6.79	1.//	25.80	PCI/GM	LASL //
2070	K40	19//		11.09	4.52	7.40	PCI/GM	LASL //
2052	K40	19//		11.11	5.55	22.60	PCI/GM	
2133	K40	19//		3.91	3.49	13.50	PCI/GM	
2140	K40	19//		2.98	3.62	19.70	PCI/GM	
2100	NROS	19/1		3-94	4.88	7.25	PCI/GM	
2030	NR95	19/1		14.49	9.24	5.06	NCI/M2	
2123	NB95	1977		10.53	6 70	4.01	NCI/M2	
2081	NB95	1977		13.00	7 01	0.00	NCI/M2	
2097	NB95	1977		15 /5	0 75	2 70	NCI/M2	
2052	NB95	1977	INSTITU	11.40	5.75	3.75	NCT/M2	
2122	NB95	1977		12 60	5.55	4.40	NCI/M2	
2130	NB95	1977	INSTITU	6 03	60.87	1 66	NCT/M2	
2142	NB95	1977	INSTITU	6 27	.00	2 01	NCT/M2	
2138	NB95	1977	INSTIU	5 81	2 17	1 55	NCT/M2	
2118	NB95	1977	INSITU	14.55	6.45	5 46	NCI/M2	
2115	NB95	1977	INSTIU	13 57	6 49	5 35	NCT/M2	
2129	NB95	1977	INSTTU	6 27	0.00	2 88	NCT/M2	
1998	NB95	1977	INSTIU	6 63	55	2.00	NCT/M2	
2079	NB95	1977	INSTTU	10 53	7 20	4 16	NCT/M2	
2135	NB95	1977	INSITU	6.58	. 55	0.00	NCT/M2	
2141	NB95	1977	INSITU	6.58	. 55	3.20	NCT/M2	
2030	NB95	1977	INSITU	10.39	4.30	5.19	NCT/M2	
2033	NB95	1977	INSITU	3,14	3.57	0.00	NCI/M2	LASL77
2058	NB95	1977	INSITU	10.00	5.31	4.59	NCI/M2	LASL77
2127	NB95	1977	INSITU	13,40	5,21	5.00	NCI/M2	LASL77
2090	NB95	1977	INSITU	13.85	7.69	4.77	NCI/M2	LASL77
2024	NB95	1977	INSITU	8,95	3.88	4.55	NCI/M2	LASL77
2148	NB95	1977	INSITU	2.98	3.62	2.59	NCI/M2	LASL77
2034	NB95	1977	INSITU	3.16	3.70	3.56	NCI/M2	LASL77
2032	NB95	1977	INSITU	3.17	3.48	2.82	NCI/M2	LASL77
2055	NB95	1977	INSITU	11.35	5.86	3.89	NCI/M2	LASL77
2087	NB95	1977	INSITU	12.92	7.66	4.57	NCI/M2	LASL77
2080	NB95	1977	INSITU	10.91	7.22	4.98	NCI/M2	LASL77
2016	NB95	1977	INSITU	7.24	2.33	3.66	NCI/M2	LASL77

2121	NB95	1977	INSITU	13.68	6.87	6.39 NCI/M2	LASL77
2136	NB95	1977	INSITU	6.58	.55	0.00 NCI/M2	LASL77
2023	NB95	1977	INSITU	9.54	3.98	5.48 NCI/M2	LASL77
2022	NB95	1977	INSITU	9.60	4.32	6.32 NCI/M2	LASL77
2088	NE95	1977		13.22	1.66	0.00 NC1/M2	
20/5	NB95	19//		14 68	4.60	4.25 NCI/M2 5 52 NCI/M2	
2125	NB95	1977		6 59	1 65	3 63 NCI/M2	
2154	NB95	1977	INSTIL	3.95	4.57	2.01 NCI/M2	
1997	NB95	1977	INSITU	6.46	1.16	1.40 NCI/M2	LASL77
2064	NB95	1977	INSITU	10.54	7.19	4.37 NCI/M2	LASL77
2143	NB95	1977	INSITU	4.81	3.00	1.26 NCI/M2	LASL77
2057	NB95	1977	INSITU	10.35	5.34	5.71 NCI/M2	LASL77
2085	NB95	1977	INSITU	12.60	6.58	5.17 NCI/M2	LASL77
2076	NB95	1977	INSITU	11.09	4.52	4.38 NCI/M2	LASL77
2073	NB95	1977	INSITU	9.86	4.42	5.50 NC1/M2	
2041	NB95	19//		9.01	4.32	4.02 NCI/M2	
2010	NR95	1977		6 79	1.77	4.46 NCI/M2	
2020	NB95	1977	INSITU	3,17	3.48	1.78 NCI/M2	LASL77
2047	NB95	1977	INSITU	11.08	5.74	4.16 NCI/M2	LASL77
2116	NB95	1977	INSITU	13.74	6.12	4.31 NCI/M2	LASL77
2072	NB95	1977	INSITU	9.86	4.42	5.37 NCI/M2	LASL77
2008	NB95	1977	INSITU	7.40	2.10	4.04 NCI/M2	LASL77
2099	NB95	1977	INSITU	11.12	10.93	4.37 NCI/M2	LASL77
2146	NB95	1977	INSITU	9.82	4.27	2.63 NCI/M2	LASL77
2014	NB95	1977	INSITU	7.37	2.22	3.00 NC1/M2	LASL77
2134	NB95	19//		6.58	.55	6 62 NCI/M2	
2031	NBOE	19//		10.41	4.20	0.03 NCI/M2	
2025	NB95	1977	INSTIU	10.05	4.07	5.03 NCI/M2	
2060	NB95	1977	INSITU	9.91	5.07	4.69 NCI/M2	LASL77
2074	NB95	1977	INSITU	9.85	4.35	4.66 NCI/M2	LASL77
2027	NB95	1977	INSITU	10.28	4.20	6.19 NCI/M2	LASL77
1996	NB95	1977	INSITU	6.45	.75	4.36 NCI/M2	LASL77
2140	NB 95	1977	INSITU	6.58	.55	2.76 NCI/M2	LASL77
2094	NB95	1977	INSITU	14.49	9.25	4.82 NCI/M2	LASL77
2068	NB95	1977	INSTIU	9.30	5.02	3.88 NCI/M2	
2037	NBOE	19//		9.82	4.27	5 29 NCT/M2	
2147	NB95	1977	INSTIU	7 77	3.07	1.65 NCI/M2	
2093	NB95	1977	INSITU	14.60	8.57	4.24 NCI/M2	LASL77
2019	NB95	1977	INSITU	6.69	2.24	3.81 NCI/M2	LASL77
2084	NB95	1977	INSITU	12.58	7.17	4.52 NCI/M2	LASL77
2013	NB95	1977	INSITU	7.43	2.11	0.00 NCI/M2	LASL77
2059	NB95	1977	INSITU	9.74	5.42	5.64 NCI/M2	LASL77
2067	NB95	1977	INSTIU	9.31	4.96	3.27 NC1/M2	
2028	NBOE	19//		6 70	4.33	1 83 NCI/M2	
2061	NR95	1977		9 91	5.07	4.76 NCI/M2	
2017	NB95	1977	INSITU	7.25	2.33	4.10 NCI/M2	LASL77
2007	NB95	1977	INSITU	7.10	2.07	3.98 NCI/M2	LASL77
2119	NB95	1977	INSITU	14.34	7.21	4.43 NCI/M2	LASL77
2062	NB95	1977	INSITU	9.83	5.10	3.68 NCI/M2	LASL77
2155	NB95	1977	INSITU	3.91	3.49	2.18 NCI/M2	LASL77
2025	NB95	1977	INSITU	10.12	4.27	5.23 NCI/M2	LASL77
2039	NBOE	19//		9.60	4.32	4.19 NCI/M2	
2114	NB95	1977		12 45	4 27	4.43 NCI/M2 4 77 NCI/M2	
2015	NB95	1977	INSTIU	7.37	2.31	3.78 NCI/M2	LASL77
2092	NB95	1977	INSITU	13.52	9.21	4.51 NCI/M2	LASL77
2066	NB 95	1977	INSITU	10.60	4.42	5.02 NCI/M2	LASL77
2077	NB95	1977	INSITU	10.31	4.41	4.29 NCI/M2	LASL77
2006	NB95	1977	INSITU	7.07	2.04	2.81 NCI/M2	LASL77
2131	NB95	1977	INSITU	6.62	1.87	2.14 NCI/M2	LASL77
2100	NB95	1977	INSITU	14.50	12.20	4.96 NCI/M2	LASL77
2120	NB95	19//		14.30	7.10	5 62 NCI/M2	
2038	NB95	1977	INSTTU	9 60	4,32	4.57 NCI/M2	LASI 77
2011	NB95	1977	INSITU	6.32	.00	4.65 NCI/M2	LASL77
2083	NB95	1977	INSITU	12.14	7.19	4.50 NCI/M2	LASL77
2128	NB95	1977	INSITU	13.77	5.47	3.82 NCI/M2	LASL77
2040	NB95	1977	INSITU	9.60	4.32	4.69 NCI/M2	LASL77
2082	NB95	1977	INSITU	11.62	7.18	5.35 NCI/M2	LASL77
2071	NB95	1977	INSITU	9.83	4.48	4.68 NCI/M2	LASL77
2053	NB95	1977		10.69	5.56	5.25 NC1/M2	LASL//
2139	NBOE	19//		2.58	. 22	1 76 NCT/M2	LASL//
2153	NRQS	1977	INSITU	14 AQ	9.25	5.44 NCT/M2	LASI 77
2144	NB95	1977	INSITU	10.46	7.19	2.19 NCI/M2	LASL77
						•	

.

1995	PU238	1977	SOIL	2.5	6.66	. 76	0.00	PCI/GM	LASLCHEM
2019	DI1228	1077	SOTI	12 5	6 66	1 76	0 00	PCT/GM	LASICHEM
2010	FU230	1577	SOIL	12.5	40.00	6.70	0.00		
2123	PU238	1977	SOIL	2.5	13.68	6.79	.02	PCI/GM	LASLCHEM
2097	PU238	1977	SOIL	7.5	15.45	9.75	.00	PCI/GM	LASLCHEM
2072	DUDDO	1077	5011	7 6	0 96	4 40	10	DCT /CM	LASICHEM
2072	PU236	19//	SUIL	1.5	5.00	4.42	. 15		LASECHEM
2115	PU238	1977	SOIL	12.5	13.57	6.49	0.00	PCI/GM	LASLCHEM
2097	PI1238	1977	SOTI	12.5	15.45	9.75	0.00	PCI/GM	LASLCHEM
2057	0200	1077			10.40	E 04	0.00	DOT /ON	
2057	PU238	1977	SOIL	2.5	10.35	5.34	.03	PCI/GM	LASLUMEM
2052	PU238	1977	SOIL	2.5	11.11	5.55	.00	PCI/GM	LASLCHEM
2002	01000	1077	SOTI	40 E	11 62	7 40	0.00	DCT/CM	
2082	PU238	19//	SUIL	12.5	11.02	1.10	0.00		LASECHEM
2088	PU238	1977	SOIL	2.5	13.22	7.66	. 03	PCI/GM	LASLCHEM
2071	PI1238	1977	SOTI	2.5	9.83	4.48	. 08	PCI/GM	LASLCHEM
2011	DUDDD	1077	COTL	47 6	44.00	E 74	0.00	DCT /CM	LASICHEM
2047	P0238	1977	SOIL	17.5	11.08	5.74	0.00	PCI/GM	LASLOHEM
1998	PU238	1977	SOIL	12.5	6.63	. 55	0.00	PCI/GM	LASLCHEM
2052	PI1238	1977	SOTI	12 5	11 11	5 55	.01	PCT/GM	LASICHEM
2052	0200	1077	COTL			4 40	0.00	DOT /OM	
2071	PU238	19//	SUIL	12.5	9.83	4.48	0.00	PC1/GM	LASLUMEM
2026	PU238	1977	SOIL	12.5	10.05	4.07	0.00	PCI/GM	LASLCHEM
2072	DI1238	1977	ŚOTI	25	9 86	4 42	22	PCT/GM	LASICHEM
2072	10200	1077	SOL	2.5	40.07	4.00			
2028	PU238	1977	SOIL	7.5	10.37	4.33	.01	PCI/GM	LASLCHEM
2016	PU238	1977	SOIL	2.5	7.24	2.33	.00	PCI/GM	LASLCHEM
1000	011220	1077	SOTI	7 5	6 63	55	3 00	DCT/CM	
1330	F0238	1977	3011	1.5	0.00		0.00		
2001	PU238	1977	SOIL	7.5	6.63	. 55	2.29	PC1/GM	LASLCHEM
2097	PU238	1977	SOIL	2.5	15.45	9.75	.02	PCI/GM	LASLCHEM
2017	011220	1077	SOTI	12 5	11 09	5 74	01	DCT/CM	LASICHEM
204/	10230	1077	SOIL	12.0	44.00	3.17			
2082	PU238	1977	SUIL	7.5	11_62	/.18	0.00	PCI/GM	LASLUHEM
1998	PU238	1977	SOIL	2.5	6.63	. 55	1.26	PCI/GM	LASLCHEM
1065	011220	1077	50 T I	7 5	10 20	5 01	0 00	DCT /CM	LASICHEM
2005	PU236	1977	2011	1.5	10.39	5.01	0.00		LASECHEM
2080	PU238	1977	SOIL	7.5	10.91	7.22	0.00	PCI/GM	LASLCHEM
2037	PU238	1977	SOIL	2.5	9.82	4.27	. 10	PCI/GM	LASLCHEM
2000	01000	4077	501-	40 E	40.04	7 00	0.00	DOT /CH	LASICHEM
2080	PU238	19//	SUIL	12.5	10.91	1.22	0.00	FCI/GM	LASECHEM
2047	PU238	1977	SOIL	2.5	11.08	5.74	.04	PCI/GM	LASLCHEM
2027	PU238	1977	SOTI	12.5	10.28	4.20	0.00	PCI/GM	LASLCHEM
2021	0200	1077	5011	7 6	+0 E0	7 47	0.00	DOT /CM	ASLOHEM
2084	PU238	1977	SUIL	1.5	12.58	1.17	0.00	PC1/GM	LASLUMEN
2027	PU238	1977	SOIL	2.5	10.28	4.20	- 09	PCI/GM	LASLCHEM
2028	PI1238	1977	SOTI	12 5	10.37	4.33	0.00	PCT/GM	LASICHEM
2020	10200	1077	COTL	10.5	44 55		0.00	DOT /ON	
2118	PU238	1977	SUIL	12.5	14.55	6.45	0.00	PC1/GM	LASLUMEM
2009	PU238	1977	SOIL	12.5	6.59	1.65	.02	PCI/GM	LASLCHEM
2006	DI1228	1077	ŚOTI	25	14 49	9 24	01	PCT/GM	LASICHEM
2050	F0238	1077	JUIL	2.5	40.07	4 00		DOT /ON	
2028	PU238	1977	IH		10.37	4.33	0.00	PC1/GM	CVEG
2001	PU239	1977	GR		6.63	. 55	. 02	PCI/GM	CVEG
2065	PI1239	1977	GP		10.39	5.01	.07	PCT/GM	CVEG
2005	10200	1077	00		40.05	E 04			CVE C
2057	P0239	1977	GR		10.35	5.34	.01	PC1/GM	CVEG
2003	PU239	1977	GR		6.63	. 55	.02	PCI/GM	CVEG
1005	DI 1220	1977	CP		6 66	76	00	PCT/GM	CVEG
1333	F0235	1077			40.50				
2045	PU239	1977	INSTIC		10.52	5.51	2.60	NC1/M2	PREDICTED
2047	PU239	1977	INSITU		11.08	5.74	53.70	NCI/M2	PREDICTED
2046	DI1239	1977	TNSTTH		11.08	5 73	55 30	NCT/M2	PREDICTED
2040	DU200	4077	TNCTTU		10.60	E EC	404 60	NCT /MO	DREDICTED
2053	PU239	1977	INSTID		10.69	5.50	121.60	NC1/M2	PREDICIED
2064	PU239	1977	INSITU		10.54	7.19	2.30	NCI/M2	PREDICTED
2068	DI 1239	1977	TNSTTH		9.30	5.02	62.00	NCT/M2	PREDICTED
2000	10205		INCITU		40.40	5.02	02.00		
2127	PU239	1977	INSTIU		13.40	5.21	. 29	NC1/M2	PREDICIED
2024	PU239	1977	INSITU		8.95	3.88	25.70	NCI/M2	PREDICTED
2101	PI1239	1977	TNSTTH		16.52	14.74	2.00	NCT/M2	PREDICTED
2101	F0235	1577	1103110		10.52		2.00		PREDICTED
2050	PU239	1977	INSTIU		11.11	5.55	20.50	NC1/M2	PREDICIED
2072	PU239	1977	INSITU		9.86	4.42	470.50	NCI/M2	PREDICTED
2021	DI 1220	1977	TNSTTH		9 60	4 33	351 80	NCT/M2	PREDICTED
2021	0200	4077	TNCTTU		10.00	6 70	46 00	NCT /MO	PREDICTED
2123	PU239	19//	TINETIO		13.08	0./9	10.00	NOT/M2	
2054	PU239	1977	INSITU		10.52	5.50	1.20	NCI/M2	PREDICTED
2055	PU239	1977	INSITU		11.35	5.86	1.40	NCI/M2	PREDICTED
2010	DUDDO	1077	TNETTH		0 60	1 22	141 20	NCT /M2	PREDICTED
2040	P0239	1977	1112110		9.00	4.32	141.20	NCI/M2	FREDICTED
2120	PU239	1977	INSITU		14.30	7.16	27.90	NCI/M2	PREDICTED
2091	PI1239	1977	INSTIL		15.00	7.64	14.10	NCT/M2	PREDICTED
2001	0200		TNCTTU		40 50	0.04	E 40	NOT /MO	DREDICTED
2092	P0239	1977	102110		13.52	9.21	5.40	NC1/M2	PREDICIED
2026	PU239	1977	INSITU		10.05	4.07	374.60	NCI/M2	PREDICTED
2075	DI 1239	1977	TNSTTH		10.85	4 60	1.40	NCT/M2	PREDICTED
20/3	0209		TNICTTO		.0.05	2.00	70.00	NOT /MO	DEDICTED
2062	PU239	1977	INSTIC		9.83	5.10	/2.60	NC1/M2	PREDICIED
2066	PU239	1977	INSITU		10.60	4.42	60.50	NCI/M2	PREDICTED
2000	DIIJOO	1077	TNSTTU		11 12	10 92	4 50	NCT /M2	PREDICTED
2038	FU239	19//	1110110		11.12	.0.33		NOT /MZ	
2093	PU239	1977	INSIIU		14.60	8.5/	24.20	NC1/M2	PREDICIED
2095	PU239	1977	INSITU		14.49	9.25	4.90	NCI/M2	PREDICTED
2400	PUIDOO	1077	TNETTH		12 60	6 07	27.20	NCT /MO	PREDICTED
2122	FU239	19//	TINGTIO		13.09	9.01	21.30	NOTINZ	DDCDIGTED
2076	PU239	1977	INSITU		11.09	4.52	30.10	NCI/M2	PREDICTED
2022	PU239	1977	INSTTU		9.54	3,98	142.50	NCI/M2	PREDICTED
2020	. 0200	4077	TNICTTU		0.60	1 20	264 20	NCT /MO	PPEDICTED
2022	PU239	19//	1112110		5.00	7.32	201.20	NOT/M2	PREDICTED
2074	PU239	1977	INSITU		9.85	4.35	63.90	NCI/M2	PREDICTED
2090	PU239	1977	INSTTU		13.85	7.69	19.30	NCI/M2	PREDICTED
2000	. 0205	4077	TNETTI		40 50	7 47	27 00	NCT /MO	DEDICTED
2084	PU239	19//	1112110		12.38	<u>/. /</u>	27.00	NOT/WZ	
2085	PU239	1977	INSITU		12.60	6.58	33.20	NCI/M2	PREDICTED
2125	PU239	1977	INSTTU		14.68	4.45	16.70	NCI/M2	PREDICTED
0007	. 0203	4077	TNETTU			A 07	200 70	NCT /MO	DEDICTED
203/	ru239	19//	TIN2T10		9.82	4.27	390.10	NOT/MZ	FREDICIED

2058	PU239	1977	INSITU		10.00	5.31	124.20	NCI/M2	PREDICTED
2025	PU239	1977	INSITU		10.12	4.27	437.90	NCI/M2	PREDICTED
2032	PU239	1977	INSITU		3.17	3.48	11.20	NCI/M2	PREDICTED
2031	PU239	1977	INSITU		10.41	4.28	101.50	NC1/M2	PREDICTED
2087	PU239	1977	INSITU		12.92	7.66	51.20	NCI/M2	PREDICTED
2059	PU239	1977	INSITU		9.74	5.42	58.90	NCI/M2	PREDICTED
2052	PU239	1977	INSITU		11.11	5.55	18.80	NCI/M2	PREDICTED
2073	PU239	1977	INSITU		9.86	4.42	2.60	NCI/M2	PREDICTED
2049	PU239	1977	INSITU		11.11	5.55	24.60	NCI/M2	PREDICTED
2086	PU239	1977	INSITU		10.53	7.19	5.10	NCI/M2	PREDICTED
2118	PU239	1977	INSITU		14.55	6.45	16.60	NCI/M2	PREDICTED
2088	PU239	19//	INSITU		13.22	1.66	48.90	NC1/M2	PREDICTED
2128	PU239	19//	INSITU		13.77	5.4/	1.60	NCI/M2	PREDICTED
2002	PU239	19//	INSITU		11.02	7 10	S7.70	NCI/M2	PREDICTED
2003	PU235	19//	INSTIU		12.14	0 76	05.00		PREDICTED
2080	PU235	1977	INSTIU		10 91	7 22	8 20		PREDICTED
2067	PU239	1977	INSTIU		9.31	4 96	19.10	NCT/M2	PREDICTED
2089	PU239	1977	INSTIL		14.03	8.82	36.20	NCT/M2	PREDICTED
2048	PU239	1977	INSITU		11.09	5.87	41.20	NCI/M2	PREDICTED
2028	PU239	1977	INSITU		10.37	4.33	504.90	NCI/M2	PREDICTED
2039	PU239	1977	INSITU		9.60	4.32	256.90	NCI/M2	PREDICTED
2027	PU239	1977	INSITU		10.28	4.20	155.00	NCI/M2	PREDICTED
2121	PU239	1977	INSITU		13.68	6.87	17.90	NCI/M2	PREDICTED
2115	PU239	1977	INSITU		13.57	6.49	13.10	NCI/M2	PREDICTED
2071	PU239	1977	INSITU		9.83	4.48	177.20	NCI/M2	PREDICTED
2094	PU239	1977	INSITU		14.49	9.25	15.70	NCI/M2	PREDICTED
2060	PU239	1977	INSITU		9.91	5.07	122.20	NCI/M2	PREDICTED
2079	PU239	1977	INSITU		10.53	7.20	5.80	NCI/M2	PREDICTED
2038	PU239	1977	INSITU		9.60	4.32	170.80	NCI/M2	PREDICTED
2029	PU239	1977	INSITU		10.35	4.28	8.10	NCI/M2	PREDICTED
2114	PU239	1977	INSITU		10.46	7.18	4.50	NCI/M2	PREDICTED
2057	PU239	1977	INSITU		10.35	5.34	49.30	NCI/M2	PREDICTED
2100	PU239	1977	INSITU		14.50	12.20	4.20	NCI/M2	PREDICTED
2065	PU239	1977	INSITU		10.39	5.01	94.80	NCI/M2	PREDICIED
2077	PU239	1977	INSITU		10.31	4.41	1.20	NCI/M2	PREDICTED
2042	PU239	19//	INSITU		9.82	4.27	352.10	NC1/M2	PREDICTED
2126	PU239	19//	INSITU		12.45	4.27	7.40	NC1/M2	PREDICTED
2030	PU239	19//	INSITU		10.39	4.30	437.90	NC1/M2	PREDICIED
2119	PU239	19//	INSIIU		14.34	1.21	9.10	NCI/M2	PREDICIED
2041	PU239	19//	INSTIU		9.01	4.32	255.00	NCI/M2	PREDICTED
2001	PU235	1077	INSTIU		3.31	5.07	22.50		
2081	PU239	1977	INSTIL		11 31	7 21	27 60	NCT/M2	PREDICTED
2096	PU239	1977	INSITU		14.49	9.24	15.10	NCI/M2	PREDICTED
2116	PU239	1977	INSITU		13_74	6.12	10.90	NCI/M2	PREDICTED
2076	PU239	1977	JP		11.09	4.52	.01	PCI/GM	CVEG
2087	PU239	1977	ŠK		12.92	7.66	.02	PCI/GM	CVEG
2001	PU239	1977	SK		6.63	.55	0.00	PCI/GM	CVEG
2003	PU239	1977	SK		6.63	.55	.01	PCI/GM	CVEG
2048	PU239	1977	SK		11.09	5.87	.01	PCI/GM	CVEG
2059	PU239	1977	SK		9.74	5.42	.04	PCI/GM	CVEG
518	PU239	1973	SOIL	2.5	7.19	2.24	10.00	NCI/M2	EPA
584	PU239	1977	SOIL	2.5	24.04	15.09	2.20	NCI/M2	EPA
2057	PU239	1977	SOIL	12.5	10.35	5.34	.01	PCI/GM	LASLCHEM
524	PU239	1973	SOIL	2.5	7.76	2.96	8.50	NCI/M2	EPA
560	PU239	1973	SUIL	2.5	15.04	7.62	40.00	NCI/M2	EPA
2002	00239	19/3	SUIL	2.5	8.25	2.94	2.00	NCI/M2	
1002	PU239	19//	SOIL	12 5	5.91	3.49	.01	PCI/GM	
522	PU235	1073	SOTI	2.5	6 82	2 97	2 90		FDA
582	PU235	1977	SOT	2.5	21 85	15 46	2.50		FPA
581	PU239	1977	SOTE	2.5	20.83	15 53	1 80	NCT/M2	FPA
203	PU239	1972	SOTI	5.0	7.81	1.89	.33	PCT/GM	LASI 72
515	PU239	1973	SOIL	2.5	10.82	1.34	.79	NCT/M2	FPA
564	PU239	1977	SOIL	2.5	15.03	9.53	.82	NCI/M2	EPA
2082	PU239	1977	SOIL	12.5	11.62	7.18	0.00	PCI/GM	LASLCHEM
108	PU239	1948	SOIL	1.3	9.98	4.31	9.50	PCI/GM	UCLA48
520	PU239	1973	SOIL	2.5	5.72	3.04	.93	NCI/M2	EPA
580	PU239	1977	SOIL	2.5	19.82	15.59	1.80	NCI/M2	EPA
567	PU239	1977	SOIL	2.5	12.66	11.54	.56	NCI/M2	EPA
3004	PU239	1977	SOIL	12.5	3.91	3.49	0.00	PCI/GM	LASLCHEM
507	PU239	1973	SOIL	2.5	6.57	1.92	1.80	NCI/M2	EPA
107	PU239	1948	SOIL	1.3	9.49	3.78	4.10	PCI/GM	UCLA48
14	PU239	1950	SOIL	1.3	14.27	5.80	0.00	PCI/GM	UCLA50
3004	PU239	1977	SOIL	7.5	3.91	3.49	0.00	PCI/GM	LASLCHEM
517	PU239	1973	SUIL	2.5	7.45	2.21	12.00	NCI/M2	
501	PU239	19/3	SUIL	2.5 2 F	6.57	./1	1100.00		
345	PU239	19/3	SUIL	2.5 2 F	10.30	5.30 A AE	42.10	NCI/M2	
2120	F0239	19//	JUIL	2.3	14.08	4.40	.03		LASLUTEM

S36 PU239 1973 SOIL 2.5 11.31 4.39 4.90 NCI/M2 EPA 200 PU239 1972 SOIL 5.0 10.80 5.26 .09 PCI/GM LASI 566 PU239 1977 SOIL 2.5 12.06 11.12 .42 NCI/M2 EPA 556 PU239 1973 SOIL 2.5 11.49 6.59 4.10 NCI/M2 EPA 555 PU239 1973 SOIL 2.5 10.40 5.84 32.00 NCI/M2 EPA 2026 PU239 1973 SOIL 2.5 10.65 4.07 3.51 PCI/GM LASL 1 PU239 1973 SOIL 2.5 15.57 6.87 18.00 NCI/M2 EPA 562 PU239 1973 SOIL 2.5 14.27 9.56 2.50 NCI/M2 EPA 2048 PU239 1973 SOIL 2.5	-72 -72 -448 CHEM .50 CHEM .50 CHEM .50 CHEM .48
2008 PU239 1972 SOIL 1.0 10.80 5.20 200.10/LM LAS 506 PU239 1977 SOIL 2.5 12.06 11.12 .42 NCI/M2 EPA 516 PU239 1973 SOIL 2.5 12.67 7.19 45.00 NCI/M2 EPA 555 PU239 1973 SOIL 2.5 10.40 5.84 32.00 NCI/M2 EPA 5202 PU239 1973 SOIL 2.5 10.40 5.84 32.00 NCI/M2 EPA 5202 PU239 1973 SOIL 2.5 10.40 5.84 32.00 NCI/M2 EPA 548 PU239 1973 SOIL 2.5 14.57 14.00 NCI/M2 EPA 548 PU239 1977 SOIL 2.5 14.27 9.56 2.50 NCI/M2 EPA 548 PU239 1977 SOIL 2.5 14.01 0.90	.72 .448 .50 .50 .72 .50 .50 .2HEM .48
566 PU239 1977 SOIL 2.5 12.06 11.12 45.00 NCI/M2 EPA 556 PU239 1948 SOIL 2.5 12.67 7.19 45.00 NCI/M2 EPA 555 PU239 1973 SOIL 2.5 11.49 6.59 4.10 NCI/M2 EPA 520 PU239 1973 SOIL 2.5 8.46 3.83 2.60 NCI/M2 EPA 2026 PU239 1977 SOIL 2.5 15.57 6.87 18.00 NCI/M2 EPA 548 PU239 1977 SOIL 2.5 14.27 9.56 2.50 NCI/M2 EPA 548 PU239 1977 <soil< td=""> 2.5 14.01 10.96 2.50 NCI/M2 EPA 545 PU239 1977<soil< td=""> 2.5 14.01 10.96 9.00 NCI/M2 EPA 576 PU239 1977<soil< td=""> 2.5 10.38 4.94</soil<></soil<></soil<>	448 CHEM 50 CHEM .72 CHEM .50 CHEM .48
556 PU239 1973 SOIL 2.5 12.67 7.19 45.00 NCI/M2 EPA 555 PU239 1973 SOIL 2.5 11.49 6.59 4.10 NCI/M2 EPA 550 PU239 1973 SOIL 2.5 10.40 5.84 32.00 NCI/M2 EPA 2026 PU239 1973 SOIL 2.5 10.05 4.07 3.51 PCI/GM LCAL 1 PU239 1973 SOIL 2.5 15.57 6.87 18.00 NCI/M2 EPA 562 PU239 1973 SOIL 2.5 14.27 9.56 2.50 NCI/M2 EPA 2048 PU239 1973 SOIL 2.5 14.27 9.56 2.00 NCI/M2 EPA 2049 1977 SOIL 2.5 14.01 10.96 2.90 NCI/M2 EPA 210 PU239 1973 SOIL 2.5 14.30	448 CHEM 50 CHEM .72 CHEM .50 CHEM .48
112 PU239 1973 SOIL 1.3 9.74 4.84 1.40 PCI/GM UCL 555 PU239 1973 SOIL 2.5 10.40 5.84 32.00 NCI/M2 EPA 2026 PU239 1977 SOIL 2.5 8.46 3.83 2.60 NCI/M2 EPA 2026 PU239 1977 SOIL 2.5 10.05 4.07 3.51 PCI/GM UCL 577 PU239 1973 SOIL 2.5 14.27 9.56 2.00 NCI/M2 EPA 562 PU239 1977 SOIL 2.5 14.27 9.56 2.00 NCI/M2 EPA 565 PU239 1977 SOIL 2.5 14.01 9.66 2.90 NCI/M2 EPA 565 PU239 1977 SOIL 2.5 14.30 7.16 0.4 PCI/GM LASL 576 PU239 1973 SOIL 2.5	CHEM (50) CHEM .72 CHEM .50 CHEM .48
550 PU239 1973 SOIL 2.5 11.16 0.03 4.10 NCI/M2 EPA 528 PU239 1973 SOIL 2.5 8.46 3.83 2.60 NCI/M2 EPA 528 PU239 1973 SOIL 2.5 10.05 4.07 3.51 PCI/GM UAL 557 PU239 1973 SOIL 2.5 15.57 6.87 18.00 NCI/M2 EPA 548 PU239 1973 SOIL 2.5 14.27 9.56 2.50 NCI/M2 EPA 2048 PU239 1977 SOIL 2.5 14.01 10.96 2.90 NCI/M2 EPA 203 PU239 1977 SOIL 2.5 14.30 7.16 0.4 PCI/GM LASL 2120 PU239 1973 SOIL 2.5 10.38 4.94 68.00 NCI/M2 EPA 506 PU239 1973 SOIL 2.5	CHEM SO CHEM .72 CHEM .50 CHEM .48
528 PU239 1973 SOIL 2.5 8.46 3.83 2.60 NCI/M2 EPA 2026 PU239 1975 SOIL 1.3 10.24 4.22 5.40 PCI/GM LASL 557 PU239 1973 SOIL 2.5 15.57 6.87 18.00 NCI/M2 EPA 548 PU239 1977 SOIL 2.5 14.27 9.56 2.50 NCI/M2 EPA 2048 PU239 1977 SOIL 2.5 14.27 9.56 2.50 NCI/M2 EPA 2039 1977 SOIL 2.5 14.01 10.96 2.90 NCI/M2 EPA 2120 PU239 1977 SOIL 2.5 18.39 10.76 9.10 NCI/M2 EPA 506 PU239 1973 SOIL 2.5 10.38 4.94 68.00 NCI/M2 EPA 506 PU239 1973 SOIL 2.5 9.44	CHEM SO CHEM .72 CHEM .50 CHEM .48
2026 PU239 1977 SOIL 2.5 10.05 4.07 3.51 PCI/GM LAS 57 PU239 1973 SOIL 2.5 15.57 6.87 18.00 NCI/M2 EPA 548 PU239 1973 SOIL 2.5 14.27 9.56 2.50 NCI/M2 EPA 2048 PU239 1977 SOIL 2.5 14.27 9.56 2.50 NCI/M2 EPA 2048 PU239 1977 SOIL 2.5 5.22 3.09 .61 NCI/M2 EPA 203 PU239 1977 SOIL 2.5 14.01 10.96 2.90 NCI/M2 EPA 2120 PU239 1977 SOIL 2.5 18.39 10.76 9.10 NCI/M2 EPA 540 PU239 1973 SOIL 2.5 10.38 4.94 68.00 NCI/M2 EPA 506 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 512 PU239	CHEM (50) CHEM .72 CHEM .50 CHEM .48
$\begin{array}{c c c c c c c c c c c c c c c c c c c $.72 CHEM .50 CHEM .48
548 PU239 1973 SOIL 2.5 9.68 5.42 3.60 NCI/M2 EPA 2048 PU239 1977 SOIL 2.5 14.27 9.56 2.50 NCI/M2 EPA 2048 PU239 1977 SOIL 2.5 5.22 3.09 .61 NCI/M2 EPA 565 PU239 1977 SOIL 2.5 5.22 3.09 .61 NCI/M2 EPA 203 PU239 1977 SOIL 2.5 14.30 7.16 .04 PCI/GM LASL 2120 PU239 1973 SOIL 2.5 10.38 4.94 68.00 NCI/M2 EPA 540 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 513 PU239 1973 SOIL 2.5 9.91 5.07 1.06 PCI/GM LASL 511 PU239 1973 <soil< td=""> 2.5 15.05</soil<>	CHEM .72 CHEM .50 CHEM .48
562 PU239 1977 SOIL 2.5 14.27 9.56 2.50 NCI/M2 EPA 2048 PU239 1977 SOIL 2.5 5.22 3.09 .61 NCI/M2 EPA 565 PU239 1977 SOIL 2.5 5.22 3.09 NCI/M2 EPA 203 PU239 1977 SOIL 12.5 14.01 10.96 2.90 NCI/M2 EPA 2120 PU239 1977 SOIL 2.5 18.39 10.76 9.10 NCI/M2 EPA 540 PU239 1973 SOIL 2.5 10.38 4.94 68.00 NCI/M2 EPA 550 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 116 PU239 1973 SOIL 2.5 9.91 5.07 1.06 PCI/GM LASL 116 PU239 1973 SOIL 2.5 8.93	CHEM .72 CHEM .50 CHEM .48
2048 PU239 1977 SOIL 7.5 11.09 5.87 .02 PCI/GM LAS 519 PU239 1977 SOIL 2.5 5.22 3.09 .61 NCI/M2 EPA 203 PU239 1977 SOIL 2.5 14.01 10.96 2.90 NCI/M2 EPA 203 PU239 1977 SOIL 2.5 14.30 7.16 .04 PCI/GM LASL 576 PU239 1977 SOIL 2.5 10.38 4.94 68.00 NCI/M2 EPA 506 PU239 1973 SOIL 2.5 6.15 1.99 1.10 NCI/M2 EPA 515 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 2060 PU239 1977 SOIL 2.5 9.91 5.07 1.06 PC/GM UCL4 511 PU239 1973 SOIL 2.5 15.05 12.09 4.60 NCI/M2 EPA 533 PU239 <	.72 CHEM .50 CHEM .48
565 PU239 1977 SOIL 2.5 14.01 10.96 2.90 NCI/M2 EFA 203 PU239 1972 SOIL 19.0 7.81 1.89 .21 PCI/GM LASL 576 PU239 1977 SOIL 2.5 18.39 10.76 9.10 NCI/M2 EFA 540 PU239 1973 SOIL 2.5 6.15 1.99 1.10 NCI/M2 EFA 506 PU239 1973 SOIL 2.5 6.15 1.99 1.10 NCI/M2 EFA 513 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EFA 2060 PU239 1973 SOIL 2.5 9.91 5.07 1.06 PCI/GM LASL 211 PU239 1973 SOIL 2.5 8.93 2.19 1.50 NCI/M2 EPA 533 PU239 1973 <soil< td=""> 2.5 10.82</soil<>	.72 CHEM .50 CHEM .48
203 PU239 1972 SOIL 19.0 7.81 1.89 .21 PCI/GM LASL 2120 PU239 1977 SOIL 12.5 14.30 7.16 .04 PCI/GM LASL 576 PU239 1973 SOIL 2.5 18.39 10.76 9.10 NCI/M2 EPA 506 PU239 1973 SOIL 2.5 6.15 1.99 1.10 NCI/M2 EPA 513 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 2060 PU239 1973 SOIL 2.5 9.91 5.07 1.06 PCI/GM UCLA 511 PU239 1973 SOIL 2.5 8.93 2.19 1.50 NCI/M2 EPA 512 PU239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 533 PU239 1973 <soil< td=""> 2.5 11.15</soil<>	.72 CHEM .50 CHEM .48
2120 PU239 1977 SOIL 12.5 14.30 7.16 .04 PCI/GM LASL 576 PU239 1977 SOIL 2.5 18.39 10.76 9.10 NCI/M2 EPA 506 PU239 1973 SOIL 2.5 6.15 1.99 1.10 NCI/M2 EPA 513 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 2060 PU239 1977 SOIL 2.5 9.91 5.07 1.06 PCI/GM LASL 116 PU239 1948 SOIL 1.3 11.87 5.11 .77 PCI/GM LCL4 511 PU239 1973 SOIL 2.5 8.93 2.19 1.50 NCI/M2 EPA 570 PU239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 533 PU239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 512 PU239	CHEM .50 CHEM .48
540 PU239 1973 SOIL 2.5 10.38 4.94 68.00 NCI/M2 EPA 506 PU239 1973 SOIL 2.5 6.15 1.99 1.10 NCI/M2 EPA 15 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 16 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 16 PU239 1973 SOIL 2.5 9.91 5.07 1.06 PCI/GM UCLA 116 PU239 1977 SOIL 2.5 8.93 2.19 1.50 NCI/M2 EPA 510 PU239 1977 SOIL 2.5 10.68 .71 NCI/M2 EPA 512 PU239 1973 SOIL 2.5 10.80 1.68 .71 NCI/M2 EPA 525 PU239 1973 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 2052 PU239 1977 SOIL<	.50 CHEM .48
506 PU239 1973 SOIL 2.5 6.15 1.99 1.10 NCI/M2 EPA 15 PU239 1950 SOIL 1.3 13.67 7.12 .09 PCI/GM UCLA 513 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 2060 PU239 1977 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 116 PU239 1977 SOIL 2.5 9.91 5.07 1.06 PCI/GM UCLA 511 PU239 1977 SOIL 2.5 15.05 12.09 4.60 NCI/M2 EPA 533 PU239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 533 PU239 1973 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 2052 PU239 1977 SOIL 2.5 <t< td=""><td>50 CHEM 48</td></t<>	50 CHEM 48
15 PU239 1973 SOIL 1.3 13.67 7.12 .09 PCI/GM UCLA 2060 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 2060 PU239 1977 SOIL 2.5 9.91 5.07 1.06 PCI/GM LASL 116 PU239 1948 SOIL 1.3 11.87 5.11 .77 PCI/GM UCLA 511 PU239 1973 SOIL 2.5 15.05 12.09 4.60 NCI/M2 EPA 533 PU239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 512 PU239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 2052 PU239 1977 SOIL 2.5 17.82 15.76 2.10 NCI/M2 EPA 578 PU239 1977 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 2018 PU239	.50 CHEM .48
513 PU239 1973 SOIL 2.5 9.44 2.00 .63 NCI/M2 EPA 2060 PU239 1977 SOIL 2.5 9.91 5.07 1.06 PCI/GM LASL 116 PU239 1948 SOIL 2.5 8.93 2.19 1.50 NCI/M2 EPA 570 PU239 1977 SOIL 2.5 15.05 12.09 4.60 NCI/M2 EPA 533 PU239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 512 PU239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 2052 PU239 1977 SOIL 2.5 11.11 5.55 .01 PCI/GM LASL 578 PU239 1977 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 207 PU239 1977 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 207 PU239 <	CHEM 48
116 PU239 1948 SOIL 1.3 1.87 5.11 .77 PCI/GM UCLA 511 PU239 1973 SOIL 2.5 8.93 2.19 1.50 NCI/M2 EPA 570 PU239 1977 SOIL 2.5 15.05 12.09 4.60 NCI/M2 EPA 533 PU239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 512 PU239 1973 SOIL 2.5 11.11 5.55 .01 PCI/GM LASL 2052 PU239 1977 SOIL 2.5 11.25 11.11 5.55 .01 PCI/GM LASL 207 PU239 1977 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 207 PU239 1977 SOIL 2.5 16.66 1.76 .00 PCI/GM LASL 2018 PU239 1977 SOIL	48
511 PU239 1973 SOIL 2.5 8.93 2.19 1.50 NCI/M2 EPA 570 PU239 1977 SOIL 2.5 15.05 12.09 4.60 NCI/M2 EPA 533 PU239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 512 PU239 1973 SOIL 2.5 9.80 1.68 .71 NCI/M2 EPA 2052 PU239 1977 SOIL 2.5 17.82 15.76 2.10 NCI/M2 EPA 2051 PU239 1977 SOIL 2.5 17.82 15.76 2.10 NCI/M2 EPA 514 PU239 1973 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 207 PU239 1977 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 207 PU239 1977 SOIL 2.5 16.66 1.76 .00 NCI/M2 EPA 13 PU239 <	
570 PU239 1977 SOIL 2.5 15.05 12.09 4.60 NCI/M2 EPA 533 PU239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 2052 PU239 1977 SOIL 2.5 9.80 1.68 .71 NCI/M2 EPA 2052 PU239 1977 SOIL 2.5 17.82 15.76 2.10 NCI/M2 EPA 578 PU239 1977 SOIL 2.5 17.82 15.76 2.10 NCI/M2 EPA 514 PU239 1977 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 207 PU239 1977 SOIL 1.50 5.74 40.00 NCI/M2 EPA 208 1973 SOIL 2.5 18.95 15.67 2.90 NCI/M2 EPA 13 PU239 1970 SOIL 1.3 12.59 7.17 .54 PCI/GM UCLA 12 PU239 1973 SOIL	
533 F0239 1973 SOIL 2.5 10.82 3.59 1.00 NCI/M2 EPA 512 PU239 1973 SOIL 2.5 9.80 1.68 .71 NCI/M2 EPA 2052 PU239 1977 SOIL 12.5 11.11 5.55 .01 PCI/GM LASLI 578 PU239 1977 SOIL 2.5 17.82 15.76 2.10 NCI/M2 EPA 514 PU239 1977 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 207 PU239 1977 SOIL 5.0 10.22 4.59 .02 PCI/GM LASLI 2018 PU239 1977 SOIL 1.5 6.66 1.76 .00 PCI/GM LASLI 552 PU239 1973 SOIL 2.5 11.50 5.74 40.00 NCI/M2 EPA 13 PU239 1977 SOIL 1.3 12.59 7.17 .54 PCI/GM UCLA 14 PU239	
2052 PU239 1977 SOIL 12.5 11.11 5.55 .01 PCI/GM LASLI 578 PU239 1977 SOIL 2.5 17.82 15.76 2.10 NCI/M2 EPA 514 PU239 1973 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 207 PU239 1977 SOIL 5.0 10.22 4.59 .02 PCI/GM LASLI 2018 PU239 1977 SOIL 12.5 6.66 1.76 .00 PCI/GM LASLI 552 PU239 1977 SOIL 2.5 11.50 5.74 40.00 NCI/M2 EPA 13 PU239 1973 SOIL 1.3 12.59 7.17 .54 PCI/GM UCLA 14 PU239 1973 SOIL 2.5 10.38 4.45 6.10 NCI/M2 EPA 13 PU239 1973 SOIL 2.5	
578 PU239 1977 SOIL 2.5 17.82 15.76 2.10 NCI/M2 EPA 514 PU239 1973 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 207 PU239 1972 SOIL 5.0 10.22 4.59 .02 PCI/GM LASL 2018 PU239 1977 SOIL 12.5 6.66 1.76 .00 PCI/GM LASL 552 PU239 1973 SOIL 2.5 11.50 5.74 40.00 NCI/M2 EPA 579 PU239 1977 SOIL 2.5 18.95 15.67 2.90 NCI/M2 EPA 13 PU239 1950 SOIL 1.3 12.59 7.17 .54 PCI/GM UCLA 12 PU239 1973 SOIL 2.5 10.38 4.45 6.10 NCI/M2 EPA 13 PU239 1973 SOIL 2.5 15.45 9.75 .61 PCI/GM UCLA 2097 PU239	CHEM
514 PU239 1973 SOIL 2.5 10.27 1.49 .84 NCI/M2 EPA 207 PU239 1972 SOIL 5.0 10.22 4.59 .02 PCI/GM LASL 2018 PU239 1977 SOIL 12.5 6.66 1.76 .00 PCI/GM LASL 552 PU239 1973 SOIL 2.5 11.50 5.74 40.00 NCI/M2 EPA 579 PU239 1977 SOIL 2.5 18.95 15.67 2.90 NCI/M2 EPA 13 PU239 1950 SOIL 1.3 12.59 7.17 .54 PCI/GM UCLA 12 PU239 1973 SOIL 2.5 10.38 4.45 6.10 NCI/M2 EPA 2037 PU239 1973 SOIL 2.5 15.45 9.75 .61 PCI/GM LASL 2027 PU239 1973 SOIL 7.5 10.28 4.20 .20 PCI/GM LASL 546 PU239	
2018 PU239 1977 SOIL 12.5 6.66 1.76 .00 PCI/GM LASL 552 PU239 1973 SOIL 2.5 11.50 5.74 40.00 NCI/M2 EPA 579 PU239 1977 SOIL 2.5 18.95 15.67 2.90 NCI/M2 EPA 13 PU239 1950 SOIL 1.3 12.59 7.17 .54 PCI/GM UCLA 12 PU239 1973 SOIL 2.5 10.38 4.45 6.10 NCI/M2 EPA 13 PU239 1973 SOIL 2.5 10.38 4.45 6.10 NCI/M2 EPA 2097 PU239 1977 SOIL 2.5 15.45 9.75 .61 PCI/GM LASL 5 PU239 1977 SOIL 1.3 10.72 5.90 2.70 PCI/GM LASL 546 PU239 1973 SOIL 2.5 10.28 4.20 .20 PCI/GM LASL 546 PU239	72
552 PU239 1973 SOIL 2.5 11.50 5.74 40.00 NCI/M2 EPA 579 PU239 1977 SOIL 2.5 18.95 15.67 2.90 NCI/M2 EPA 13 PU239 1950 SOIL 1.3 12.59 7.17 .54 PCI/GM UCLA 12 PU239 1950 SOIL 1.3 13.20 6.36 4.10 PCI/GM UCLA 534 PU239 1973 SOIL 2.5 10.38 4.45 6.10 NCI/M2 EPA 2097 PU239 1977 SOIL 2.5 15.45 9.75 .61 PCI/GM LASL 5 PU239 1977 SOIL 7.5 10.28 4.20 .20 PCI/GM LASL 546 PU239 1973 SOIL 2.5 10.28 4.20 .20 PCI/GM LASL 546 PU239 1973 SOIL 2.5 10.29 5.37 86.00 NCI/M2 EPA 544 PU239	CHEM
579 PU239 1977 SOIL 2.5 18.95 15.67 2.90 NCI/M2 EPA 13 PU239 1950 SOIL 1.3 12.59 7.17 .54 PCI/GM UCLA 12 PU239 1950 SOIL 1.3 13.20 6.36 4.10 PCI/GM UCLA 534 PU239 1973 SOIL 2.5 10.38 4.45 6.10 NCI/M2 EPA 2097 PU239 1977 SOIL 2.5 15.45 9.75 .61 PCI/GM UCLA 2027 PU239 1977 SOIL 7.5 10.28 4.20 .20 PCI/GM UCLA 2027 PU239 1977 SOIL 7.5 10.28 4.20 .20 PCI/GM UCLA 2027 PU239 1973 SOIL 2.5 8.79 5.68 2.40 NCI/M2 EPA 546 PU239 1973 SOIL 2.5 10.29 5.37 86.00 NCI/M2 EPA 544 PU239	
12 PU239 1950 SOIL 1.3 12.39 17.17 1.34 PCI/GM UCLA 534 PU239 1950 SOIL 1.3 13.20 6.36 4.10 PCI/GM UCLA 534 PU239 1973 SOIL 2.5 10.38 4.45 6.10 NCI/M2 EPA 2097 PU239 1977 SOIL 2.5 15.45 9.75 .61 PCI/GM LASLI 5 PU239 1950 SOIL 1.3 10.72 5.90 2.70 PCI/GM UCLA 2027 PU239 1977 SOIL 7.5 10.28 4.20 .20 PCI/GM LASLI 546 PU239 1973 SOIL 2.5 8.79 5.68 2.40 NCI/M2 EPA 544 PU239 1973 SOIL 2.5 10.29 5.37 86.00 NCI/M2 EPA 553 PU239 1973 SOIL 2.5 14.49 9.24 .21 PCI/GM LASLI 530 PU239	50
534 PU239 1973 SOIL 2.5 10.38 4.45 6.10 NCI/M2 EPA 2097 PU239 1977 SOIL 2.5 15.45 9.75 .61 PCI/GM LASL 5 PU239 1977 SOIL 2.5 15.45 9.75 .61 PCI/GM LASL 2027 PU239 1977 SOIL 7.5 10.28 4.20 .20 PCI/GM UCLA 2027 PU239 1977 SOIL 7.5 10.28 4.20 .20 PCI/GM LASL 546 PU239 1973 SOIL 2.5 8.79 5.68 2.40 NCI/M2 EPA 544 PU239 1973 SOIL 2.5 10.29 5.37 86.00 NCI/M2 EPA 553 PU239 1973 SOIL 2.5 14.49 9.24 .21 PCI/GM LASL 530 PU239 1973 SOIL 2.5	50 \50
2097 PU239 1977 SOIL 2.5 15.45 9.75 .61 PCI/GM LASL 5 PU239 1950 SOIL 1.3 10.72 5.90 2.70 PCI/GM UCLA 2027 PU239 1977 SOIL 7.5 10.28 4.20 .20 PCI/GM LASL 546 PU239 1973 SOIL 2.5 8.79 5.68 2.40 NCI/M2 EPA 544 PU239 1973 SOIL 2.5 10.29 5.37 86.00 NCI/M2 EPA 553 PU239 1973 SOIL 2.5 11.66 5.05 29.00 NCI/M2 EPA 2096 PU239 1977 SOIL 2.5 14.49 9.24 .21 PCI/GM LASL 530 PU239 1973 SOIL 2.5 9.34 4.12 52.00 NCI/M2 EPA 1995 PU239 1977 SOIL 7.5	
5 FU239 1977 SOIL 1.3 10.72 5.30 2.70 PCI/GM UCLA 2027 FU239 1977 SOIL 7.5 10.28 4.20 .20 PCI/GM LASL 546 FU239 1973 SOIL 2.5 8.79 5.68 2.40 NCI/M2 EPA 544 FU239 1973 SOIL 2.5 10.29 5.37 86.00 NCI/M2 EPA 553 FU239 1977 SOIL 2.5 11.66 5.05 29.00 NCI/M2 EPA 2096 FU239 1977 SOIL 2.5 14.49 9.24 .21 PCI/GM LASL 530 FU239 1973 SOIL 2.5 9.34 4.12 52.00 NCI/M2 EPA 1995 FU239 1977 SOIL 7.5 6.66 .76 0.00 PCI/GM LASL	CHEM
546 PU239 1973 SOIL 2.5 8.79 5.68 2.40 NCI/M2 EPA 544 PU239 1973 SOIL 2.5 10.29 5.37 86.00 NCI/M2 EPA 553 PU239 1973 SOIL 2.5 11.66 5.05 29.00 NCI/M2 EPA 2096 PU239 1977 SOIL 2.5 14.49 9.24 .21 PCI/GM LASL 530 PU239 1973 SOIL 2.5 9.34 4.12 52.00 NCI/M2 EPA 1995 PU239 1977 SOIL 7.5 6.66 .76 0.00 PCI/GM LASL	CHEM
544 PU239 1973 SOIL 2.5 10.29 5.37 86.00 NCI/M2 EPA 553 PU239 1973 SOIL 2.5 11.66 5.05 29.00 NCI/M2 EPA 2096 PU239 1977 SOIL 2.5 14.49 9.24 .21 PCI/GM LASL 530 PU239 1973 SOIL 2.5 9.34 4.12 52.00 NCI/M2 EPA 1995 PU239 1977 SOIL 7.5 6.66 .76 0.00 PCI/GM LASL	
553 PU239 1973 SOIL 2.5 11.06 5.05 29.00 NCI/M2 EPA 2096 PU239 1977 SOIL 2.5 14.49 9.24 .21 PCI/GM LASL 530 PU239 1973 SOIL 2.5 9.34 4.12 52.00 NCI/M2 EPA 1995 PU239 1977 SOIL 7.5 6.66 .76 0.00 PCI/GM LASL	
530 PU239 1973 SOIL 2.5 9.34 4.12 52.00 NCI/M2 EPA 1995 PU239 1977 SOIL 7.5 6.66 .76 0.00 PCI/GM LASL	CHEM
1995 PU239 1977 SOIL 7.5 6.66 .76 0.00 PCI/GM LASL	
	CHEM
2009 PU239 1977 SOIL 2.5 6.59 1.65 .48 PCI/GM LASL	CHEM
541 PU239 1973 SOIL 2.5 10.90 4.88 28.00 NCI/M2 EPA	
532 PU239 1973 SOIL 2.5 10.43 4.16 .40 NCI/M2 EPA	
102 PU239 1948 SOIL 1.3 7.69 1.76 2.50 PCI/GM UCLA	
551 PU239 1973 SOIL 2.5 11.09 5.83 17.00 NCI/M2 EPA	
2026 PU239 1977 SOIL 12.5 10.05 4.07 .02 PCI/GM LASL	CHEM
2096 PU239 1977 SOIL 12.5 14.49 9.24 0.00 PCI/GM LASL	CHEM
2121 P0239 1977 SOIL 7.5 13.68 6.87 .51 PCI/GM LASL	-HEIM
529 PU239 1973 SOIL 2.5 8.95 3.94 3.00 NCI/M2 EPA	
11 PU239 1950 SOIL 1.3 13.43 5.88 .72 PCI/GM UCLA	50
2009 PU239 1977 SOIL 12.5 6.59 1.65 .47 PCI/GM LASL	CHEM
503 PU239 1973 SOIL 2.5 7.42 1.23 1.70 NCI/M2 EPA	
2052 PU239 1977 SOIL 17.5 11.11 5.55 .00 PCI/GM LASL	CHEM
505 PU239 1973 SOIL 2.5 6.70 1.45 110.00 NCI/M2 EPA	
559 PU239 1973 SOIL 2.5 0.27 3.00 .50 NCI/M2 EPA	
2048 PU239 1977 SOIL 12.5 11.09 5.87 .01 PCI/GM LASL	CHEM
568 PU239 1977 SOIL 2.5 13.34 12.05 1.90 NCI/M2 EPA	-0
10 FUZ39 1950 SULL 1.3 14.49 6.57 .77 PCI/GM UCLA	5U 48
2060 PU239 1977 SOIL 12.5 9.91 5.07 .16 PCI/GM LASL	CHEM
2052 PU239 1977 SOIL 2.5 11.11 5.55 .12 PCI/GM LASL	CHEM
2016 PU239 1977 SOIL 2.5 7.24 2.33 .12 PCI/GM LASL	CHEM
8 PU239 1973 SOIL 2.5 8.82 3.45 48.00 NCI/M2 EPA 8 PU239 1950 SOIL 1.3 11.07 6.63 1.30 PCI/CM UCLA	50
3003 PU239 1977 SOIL 7.5 3.91 3.49 0.00 PCI/GM LASL	CHEM

							. .	/	
2047	PU239	1977	SOIL	22.5	11.08	5.74	.01	PCI/GM	LASLCHEM
2014	PU239	1977	SOIL	12.5	7.37	2.22	. 15	PCI/GM	LASLCHEM
104	PU239	1948	SOIL	1.3	8.99	3_23	1.30	PCI/GM	UCLA48
2072	PU239	1977	SOIL	7.5	9.86	4.42	3.88	PCI/GM	LASLCHEM
535	PU239	1973	SOTI	2.5	10 87	4.55	54	NCT/M2	FPA
105	D11230	1948	SOTI	1 3	8 41	3 23	50	PCT/GM	
2052	PU235	4077	SOT	7 5	44 44	5.20		PCT/GM	
2052	PU239	19//	SUIL	1.5		5.55	.00	PCI/GM	
2115	PU239	1977	SOIL	2.5	13.57	6.49	-23	PC1/GM	LASLCHEM
2016	PU239	1977	SOIL	12.5	7.24	2.33	. 68	PCI/GM	LASLCHEM
2018	PU239	1977	SOIL	7.5	6.66	1.76	0.00	PCI/GM	LASLCHEM
18	PU239	1950	SOIL	1.3	14.72	7.12	.86	PCI/GM	UCLA50
2047	PU239	1977	SDIL	17.5	11.08	5.74	.01	PCI/GM	LASLCHEM
2003	PU239	1977	SOTI	12 5	6 63	55	0.00	PCT/GM	LASI CHEM
2000	DI1230	1072	SOTE	1 3	8 45	2 59	13	PCT/GM	
E01	PU233	1072	SOTE	2 5	6 16	1 16	. 10	NCT /M2	
502	PU239	19/3	SUIL	2-5	0.40	1.10			
101	PU239	1948	SUIL	1.3	7.46	1.50	1.10	PCI/GM	UCLA48
2076	PU239	1977	SOIL	7.5	11.09	4.52	.02	PC1/GM	LASLCHEM
2084	PU239	1977	SOIL	7.5	12.58	7.17	.06	PCI/GM	LASLCHEM
2097	PU239	1977	SOIL	7.5	15.45	9.75	. 15	PCI/GM	LASLCHEM
2018	PU239	1977	SOIL	2.5	6.66	1.76	. 67	PCI/GM	LASLCHEM
526	PU239	1973	SOIL	2.5	7.91	3.31	12.00	NCI/M2	EPA
2027	PU239	1977	SOTI	12 5	10 28	4 20	.07	PCT/GM	LASICHEM
2027	DU220	1077	SOTE	57 5	11 11	5 55	01	PCT/GM	LASICHEM
2032	FU235	1050	SOIL	57.5	10.00	5.55 6 0E	.01	PCT/CM	
2000	PU239	1950	SUIL	1.3	10.30	0.35	.40	FCI/GM	
2026	PU239	1977	SUIL	7.5	10.05	4.07	. 12	PC1/GM	LASLCHEM
2082	PU239	1977	SOIL	7.5	11.62	7.18	.01	PCI/GM	LASLCHEM
2001	PU239	1977	SOIL	7.5	6.63	. 55	44.40	PCI/GM	LASLCHEM
202	PU239	1972	SOIL	5.0	7.23	1.23	0.00	PCI/GM	LASL72
2119	PU239	1977	SOIL	12.5	14.34	7.21	0.00	PCI/GM	LASLCHEM
204	PU239	1972	SOTI	19 0	8.45	2.59	. 17	PCI/GM	LASL72
2057	PI1239	1977	SOTI	2 5	10 35	5 34	70	PCT/GM	LASICHEM
1007	DU220	10/0	SOTE	1 3	9 67	4 57	1 20	PCT/GM	
2000	FU239	1340	SOIL	7 5	9.07	4.57	1.30		
2060	PU239	19//	SUIL	7.5	9.91	5.07	- 30	PCI/GM	
2082	PU239	1977	SOIL	2.5	11.62	7.18	.95	PC1/GM	LASLCHEM
2057	PU239	1977	SOIL	7.5	10.35	5.34	.38	PCI/GM	LASLCHEM
2097	PU239	1977	SOIL	22.5	15.45	9.75	.00	PCI/GM	LASLCHEM
2084	PU239	1977	SOIL	12.5	12.58	7.17	.01	PCI/GM	LASLCHEM
3003	PU239	1977	SOIL	2.5	3.91	3.49	.01	PCI/GM	LASLCHEM
2028	PU239	1977	SOIL	7.5	10.37	4.33	. 11	PCI/GM	LASLCHEM
2126	PU239	1977	SOTI	7 5	12.45	4.27	0.00	PCT/GM	LASI CHEM
2087	PI1230	1977	SOTI	2 5	12 92	7 66		PCT/GM	LASICHEM
2007	F0239	4077	SOIL	2.5	0.04	F 07	.00	DCT/CM	
2000	PU239	19/1	SUIL	22.5	3.31	3.07	.05		
5/4	PU239	19//	SUIL	2.5	17.51	11.20	0.10	NCI/M2	
204	PU239	1972	SOIL	5.0	8.45	2.59	. / 5	PC1/GM	LASL/2
542	PU239	1973	SOIL	2.5	10.30	5.37	28.00	NCI/M2	EPA
202	PU239	1972	SOIL	1.3	7.23	1.23	.43	PCI/GM	LASL72
539	PU239	1973	SOIL	2.5	12.28	3.54	1.30	NCI/M2	EPA
2118	PU239	1977	SOIL	12.5	14_55	6.45	0.00	PCI/GM	LASLCHEM
510	PU239	1973	SOTI	2.5	8.63	2.52	2.80	NCI/M2	EPA
2028	PU239	1977	SOTI	2 5	10 37	4 33	4 07	PCT/GM	LASICHEM
2020	DU220	4077	SOTE	2.5	0.07	5 42	4.07	PCT/GM	
2059	PU239	19/1	SOIL	2.5	3.74	5.42	1.21	PCI/GM	
2128	PU239	19//	SOIL	2.5	13.77	5.47	.00	PCI/GM	
114	PU239	1948	SUIL	1.3	10.68	5.11	3.80	PC1/GM	UCLA48
208	PU239	1972	SOIL	19.0	10.80	5.26	.03	PCI/GM	LASL72
2049	PU239	1977	SOIL	2.5	11.11	5.55	. 25	PCI/GM	LASLCHEM
2037	PU239	1977	SOIL	2.5	9.82	4.27	1.83	PCI/GM	LASLCHEM
100	PU239	1948	SOIL	1.3	7.10	1.09	. 10	PCI/GM	UCLA48
208	PU239	1972	SOIL	1.3	10.80	5 26		PCT/GM	LASL72
115							1.44		
	PH239	1948	SOTI	13	9,90	5.10	1.44	PCI/GM	UCLA48
2022	PU239	1948	SOIL	1_3	9.90	5.10	1.44 .81 4 58	PCI/GM	UCLA48
2072	PU239 PU239	1948 1977	SOIL	1_3 2.5	9.90	5.10	1.44 .81 4.58	PCI/GM PCI/GM	UCLA48 LASLCHEM
2072 1998	PU239 PU239 PU239	1948 1977 1977	SOIL SOIL SOIL	1_3 2.5 12.5	9.90 9.86 6.63	5.10 4.42 .55	1.44 .81 4.58 .15	PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM
2072 1998 207	PU239 PU239 PU239 PU239	1948 1977 1977 1972	SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3	9.90 9.86 6.63 10.22	5.10 4.42 .55 4.59	1.44 .81 4.58 .15 .28	PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72
2072 1998 207 2088	PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977	SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 2.5	9.90 9.86 6.63 10.22 13.22	5.10 4.42 .55 4.59 7.66	1.44 .81 4.58 .15 .28 .03	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM
2072 1998 207 2088 206	PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972	SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 2.5 1.3	9.90 9.86 6.63 10.22 13.22 9.59	5.10 4.42 .55 4.59 7.66 3.89	1.44 .81 4.58 .15 .28 .03 .67	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72
2072 1998 207 2088 206 2080	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 2.5 1.3 7.5	9.90 9.86 6.63 10.22 13.22 9.59 10.91	5.10 4.42 .55 4.59 7.66 3.89 7.22	1.44 .81 4.58 .15 .28 .03 .67 .02	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 LASLCHEM
2072 1998 207 2088 206 2080 203	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972 1977 1972	SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 2.5 1.3 7.5 1.3	9.90 9.86 6.63 10.22 13.22 9.59 10.91 7.81	5.10 4.42 .55 4.59 7.66 3.89 7.22 1.89	1.44 .81 4.58 .15 .28 .03 .67 .02 .31	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 LASLCHEM LASL72
2072 1998 207 2088 206 2080 203 9	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972 1977 1972 1950	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 2.5 1.3 7.5 1.3	9.90 9.86 6.63 10.22 13.22 9.59 10.91 7.81 11.59	5.10 4.42 .55 4.59 7.66 3.89 7.22 1.89 7.21	1.44 .81 4.58 .15 .28 .03 .67 .02 .31 .20	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 LASLCHEM LASL72 UCLA50
2072 1998 207 2088 206 2080 203 9	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972 1977 1972 1950 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 2.5 1.3 7.5 1.3 7.5 1.3	9.90 9.86 6.63 10.22 13.22 9.59 10.91 7.81 11.59 9.60	5.10 4.42 .55 4.59 7.66 3.89 7.22 1.89 7.21 4.33	1.44 .81 4.58 .15 .28 .03 .67 .02 .31 .20 2.24	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM
2072 1998 207 2088 206 2080 203 9 2021 3001	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972 1977 1972 1950 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 2.5 1.3 7.5 1.3 1.3 2.5	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91	5.10 4.42 .55 4.59 7.66 3.89 7.22 1.89 7.21 4.33 3.49	1.44 .81 4.58 .15 .28 .03 .67 .02 .31 .20 2.24	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM LASLCHEM
2072 1998 207 2088 206 2080 203 9 2021 3001	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972 1977 1972 1950 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 2.5 1.3 7.5 1.3 2.5 7.5 7.5	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91	5.10 4.42 .55 4.59 7.66 3.89 7.22 1.89 7.21 4.33 3.49	1.44 .81 4.58 .03 .03 .67 .02 .31 .20 2.24 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 UCLAS0 LASLCHEM LASLCHEM LASLCHEM
2072 1998 207 2088 206 2080 203 9 2021 3001 7	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972 1977 1972 1950 1977 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 7.5 1.3 7.5 7.5 7.5 7.5	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91 11.49	5.10 4.42 55 4.59 7.66 3.89 7.22 1.89 7.21 4.33 3.49 5.91	1.44 .81 4.58 .15 .28 .03 .67 .02 .31 .20 2.24 0.00 .40	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM LASLCHEM UCLA50
2072 1998 207 2088 206 2080 203 9 2021 3001 7 2115	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972 1977 1972 1950 1977 1950 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 2.5 1.3 7.5 1.3 7.5 1.3 2.5 1.3 2.5 1.3	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91 11.49 13.57	5.10 5.42 5.425 4.559 7.229 7.229 7.229 7.229 7.229 7.229 7.233 3.491 5.	1.44 .81 4.58 .15 .28 .03 .67 .02 .31 .20 2.24 0.00 .40 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM LASLCHEM UCLA50 LASLCHEM
2072 1998 207 2088 206 2080 203 9 2021 3001 7 2115 2001	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972 1977 1977 1950 1977 1950 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 2.3 7.5 1.3 2.5 7.5 1.3 2.5 7.3 12.5 1.3 2.5	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91 11.49 13.57 6.63	5.10 4.42 .55 4.59 7.66 7.66 7.22 1.89 7.21 4.33 3.49 1 6.49 .55	1.44 .81 4.58 .03 .03 .67 .02 .31 .20 2.24 0.00 .40 0.00 64.90	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM LASLCHEM UCLA50 LASLCHEM LASLCHEM
2072 1998 207 2088 206 2080 203 9 2021 3001 7 2115 2001 2009	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972 1977 1977 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.5 1.5 1.5 7.5 1.3 7.5 1.3 5 5 5 1.5 5 7.5 7.5	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91 11.49 13.57 6.63 6.59	5.10 5.10 4.42 .55 4.59 7.66 3.89 7.21 4.33 3.49 5.91 6.94 .55 1.65	1.44 .81 4.58 .15 .28 .03 .67 .02 .31 .20 2.24 0.00 .40 0.00 64.90 .45	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM LASLCHEM UCLA50 LASLCHEM LASLCHEM LASLCHEM LASLCHEM
2072 1998 207 2088 206 2080 203 9 2021 3001 7 2115 2001 2009 205	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1977 1972 1977 1972 1977 1977 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.3 1.3 7.5 1.3 7.5 1.3 7.5 1.3 7.5 1.3 2.5 5 7.5 1.3	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91 11.49 13.57 6.63 6.59 9.03	5.10 4.42 .55 4.59 7.22 1.89 7.21 3.49 7.21 3.49 5.91 6.49 .55 3.26	1.44 .81 4.58 .15 .28 .03 .67 .02 .31 .20 2.24 0.00 64.90 64.90 .45 .29	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM LASLCHEM UCLA50 LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM
2072 1998 207 2088 206 2080 203 9 2021 3001 7 2115 2001 2001 2005 106	PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239 PU239	1948 1977 1972 1977 1972 1977 1977 1977 1950 1977 1977 1977 1977 1972	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 2.5 1.3 7.5 1.3 2.5 1.3 2.5 1.3 12.5 7.5 1.3	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91 11.49 13.57 6.63 9.03 9.90	5.10 4.42 .55 4.59 7.689 7.21 4.33 5.91 6.49 .55 1.65 3.23	1.44 .81 4.58 .15 .28 .03 .67 .02 .31 .20 2.24 0.00 64.90 .45 .29 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM LASLCHEM UCLA50 LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM
2072 1998 207 2088 206 2080 203 9 2021 3001 7 2115 2001 2009 205 106 2065	PU239 PU239	1948 1977 1977 1977 1977 1977 1977 1977 197	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 7.5 1.3 7.5 1.3 2.5 7.5 1.3 2.5 7.5 1.3 2.5 7.5 3 12.5 1.3 5 7.5 1.3 5 5 3 5 5 3 5 5 1.3 5 5 5 3 5 5 1.3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91 11.49 13.57 6.63 9.03 9.03 9.03 9.03 9.03 9.03	5.10 4.42 .55 4.59 7.68 7.21 4.33 3.91 6.49 .55 1.65 3.26 3.26 3.26 5.01	1.44 .81 4.58 .03 .03 .67 .02 .31 .20 2.24 0.00 64.90 .40 64.90 .45 0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM
2072 1998 207 2088 206 2080 203 9 2021 3001 7 2115 2001 2009 205 106 2065 2048	PU239 PU239	1948 1977 1972 1972 1972 1977 1972 1977 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 12.5 1.5 1.5 1.5 1.5 7.5 1.3 5 7.5 1.3 5 7.5 1.3 5 7.5 1.3 5 7.5 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91 11.49 13.57 6.63 9.03 9.90 10.39 11.09	5.10 4.25 4.59 7.22 7.23 7.22 7.23 7.23 7.23 5.91 6.49 5.91 6.49 5.23 5.23 5.23 5.87	1.44 .81 4.58 .03 .03 .67 .02 .31 .20 2.24 0.00 0.40 0.00 64.90 .45 .29 0.000 0.000 .40	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM LASLCHEM UCLA50 LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM
2072 1998 207 2088 206 2080 203 9 2021 3001 7 2115 2001 2005 2005 2048 2076	PU239 PU239	1948 1977 1972 1977 1972 1977 1977 1977 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.3 1.35 1.35 1.3 7.5 1.3 7.5 1.3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91 11.49 13.57 6.63 6.59 9.03 9.90 10.39 11.09	5.10 4.59 7.26 7.26 7.26 7.21 7.21 3.39 7.21 3.49 5.97 5.20 7.21 3.49 5.97 5.20 5.20 7.21 5.20 5.20 7.21 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20 5.20 7.20	1.44 .81 4.58 .03 .02 .31 .20 0.00 64.90 64.90 0.40 64.90 0.00 64.90 0.00 64.90 0.00 64.90 0.00 64.90 0.00 0.00	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM
2072 1998 207 2088 206 2080 203 9 2021 3001 7 2115 2001 2095 2048 2076 1998	PU239 PU239	1948 1977 1972 1977 1972 1977 1972 1977 1977	SOIL SOIL SOIL SOIL SOIL SOIL SOIL SOIL	1_3 2.5 12.5 1.3 5 1.3 5 1.3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	9.90 9.86 6.63 10.22 9.59 10.91 7.81 11.59 9.60 3.91 11.49 13.57 6.63 9.90 10.39 11.09 6.63	5.10 4.55 4.55 7.689 7.21 4.339 7.21 3.391 6.495 5.95 1.656 3.23 5.01 5.872 5.55 4.55 5.55	1.44 .81 4.58 .03 .03 .02 .31 .20 2.24 0.00 .40 0.00 64.90 0.00 64.90 0.00 64.90 .45 .29 0.00 0.40 0.44	PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM PCI/GM	UCLA48 LASLCHEM LASLCHEM LASL72 LASLCHEM LASL72 UCLA50 LASLCHEM LASLCHEM UCLA50 LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM LASLCHEM

2071	PU239	1977	SOIL	12.5	9.83	4.48	. 06	PCI/GM	LASLCHEM
2028	PU239	1977	тн		10.37	4.33	. 04	PCI/GM	CVEG
2055	RU103	1977	GR		11.35	5.86	1.31	PCI/GM	LLL GELI
1990	RU103	1977	GR		6.64	. 55	0.00	PCI/GM	LLL GELI
2018	RU103	1977	GR		6.66	1.76	0.00	PCI/GM	LLL GELI
1988	RU103	1977	GR		6.64	.55	. 57	PCI/GM	LLL GELI
2073	RU103	1977	INSITU		9.86	4.42	0.00	NCI/M2	LASL77
2022	RU103	1977	INSITU		9.60	4.32	1.42	NCI/M2	LASL77
2038	RU103	1977	INSITU		9.60	4.32	0.00	NCI/M2	LASL77
2144	RU103	1977	INSITU		10.46	7.19	0.00	NCI/M2	LASL77
2142	RU103	1977	INSITU		6.27	.00	0.00	NCI/M2	LASL77
2012	RU103	1977	INSITU		6.79	1.77	0.00	NC1/M2	LASL77
2031	RU103	1977	INSITU		10.41	4.28	0.00	NC1/M2	LASL77
2011	RU103	1977	INSITU		6.32	.00	0.00	NC1/M2	LASL77
2041	RU103	1977	INSITU		9.61	4.32	1.90	NC1/M2	LASL77
2125	RU103	1977	INSITU		14.68	4.45	1.01	NC1/M2	LASL77
2032	RU103	1977	INSITU		3.17	3.48	0.00	NC1/M2	LASL77
2026	RU103	19//	INSITU		10.05	4.07	0.00	NC1/M2	LASL//
2023	RU103	1977	INSITU		9.54	3.98	0.00	NC1/M2	LASL77
2052	RU103	19//	INSITU		11.11	5.55	0.00	NCI/M2	
2008	R0103	19//	INSITU		7.40	2.10	0.00	NCI/M2	LASL//
2033	R0103	19//	INSTIU		3.14	3.5/	0.00	NC1/M2	LASL//
2077	RU103	19//	INSITU		10.31	4.41	0.00	NC1/M2	
2007	RU103	19//	INSITU		7.10	2.07	1.48	NC1/M2	
2029	RU103	19//	INSTIU		10.35	4.28	0.00	NCI/M2	
2039	RU103	19//			9-00	4.32	0.00	NCI/M2	
2090	RU 103	19//	INSTIU		14.49	9.24	1.32	NCI/M2	
2019	RU 103	19//			0.09	2.24	. 93	NCI/M2	
2040	PU103	19//	INSTIU		7 25	4.27	0.00		
2116	PUITOS	1977	INSTIU	•	12 74	2.33	0.00		
2086	RU103	1977	INSTITU		10 53	7 19	0.00		
2139	RU103	1977	INSTIL		6 58	55	0.00		
2115	PU103	1977	INSTITU		13 57	6 49	88		
2092	RU103	1977	INSTIL		13 52	.9 21	1 12	NCT/M2	
2085	RU103	1977	INSTIL		12 60	6 58	0.00		
2000	RU103	1977	INSTIL		10 53	7 20	0.00	NCT/M2	
1997	RU103	1977	INSTIL		6 46	1 16	0.00	NCT/M2	
2080	RU103	1977	INSTITU		10.91	7.22	1.04	NCI/M2	
2147	RU103	1977	INSITU		7.77	3.07	0.00	NCI/M2	
2132	RU103	1977	INSITU		6.70	2.16	0.00	NCI/M2	LASL77
2020	RU103	1977	INSITU		3.17	3.48	0.00	NCI/M2	LASL77
2120	RU103	1977	INSITU		14.30	7.16	1.59	NCI/M2	LASL77
2057	RU 103	1977	INSITU		10.35	5.34	0.00	NCI/M2	LASL77
2016	RU 103	1977	INSITU		7.24	2.33	0.00	NCI/M2	LASL77
2082	RU103	1977	INSITU		11.62	7.18	1.25	NCI/M2	LASL77
2123	RU103	1977	INSITU		13.68	6.79	0.00	NCI/M2	LASL77
2049	RU103	1977	INSITU		11.11	5.55	0.00	NCI/M2	LASL77
2097	RU 103	1977	INSITU		15.45	9.75	0.00	NCI/M2	LASL77
2072	RU 103	1977	INSITU		9.86	4.42	0.00	NCI/M2	LASL77
2118	RU 103	1977	INSITU		14.55	6.45	0.00	NCI/M2	LASL77
2059	RU103	1977	INSITU		9.74	5.42	. 94	NCI/M2	LASL77
2087	RU103	1977	INSITU		12.92	7.66	0.00	NCI/M2	LASL77
2134	RU103	1977	INSITU		6.58	. 55	0.00	NCI/M2	LASL77
2101	RU103	1977	INSITU		16.52	14.74	0.00	NCI/M2	LASL77
2135	RU103	1977	INSITU		6.58	.55	0.00	NC1/M2	LASL77
2126	RU103	19//	INSTIU		12.45	4.27	0.00	NC1/M2	
2122	R0103	19//	INSTIU		13.69	5.8/	0.00	NCI/M2	
2055	RU103	19//	INSITU		11.35	5.80	.8/	NCI/M2	
2075	RU 103	19//	INSIIU		10.85	4.60	0.00	NCI/M2	
1990	RU 103	19//			6.45	. / 5	0.00	NCI/M2	
2010	RU IO3	19//	INSTIU		44 42	1.71	0.00	NCI/M2	
2099	DUMO2	19//			6 59	10.93	0.00	NCI/M2	
2130	PU103	1077	INSTIU		10.50	5 56	0.00	NCI/M2	
2000	PU103	1077	INSTIU		10.03	1 33	1 26	NCI/M2	
2020	PU103	1077	INSTIU		14 49	9.35	0.00	NCT/M2	
2033	PU103	1977	INSTIU		7 37	2.23	0.00	NCT/M2	
2015	RU103	1977	INSTIU		7 37	2.22	0.00	NCT/M2	
2009	RU103	1977	INSTIL		6.59	1.65	0.00	NCI/M2	
2081	RU103	1977	INSTTU		11.31	7.21	.75	NCI/M2	
2024	RU103	1977	INSTTU		8.95	3.88	0.00	NCI/M2	LASL77
2066	RU103	1977	INSITU		10,60	4,42	0.00	NCI/M2	LASL77
2148	RU103	1977	INSITU		2.98	3.62	0.00	NCI/M2	LASL77
2068	RU103	1977	INSITU		9.30	5.02	0.00	NCI/M2	LASL77
2153	RU103	1977	INSITU		3.94	4.88	0.00	NCI/M2	LASL77
2027	RU 103	1977	INSITU		10.28	4.20	.99	NCI/M2	LASL77
2018	RU 103	1977	INSITU		6.66	1.76	0.00	NCI/M2	LASL77
2094	RU 103	1977	INSITU		14.49	9.25	0.00	NCI/M2	LASL77
2006	RU103	1977	INSITU		7.07	2.04	0.00	NCI/M2	LASL77

•

2042	RU 103	1977	INSITU		9.82	4.27	0.00 1	NCI/M2	LASL77
2034	PU103	1977	TNSTTH		3 16	3 70	0 00 1	NCT/M2	1 451 73
2004	RU 100	4077	INCITU		0.10	4 07			1/5175
2037	RU103	1977	INSTIC		9.82	4.27	0.00 1	NC1/M2	LASL
2127	RU 103	1977	INSITU		13.40	5.21	0.00	NCI/M2	LASL77
2058	RU103	1977	INSITU		10.00	5.31	0.00 1	NCI/M2	LASL77
2154	RU103	1977	TNSTTH		3 95	4 57	0.00 1	NCT/M2	1 451 77
2040	DU 402	1077	TNETTU		7 40	7.01			
2013	RU 103	19//	1115110		7.43	2.11	0.00		LASL
1998	RU 103	1977	INSITU		6.63	.55	0.00	NCI/M2	LASL7/
2141	RU 103	1977	INSITU		6.58	. 55	0.00	NCI/M2	LASL77
2130	RU103	1977	INSTIU		6.03	. 60	0.00 1	NCT/M2	1 451 77
2060	RU 100	1077	TNETTH		0.00	5 10			
2002	RU 103	19//	INSTIC		9.83	5.10	0.00		
2074	RU 103	1977	INSTIU		9.85	4.35	0.00	NCI/M2	LASL77
2067	RU 103	1977	INSITU		9.31	4.96	0.00	NCI/M2	LASL77
2121	RU 103	1977	INSITU		13.68	6.87	0.00	NCI/M2	LASL77
2004	DU 102	1077	TNSTTU		12 58	7 17	0.00		
2004	R0 103	1977	INSTIC		12.00	1.17	0.00		
2025	RU103	1977	INSTIU		10.12	4.27	0.00	NC1/M2	LASL//
2065	RU 103	1977	INSITU		10.39	5.01	0.00	NCI/M2	LASL77
2090	RU 103	1977	INSITU		13.85	7.69	0.00	NCI/M2	LASL77
2047	PU103	1077	TNSTTH		11 08	5 74	0.00	NCT/M2	1 451 77
204/	R0103	1077	INGITU		11.00	5.74	0.00		
2061	RU103	1977	INSTIC		a.ai	5.07	0.00	NC1/M2	LASL//
2088	RU 103	1977	INSITU		13.22	7.66	.94	NCI/M2	LASL77
2048	RU 103	1977	INSITU		11.09	5.87	1.02	NCI/M2	LASL77
2093	RU103	1977	TNSTTH		14 60	8 57	0 00	NCT/M2	1 451 77
2000	DU 400	1077	TNCTTU		40.77	E 47	0.00		
2120	RUIUS	19//	INSTIU		13.77	5.47	0.00		LASLII
2076	RU 103	1977	INSITU		11.09	4.52	0.00	NCI/M2	LASL//
2064	RU 103	1977	INSITU		10.54	7.19	0.00	NCI/M2	LASL77
2131	RU 103	1977	INSITU		6.62	1.87	0.00	NCI/M2	LASL77
2100	DU 102	1077	TNSTTU		6 17	0.00	0.00	NCT/M2	
2123	RU IU3	19//	THETTH		10.2/	9.00	0.00		LAGL 77
2083	RU 103	1977	INSTIU		12.14	7.19	0.00	NCI/M2	LASL//
2043	RU 103	1977	INSITU		3.91	3.49	0.00	NCI/M2	LASL77
2071	RU 103	1977	INSITU		9.83	4.48	0.00	NCI/M2	LASL77
2155	PU103	1077	TNSTTH		2 01	3 19	83	NCT/M2	
2100	RUIUS	19/1	INSTIU		3.51	3.45			
2143	RU103	1977	INSTIU		4.81	3-00	0.00	NC1/M2	LASL
2114	RU 103	1977	INSITU		10.46	7.18	.95	NCI/M2	LASL77
2030	RU 103	1977	INSITU		10.39	4.30	0.00	NCI/M2	LASL77
2100	RU103	1977	TNSTTU		14.50	12.20	0.00	NCT/M2	1 4 51 77
2440	DU 402	1077	TNICTTU		6 60	E E E	0.00	NCT /MO	
2140	R0103	1977	1115110		0.50	. 55	0.00	NCI/MZ	LASL
2060	RU 103	1977	INSITU		9.91	5.07	0.00	NC1/M2	LASL77
2050	RU 103	1977	INSITU		11.11	5.55	1.12	NCI/M2	LASL77
2040	RU 103	1977	INSITU		9.60	4.32	0.00	NCI/M2	LASL77
2120	PU103	1077	TNISTTU		5 81	2 17	0.00	NCT/M2	1 451 77
2100	RU 100	1077	TNCTTU		44.04	3.04	0.00	NOT /MO	
2119	RU 103	1977	TNSTID		14.34	1.21	0.00	NCI/MZ	LASLII
2049	RU 103	1977	SG		11.11	5.55	.50	PCI/GM	LLL GELI
2007	RU 103	1977	SK		7.10	2.07	1.17	PCI/GM	LLL GELI
1987	RU 103	1977	SK		6.63	. 55	0.00	PCI/GM	III GELI
2016	BU 100	1077	CV		7 24	1.22	1 06	PCT/GM	
2010	RUIUS	19//	35		7.24	2.33	1.00		
1991	RU103	1977	SK		6.63	. 55	. 35	PCI/GM	LLL GELI
2045	RU 103	1977	SK		10.52	5.51	0.00	PCI/GM	LLL GELI
2028	RU 103	1977	тн		10.37	4.33	0.00	PCI/GM	LLL GELI
2052	RU103	1977	UK		11.11	5.55	0.00	PCI/GM	III GELI
2040	5000	1077	CP.		6 66	1 76	50	PCT/CM	CVEG
2010	3890	1977	GR		0.00	1.70			CVEG
2028	SR90	1977	GR		10.37	4.33	. 15	PCI/GM	CVEG
2048	SR 90	1977	GR		11.09	5.87	. 50	PCI/GM	CVEG
2019	SR90	1977	OTHER		6.69	2.24	. 19	PCI/GM	CVEG
2052	SP90	1977	OTHER		11 11	5 55	.23	PCT/GM	CVEG
2002	SR00	1077	SK		6 66	1 76	24	PCT/CM	CVEG
2010	3890	19//	35		0.00	1.70	. 24	PCI/GM	OVEG
1995	2890	1977	SK		6.66	. 76	• 11	PC1/GM	CVEG
2018	SR90	1.977	SOIL	2.5	6.66	1.76	. 50	PCI/GM	LASLCHEM
2072	5890	1977	SOIL	2.5	9.86	4.42	5.50	PCI/GM	LASLCHEM
2052	SPOO	1077	SOTI	12 5	11 11	5 55	22	PCT/GM	LASI CHEM
2032	38 30	1077	SOIL	2.5	11.11	3.33	. 22	DOT/ON	
2014	2890	1977	SUIL	2.5	1.31	2.22	. 42	PCI/GM	LASLUMEM
2016	SR90	1977	SOIL	12.5	7.24	2.33	1.60	PCI/GM	LASLCHEM
2016	SR 90	1977	SOIL	7.5	7.24	2.33	.37	PCI/GM	LASLCHEM
2073	SP90	1977	SOTI	25	9.86	4 42	6 80	PCT/GM	LASI CHEM
2070	5000	4077	SOTE	2.5	4 4 4 4		0.00	DOT / CM	
2052	2890	1977	SUIL	22.5	11.11	5.55	. 20	PCI/GM	LASLUTEM
2121	SR90	1977	SOIL	2.5	13.68	6.87	3.50	PCI/GM	LASLCHEM
2121	SR90	1977	SOIL	7.5	13.68	6.87	2.16	PCI/GM	LASLCHEM
2028	SR90	1977	SOIL	2.5	10.37	4.33	. 20	PCI/GM	LASLCHEM
2010	SPOA	1077	SOL	2 5	11 00	5 97	50	PCT/CM	LASLOHEM
2040	38 90	19//	SOIL	2.5	11.09	5.07	. 50		
2019	2890	1977	SUIL	7.5	6.69	2.24	.57	PCI/GM	LASLCHEM
2097	SR90	1977	SOIL	2.5	15.45	9.75	. 88	PCI/GM	LASLCHEM
2052	SR 90	1977	SOIL	42.5	11.11	5.55	. 09	PCI/GM	LASLCHEM
2060	SPOO	1077	SOT	22 5	0 01	5 07	51	PCT/GM	LASI CHEM
2000	5000	4077	SOIL	~~.J	3.51	3.07	4 05		
20/1	2440	19//	SUIL	2.5	9.83	4.48	1.05	PCI/GM	LASLUTEM
2097	SR90	1977	SOIL	22.5	15.45	9.75	. 21	PCI/GM	LASLCHEM
2118	SR90	1977	SOIL	2.5	14.55	6.45	.71	PCI/GM	LASLCHEM
2077	SROO	1977	SOTI	12 5	9.86	4 42	1 69	PCI/GM	LASLCHEM
20/2	5000	1077	5011	2.5	0.00	5 07	4 00	PCT/CM	
2000	2430	19//	201L	2.5	2.21	5.07	1.32	POT/GM	LASLONEM
2018	SR90	1977	SOIL	12.5	6.66	1.76	. 10	PCI/GM	LASLCHEM

2052	SPOO	1977	SOTI	25	44 44	5 55	13	DCT /GM	
2002	5000	4077	5015	2.5		5.55	. 43		
2000	3890	19//	SUIL	12.5	9.91	5.07	. 38	PC1/GM	LASLCHEM
2125	SR90	1977	SDIL	2.5	14.68	4.45	.78	PCI/GM	LASLCHEM
2097	SR90	1977	SOIL	12.5	15.45	9.75	. 30	PCI/GM	LASLCHEM
2014	SPAO	1977	SOTI	7 5	7 37	2 22	4 1	PCT/CM	
2019	5000	4077	COTL	7.5	6.60	2.22			
2010	3890	19//	501L	1.5	0.00	1.70	. 17	PC1/GM	LASLCHEM
2016	SR90	1977	SOIL	2.5	7.24	2.33	. 30	PCI/GM	LASLCHEM
2019	SR90	1977	SOIL	2.5	6.69	2.24	6.00	PCI/GM	LASLCHEM
2135	TH232	1977	INSTIL		6 58	55	81	PCT /GM	
2007	TU000	4077			0.00				
2007	TH232	19//	INSTID		7.10	2.07	.83	PCI/GM	LASL//
2084	TH232	1977	INSITU		12.58	7.17	1.10	PCI/GM	LASL77
2052	TH232	1977	INSITU		11.11	5.55	1.39	PCI/GM	LASL77
2006	TH232	1977	TNSTTH		7 07	2 04	96	PCT/CM	
2000	T11202	4077	INGITU			2.04	. 50		
2081	18232	19//	INSTIC		11.31	7.21	.63	PCI/GM	LASL//
2012	TH232	1977	INSITU		6.79	1.77	1.12	PCI/GM	LASL77
2029	TH232	1977	INSITU		10.35	4.28	. 96	PCT/GM	145177
2101	TH232	1977	TNSTTU		16 52	14 74	90	DOT /GM	
2101	T11202	1077	INSTIC		10.52	14.74	. 50	FCI/GM	
2059	18232	1977	INSTIC		9.74	5.42	.98	PCI/GM	LASL//
2083	TH232	1977	INSITU		12.14	7.19	.54	PCI/GM	LASL77
2090	TH232	1977	INSITU		13.85	7.69	2.28	PCT/GM	LASI 77
2114	TH222	1977	TNSTTH		10 46	7 10		DCT/CM	
2050	TU202	4077	INSITU		10.40	7.10		POT /OM	
2058	18232	19//	INSTIC		10.00	5.31	1.09	PC1/GM	LASL//
2088	TH232	1977	INSITU		13.22	7.66	1.04	PCI/GM	LASL77
2071	TH232	1977	INSITU		9.83	4.48	1.02	PCI/GM	LASL77
2015	TH232	1977	TNSTTH		7 37	2 31	20	PCT/GM	
2000	TU202	4077	TNCTTU		,,	2.01	. 25		
2060	1H232	19//	INSTIC		9.91	5.07	1.32	PC1/GM	LASL//
2120	TH232	1977	INSITU		14.30	7.16	1.28	PCI/GM	LASL77
2096	TH232	1977	INSITU		14.49	9.24	. 61	PCI/GM	LASL77
2152	TH232	1077	TNSTTH		2 04	1 00	64	PCT /CM	1 4 51 77
2133	11232	19/1	INSTIU		3.54	4.00	.04		LASLII
2040	TH232	1977	INSTIC		9.60	4.32	.65	PCI/GM	LASE77
2123	TH232	1977	INSITU		13.68	6.79	2.03	PCI/GM	LASL77
2086	TH232	1977	INSITU		10.53	7.19	. 45	PCI/GM	LASL77
2075	TH222	1077	INSTIL		10.05	1 60	75	PCT/CM	
2075	T11232	1077	INSTIC		10.25	4.00	- / 5		LASLIT
2127	TH232	1977	INSTIU		13.40	5.21	1.18	PCI/GM	LASL77
2067	TH232	1977	INSITU		9.31	4.96	. 36	PCI/GM	LASL77
2062	TH232	1977	INSITU		9.83	5.10	. 88	PCI/GM	LASL77
2019	THOOD	1077	TNSTTH		6 60	2 24	51	DCT /GM	
2013	TH232	1077	INSTIC		0.05	2.24			
2057	TH232	19//	INSTIU		10.35	5.34	.94	PCI/GM	LASL//
2093	TH232	1977	INSITU		14.60	8.57	.89	PCI/GM	LASL77
2126	TH232	1977	INSITU		12.45	4.27	. 96	PCI/GM	LASI 77
2141	TH232	1977	TNSTTH		6 58	55	95	PCT/GM	1 451 77
2070	TU202	4077	INCITU		0.50				
2073	TH232	1977	INSTIC		9.86	4.42	1.33	PC1/GM	LASL77
2032	TH232	1977	INSITU		3.17	3.48	1.32	PCI/GM	LASL77
2132	TH232	1977	INSITU		6.70	2.16	. 47	PCI/GM	LASL77
2085	TH232	1977	TNSTTH		12 60	6 58	89	PCT/GM	1 451 77
2003	TU000	4077	TNETTU		12.00	7.00	.05		
20/9	17232	19//	INSTIC		10.53	1.20	.45	PCI/GM	LASL
2047	TH232	1977	INSITU		11.08	5.74	.73	PCI/GM	LASL77
2049	TH232	1977	INSITU		11.11	5.55	.71	PCI/GM	LASL77
2115	TH232	1977	INSITU		13.57	6.49	1.00	PCI/GM	LASL77
2119	TH232	1077	TNSTTU		14 55	6 45	1 27	PCT /GM	
2110	T11202	4077	INGITU		14-55	0.45	1.2/	POT/GM	
2134	18232	1977	INSTIC		6.58	. 55	. 79	PCI/GM	LASL//
2042	TH232	1977	INSITU		9.82	4.27	1.36	PCI/GM	LASL77
2018	TH232	1977	INSITU		6.66	1.76	.71	PCI/GM	LASL77
2072	TH232	1977	TNSTTH		9 86	4 42	1 21	PCT/GM	1 451.77
2075	TUDDO	4077	TNICTTU		40.40	4 07	1.21	DCT/CM	
2025	11232	19//	INSTIU		10.12	4.2/	. 80	PCI/GM	LASL//
2148	1H232	1977	INSITU		2.98	3.62	. 14	PCI/GM	LASL77
2116	TH232	1977	INSITU		13.74	6.12	1.35	PCI/GM	LASL77
2138	TH232	1977	INSTIL		5.81	2 17	84	PCT/GM	1 4 5 1 7 7
2012	THOOD	1077	TNETTH		7 42	2 4 4	1 22	DCT /CM	
2013	T11202	1077	INSTIC		1.45	2.11	1.23	POT/GM	
2094	TH232	1977	INSTID		14.49	9.25	.87	PC1/GM	LASL//
2128	TH232	1977	INSITU		13.77	5.47	1.45	PCI/GM	LASL77
2020	TH232	1977	INSITU		3.17	3.48	. 97	PCI/GM	LASL77
2080	TH232	1977	INSTIL		10 91	7 22	47	PCT/GM	1 451 77
2000	TUDDO	4077	TNICTTU		44 40	10 02		DCT/CM	
2099	11232	19//	INSTIC		11.12	10.93	. 39	PCI/GM	LASL//
2095	TH232	1977	INSTIU		14.49	9.25	.67	PCI/GM	LASL77
1996	TH232	1977	INSITU		6.45	.75	.95	PCI/GM	LASL77
2155	TH232	1977	INSITU		3.91	3.49	. 95	PCT/GM	145177
2077	TH232	1977	INSTIL		10 31	4 4 1	Q 4	PCT/CM	1 451 77
2011	TU000	1077	TNETTU		10.31	4.41	. 91		
2024	18232	19/7	INSTIU		8.95	3.88	-83	PCI/GM	LASL //
2154	TH232	1977	INSITU		3.95	4.57	.54	PCI/GM	LASL77
2065	TH232	1977	INSITU		10.39	5.01	. 73	PCI/GM	LASL77
2140	THOOD	1977	INSTIL		6 50	55	07	PCT /GM	1 4 51 77
2400	TUDDO	1077	TNCTTU		0.00	~·~~			
2129	17232	19//	INSTIC		0.2/	0.00	.87	PCI/GM	LASL//
2017	TH232	1977	INSITU		7.25	2.33	1.47	PCI/GM	LASL77
2068	TH232	1977	INSITU		9.30	5.02	1.08	PCI/GM	LASL77
2008	TH232	1977	INSTIL		7 40	2 10	76	PCT/GM	1 451 77
2040	TUDDO	1077	TNETTH		11 00	5 07	. , 5	DCT/CH	
2040	17232	19//	TNSTIU		11.09	5.6/	.04	POI/GM	LASLII
2010	TH232	1977	INSITU		6.79	1.71	.71	PCI/GM	LASL77
1998	TH232	1977	INSITU		6.63	.55	.93	PCI/GM	LASL77
2144	TH232	1977	INSTTU		10.46	7,19	36	PCI/GM	LASI 77

2014	TH232	1977	INSITU	7.37	2.22	1.82 PCT/GM	1 4 51 77
2147	TH232	1977	INSTIL	7 77	3 07	64 PCT/CM	
2076	TH222	1077		11.00	4 50		
2070	T1232	1077		11.09	4.52	.43 PCI/GM	LASL
2037	111232	19//	INSTIU	9.82	4.27	1.24 PC1/GM	LASL77
2119	1H232	19//	INSTIU	14.34	7.21	.84 PCI/GM	LASL77
2038	TH232	1977	INSITU	9.60	4.32	.64 PCI/GM	LASL77
2033	TH232	1977	INSITU	3.14	3.57	1.03 PCI/GM	LASL77
2009	TH232	1977	INSITU	6.59	1.65	1.39 PCI/GM	LASL77
1997	TH232	1977	INSITU	6.46	1.16	50 PCT/GM	1 451 77
2016	TH232	1977	INSTIL	7 24	2 33	1 22 PCT/GM	
2082	TH232	1977	INSTIL	11 62	7 19	1 00 DCI/CM	
2002	TU202	1077		11.02	7.10	1.09 PCI/GM	LASLII
2034	11232	19//	INSTIU	3.10	3.70	1.15 PCI/GM	LASL77
2030	17232	19//	INSTIU	10.39	4.30	1.11 PCI/GM	LASL77
2023	TH232	1977	INSITU	9.54	3.98	1.00 PCI/GM	LASL77
2027	TH232	1977	INSITU	10.28	4.20	.47 PCI/GM	LASL77
2139	TH232	1977	INSITU	6.58	. 55	.89 PCI/GM	LASL77
2074	TH232	1977	INSITU	9.85	4.35	.81 PCI/GM	LASL77
2092	TH232	1977	INSITU	13.52	9.21	31 PCT/GM	
2055	TH232	1977	INSTIU	11.35	5 86	98 PCT/CM	
2136	TH232	1977	INSTIL	6 58	55	79 PCI/CM	
2442	TH222	1077		6 07			
2142	TU000	4077		0.2/	.00	.79 PCI/GM	LASL//
2143	11232	19//	INSTIU	4.81	3.00	.71 PCI/GM	LASL77
2031	TH232	1977	INSITU	10.41	4.28	.78 PCI/GM	LASL77
2026	TH232	1977	INSITU	10.05	4.07	1.17 PCI/GM	LASL77
2087	TH232	1977	INSITU	12.92	7.66	1.19 PCI/GM	LASL77
2011	TH232	1977	INSITU	6.32	.00	1.06 PCI/GM	LASL77
2066	TH232	1977	INSITU	10.60	4.42	1.22 PCT/GM	145177
2097	TH232	1977	INSTIL	15 45	9 75	1 04 PCT/GM	
2130	TH232	1977	INSTIL	6 03	60	1 52 PCI/CM	
2125	TH222	1077		44 69		1.32 PCI/GM	
2020	TU000	4077		14.00	4.45	1.49 PCI/GM	LASL//
2028	10232	19//	INSTIU	10.37	4.33	1.08 PCI/GM	LASL77
2050	TH232	1977	INSITU	11.11	5.55	.67 PCI/GM	LASL77
2064	TH232	1977	INSITU	10.54	7.19	.46 PCI/GM	LASL77
2053	TH232	1977	INSITU	10.69	5.56	.49 PCI/GM	LASL77
2041	TH232	1977	INSITU	9.61	4.32	.84 PCI/GM	LASI 77
2043	TH232	1977	INSITU	3.91	3.49	69 PCT/GM	
2039	TH232	1977	INSTIL	9 60	4 32	68 PCT/GM	
2022	TH222	1077	TNISTTI	9.60	4 22		
2100	TH232	1077		9.60	4.32	.98 PCI/GM	LASLII
2100	10232	19//	INSTIU	14.50	12.20	1.09 PCI/GM	LASL77
2121	18232	19//	INSTIU	13.68	6.87	2.80 PC1/GM	LASL77
2061	TH232	1977	INSTIU	9.91	5.07	1.42 PCI/GM	LASL77
2146	TH232	1977	INSITU	9.82	4.27	.45 PCI/GM	LASL77
2122	TH232	1977	INSITU	13.69	6.87	2.74 PCI/GM	LASL77
2131	TH232	1977	INSITU	6.62	1.87	.70 PCI/GM	LASL77
2017	U238	1977	INSITU	7.25	2.33	1.45 PCI/GM	LASL77
2029	U238	1977	INSITU	10.35	4.28	82 PCT/GM	
2057	U238	1977	INSTIL	10 35	5 34	83 PCT/GM	
2043	11238	1977	INSTIL	2 01	2 10	1 01 PCI/GM	
2010	11230	1077		5.51	0.45		
2015	0238	4077		0.09	2.24	.58 PCI/GM	LASL//
2056	0230	19//	105110	10.00	5.31	.89 PCI/GM	LASL77
2015	0238	1977	INSTIU	7.37	2.31	.69 PCI/GM	LASL77
2093	0238	1977	INSITU	14.60	8.57	.85 PCI/GM	LASL77
2010	U238	1977	INSITU	6.79	1.71	.65 PCI/GM	LASL77
2129	U238	1977	INSITU	6.27	0.00	.76 PCI/GM	LASL77
2090	U238	1977	INSITU	13.85	7.69	1.29 PCI/GM	LASI 77
2128	U238	1977	INSITU	13.77	5 47	1.06 PCT/GM	
2012	U238	1977	INSITU	6.79	1.77	93 PCT/CM	
2080	U238	1977	INSITU	10 91	7.22	69 DCT/CM	
2142	11238	1977	INSTIL	6 27	/ . 22		
2147	11220	1077		7 77	2.00	.// PUI/GM	
2050	11220	1077		1.11	3.07	./5 PCI/GM	LASL 77
2052	0238	19//		11.11	5.55	-93 PCI/GM	LASL77
2062	0238	1977	INSITU	9.83	5.10	.85 PCI/GM	LASL77
2048	0238	1977	INSITU	11.09	5.87	1.41 PCI/GM	LASL77
2138	U238	1977	INSITU	5.81	2.17	.68 PCI/GM	LASL77
2060	U238	1977	INSITU	9.91	5.07	.82 PCI/GM	LASL77
2155	U238	1977	INSITU	3.91	3.49	1.04 PCI/GM	LASL77
2016	U238	1977	INSITU	7.24	2.33	1.15 PCT/GM	145177
2027	U238	1977	INSITU	10 28	4.20	71 DCT/CM	
2131	U238	1977	INSTIU	6 62	1 87		
2024	11220	1077	INSTIL	0.02	2 00	1 00 PUI/GM	LASL//
2024	11220	19//		0.95	3.00	1.81 PC1/GM	LASL//
2004	0238	19//		10.54	1.19	.4/ PCI/GM	LASL77
2132	0238	1977	INSTIU	6.70	2.16	.64 PCI/GM	LASL77
2141	0238	1977	INSITU	6.58	.55	.72 PCI/GM	LASL77
2022	U238	1977	INSITU	9.60	4.32	.84 PCI/GM	LASL77
2146	U238	1977	INSITU	9.82	4.27	.57 PCI/GM	LASL77
2154	U238	1977	INSITU	3.95	4.57	.67 PCI/GM	LASL77
2025	U238	1977	INSITU	10.12	4.27	91 PCT/GM	1 451 77
2085	U238	1977	INSITU	12 60	6 58	96 DCT/CM	
2034	11238	1077	INSTIC	2.00	3.30	1 11 POT/OM	
2034	0230	19//		3.10	3.70	I.II PCI/GM	LASL77
2014	U238	19//	TN2TIO	1.37	2.22	1.27 PCI/GM	LASL77

2071	U238	1977	INSITU	9.83	4.48	.96 PCI/GM	LASL77
2028	U238	1977	INSITU	10.37	4.33	.90 PCI/GM	LASL77
2032	U238	1977	INSITU	3.17	3.48	1.11 PCI/GM	LASL77
2127	U238	1977	INSITU	13.40	5.21	.93 PCI/GM	LASL77
2086	U238	1977	INSITU	10.53	7.19	.43 PCI/GM	LASL77
2049	U238	1977	INSITU	11.11	5.55	.71 PCI/GM	LASL77
2099	0238	1977	INSITU	11.12	10.93	.51 PCI/GM	LASL77
2130	0238	1977	INSTIU	6.03	. 60	1.23 PCI/GM	LASL77
2095	0238	1977	INSTIU	14.49	9.25	.63 PCI/GM	LASL77
2047	0238	19//	INSTIC	11.08	5.74	1.54 PCI/GM	LASL77
2118	0238	19//	INSTIU	14.55	6.45	.96 PCI/GM	LASL77
2148	0238	1977	INSTIU	2.98	3.62	.96 PCI/GM	LASL77
2068	0238	19//		9.30	5.02	.96 PCI/GM	LASL77
2077	0238	19//	INSTIU	10.31	4.41	.91 PCI/GM	LASL/7
2084	0238	19//		12.58	/.1/	.93 PCI/GM	LASL77
2011	0238	19//		0.32	.00	.89 PCI/GM	
2007	0238	19//		1.10	2.07	.75 PCI/GM	
2088	11220	19//		13.22	7.00	1./1 PC1/GM	
2092	0238	19//		13.52	9.21	.43 PCI/GM	
2139	11228	1977		0.50	. 22		
2033	11238	1077	INSTIU	9.60	4.32		
2030	11238	1977		12 68	4.32	1 17 PCI/GM	
2027	11238	1977	INSTIL	9 92	1 27	1 02 PCI/GM	
2031	11238	1977	INSTIL	10 41	4.27	75 PCI/GM	
2136	11238	1977	INSTIL	6 58	7.20	56 PCI/GM	
2076	11238	1977	INSTIL	11 09	4 52	71 PCI/GM	
2041	11238	1977	INSTIL	9 61	4 32	1 O1 PCI/GM	
2087	11238	1977	INSTIL	12 92	7 66	93 PCI/GM	
2125	U238	1977	INSTIU	14 68	4 45	1 18 PCT/GM	
2096	U238	1977	INSTIL	14 49	9 24	78 PCI/GM	
2115	U238	1977	INSTTU	13 57	6 49	95 PCI/GM	
2082	U238	1977	INSTTU	11 62	7 18	88 PCI/GM	
2119	U238	1977	INSTTU	14 34	7 21	68 PCI/GM	
2008	U238	1977	INSTTU	7.40	2.10	83 PCI/GM	
2026	U238	1977	INSITU	10.05	4.07	.96 PCI/GM	
2094	U238	1977	INSITU	14.49	9.25	.73 PCI/GM	LASL77
2123	U238	1977	INSITU	13.68	6.79	.98 PCI/GM	LASL77
2122	U238	1977	INSITU	13.69	6.87	1.39 PCI/GM	LASL77
2013	U238	1977	INSITU	7.43	2.11	.98 PCI/GM	LASL77
2120	U238	1977	INSITU	14.30	7.16	.92 PCI/GM	LASL77
2067	U238	1977	INSITU	9.31	4.96	.75 PCI/GM	LASL77
1998	U238	1977	INSITU	6.63	.55	.89 PCI/GM	LASL77
2009	U238	1977	INSITU	6.59	1.65	1_20 PCI/GM	LASL77
2079	U238	1977	INSITU	10.53	7.20	.68 PCI/GM	LASL77
208 1	U238	1977	INSITU	11.31	7.21	.77 PCI/GM	LASL77
2116	U238	1977	INSITU	13.74	6.12	1.00 PCI/GM	LASL77
2153	U238	1977	INSITU	3.94	4.88	1.31 PCI/GM	LASL77
2140	U238	1977	INSITU	6.58	.55	.77 PCI/GM	LASL77
2083	U238	1977	INSITU	12.14	7.19	.79 PCI/GM	LASL77
2101	U238	1977	INSITU	16.52	14.74	.81 PCI/GM	LASL77
2023	U238	1977	INSITU	9.54	3.98	1.08 PCI/GM	LASL77
2100	0238	1977	INSITU	14.50	12.20	1_02 PCI/GM	LASL77
2059	0238	1977	INSITU	9.74	5.42	.96 PCI/GM	LASL77
2030	0238	1977	INSITU	10.39	4.30	.88 PCI/GM	LASL77
1007	0238	19//		15.45	9.75	1.03 PCI/GM	
2074	11220	19//		0.40	1.10	.48 PCI/GM	
20/4	11220	19//		9.85	4.35	.94 PCI/GM	
2001	11238	1077		5.51	1 27	1 02 PCI/GM	
2055	11238	1077		11 25	5 96	72 PCI/GM	
2114	11238	1077		10.46	7 18	54 PCI/GM	
2072	U238	1977	INSTIL	9.86	4 42	95 PCI/GM	
2065	U238	1977	INSTIU	10 39	5 01	91 PCI/GM	
2018	U238	1977	INSTTU	6 66	1 76	71 PCI/GM	
2040	U238	1977	INSTTU	9.60	4 32	1.02 PCI/GM	
2053	U238	1977	INSTTU	10.69	5.56	80 PCI/GM	
2135	U238	1977	INSITU	6.58	.55	0.00 PCI/GM	LASL77
2144	U238	1977	INSITU	10.46	7.19	.34 PCI/GM	LASL77
2020	U238	1977	INSITU	3.17	3.48	2.04 PCI/GM	LASL77
2006	U238	1977	INSITU	7.07	2.04	1.02 PCI/GM	LASL77
2066	U238	1977	INSITU	10.60	4.42	.91 PCI/GM	LASL77
2073	U238	1977	INSITU	9.86	4.42	1.05 PCI/GM	LASL77
2134	U238	1977	INSITU	6.58	.55	.88 PCI/GM	LASL77
2143	U238	1977	INSITU	4.81	3.00	.85 PCI/GM	LASL77
2126	U238	1977	INSITU	12.45	4.27	.83 PCI/GM	LASL77
2033	U238	1977	INSITU	3.14	3.57	1.34 PCI/GM	LASL77
2050	U238	1977	INSITU	11.11	5.55	.72 PCI/GM	LASL77
2075	U238	1977	INSITU	10.85	4.60	.71 PCI/GM	LASL77
1996	U238	1977	INSITU	6.45	.75	.93 PCI/GM	LASL77

•

2055	ZR95	1977	GR	11.35	5.86	5.80	PCI/GM	LLL GELI
1990	7895	1977	GR	6.64	. 55	2.99	PCI/GM	LLL GELI
2010	7005	1077	GP	6 66	1 76	3 54	PCT/GM	ILL GELT
2010	2005	4077		6 64	FE	0.07	DCT/CM	LLL GELT
1988	2895	19//	GR	0.04	. 55	2.33		LLL GELI
2140	ZR95	1977	INSTIU	6.58	. 55	0.00	NC1/M2	LASL//
2024	ZR95	1977	INSITU	8.95	3.88	2.58	NC1/M2	LASL77
2019	ZR95	1977	INSITU	6.69	2.24	2_37	NCI/M2	LASL77
2093	ZR95	1977	INSITU	14.60	8.57	2.75	NCI/M2	LASL77
2097	ZR95	1977	INSITU	15.45	9.75	3.05	NCI/M2	LASL77
2022	7295	1977	INSTIL	9.60	4 32	2.88	NCT/M2	LASI 77
2022	7005	1077	INSTITU	10 37	4 33	3 41	NCT/M2	
2020	2895	1077		10.37	4.00	4 57	NCT/M2	
2039	2895	19//	INSTIC	9.00	4.32	1.5/	NCI/M2	
2047	ZR95	1977	INSTIU	11.08	5.74	3.33	NC1/M2	LASL
2138	ZR95	1977	INSITU	5.81	2.17	5.04	NC1/M2	LASL77
208 1	ZR95	1977	INSITU	11.31	7.21	2.86	NCI/M2	LASL77
2076	ZR95	1977	INSITU	11.09	4.52	2.74	NCI/M2	LASL77
2119	ZR95	1977	INSITU	14.34	7.21	3.57	NCI/M2	LASL77
2094	ZR95	1977	INSITU	14.49	9.25	2.79	NCI/M2	LASL77
2017	ZR95	1977	INSITU	7.25	2.33	2.86	NCI/M2	LASL77
2096	7895	1977	INSTIL	14.49	9.24	2.56	NCI/M2	LASL77
2118	7095	1077	INSTIT	14 55	6 45	3 16	NCT/M2	
2110	2895	1077		14.00	7 66	2.10	NCT/M2	
2087	2895	19//	INSTIC	12.92	7.00	2.04		
2052	ZR95	1977	INSTIU	11.11	5.55	3.12	NC1/M2	LASL//
2059	ZR95	1977	INSITU	9.74	5.42	2.30	NC1/M2	LASL77
2125	ZR95	1977	INSITU	14.68	4.45	3.24	NCI/M2	LASL77
2086	ZR95	1977	INSITU	10.53	7.19	2.27	NCI/M2	LASL77
2088	ZR95	1977	INSITU	13.22	7.66	5.82	NCI/M2	LASL77
2010	ZR95	1977	INSITU	6.79	1.71	2.57	NCI/M2	LASL77
2037	7895	1977	INSTIL	9 82	4.27	3.28	NCI/M2	LASL77
2143	7095	1077	INSTIL	4 81	3 00	0.00	NCT/M2	
2140	7005	1077		6 59	5.00	0.00	NCT/M2	
2134	2895	19/1		0.00	5.07	0.00	NCT /M2	
2001	2895	19//	105110	9.91	5.07	2.90		
2023	ZR95	1977	INSTIU	9.54	3.98	2.74	NC1/M2	LASL//
2121	ZR95	1977	INSITU	13.68	6.87	2.95	NC1/M2	LASL77
2080	ZR95	1977	INSITU	10.91	7.22	2.98	NCI/M2	LASL77
2073	ZR95	1977	INSITU	9.86	4.42	3.19	NCI/M2	LASL77
2042	ZR95	1977	INSITU	9.82	4.27	3.02	NCI/M2	LASL77
2083	ZR95	1977	INSITU	12.14	7.19	2.42	NCI/M2	LASL77
2033	7895	1977	INSTIL	3.14	3.57	1.45	NCI/M2	LASL77
1007	7005	1077	INSTIL	6 46	1 16	1 01	NCT/M2	
2074	7005	1077		0.40	1.10	2 24	NCT/M2	
20/4	2895	1077		10 60	6 70	Å Å		
2123	2895	19//	INSTIU	13.08	0.79	0.00	NCI/M2	
2095	ZR95	1977	INSITU	14.49	9.25	2.1/	NC1/M2	
2147	ZR95	1977	INSITU	7.77	3.07	0-00	NC1/M2	LASL//
1996	ZR95	1977	INSITU	6.45	.75	3.04	NCI/M2	LASL77
2049	ZR95	1977	INSITU	11.11	5.55	3.05	NCI/M2	LASL77
2057	ZR95	1977	INSITU	10.35	5.34	3.32	NCI/M2	LASL77
2040	ZR95	1977	INSITU	9.60	4.32	3.12	NCI/M2	LASL77
2072	ZR95	1977	INSITU	9.86	4.42	3.32	NCI/M2	LASL77
2026	ZR95	1977	INSTIU	10.05	4.07	2.99	NCI/M2	LASL77
2065	7095	1977	INSTIL	10 39	5 01	0.00	NCT/M2	LASI 77
2000	7005	1077	TNSTTU	6 32	00	2 44	NCT/M2	
2011	7005	4077		12 60	6.87	2.22	NCT/M2	
2122	2895	19/1		13.05	0.07	0.02		
2013	2895	1977	INSTIU	7.43	2.11	2.40	NCI/M2	
2136	ZR95	19//	INSTIU	0.58	. 55	0.00	NCI/M2	LASL//
2155	ZR95	1977	INSIIU	3.91	3.49	2.62	NC1/M2	LASL//
2092	ZR95	1977	INSITU	13.52	9.21	2.56	NCI/M2	LASL77
2016	ZR95	1977	INSITU	7.24	2.33	3.78	NCI/M2	LASL77
2029	ZR95	1977	INSITU	10.35	4.28	4.11	NCI/M2	LASL77
2130	ZR95	1977	INSITU	6.03	. 60	0.00	NCI/M2	LASL77
2077	ZR95	1977	INSITU	10.31	4.41	3.38	NCI/M2	LASL77
2038	ZR95	1977	INSITU	9.60	4.32	2.33	NCI/M2	LASL77
2067	7895	1977	INSTIU	9.31	4.96	0.00	NCI/M2	LASL77
2100	7895	1977	INSTIL	14.50	12.20	2.76	NCI/M2	LASL77
2100	7005	1077		16 52	14 74	3 78	NCT/M2	
2101	2895	1077		0.01	5 07	2.70	NCT /M2	
2000	2890	19//		3.31	7 40	4 50	NCT /M2	
2144	7892	19//	TN2TIO	10.46	7.19	1.52	NOT /M2	LASL//
2034	ZK82	1977	INSTIU	3.16	3.70	2.41	NG1/M2	
2127	ZR95	1977	INSITU	13.40	5.21	2.56	NCI/M2	LASL77
2129	ZR95	1977	INSITU	6.27	0.00	1.78	NCI/M2	LASL77
2012	ZR95	1977	INSITU	6.79	1.77	3.22	NCI/M2	LASL77
2154	ZR95	1977	INSITU	3.95	4.57	1_36	NCI/M2	LASL77
2128	ZR95	1977	INSITU	13.77	5.47	2.12	NCI/M2	LASL77
2114	ZR95	1977	INSITU	10.46	7.18	0.00	NCI/M2	LASL77
2025	7R95	1977	INSITU	10.12	4.27	2.89	NCI/M2	LASL77
2010	7005	1077	INSTIL	6.66	1.76	3.05	NCT/M2	LASL77
2010	7005	1077		0.00	5 00	2 50	NCT/M2	
2008	2893	19//		3.30	2.02	2.23	NCT/M2	
2015	2K92	19//		1.3/	2.31	2.22		LAGL 77
2075	ZK95	1977	INSTIU	10.85	4.60	2.09		
2064	ZR95	1977	INSTIU	10.54	1.19	2.42	NC1/M2	LASL//

•

2027	ZR95	1977	INSITU	10.28	4.20	2.48	NCI/M2	LASL77
2153	ZR95	1977	INSITU	3.94	4.88	1.46	NCI/M2	LASL77
2090	ZR95	1977	INSITU	13.85	7.69	5.81	NCI/M2	LASL77
2099	ZR95	1977	INSITU	11.12	10.93	2.01	NCI/M2	LASI 77
2031	ZR95	1977	INSITU	10.41	4.28	2.59	NCT/M2	
2082	ZR95	1977	INSITU	11.62	7 18	4 17	NCT/M2	
2043	ZR95	1977	INSITU	3.91	3 49	0 00	NCT/M2	
2126	ZR95	1977	INSITU	12 45	4 27	2 29	NCT/M2	
2148	ZR95	1977	INSTIL	2 98	3 62	2.25		
2062	ZR95	1977	INSTIL	9 83	5 10	0.00		
2008	7895	1977	INSTITU	7 40	2 10	2 40	NCT/M2	
2131	7895	1977	INSTITU	6 62	1 97	3.42		
2014	7095	1977	INSTITU	7 27	1.07	1.00	NCI/M2	
2125	7005	1077		6 50	2.22	2.09	NCI/M2	
2133	2833	1077		0.58	. 55	0.00	NCI/M2	LASL//
2055	2895	19//	INSTIU	11.35	5.80	1,93	NC1/M2	LASL77
2050	2895	19//	INSTIU	11.11	5.55	0.00	NC1/M2	LASL77
2110	2895	1977	INSITU	13.74	6.12	3.13	NCI/M2	LASL77
2142	2895	1977	INSITU	6.27	.00	1.52	NCI/M2	LASL77
2084	ZR95	1977	INSITU	12.58	7.17	2.94	NCI/M2	LASL77
2058	ZR95	1977	INSITU	10.00	5.31	2.77	NCI/M2	LASL77
2139	ZR95	1977	INSITU	6.58	.55	0.00	NCI/M2	LASL77
2032	ZR95	1977	INSITU	3.17	3.48	2.04	NCI/M2	LASL77
2085	ZR95	1977	INSITU	12.60	6.58	4.64	NCI/M2	LASL77
2009	ZR95	1977	INSITU	6.59	1.65	2.83	NCI/M2	LASL77
1998	ZR95	1977	INSITU	6.63	.55	3.27	NCI/M2	LASL77
2146	ZR95	1977	INSITU	9.82	4.27	1.69	NCI/M2	LASL77
2132	ZR95	1977	INSITU	6.70	2.16	0.00	NCI/M2	LASL77
2041	ZR95	1977	INSITU	9.61	4.32	3.31	NCI/M2	LASL77
2006	ZR95	1977	INSITU	7.07	2.04	4.79	NCI/M2	LASL77
2141	ZR95	1977	INSITU	6.58	.55	0.00	NCI/M2	LASL77
2066	ZR95	1977	INSITU	10.60	4.42	3.04	NCI/M2	LASL77
2020	ZR95	1977	INSITU	3.17	3 48	0.00	NCI/M2	LASL77
2048	ZR95	1977	INSITU	11.09	5.87	2.48	NCI/M2	LASI 77
2007	ZR95	1977	INSITU	7.10	2.07	1.92	NCI/M2	LASL77
2115	ZR95	1977	INSITU	13.57	6.49	3.16	NCT/M2	
2120	ZR95	1977	INSITU	14.30	7.16	0.00	NCT/M2	
2030	ZR 95	1977	INSITU	10.39	4.30	3 47	NCT/M2	
2053	ZR95	1977	INSITU	10.69	5.56	3.09	NCT/M2	
2079	ZR95	1977	INSITU	10.53	7.20	2.44	NCT/M2	
2071	ZR95	1977	INSITU	9.83	4.48	3 83	NCT/M2	
2049	ZR95	1977	SG	11.11	5.55	2 53	PCT/GM	
2007	ZR95	1977	SK	7 10	2 07	2 63	PCT/GM	111 GELT
1987	ZR95	1977	SK	6,63	- 55	80	PCT/GM	ILL GELT
2045	ZR95	1977	ŠK	10.52	5.51	2.45	PCT/GM	LLL GELI
1991	ZR95	1977	ŠK	6.63	.55	1.40	PCT/GM	LLL GELT
2016	ZR95	1977	SK	7 24	2 33	3 50	PCT/GM	LLL GELI
2028	ZR95	1977	ŤH	10.37	4 33	1 24	PCT/GM	LLL GELT
2052	ZR95	1977	UK	11.11	5.55	1 59	PCT/GM	LLL GELT
					~ . ~ ~			

APPENDIX B

LOG OF FIELD OPERATIONS FOR SURVEY OF TRINITY, 1977

During the survey of the Trinity fallout zone, each sample location was marked with a wooden stake with a brass tag attached. The number corresponding to the data "tag word" was stamped on the brass tag. The locations were noted on topographical maps of the area and in field notebooks. These documents will be kept in a master file with the Los Alamos National Laboratory Environmental Surveillance Group. Tag words that are not in the following list represent calibration checks or measurements at locations outside the Trinity fallout zone.

- 1985 6/20/77; background spectrum taken with planar Ge(Li) at Los Alamos National Laboratory control plot ~3 miles south of GZ.
- 1986 6/20/77; inside GZ inner fence. Planar Ge(Li).
- 1987 6/20/77; inside GZ inner fence, 13 m from fence northeast of monument. Planar Ge(Li).
- 1988 6/20/77; inside GZ inner fence, 7 m north of the monument. Planar Ge(Li).
- 1989 6/20/77; inside GZ inner fence, 10 m from fence east of the monument. Planar Ge(Li).
- 1990 6/21/77; outside of inner fence at GZ, 12 m south of east outhouses. Planar Ge(Li).
- 1991 6/21/77; outside of the inner fence at GZ. Located east of entrance road, 13 m north of the gate. Planar Ge(Li).
- 1992 6/21/77; located at Los Alamos National Laboratory GZ study plot, 1 mile north of fence. Taken at west side of the plot near the stake, 20 m southeast of bunkers, 80 m southwest of Bagnold sampler. Planar Ge(Li).
- 1993 6/22/77; near EPA No. 12117 (Beck Site). Planar Ge(Li).
- 1994 6/27/77; control site, 3 miles south of GZ. V-8 Ge(Li) set up over stake at southeast corner of plot.
- 1995 6/27/77; at northwest corner of plot, 1 mile north of GZ. Same location as No. 1992.

- 1996 6/27/77; taken at end of a playa north and west of GZ.
- 1997 6/27/77; 1 mile north of Beck Site. Same as No. 1993.
- 1998 6/28/77; 23 m inside gate at outer fence at GZ and 16 m of barbed wire fence along roadway.
- 1999 6/28/77; corresponds to location at tag word No. 1991.
- 2000 6/28/77; inside inner fence, 10 m north of gate. Close to No. 1986 location.
- 2001 6/28/77; inside inner fence; 7 m north of the monument.
- 2002 6/28/77; inside inner fence, 8 m west of fence on east side of the monument.
- 2003 6/28/77; inside inner fence, 13 m from fence north northeast of the monument. Same as No. 1987 location.
- 2004 6/28/77; 1 mile south of outer gate of GZ, 100 m west of roadway.
- 2005 6/29/77; several miles east of Mine Site, about8-10 miles northeast of GZ. See page 17 ofTrinity Field log book for sketch.
- 2006 6/29/77; near WSMR radar site, close to No. 2005.
- 2007 6/29/77; east of Nos. 2005 and 2006 in a drainage basin.
- 2008 6/29/77; 1.4 miles west of No. 2007.
- 2009 2/29/79; taken in a watering pond 0.7 mile south of Mine Site, which collects sediment from areas to the east.
- 2010 6/29/77; located at southwest corner of Los Alamos National Laboratory Area 16 study plot.
- 2011 6/30/77; located at southeast corner of Los Alamos National Laboratory Control Plot 3 miles south of GZ. Same location as No. 1994.
- 2012 6/30/77; located 1 mile east of Junction of Beck Site Road and WSMR, Route 13 and ~50 miles north of road.

- 2013 6/30/77; located 4.1 miles by road from Beck Site Road/Route 13 Junction. Sample site is 1.7 miles north of the point where the road turns north and is ~30 miles west of road.
- 2014 6/30/77; located in bottom of Smith Tank (larger tank to the west); 6.4 miles by road from Beck Site Road/Route 13 Junction and 2.3 miles from No. 2013.
- 2015 6/30/77; located at the crest of a ridge 0.3 mile north of Smith Tank.
- 2016 6/30/77; located 0.4 mile west of fence around Smith Ranch buildings along old road, then 0.2 mile north of road at east edge of an old playa collecting sediment from the east.
- 2017 6/30/77; located ~0.4 mile west of No. 2016 at the west edge of the same playa.
- 2018 7/4/77; 6 miles north of outer fence of GZ about30 m to the east of road.
- 2019 7/4/77; 8-9 miles north of GZ fence, ~30 m east of a telephone right of way.
- 2020 7/4/77; located 20 miles south of Hwy 380 in a large arroyo. The arroyo is 2.5 miles east of San Antonio.
- 2021 7/5/77; located above Area 21 study plot at a large black water tower. Same location as No. 2146.
- 2022 7/5/77; 12 m south of Meteorological Station at Area 21 study plot on ridge.
- 2023 7/5/77; on USGS "Broken Back Crater" 15 min quadrangle: R.I.E.; T.4S. Section 10, 600 m south of 1919 m elevation marker. In basin.
- 2024 7/5/77; ~0.3 mile east and south of Hinkle Range Headquarters, 0.1 mile east of main highway on dirt access road. Adjacent to large drainage.
- 2025 7/6/77; 0.7 mile past turnoff to Area 21 study plot on top of a saddle, 30 miles north of the road.
- 2026 7/6/77; past No. 2025 east to first cattle guard, then south ~ 0.6 mile to a point where the drainage basin begins to narrow.
- 2027 7/6/77; ~1.5 to 2 miles east of a gas pump house on the north. Sample site is on a knoll east of a large basin 0.2 mile south of the main road.
- 2028 7/6/77; ~0.5 mile east of No. 2027 and 0.3 mile south of the highway in a closed basin.
- 2029 7/6/77; same as No. 2028 but 60 m farther south next to water hole.
- 2030 7/6/77; 150 m northeast of No. 2028 in same sediment basin.

- 2031 7/6/77; same sediment basin as in No. 2028 but up on a slope leading to the basin. Severe sheet erosion.
- 2032 7/7/77; ~10 miles south of Hwy 380, ~0.3 mile east of Rio Grande, in dirt tank.
- 2033 7/7/77; 100 m north of Hwy 380 at bridge over Rio Grande. Detector set up 10 m into river bed.
- 2034 7/7/77; located on a flood plain on east bank of the Rio Grande, 0.25 mile north from bridge.
- 2037 7/12/77; below Area 21 at water bank in basin,
 ~0.5 mile off main road and 150 m west of the large dirt tank.
- 2038 7/12/77; located at the northeast corner of Area 21 study plot.
- 2039 7/12/77; located at the northwest corner of the Area 21 study plot.
- 2040 7/12/77; located at the southwest corner of the Area 21 study plot.
- 2041 7/12/77; located at the southeast corner of the Area 21 study plot.
- 2042 7/12/77; located 100 m west of No. 2037 at dirt tank below Area 21.
- 2045 7/13/77; located 90 m north of 20° west of garage at Copeland Ranch.
- 2046 7/13/77; 1 mile south of EPA No. 151 at a windmill. Also, at a section corner 1 mile north and 3 miles east of Copeland Ranch.
- 2047 7/13/77; replicate of No. 2046, but 100 m northeast.
- 2048 7/13/77; located at EPA No. 151.
- 2049 7/14/77; located on the shoulder of a large enclosed watershed. Located at the depression and tank in Section 24 R.8E., T.25, of "Cat Mesa" USGS quadrangle.
- 2050 7/14/77; 100 m east of No. 2049 on shoulder. Replicate.
- 2051 7/14/77; located in bottom of depression 100 m east of the water tank. Same depression as Nos. 2049 and 2050.
- 2052 7/14/77; replicate of No. 2051, 100 m north and 45 m east of No. 2051.
- 2053 7/14/77; located on a ridge top 1 mile north and 0.7 mile east of Copeland Ranch.
- 2054 7/14/77; 100 m north of No. 2045. Replicate.
- 2055 7/14/77; 4.5 miles east of Copeland Ranch turnoff, 16 miles south of the road in a wide, low area.
- 2057 7/18/77; located ~100 m from Monte Puerto Ranch headquarters, north 65° west to front door of house.

- 2058 7/18/77; located ~ 1.5 miles south of Monte Puerto Ranch past Bench Mark, then 0.2 mile south of road in open, grassy basin.
- 2059 7/18/77; located at Mesa Well on Monte Puerto Ranch, north of the windmill ~200 m.
- 2060 7/18/77; located at a dirt tank called South Pothole on the Monte Puerto Ranch, at middle of sediment accumulation.
- 2061 7/18/77; replicate of No. 2060.
- 2062 7/18/77; 100 m from fence gate at Pothole.
- 2064 7/19/77; ~0.25 mile south of paved road No. 14. This is the Gran Quivira control site and is ~10 m west of the road just south of the Gran Quivira service road.
- 2065 7/19/77; located on Cat Mesa 20 m east of road,0.1 miles south of Bench Mark 6239.
- 2066 7/19/77; located 1.3 miles east of Rugh Well just south of Maxwell Ranch headquarters, 20 m west of road near junction of several major drainages off Cat Mesa.
- 2067 7/19/77; located 2.25 miles south and 1.1 miles west of Mesa Well on the Monte Puerto Ranch.
- 2068 7/19/77; located 0.2 mile north of No. 2067 on a ridge.
- 2069 7/19/77; located 1.2 miles east of Line Tank on the Monte Puerto Ranch, 0.1 mile east of USGS Bench Mark 6213.
- 2071 7/20/77; ridge north of Cuate Tank on Hinkle Ranch.
- 2072 7/20/77; located in flat, grassy sediment trap at Cuate Tank on Hinkle Ranch.
- 2073 7/20/77; replicate of No. 2072, located 100 m east of No. 2072.
- 2074 7/20/77; located 1 mile south of Cuate Tank on south facing slope.
- 2075 7/20/77; cabin in the "Y" of the road.
- 2076 7/20/77; located near a water tank 3.25 miles east of Maxwell Ranch turnoff, ~0.25 mile south of road.
- 2077 7/20/77; located at intersection of NM 14 and road to Lovelace/Maxwell Ranches.
- 2079 7/21/79; control site, same as No. 2064.
- 2080 7/21/77; located on NM 14, 2 miles east of pavement past Gran Quivira.
- 2081 7/21/77; located on NM 14, 4 miles east of pavement past Gran Quivira.
- 2082 7/21/77; located on NM 14, 6 miles east of pavement past Gran Quivira, 100 m south past place where road turns toward Claunch.

- 2083 7/21/77; located on Forest Road 167, 3.5 miles east of NM 14, 20 m south of road.
- 2084 7/21/77; located at the junction of Forest Road 167 and Forest Road 161.
- 2085 7/21/77; located 3 miles south of Forest Road 167 on Forest Road 161. Site is at the intersection with a road from NM 14 going to the Surrat Ranch.
- 2086 7/25/77; Gran Quivira control site.
- 2087 7/25/77; located near the intersection of SR 14 and the road to the Atkinson Ranch, T.1.N;
 R.10.E, Sec. 23 at northeast side of Forest Road 167 and Forest Road 137 jet.
- 2088 7/25/77; located 2 miles east of No. 2087, 10 m north of the road.
- 2090 7/26/77; located 7.25 miles west of SR 42 on Forest Road 167. Located north of the road near an occupied ranch.
- 2090 7/26/77; located just east of the intersection of Forest Road 167 and NM 42 at location of EPA No. 19.
- 2092 7/26/77; located about 6 miles northwest of Cedarvale on NM 42 at southwest side of roadside rest area.
- 2093 7/27/77; located ~1.5 miles southeast of Cedarvale near aircraft radio beacon at "Corona Airport."
- 2094 7/27/77; located on north-south road to Piños Wells in an arroyo upstream to a cattle tank, T.2.N; R.12.E.
- 2095 7/27/77; same as No. 2094, but moved up to nearest bench to the north above arroyo bottom.
- 2096 7/27/77; same as No. 2094, but moved up to nearest bench to the south above the arroyo bottom.
- 2097 7/27/77; located in Salt Lake basin (southern extreme) R. 13.E; T.2.N.
- 2099 7/28/77; located near the junction of NM 42 and the ERDA Solar Irrigation Project turnoff, close to EPA No. 24.
- 2100 7/28/77; located about 22 miles east of Willard on U.S. 60. Located on high ground, that is, slight rise.
- 2101 7/28/77; located about 15 miles north of Encino on U.S. 285 on east side of road on east ridge of Pedernal Mountain.
- 2102 to 2113 were locations around Los Alamos used for TA-45, Bayo Canyon, Acid Canyon, and Pueblo Canyon Resurvey.

- 2114 8/8/77; Gran Quivira control site.
- 2115 8/8/77; located at junction of Forest Roads 99 and 161, 10 miles west of NM 54. Sample site is on the northeast side of the "T" intersection and 30 m north of Forest Road 161 and 30 m east of Forest Road 99.
- 2116 8/8/77; located ~2.3 miles east of No. 2115 on Forest Road 161. Site is in a medium-sized arroyo 40 m north of road.
- 2118 8/9/77; located 5.5 miles west of Corona, 2.5 miles west on Forest Road 141 to "Primitive Road" sign on south side of road, 30 m west of sign.
- 2119 8/9/77; located in a saddle ~0.5 mile southeast of North Peak, 0.7 mile east of Forest Road 104 on a "two-rut" road.
- 2120 8/9/77; located in a large stream channel just east of Forest Road 140. Site is at the confluence of a side stream with the main channel, 40 m east of Forest Road 140 and just above a newly constructed dirt tank.
- 2121 8/9/77; located on Gallinas Peak ~10 m north of Forest Road 102 at a small jeep trail. Site is on the leeward slope (north).
- 2122 8/9/77; Replicate of 2121, 200 m east.
- 2123 8/9/77; located near the intersection of Forest Roads 99 and 102 on Forest Road 102, 50-75 m west of Forest Road 99, 10 m south of road.
- 2125 8/10/77; located 3 miles east of NM 54 on the Bond Ranch. Site is 40 m south of the road in grassy stream bottom.
- 2126 8/10/77; located 17.2 miles west of NM 54, past Harvey Ranch.
- 2127 7/10/77; located near the windmill at the Erramouspe Ranch.
- 2128 8/10/77; located ~0.5 mile north of the Erramouspe Ranch, 15 m from dirt tank.
- 2129 10/4/77; located at southeast corner of the GZ control plot. Same as Nos. 1985 and 1994.
- 2130 10/5/77; located ~2 miles west of fence at GZ along WSMR No. 20. Site is 150 m north of road on a playa.

- 2131 10/5/77; 5.5 to 6 miles north of GZ. Fence at right-hand bend in the road, 50 m west of apex of turn.
- 2132 10/5/77; located near mine site on WSMR. Site is ~ 60 m southwest of the white dome.
- 2133 10/5/77; recount of No. 1998 inside the outer fence at GZ.
- 2134 10/5/77; inside inner GZ fence and the right, ~10 m inside gate.
- 2135 10/5/77; inside inner GZ fence, north of the monument and 7 m from fence.
- 2136 10/5/77; inside inner fence, 10 m west of wooden cover.
- 2138 10/5/77; located on WSMR midway from Route7 to mine site at intersection of a road leading south.
- 2139 10/6/77; within outer fence at GZ, from gate, 3rd fence corner in clockwise direction and 20 m toward monument.
- 2140 10/6/77; within outer fence at GZ. Site is at 6th fence corner clockwise and 15 m toward monument.
- 2141 10/6/77; within outer fence at GZ. Site is at 10th corner clockwise and 30 m toward monument.
- 2142 10/6/77; southeast corner of Ecology GZ control site.
- 2143 10/6/77; located at White Sands "Gold" road block along NM 380, ~45 m south of road.
- 2144 20/7/77; Gran Quivira control site.
- 2146 10/7/77; recount of Nos. 2021 and 1981 above Area 21 at the black water tower.
- 2147 10/9/77; located ~0.5 mile northeast of Bingham in large dirt tank.
- 2148 10/9/77; located 1.5 miles east of San Antonio along NM 380.
- 2153 10/11/77; located 4.6 miles past the first cattle guard after crossing Rio Grande Bridge at Escondida. This is east of the river at Socorro.
- 2154 10/11/77; located 7.7 miles from No. 2153 along the road. Site is east and a little south of Socorro.
- 2155 10/11/77; located 9.3 miles from No. 2154 near an old stone house. Site is several miles north of NM 380.

APPENDIX C

IN SITU INSTRUMENT CALIBRATION

I. CALIBRATION OF INSTRUMENT RESPONSE AND FIELD APPLICATION

Calibration of *in situ* gamma-ray spectroscopy instrument response depends on the distribution of the radionuclides of interest as a function of depth of soil. Naturally occurring radionuclides are usually uniformly distributed, but surface-deposited radionuclides such as those from the Trinity event, which have leached into the soil horizons, exhibit a distribution that is a complicated function of rainfall input, soil properties, vegetation type and density, and the like. Accordingly, soil profile sampling at certain of the *in situ* measurement locations was done, and the results extrapolated to the rest of the locations by a model to be described below.

A. Calibration of Instrument Response

The response of the closed-end, cylindrical Ge(Li) detector, placed at a fixed height of one meter above the soil, is an energy-dependent function of the angular response of the detector and the flux of unscattered photons incident at the detector per unit of soil radioactivity.

A general equation expressing this relation is

$$N_{f}/s = (N_{o}/\phi) (N_{f}/N_{o}) (\phi/s)$$
, (C-1)

where N_f/s is the counting rate in the photopeak per unit of soil radioactivity; No/ϕ is the number of counts in the photopeak of interest per incident photon/cm² for a point source at 0° from the detector's axis; N_f/N_o is an angular correction factor to account for nonuniform response at angles between 0° and 90°; and ϕ/s is the theoretical flux of unscattered photons incident at the detector per unit of soil activity. Normally, calibration involves a calculational procedure independent of the geometries of the distributed sources to be evaluated. Radionuclides that have been redistributed through the vertical profile from an initial surface deposition are usually assumed to be exponentially distributed. As a crosscheck of the laboratory calibration and suitability of the soil sampling for estimation of vertical distribution, an empirical calibration was attempted as well.

The coefficient $N_f/\phi = (N_o/\phi)(N_f/N_o)$ (that is, the product of the first two terms on the right) represents the total detector registration efficiency for unscattered photons under field conditions. It is a function of the energy and distribution of unscattered photons. The unscattered photon distribution itself is a function of photon energy, source activity distribution vertically and over area, detector height, and the mass attenuation coefficients and densities of soil and air. The source activity distribution and photon energy are the most important parameters. Small variations in the other parameters result in only minor variations in the coefficient $N_{\rm f}/\phi$. In Appendix D, it is shown that an independent determination of this coefficient based on measured instrument response and a source term developed from measured vertical profiles of ¹³⁷Cs activity fitted to an exponential distribution function provides an empirical estimate of detector efficiency, which compares very well with the laboratory calibration performed at Lawrence Livermore National Laboratory (LLNL).

B. Field Applications

The gross, short-term stability of the total spectrometer as well as long-term stability under the stresses of a rather severe environment typical of the New Mexico desert during the summer months were both concerns during field operations.

The gross response of the system was checked at the beginning of each day and at regular intervals during the day by counting a small calibration source placed directly under the detector. As a check of long-term stability, two control plots were selected as convenient background locations that could be repeatedly counted during the course of the field work. One was an intensive study area about 1 mile south of the Trinity event GZ site on the White Sands Missile Range; the other was near the Gran Quivira National Park in the vicinity of Chupadera Mesa.

II. EVALUATIONS OF TRINITY ¹³⁷Cs DATA

As a result of the present Trinity resurvey, there are two basic sources of raw data on ¹³⁷Cs concentrations in soils and biota in the Trinity fallout field: the measurements made on canned samples submitted to LLNL for analysis, and the *in situ* Ge(Li) spectral data. For most of the *in situ* locations, field integration of the cesium peak was made by a reliable approximation technique. These field data and the results of the laboratory measurements of canned samples provided the basis for the preliminary evaluations described in the following discussion.

An essential factor for purposes of estimating the total inventory of ¹³⁷Cs in the soil is the reciprocal of the exponential relaxation depth of contaminant in the soil profile (α). Only nine sample locations on Chupadera Mesa yielded profile concentration data usable for estimating the profile distribution. Of these, three were estimates based on data for the first and third 5-cm profiles only, which would tend to make the estimated profile parameters less reliable. Overall, there is uncertainty in the estimates of α from the soil data because of the way samples were collected and analyzed, as well as the natural variability in the distribution from place to place in the vicinity of the *in situ* measurement. Estimates of α were generated from the soil profile data using standard least-squares regression techniques.

In order to extend this profile data set to the remainder of the sample locations on the mesa, it was determined by multiple regression studies that a useful predictor could be developed from data on the elevation of each sample location and position on the local topological sequence (reduced to simply ridge top, side slope, or depression). The topological sequence information was made quantitative by means of a linear compartment model of ¹³⁷Cs redistribution during the past 30 years among these topological sequences on the mesa. The regression relationship derived accounts for 76% of the variability in the data, which, considering the many sources of variability in ¹³⁷Cs redistribution through the soil profile, seem remarkably good. Predicted reciprocal relaxation depths ranged from 0.1 cm^{-1} to 1.2 cm^{-1} , with the higher values (corresponding to shallower distributions) predicted for highest elevations. For simplicity in computer processing the field Ge(Li) spectrometer data, these predicted values were reduced to one of four values of α , uniform (α =0), 0.2, 0.4, or 0.7. Sample locations off Chupadera Mesa were assigned α values based on judgment and on limited distribution data when available. Ground Zero areas were found to exhibit nearly uniform profiles, while intervening regions had profiles typical of worldwide fallout (relaxation depth of 5 cm).

The response of a bare Ge(Li) detector to the inventory of gamma-emitting radionuclides in the soil over which it is placed is dependent on detector-source geometry, photon energy, and the vertical distribution of activity (characterized by the α -parameter). Usually the detector is calibrated for photon energy and geometry dependence by the use of sealed sources, while the α -dependence is accounted for theoretically. (See Chapter 2 for details on standard calibration techniques.) The *in situ* calibration efficiency term, N_f/s, is defined for sealed source calibration by an energy-dependent zero-angle response term, N_f/ ϕ , an angular correction (geometry) term N_f/N_o, and an α -dependent source term ϕ/s :

$$N_f/s = (N_o/\phi)(N_f/N_o)(\phi/s)$$
,

where

- $N_f/s = \text{count rate in photopeak/unit of soil activity}$ (nCi/m²),
- N_o/ϕ = counts per min per incident photon/cm² at the detector for a source at 0° from detector axis,
- N_{f}/s = angular correction term, and
- $\phi/s =$ flux of unscattered photons incident at the detector per unit of soil activity.

However, the *in situ* efficiency can also be estimated from field data. In fact, an independent check of the suitability of the relatively weakly determined profile parameter for estimating total profile inventory, α , can be made by an independent determination of the efficiency of the detector, N_f/s, from a set of field data. The flux per unit source, ϕ /s, is determined mathematically as a function of α . The count rate in the photopeak of ¹³⁷Cs was field-integrated, yielding an estimate of N_f at each location. "S" can be approximated under the assumption that the ¹³⁷Cs activity is exponentially distributed in the soil profile by integrating the exponential distribution:

$$S = S_o \int_o^{\alpha} e^{-\alpha x} dx = \frac{S_o}{\alpha} , \qquad (C-3)$$

where

- $S_o = approximate activity in the top layer of soil, nCi/m², and$
- α = reciprocal of relaxation depth, cm⁻¹.

 S_o can be approximated from the measured ¹³⁷Cs concentration at each location where profile data are available with which to estimate α . These parameters suffice to determine a lumped parameter, N_f/ϕ , which, when multiplied by ϕ/S , yields an estimate of the calibration factor, N_f/S . The theoretical relation between ϕ/S and α is shown in Fig. C-1. The product of ϕ/S and the estimated S for each measured α divided into N_f yields estimates of



Fig. C-1. $N_{\rm f}/\phi$ as a function of α .

 N_f/ϕ as a function of α . These values are tabulated in Table C-I. In Fig. C-2, these data are fitted to an exponential curve using standard regression techniques. The low coefficient of determination ($R^2 = 0.12$) is indicative of the large variability in the data, and hence the somewhat arbitrary choice of an exponential fit to the data. The predicted calibration term $N_f/s = (N_f/\phi)(\phi/s)$ is plotted in Fig. C-2.

III. STATISTICAL CONSIDERATIONS OF MINI-MUM DETECTABLE ACTIVITY OF ¹³⁷Cs AND ^{239,240}Pu

In the Trinity resurvey project there were several types of radioactivity measurements made with a variety of equipment and techniques. Results are reported as activity per gram or per square meter. The sensitivity and precision of a given instrumentation and method depends on such parameters as detection efficiency, energy resolution, and background levels. In addition, sample volume, available counting time, and degree of statistical precision required are crucial determinants. Following the approach of Walford and Gilboy,^{C1} and Kirby,^{C2} an expression can be derived what will enable an estimation of sensitivity limits (or minimal detectable activity) in terms of zone of these parameters.

It was assumed that whether 137 Cs or 239 Pu was being measured, the detection system utilized possessed an energy resolution capability such that radionuclide-specific counts (for example, counts in a photopeak) were identifiable while situated on a background continuum. In this context, precision of the count is definable in terms of the coefficient of variation c, where c = standard deviation of the net peak counts/net peak counts. If S is the measured peak plus background counts within the channel defining the peak and B and D are the background and peak counts in this region, all measured for a time T, then

$$\mathbf{S} = \mathbf{D} + \mathbf{B} \quad . \tag{C-4}$$

For a highly stable counting system, variation is principally from counting statistics in both the peak channels $(s = B)^{1/2}$ and in the statistical variation in the data on either side, giving rise to an additional variance V. The coefficient of variation can be written in these terms as

$$C = \frac{(D + 2B + V)^{1/2}}{D} .$$
 (C-5)

TABLE C-I

Sample No.	$\frac{\alpha (cm^{-1})}{\alpha}$	Inventory $S (nCi/m^2)$	MeasuredN _f	Flux 	N _f /¢
2027	0.27	187.5	111.22	3.28	33.89
2045	0.27	68.8	15.76	1.2	13.09
2048	0.43	39.7	81.81	0.87	93.69
2058	0.42	193.7	170.37	4.20	40.53
2071	0.39	126.8	187.0	2.66	70.27
2080	0.10	51.1	29.6	0.46	65.06
2115	0.71	66.1	56.37	1.82	31.01
2118	0.60	54.6	69.02	1.42	48.63
2120	0.79	252.7	88.05	7.33	12.02

COUNT RATE PER UNIT FLUX AT THE DETECTOR, N_{f}/ϕ , AS A FUNCTION OF MEASURED α



Fig. C-2. $N_f/s = N_f/\phi \cdot \phi/s$ as a function of α .

Solving for D yields

$$D = \frac{\{1 + [1 + 4C^{2}(2B + V)]^{1/2}\}}{2C^{2}} \quad . \tag{C-6}$$

The total count in a peak is a product of the detector peak efficiency, N_f/S , which is the count rate in the peak per unit activity in the ground S, the time of the count T, and the activity in the ground S_A

$$\mathbf{D} = (\mathbf{N}_{\mathbf{f}} / \mathbf{S})(\mathbf{T})(\mathbf{S}_{\mathbf{A}}) \quad . \tag{C-7}$$

The minimal detectable level of activity (minimum S_A) is, thus, from Eqs. (C-6) and (C-7)

$$S_{min} = \frac{1}{2C^{2}(N_{f}/s)T^{-}} \{ (1 + 4C^{2}(2B + V))^{1/2} \} .$$
(C-8)

Since the variance in the net peak counts, VAR(D), is the square of the numerator of Eq. (C-5), the quantity (2B + V) in Eq. (C-8) can be replaced by the equivalent VAR(D) – D. This permutation allows calculation of the minimum detectable activity without introducing the specific background count. The *in situ* and laboratory Ge(Li) data are reported only in terms of peak count rate and standard deviation or fractional standard deviation.

If the criterion of acceptability is that the coefficient of variation be no larger than 0.3 for a typical count time of 2000 s (33.3 min), then S_{min} becomes

$$S_{min} = \frac{0.167}{N_f/s} \{1 + [1 + 0.36(VAR(D)]^{1/2}\}$$
 (C-9)

For the known peak count, R, and the fractional standard deviation of the peak count rate, σ_{cpm} , S_{min} becomes

$$S_{mln} = \frac{0.167}{N_f/s} \{1 + [1 + 400(\sigma_{cpm}R^2 - 0/03R)]^{1/2}\} .$$
(C-10)

REFERENCES

- C1. H. G. V. Walford and W. B. Gilboy, "Fundamentals of Sensitivity Units in Low Level Counting," in *The Proc. Natural Radiation Environment II*, August 7-11, 1972, Houston, Texas (1973).
- C2. J. A. Kirby, L. R. Anspaugh, P. L. Phelps, G. A. Armantrout, and D. Sawyer, "A Detector System for *In Situ* Spectrometric Analysis of ²⁴¹Am and Pu in Soil," *IEEE Transactions on Nuclear Science* (February 1976).

APPENDIX D

INTERPRETATION OF DATA

This appendix provides the information and assumptions used to calculate the doses from the current conditions at Trinity Site and the fallout zone to the northeast including Chupadera Mesa. The land uses in the area include the restricted area of White Sands Missile Range, grazing of cattle, and a few crops grown in the far fallout areas. Chupadera Mesa is all grazing with ranches ranging in size from 100 square miles to some exceeding 200 square miles. Home gardening is practiced with irrigation water being supplied from wells. Well water samples did not contain any significant amounts of the fallout radionuclides now remaining in the area.

I. SOILS DATA BY AREA

A. Background Levels of Radionuclides and Radiation

Reference values for background concentrations of radioactivity in soils and sediments attributable to natural constituents or general worldwide fallout were assembled from several studies to provide a basis for comparison (Refs. D1, D2, D3, and D4). This information is summarized in Table D-I. Most of the data were from a compilation on soils and sediments collected in northern New Mexico over the period 1974-1977 as part of the Los Alamos National Laboratory routine environmental surveillance program. Some of the data were taken from other studies representing generally smaller numbers of samples.

The data in Table D-I can be used only as a general comparison for the data taken for Trinity fallout zone. The distribution of worldwide fallout radionuclides varies with latitude and longitude in the U.S. However, the data for northern New Mexico are the only compilation available for this area of the U.S.

B. Survey Sample Results

1. Trinity Site GZ Area. Measurements of the radiation present at GZ of Trinity Site were started very early. On July 16, 1945, measurements at 30 000 feet to the north of GZ recorded 10 R/h, while 30 000 feet to the west only 0.2 R/h was recorded (Ref. D5). At 12 000 feet south of GZ, nothing was recorded. At 4500 feet south, 0.011 R/h was recorded. At 6:30 p.m. on July 16, 1945, a measurement 30 feet west of GZ recorded 6000 R/h (Ref. D5). Measurements made August 12 and 14, 1945, recorded 7 R/h at GZ with a circular area around GZ reading 15 R/h (Ref. D6). In October, 1945, a number of excavations were made to study the blast effects of the test (Ref. D7).

Ground disturbances at the GZ area occurred a number of times. In 1947, the Trinitite containing the most radioactivity was placed in 12 drums and buried inside the GZ area (Ref. D8). In 1952, the removal of the top inch of earth including the remaining lower activity Trinitite was arranged (Ref. D9). In 1965 a monument was erected at the center of the GZ tower. In 1967 a detailed radiological survey was conducted to document the radiation doses present. The study detected a high of 3 mR/h and low of 0.03 mR/h within the fenced areas (Ref. D10). At the same time, the 12 drums of Trinitite were dug up with a backhoe and shipped to Los Alamos National Laboratory where disposal was accomplished in the low-level waste burial facility (Ref. D8). The 1967 study concluded there was no risk to persons visiting the site.

Visits by the public to the site currently are limited to an Army-sponsored 2-h stay time. The keys to the area are only available from the White Sands Missile Range security office and only after approval by the safety officer.

In 1977 the radiation survey for the DOE Remedial Action Programs made a few surface measurements at GZ. However, no data were taken on the depth of contamination during previous surveys. In 1983 both auger samples and split-spoon samples were obtained in the fenced areas of GZ. Figure D1 indicates the locations of the soil samples at depth as well as locations of air samples and external radiation measurements. External

TABLE D-I

	Mean Concentration	Range of		No. of		
Isotope	$(\bar{\mathbf{x}} \pm \mathbf{s})$	Concentrations	Units	Samples	Comment	Reference
²³⁹ Pu	0.008 ± 0.010	<0.002 - 0.045	pCi/g	149	Soils and sediments 0-5 cm	DI
²³⁸ Pu	<0.000 ± 0.0064	<0.003 - 0.010	pCi/g	151	Soils and sediments 0-5 cm	Di
²⁴¹ Am	0.004 ± 0.004	<0.001 0.009	pCi/g	7	Sediments 0-5 cm	D2
⁹⁰ Sr	0.25 ± 0.27	<0.05 - 1.0	pCi/g	68	Soils and sediments 0-5 cm	Dl
¹³⁷ Cs	0.32 ± 0.30	<0.10 - 1.06	pCi/g	76	Soils and sediments 0-5 cm	DI
Total U	1 8 ± 1.3	<0.1 - 5.1	µg/g	118	Soils and sediments 0-5 cm	Dl
²³² Th	14.3 ± 3.6	9.2 - 20.1	μG/G	8	Soils 0-30 cm	D3
²²⁶ Ra	$\textbf{2.4} \pm \textbf{0.8}$	1.6 - 3.9	pCi/g	7	Soil 0-5 cm	D4

NORTHERN NEW MEXICO BACKGROUND REFERENCE VALUES FOR NATURAL OR FALLOUT LEVELS OF RADIOACTIVITY

radiation measurements were made with four thermoluminescent dosimeters (TLDs) at each location.

Tables D-II and D-III provide the data from soil samples for ²³⁹⁻²⁴⁰Pu and ¹⁵²Eu. Samples from the GZ inner fence area exhibit ²³⁹⁻²⁴⁰Pu levels 1.5 to 2.5 times proposed guidance levels of 100 pCi/g developed by the DOE Remedial Action Programs (Ref. D11). The quantities in the GZ samples also exceed the U.S. Environmental Protection Agency (EPA) guidance on transuranics of 0.2 μ Ci/m² for the top 1 cm of soil (Ref. D12).

Examination of the ²³⁹⁻²⁴⁰Pu surface sample data for between the fences indicates none of the surface samples exceeds the Remedial Actions Program criteria. Table D-IV includes the means for surface samples at similar distances from GZ. None of the means exceeds either DOE or EPA proposed criteria for surface contamination. For soil samples between 1-6 cm taken between the fences, all results were below DOE and EPA proposed criteria. Below 40 cm (16 inches), all soil sample results for ²³⁹⁻²⁴⁰Pu were the same as fallout levels in northern New Mexico.

Europium-152 is the predominant gamma-ray emitter in the soils of the GZ area. In undisturbed areas between the fences around GZ, the ¹⁵²Eu appeared in soil samples at deeper levels than plutonium. This would appear to suggest some mobility greater than plutonium. Also, measurements by *in situ* gamma-ray spectroscopy indicate ¹⁵²Eu is the major contributor to external radiation doses at GZ. There are no specified criteria for the amount of ¹⁵²Eu in soils. However, the DOE limits the



Fig. D-1. Location of June 1983 sampling,

maximum acceptable whole-body exposure to 500 mrem/yr. The annual visit allowed by the Army would result in a maximum dose of 1 mrem/yr added to about 150 mrem/yr from natural radiation for the area. The average dose per 2-h visit is likely to be about 0.5 mrem.

2. Radioactivity in Soils of Trinity Fallout Areas. Based on the soil data taken by this survey and the 1973 and 1974 survey by the U.S. EPA, the ²³⁹⁻²⁴⁰Pu arithmetic mean content of surface soils and deeper soil samples is less than criteria for removal by both the DOE and EPA. That is, the levels are considered safe for continuous residence by the public in the area. The plutonium content and content of other radionuclides from the Trinity test fallout are summarized in Tables XIV through XIX in Chapter 4. The tables are summaries of the data from Appendix A.

II. DOSE CALCULATIONS

The EPA guidance for transuranics in the general environment is based on a set of assumptions on how

TABLE D-II

1983 PLUTONIUM DATA FOR SPLIT SPOON CORE SAMPLES FROM GROUND ZERO AREA

			239-240Pu (j	pCi/g)		
		Sample	e Number and l	Distance from GZ		
Depth	GZ-1 (12 m)	GZ-2 (12 m)	Depth	I-3 (210 m)	II-4 (275 m)	II1-5 (280 m
0-1 cm	-•	22.8000 ± 0.200	0 0-1 cm	20.6000 ± 0.2000	0.3100 ± 0.0200	0.9900 ± 0.0300
1-6 cm		156.0000 ± 15.00	00 1-6 cm		0.1810 ± 0.0150	0.0440 ± 0.014
0-6 in.		23.7000 ± 0.400	0 16-22 in.	0.0056 ± 0.0010	0.0043 ± 0.0010	0.0022 ± 0.001
6-12 in.	256.0000 ± 3.0000		22-28 in.	0.0029 ± 0.0010	0.0110 ± 0.0030	0.0041 ± 0.0010
12-18 in.	0.4000 ± 0.0200	•				
18-24 in.	1.3300 ± 0.0400					
24-30 in.	_	9.9000 ± 0.300	0			
30-36 in.	_	0.1030 ± 0.008	0			
36-42 in.		4.9300 ± 0.130	0			
42-48 in.	_	0.1350 ± 0.008	0			
Depth	IV-6 (265 m)	I-7 (250 m)	11-8 (245 m)	Depth	IV-10 (185 m)	1-11 (330 m)
0-1 cm	5.0900 ± 0.8000	0.0440 ± 0.0070	27.5000 ± 0.300	00 0-1 cm	0.5600 ± 0.0300	8.5000 ± 0.1500
1-6 cm		0.0590 ± 0.0080	0.7300 ± 0.040	00 1-6 cm	0.1570 ± 0.0150	
				4-10 in.	0.0230 ± 0.0050	
16-22 in.	0.0021 ± 0.0010	0.0070 ± 0.0020	0.0100 ± 0.002	20 16-22 in.	0.0021 ± 0.0010	0.0068 ± 0.0010
22-28 in.	0.0070 ± 0.0020	0.0160 ± 0.0030	0.0180 ± 0.003	30 22•28 in.	0.0005 ± 0.0000	0.0130 ± 0.0020
Depth	II-12 (510 m)	III-13 (475 m)	1V-14 (520 m)	Depth	Control (5200 m)	
0-1 cm	0.0430 ± 0.0080	0.0940 ± 0.0130	0.0410 ± 0.0	090 0-1 ft	0.0019 ± 0.0010	
1-6 cm	0.0410 ± 0.0100	0.1500 ± 0.0200	0.0190 ± 0.0	060 1-2 ft	0.0006 ± 0.0000	
16-22 in.	0.0110 ± 0.0020	0.0025 ± 0.0010	0.0047 ± 0.0	010 2-3 ft	0.0024 ± 0.0010	
22.20 :	0.0038 ± 0.0010	0.0091 + 0.0010	0.0040 + 0.0	010 3-4 ft	0.0011 + 0.0000	

TABLE D.III

.

1983 ¹⁵²Eu DATA FROM SPLIT SPOON CORE SAMPLES IN GROUND ZERO AREA

¹⁵²Eu (pCi/g)

	Sample Number and Distance from GZ												
Depth	GZ-1 (10 m)	GZ-2 (12 m)	Depth	I-3 (210 m)	II-4 (275)	II1-5 (280 m)							
0-1 cm		284.3388 ± 29.0322	0-1 cm	33.6445 ± 3.5359	13.3744 ± 1.7159	9.9419 ± 1.3869							
1-6 cm		245.4959 ± 24.9538	1-6 cm	30.8438 ± 3.4902	10.5350 ± 1.2412	10.0096 ± 1.4444							
0-6 in.	500.7191 ± 50.6747	264.5681 ± 26.8594	4-10 in.	14.7625 ± 1.6236	5.4157 ± 0.9014	5.3234 ± 0.8980							
6-12 in.	1069.0675 ± 107.7231	957.6400 ± 96.2607	10-16 in.	5.7801 ± 0.6222	0.8868 ± 0.7104	2.2046 ± 0.2800							
12-18 in.	282.0225 ± 28.3633	169.0552 ± 17.4506	16-22 in.	0.9959 ± 0.1536	0.5379 ± 0.2188	0.7792 ± 0.2400							
18-24 in.	40.1567 ± 4.0812	222.9221 ± 22.4308	22-28 in.	0.8026 ± 0.1551	0.2654 ± 0.1115	0.3642 ± 0.1086							
24-30 in.	22.5086 ± 2.2929	129.8201 ± 13.0731	28-34 in.	1.4461 ± 0.2819									
30-36 in.	0.5566 ± 0.1335	24.1423 ± 2.4623	34-40 in.	0.0415 ± 0.1552									
36-42 in.	1.0331 ± 0.1636	10.4316 ± 1.0858	40-46 in.	0.1950 ± 0.1169	•								
42-48 in.	0.4203 ± 0.1278	3.9016 ± 0.4443	46-52 in.	0.3665 ± 0.1436									

Depth	IV-6 (265 m)	I-7 (250 m)	IV-10 (185 m)	Depth	1-11 (330 m)	II-12 (510 m)	III-13 (475 m)
0-1 cm	13.8847 ± 1.6654	3.4109 ± 0.3888	58.6909 ± 6.1822	0-1 cm	5.1252 ± 1.0778	1.3496 ± 0.6956	0.0760 ± 0.2515
1-6 cm	16.9154 ± 2.0174	4.5362 ± 1.1405	46.1493 ± 4.8400	1-6 cm	3.5483 ± 0.9248	1.1844 ± 0.5368	2.5695 ± 1.0400
4-10 in.	2.0848 ± 1.5203	2.8248 ± 0.8710	23.0370 ± 2.5576	4-10 in.	0.8999 ± 0.7806	2.1175 ± 0.5756	0.6602 ± 0.4074
10-16 in.	4.1317 ± 0.9492	0.4960 ± 0.1940	5.7562 ± 0.6522	10-16 in.	2.1553 ± 0.6975	0.6941 ± 0.4311	0.4506 ± 0.5043
16-22 іл.	0.6858 ± 0.1823	0.2761 ± 0.1871	1.5456 ± 0.2405	16-22 in.	0.3492 ± 0.1666	0.4024 ± 0.1540	0.6390 ± 0.2391
22-28 in.	0.4285 ± 0.1389	0.4526 ± 0.1697	0.5428 ± 0.1321	22-28 in.	0.2080 ± 0.1061	0.2385 ± 0.2039	0.2231 ± 0.1409
28•34 in.			0.4930 ± 0.1476	_			•
34-40 in.			0.2072 ± 0.4930		-	-•	

•

Depth	IV-14 (520 m)	Depth	II-8 (245 m)	Depth	II-8c (245 m)
0-1 cm	0.6312 ± 0.5778	0-6 in.	18.2777 + 2.2156	0-1 cm	25.0172 + 3.0114
1-6 cm	0.1291 ± 0.4440	6-12 in.	5.2162 ± 0.9229	1-6 cm	21.0319 ± 2.7315
4-10 in.	0.5836 ± 0.2980	12-18 in.	4.1792 ± 0.1840	6-11 cm	16.4178 ± 2.1762
10-16 in.	0.1585 ± 0.5181	18-25 in.	0.2456 ± 0.1056	8-13 in.	6.7864 ± 1.0562
16-22 in.		24-30 in.	0.3192 ± 0.1996	13-19 in.	2.2228 ± 0.2649
22•28 in.	0.4468 ± 0.1902	30-36 in.	0.4045 ± 0.1628	19-25 in.	0.6343 ± 0.1665
		36-42 in.	0.3108 ± 0.1398	25•27•1/2 in.	0.4335 ± 0.1455

TABLE D-IV

				Distance
Location	Sample	0-1 cm	1–6 c m	from GZ
	111 6	0.00 ± 0.03	0.044 ± 0.014	280 m
Ora Elana D 1	111 - 5	0.99 ± 0.03	0.044 ± 0.014	260 m
See Figure D-1	IV - 6	5.09 ± 0.8		265 m
	I - 7	0.044 ± 0.01	0.059 ± 0.01	250 m
	II - 8	27.5 ± 0.3	0.73 ± 0.04	245 m
	II-4	0.31 ± 0.02	0.18 ± 0.02	275 m
		$\bar{x} = 6.78 \pm 11.8$		
Outside fences	II – 12	0.043 ± 0.008	0.041 + 0.01	510 m
Outside fences	III - 13	0.094 ± 0.013	0.15 ± 0.02	475 m
Outside fences	IV = 14	0.041 ± 0.009	0.019 ± 0.006	520 m
		$\bar{x} = 0.059 \pm 0.03$		
Between fences	IV – 10	0.56 + 0.03	0.157 ± 0.015	185 m
Between fences	I-11	8.5 ± 0.15	8.8 ± 0.13	330 m
Mean for Between		$x = 5.8 \pm 9.5$		
fenced area				
3 Miles South of Entrance gate	Control site	$0.0019 \pm 0.001^{*}$		5.2 km
Ground Zero	GZ	22.8 ± 0.2	156 ± 15	12 m
Northern New Mexico	Average	0.008 ± 0.01		

JUNE 1983 PLUTONIUM DATA FROM TRINITY GZ AREA

^aData for 0-1 foot.

radionuclides reach man. The guidance only considers transuranic elements such as plutonium. In the Trinity fallout zone, there are also residual fission products. The residual fission products are dominated by ¹³⁷Cs and ⁹⁰Sr. Thus, investigations regarding the safety of living in the fallout zone need to consider the total doses from all radionuclides present.

The doses are from three major paths to man. The external radiation doses as measured are reported in Chapter 4. The doses from inhalation and ingestion of radionuclides in air and food require calculational estimates. The following sections discuss the information used for these calculations, as well as present, intermediate, and final results.

A. Inhalation of Radionuclides

The residual contamination in the soils of the fallout zone provides a source of particulate matter that may be resuspended by wind movement or other mechanical

TABLE D-V

PARAMETERS FOR ESTIMATION OF RESUSPENSION OF RADIONUCLIDES USING MASS LOADING (24 µg/m³)^a

	Effec Concentr	tive Soil ation (p	Ci/g)		C	Measured 239,240 pu		
Area	^{239,240} Pu ^b	⁹⁰ Sr	¹³⁷ Cs	$\underline{\Sigma \; g_1 \; f_1}$	^{239,240} Pu	⁹⁰ Sr	¹³⁷ C8	(μCi/m ³)
Trinity Site								
Inner Fence	22.8		16.5	0.071	3.8×10^{-11}		2.8×10^{-11}	6.3×10^{-11}
Outer Fence	5.8		0.54	0.071	$9.8 imes 10^{-12}$		9.2×10^{-13}	0.1×10^{-11}
White Sands	13.2 ^b	1.8	4.5	0.071	2.2×10^{-11}	3×10^{-12}	1.8×10^{-12}	
Bingham	0.36°		3.7°	0.78	$6.7 imes 10^{-12}$		6.9×10^{-11}	
Chupadera Mesa	3.2 ^b	2.3	2.8	1.6	1.2×10^{-10}	8.8×10^{-11}	1.1×10^{-10}	4.1×10^{-11} d
Far Fallout Zone	0.57 ^b	1.47	2.0	1.6	2.2×10^{-11}	5.6×10^{-11}	7.7×10^{-11}	
San Antonio, NM	0.019 ^b		4.8 ^c	1.6	$7.3 imes 10^{-13}$		$1.8 imes 10^{-10}$	$4.3 \times 10^{-11.d}$

*Reference D13.

^bFor samples other than 1 cm deep, a Correction Factor Applied for profit distribution: 1.32 for White Sands, 0.34 for Bingham, 1.9 for Chupadera Mesa, Far Fallout Zone and San Antonio. See Reference D14.

^cEstimated from *in situ* measurements.

^dReference D15.

action. Such airborne particulate matter could be inhaled by persons occupying the areas. Few direct measurements of total airborne radioactivity have been made in the area. Some of these results were discussed in Chapter 4. Another method of evaluating the potential contribution of resuspension of residual contamination in the areas is described here. The theoretical model selected is the straightforward mass-loading approach, which has been assessed as being suitable for conditions where the contaminant has been aged in the environment for some time (Ref. D16). Refinements to account for unequal distribution of the contaminant on different particle sizes and for the limited size of the contaminated area were included. The basic approach predicts the concentration of airborne activity (activity/unit volume of air) as the product of the mass of particulates in the air (mass/unit volume of air) and the concentration of activity in the soil (activity/unit mass of soil) in the area. This predicted air

concentration is modified by an enrichment factor to account for the generally higher concentration per unit mass on smaller particles in the respirable range and for the generally small weight fraction of small particles in soils.

The various parameters and the estimated airborne concentrations of ²³⁹Pu for the individual areas are summarized in Table D-V. The arithmetic mean ²³⁹Pu soil concentrations came from Tables XIV through XIX.

The enrichment factors for each area where particle size and activity distribution data were available were calculated as shown in Table D-VI. The enrichment ratio g_1 is the quotient of the activity fraction for a given particle size increment i and the mass fraction for that size increment. These fractions were taken from or based on actual measurements of soils in the GZ and Chupadera Mesa areas as indicated by the references in the table. The airborne mass fraction f_1 for the size

TABLE D-VI

Агеа	Size Increment (µm)	Wt. Fraction	²³⁹ Pu Activity Fraction	Activity Mass Ratio <u>g₁</u>	Airborne Mass Fraction f_1^d	Enrichment $\mathbf{g_1} \mathbf{f_1}$	$\Sigma g_1 f_1$
Trinity Site	53 - 105	0.11ª	0.0043ª	0.039	0.35	0.014	
	< 53	0.089 [±]	0.078ª	0.088	0.65	0.057	0.071
White Sands	53 - 105	0.11 ^b	0.0043 ^b	0.039	0.35	0.014	
	< 53	0.089 ^b	0.078 ^b	0.088	0.65	0.057	0.071
Bingham	53 - 105	0.19 ^b	0.03 ^b	0.16	0.35	0.056	
	< 53	0.10 ^b	0.11 ^b	1.1	0.65	0.752	0.78
Chupadera Mesa	53 - 105	0.18 ^b	0.16 ^b	0.89	0.35	0.31	
	< 53	0.36 ^b	0.73 ^b	2.0	0.65	1.32	1.6
Far Fallout Zone	53 - 105	0.18°	0.16 ^c	0.89	0.35	0.31	
	< 53	0.36°	0.73°	2.0	0.65	1.32	1.6
San Antonio	53 - 105	0.18°	0.16 ^c	0.89	0.35	0.31	31
	< 53	0.36°	0.73°	2.0	0.65	1.32	1.6

ENRICHMENT FACTORS FOR RESUSPENDABLE PARTICLES

*Assumed to be the same as measured at 1.6 km location northeast of GZ.

^bReference D14.

^cAssumed to be the same as measured at Chupadera Mesa.

^dReference D13.

increment was taken from Fig. A2-3 in Ref. D13. The enrichment factor $(\Sigma_1 \ f_1 \ g_1)$ is the sum over the size increments of the respective $f_1 \ g_1$ products.

The annual average mass loading was taken to be 24 μ g/m³ (Ref. D16). This value is an annual geometric mean.

The estimated annual average ²³⁹Pu air concentration is shown for each area. Table D-V also shows estimated annual average air concentrations for ⁹⁰Sr and ¹³⁷Cs for each area in which these isotopes occurred at concentrations on soil statistically above background as summarized in Table D-I as measurements had been made. Potential doses that could result from the estimated air concentrations were calculated by using standard inhalation rates to determine intakes and appropriate dose conversion factors (Ref. D17). For dose estimation, the presence of transuranics other than ²³⁹Pu (i.e., ²³⁸Pu, ²⁴¹Pu, and ²⁴¹Am) was accounted for by using a dose factor combining the effect of aging weapons grade plutonium for 50 years (Ref. D18). Table D-VII presents a summary of the dose factors for the first year and 50year committed dose equivalents for the isotopes and organs of interest.

INHALATION DOSE FACTORS USED (mrem/µCi)⁸

Radionuclides	First Year Dose			50-Year Committed Dose Equivalent				
	Whole Body	Bone	Lung	Whole Body	Bone	Lung	Liver	
Plutonium isotopes ^{b,c}	2.3 × 10 ²	8.3 × 10 ³	5.3 × 104	8.7 × 10 ⁴	9.0 × 10 ⁵	9.4 × 10 ⁵	4.5 × 10 ⁵	
⁹⁰ Sr ¹³⁷ Cs	8.3 3.3 × 10 ¹	1.9 × 10 ² 3.3 × 10 ¹	7.0 × 10 ² 5.2	7.6 × 10 ² 5.6 × 10 ¹	1.2 × 10 ⁴ 6.1 × 10 ¹	1.2 × 10 ³ 9.4	•• 	

Dose factors are from References D19 and D17.

^bAnnual air intake of 8.4×10^3 m³/yr.

'Includes decay of ²⁴¹Pu to ²⁴¹Am for 50 years plus other plutonium isotopes.

Doses for transuranics were estimated as the product of the estimated average airborne ²³⁹Pu concentrations for each stratum, a standard average breathing rate of 23 m³ day (from Ref. D17), continuous occupancy, and the dose factors. These results are summarized in Table D-VIII by stratum for ²³⁹Pu and total transuranics including ²³⁹Pu. Doses estimated for ⁹⁰Sr and ¹³⁷Cs are also shown in Table D-VIII. They are the products of the estimated resuspended air concentration attributable to soil contamination, the breathing rate, and the appropriate dose factor.

In the case of some air sampling data being available, the measured average for 10 months on Chupadera Mesa is 41 aCi/m³ (Ref. D14), while the estimated resuspension by calculation is 120 aCi/m³. The estimated doses from inhalation are likely to be an overestimate.

B. Ingestion of Radionuclides

Dose calculations for ingested radionuclides considered the land use limitations of the areas of interest. Cattle grazing is the only land use out to the far fallout area. Beyond Chupadera Mesa, a few scattered fields of dry land wheat is raised, but the major land use is still cattle grazing. For the dose estimates here, the present land use assumes that all meat consumed, all milk products, and one-half the produce and vegetables are raised in the area being considered. The meat is further assumed to be all beef. Feed for the beef is assumed to be be by grazing or forage raised in the area of interest. The food intakes used are those listed in Table D-IX for the average individual. Other parameters used for the estimation of transfer of radionuclides through the food chain to man are listed in Table D-IX. Based on the feed crops available per unit area, the doses calculated for the inner fenced area and the area between fences at GZ are overestimates. Not all of the food assumed to be consumed could be produced in the area available without altering present land use practices. The dose factors used for the calculations are listed in Table D-X.

1. Produce, Vegetables, and Forage. The transfer of radionuclides from soil to plants was estimated using the soil concentrations measured for the fallout areas in 1974 and 1977 listed in Tables XIV through XIX in Chapter 4. The GZ data for 1983 were used for plutonium isotopes. The plant transfer parameters used for ²³⁹⁻²⁴⁰Pu were measured for GZ and Chupadera Mesa (Ref. D20). The concentration ratio (CR) between plant and soils was used for calculations at GZ and the White Sands Missile Range fallout area. The measured ²³⁹⁻²⁴⁰Pu CR for Chupadera Mesa was used for the other fallout areas. The CRs listed in Table D-X were used to calculate estimated radionuclide intake by beef and milk cows from forage and grazing. The produce and vegetable uptakes of radionuclides were estimated from the wet weight transfer parameter, B_v, and reduced 50% for removal of soils by washing. Estimated yearly radionuclide intakes from 50% locally grown produce and vegetables are listed in Table D XI.

2. Beef and Milk Pathways. To estimate the amount of radionuclide intake by cattle, both the radionuclide transfer from soil to plant and direct consumption of soil were used.

TABLE D-VIII

ESTIMATED DOSES FROM INHALATION OF AIRBORNE MATERIALS FROM RESUSPENSION

	Inhalation Dose in Area of Interest (mrem/yr)									
Dose Calculated for	Trinity Site Inner Fenced Area	Trinity Site Outer Fenced Area	White Sands Missile Range	Bingham	Chupadera Mesa	Far Failout Zone	San Antonio			
Transuranics										
First Year Residence										
Whole body	7.3 × 10 ⁻⁵	1.9 × 10 ⁻³	4.2 × 10 ⁻⁵	1.3 × 10 ^{- s}	2.3 × 10 ⁻⁴	4.2 × 10 ⁻⁵	1.4 × 10 ⁻⁶			
Bone	2.6×10^{-3}	7.0 × 10 ⁻⁴	1.5×10^{-3}	5.0 × 10⁻⁴	8.4 × 10 ⁻³	1.5 × 10 ⁻³	5.1 × 10 ⁻⁵			
Lung	1.2×10^{-2}	4.4×10^{-3}	9.8×10^{-3}	3.0 × 10 ⁻³	5.3 × 10 ⁻²	9.8 × 10 ⁻³	3.0 × 10 ⁻⁴			
50-Year Committed Dose										
Whole body	2.8×10^{-2}	07.3 × 10 ⁻³	1.6×10^{-2}	4.9 × 10 ⁻³	8.8 × 20 ⁻²	1.6×10^{-2}	5.0 × 10 ⁻⁴			
Bone	0.29	7.4×10^{-2}	0.17	5.1×10^{-2}	0.91	0.17	5.5 × 10 ⁻³			
Lung	0.30	7.7×10^{-2}	0.17	5.3×10^{-2}	0.95	0.17	5.8 × 10 ⁻³			
Liver	0.14	3.7×10^{-2}	8.3×10^{-2}	2.5×10^{-2}	0.45	8.3×10^{-2}	2.8×10^{-3}			
*°Sr										
First Year Residence										
Whole body	-•	•	2.1×10^{-7}	_•	6.1 × 10 ⁻⁶	3.9 x 10 ⁻⁶	•			
Bone		-	3.1 × 10 ⁻⁶		8.9 × 10 ⁻⁵	5.6 × 10 ⁻⁵	•••			
Lung			1.8×10^{-5}	••-	5.0 × 10 ⁻⁴	3.0×10^{-4}	•••			
50-Year Committed Dose										
Whole body			2.0×10^{-5}	•••	6.0 × 10 ⁻⁴	4.0×10^{-4}	—			
Bone			3.1×10^{-4}		8.9 × 10 ⁻³	5.6×10^{-3}	••-			
Lung			3.1 × 10 ⁻⁵	-•-	8.9 × 10 ⁻⁴	5.6 × 10 ⁻⁴				
¹¹⁷ Cs										
First Year Residence										
Whole body	7.8 × 10 ⁻⁶	2.5×10^{-7}	5.0×10^{-7}	1.9 × 10 ⁻⁵	3.0×10^{-5}	2.1 × 10 ⁻⁵	5.0 × 10 ⁻⁵			
Bone	7.8×10^{-6}	2.5×10^{-7}	5.0 × 10 ⁻⁷	1.9 × 10 ⁻⁵	3.0 × 10 ⁻⁵	2.1 × 10 ⁵	5.0 × 10 ⁻⁵			
Lung	1.2×10^{-6}	4.0 × 20 ^{-\$}	7.9 × 10 ⁻⁸	3.0 × 10⁻•	4.8 × 10 ⁻⁴	3.4 × 10 ⁻⁶	7.8 × 10 ⁻⁶			
50-Year Committed Dose										
Whole body	1.3×10^{-5}	4.3×10^{-7}	8.5×10^{-7}	3.2 × 10 ⁻⁵	5.2 × 10 ⁻⁵	3.6×10^{-5}	8.5 × 10 ⁻⁵			
Bone	1.4×10^{-5}	4.3×10^{-7}	8.5×10^{-7}	3.2 × 10 ⁻⁵	5.2 × 10 ^{- 5}	3.6 × 10 ^{- s}	8.5 × 10 ⁻⁵			
Lung	2.2×10^{-6}	7.2 × 10 ^{-*}	1.4×10^{-7}	5.4 × 10 ⁻⁶	8.7 × 10 ⁻⁶	6.1 × 10 ⁻⁶	1.4 × 10 ⁻⁵			
Totals for Inhalation										
First Year Residence										
Whole body	8.1 × 10 ⁻⁵	1.9 × 10 ⁻⁵	4.3 × 10 ⁻⁵	3.2 × 10 ⁻⁵	2.3×10^{-4}	6.7 × 10 ^{- s}	5.1 × 10 ^{- 5}			
Bone	2.6×10^{-3}	7.0 × 10⁻⁴	1.5×10^{-3}	5.2 × 10 ⁻⁴	8.4×10^{-3}	1.5×10^{-3}	1.0×10^{-4}			
Lung	1.7×10^{-2}	4.4 × 10 ⁻³	9.8 × 10 ⁻³	3.0×10^{-3}	5.3×10^{-2}	1.0×10^{-2}	3.0×10^{-4}			
50-Year Committed Dose										
Whole body	2.8×10^{-2}	7.3 × 10 ⁻³	1.6×10^{-2}	4.9 x 10 ⁻³	8.8×10^{-2}	1.6 × 10 ⁻²	5.8×10^{-4}			
Bone	0.29	7.4 × 10 ^{- 2}	0.17	5.1 × 10 ⁻²	0.91	0.17	5.6×10^{-3}			
Lung	0.30	7.7 × 10 ⁻²	0.17	5.3 × 10 ⁻²	0.95	0.17	5.8×10^{-3}			
Liver	0.14	3.7×10^{-2}	8.3×10^{-2}	2.5×10^{-2}	0.45	8.3 × 10 ⁻²	2.8 × 10 ⁻³			

--- means no data.

_
TABLE D-IX

INPUT PARAMETERS FOR DOSE CALCULATIONS•

Breathing Rate	22.8 m ³ /day			(Ref. D18)
Ingestion Rates	Max Individual	Population	(Average Individual)	(Refs. D21, D22)
Produce (kg/yr) Leafy vegetables (kg/yr) Milk (l/yr)	520 64 310	176 18 112		
Average Agricultural Pro- ductivity per Unit Area	Chupadera	Other	-	
Feed crops (kg/m ²) (dry weight)	0.043	0.056		
Produce or leafy vegetables for garden of maximum exposed individual (kg/m ²) (wet weight)	2.0	2.0		(Ref. D22)
Consumption rate of feed by animal (kg/day) (dry weight)	11.9 ^b	11.9 ⁶		(Ref. 23)
Fraction of radioactivity re- moved from plant by washing	0.5	0.5		(Ref. D24)
Soil ingested by cattle	250	250		(Ref. D25)

	Plute	onium				-
Transfer Parameters ^c	GZ	Chupadera	Strontium	Cesium	Europium	
F _m	1.0×10 ⁻⁷	1.0×10 ⁻⁷	1.4 × 10 ⁻³	7.1 × 10 ⁻³	2.0×10 ⁻⁵	(Ref. D26)
F _F	1.0×10^{-6}	1.0×10^{-6}	3.0×10^{-4}	2.0×10 ⁻²	5.0×10^{-3}	(Ref. D27)
CR ^ª	5×10^{-2}	$1.1 \times 10^{\circ}$	$1.8 \times 10^{\circ}$	4.1×10^{-2}	2.1×10^{-2}	(Refs. D20, D28)
B,	1.2×10^{-2}	2.7×10^{-1}	7.2×10^{-2}	5.0 × 10 ⁻³	7.3 × 10 ⁻⁴	(Refs. D20, D28)

Ref. D29.

^bTaken as 2.5% of body weight, where the average live weight of cattle at slaughter of 477 kg was used.

 ${}^{c}F_{M} =$ fraction of each day's radionuclide intake appearing in each liler of milk, $F_{F} =$ fraction of each day's radionuclide intake appearing in each kilogram of flesh, CR = concentration ratio for radionuclide uptake from soil to pasture or feed (pCi/kg dry weight per pCi/kg dry soil), and $B_{v} =$ concentration ratio for radionuclide uptake from soil to edible parts of vegetable crops (pCi/kg wel weight per pCi/kg dry soil).

^dPlutonium CR based on measurements by Hakonson.

Experiments at contaminated zones of the Nevada Test Site have indicated that cattle ingest about 250 g/d of soil while grazing (Ref. D24). Transfer of the radionuclides from the cattle's diet into milk and meat were estimated using the factors lited in Table D-X. Estimates of the amount of radionuclides consumed yearly by humans in meat and milk are listed by area in Table D-XI.

3. Dose Estimates from Ingestion. The total intakes of ^{139,240}Pu, ⁹⁰Sr, ¹³⁷Cs, and ¹⁵²Eu from consumption of beef, milk, and home garden products are listed in Table D-XI. The product of these values and the dose factors in Table D-X provide the maximum year dose and the 50-year committed dose equivalent for whole body, bone, liver, and the lower large intestine. The results of these calculations are listed in Table D-XII.

C. Special Pathways

The above dose estimates assume human activities that do not create any special considerations of sources of radionuclide intake. However, to grow 50% of their produce and vegetables, individuals would have to go through soil preparation activities. Measurements made during soil preparation activities indicate higher resuspension rates than normally encountered (Ref. D30). To estimate the dose to the home gardener requires some broad assumptions regarding breathing rate, suspended particle concentration, enrichment factor, dose factors, and appropriate soil concentration. The breathing rate used for this type of work was 43 ℓ/min , or that for heavy work (Ref. D17). Air concentrations were assumed to be 10 mg/m³, the threshold for nuisance dust. Enrichment factors from Table D-VI were used. Soil concentrations used are the mean values of the summary data for 0-5, 5-10, and 10-15-cm soil samples in Chapter 4. The soil preparation time was assumed to be 30 h for a growing season. The parameters used are presented in Table D-XIII and estimated doses in Table D-XIV.

TABLE D-X

INGESTION DOSE FACTORS USED

Maximum Year Dose [(mrem/yr)(pCi)/g soil)] ^a			50-Year Committed Dose Equivalent (mrem/pCi)			
Radionuclide	Whole Body	Bone	Whole Body	Bone	Liver	GI-LLI
Plutonium isotopes ^b	с	0.45	с	7.8 × 10 ⁻⁴	3.4×10^{-4}	с
⁹⁰ Sr ^d	с	5	9.45 × 10 ⁻⁵	1.17×10^{-3}	5.7×10^{-5}	7.78 × 10 ⁻⁵
¹³⁷ Cs ^d	0.63	с	4.91 × 10 ⁻⁵	6.82×10^{-5}	7.87×10^{-5}	2.59×10^{-5}
¹⁵² Eu ^d			3.9×10^{-8}	2.0×10^{-7}	4.4×10^{-8}	2.6×10^{-5}

*Reference D30.

^bIncludes decay of ²⁴¹Pu to ²⁴¹Am after 50 years.

Not calculated.

^dReference D31 and D32 for 50-year Committed Dose factors.

TABLE D-XI

INGESTED RADIONUCLIDES (pCi/yr)*

	Area of Interest								
Radionuclide and Medium	Trinity Site Inner Fence	Trinity Site Between Fences	White Sands Missile Range	Bingham	Chupadera Mesa	Far Fallout Zone	San Antonio		
Transuranics									
Produce and vegetables ^b	9.1 × 10 ⁴	3.4×10^{3}	$5.8 imes 10^3$	4.6×10^{3}	2.2×10^4	3.9×10^{3}	$1.3 imes 10^2$		
Milk	1.46	0.055	0.095	0.052	0.25	0.045	0.0055		
Beef	12.2	0.46	0.79	0.44	2.12	0.38	0.012		
Total intake ⁹⁰ Sr	9.1 × 10 ⁴	3.4×10^{3}	5.8×10^{3}	4.6×10^{3}	2.2×10^{4}	3.9×10^3	1.3×10^2		
Produce and Vegetables ^b	с	С	6.3×10^{3}	с	8.0×10^{3}	5.2×10^{3}	с		
Milk	с	с	6.1×10^{3}	с	7.8×10^{3}	5.1×10^{3}	с		
Beef	с	с	1.10×10^3	с	1.4×10^{3}	9.2×10^2	с		
Total intake ¹³⁷ Cs	c	C	1.3×10^4	С	1.7×10^{4}	1.1 × 10 ⁴	C		
Produce and vegetables ^b	5.3×10^3	1.6×10^{2}	1.1×10^{3}	9.0×10^{2}	6.8×10^{2}	4.8×10^2	2.2×10^2		
Milk	1.3×10^4	3.8×10^2	2.6×10^{3}	2.2×10^{3}	1.6×10^{3}	1.2×10^3	5.4×10^2		
Beef	3.1×10^4	8.9×10^2	6.2×10^3	$5.1 imes 10^3$	$3.9 imes 10^3$	$2.8 imes 10^3$	$1.3 imes 10^3$		
Total intake ¹⁵² Eu	4.9 × 10 ⁴	1.4×10^3	9.9 × 10 ³	8.2×10^3	6.2×10^{3}	4.5×10^3	2.1×10^{3}		
Produce and vegetables ^b	8.7×10^{3}	7.1×10^{2}	1.9×10^{2}	с	1.1	с	с		
Milk	2.7×10^{2}	2.2×10^{1}	6.0	с	0.034	с	С		
Beef	8.6×10^{3}	7.1×10^2	1.9 × 10 ²	С	1.1	C	с		
Total intake	1.7×10^{4}	1.4×10^{3}	3.8×10^{2}	c	2.2	С	c		

•

*Estimated for average individual in population.

^bFifty per cent of produce and vegetables are grown locally in gardens.

"Not calculated because no soil data were available.

TABLE D-XII

ESTIMATED DOSES FROM INGESTION OF FOODS GROWN IN EACH AREA

	Inj	gestion Dose in	Area of Interes	t (mrem/yr)			
Dose Calculated	Trinity Site Inner Fence	Trinity Site Outer Fence	White Sands Missile Range	Bingham	Chupadera Mesa	Far Fallout Zone	San Antonio
Transuranics							
Maximum year							
Bone	70	2.6	4.5	3.6	17	3.0	0.1
50-Year Committed Dose							
Whole body							
Bone	71	2.6	4.5	3.6	17	3.0	0.1
Liver	31	1.2	2.0	1.6	7.5	1.3	0.04
GI-LLI ^b							
**Sr							
Maximum Year							
Bone			9	9°	11.5	7.5	
50-Year Committed Dose							
Whole body			1.2	1.2°	1.6	1.0	
Bone			15	155	20	13	
Liver			0.07	0.07 ^c	0.09	0.06	
GI·LLI			1.0	1.0°	1.3	0.9	
¹³⁷ Cs						0.7	-
Maximum Year							
Whole body	14	0.4	2.8	2.3	1.8	1.3	0.6
50-Year Committed Dose						•••	010
Whole body	2.4	0.1	0.5	0.4	0.3	0.2	0.1
Bone	3.4	0.1	0.7	0.6	0.4	0.3	0.1
Liver	3.8	0.1	0.8	0.6	0.5	0.4	0.2
GI-LLI	1.3	0.03	0.3	0.2	0.2	0.1	0.05
¹⁵² Eu				•••	012	•••	0.00
50-Year Committed Dose							
Whole body	7 x 10 ⁻⁴	5 x 10 ⁻⁵	1 × 10 ⁻⁵	0		-	
Bone	3 x 10 ⁻³	3 × 10 ⁻⁴	8 x 10 ⁻³	<i>.</i>	-	-	
Liver	7 x 10 ⁻⁴	6 x 10 ⁻⁵	2 x 10 ⁻⁵	:	-		-
GI-LLI	0.4	4×10^{-2}		•		•	•
Totals for Ingestion Maximum Year							
Whole body	14	04	28	2 2	18	1 2	0.6
Bone	_		13 5	2.5	28	1.5	0.0
50-Year Committed Dose				_	20		•
Whole body	2.4	0.1	17	16	10	1 7	01
Bone	74	27	20	10	1.7	1.2	0.1
Liver	35	13	20	23	97 81	19	0.2
GI-LU	13	0.03	1.7	1.3	0.1	1.0	0.2
		0.05	1.5	1.4	1.5	1.0	0.05

^aNot calculated.

^bGastrointestinal tract—large intestine. ⁵No measurements for Bingham for ⁵⁰Sr, so doses are assumed to be equal to those for White Sands Missile Range.

	Effective Soil Concentration (pCi/g)				Air Concentrations (μ Ci/m ³)		
Area	239-240	90Sr	¹³⁷ Cs	$\Sigma \mathbf{g}_{\mathbf{i}} \mathbf{f}_{\mathbf{i}}$	²³⁹⁻²⁴⁰ Pu	⁹⁰ Sr	¹³⁷ Cs
GZ							
Inner fence	24 ± 0.4		12.6 ± 2.5	0.071	1.7×10^{-8}	с	8.9 × 10 ⁻⁹
Between fences	3.5 ± 3.3		0.4 ± 0.25	0.071	2.5×10^{-9}	с	2.83×10^{-10}
White Sands Missile Range	15 ± 12	0.96 ± 0.74	3.4 ± 2.2	0.071	1.1×10^{-8}	6.8×10^{-10}	2.4 × 10 ^{−9}
Bingham ^b	0.74 ± 0.49	•	0.25 ± 0.09	0.78	5.8 × 10 ⁻⁹	с	2.0×10^{-9}
Chupadera Mesa	0.73 ± 0.85	1.5 ± 1.1	1.0 ± 1.5	1.6	1.2×10^{-8}	2.4×10^{-8}	1.6×10^{-8}
Far Fallout Field	0.15 ± 0.15	1.3 ± 0.9	0.75 ± 1.1	1.6	2.4 × 10 ⁻⁹	2.1×10^{-8}	1.2×10^{-8}

ESTIMATED AIR CONCENTRATION FOR SOIL PREPARATION FOR HOME GARDEN^a

*Dust loading of 10 000 μ g/m³.

^bEstimated from area measurements.

Not calculated.

TABLE D-XIV

ESTIMATE DOSES FROM SOIL PREPARATION FOR HOME GARDEN*

	Inhalation Dose (mrem/yr)						
	GZ	GZ	White Sands	D: 1	Chupadera	Far	
50-Yr Committed Doses for	Inner Fence	Between Fences	Missile Range	Bingham	Mesa	Fallout Zone	
Transuranics							
Whole body	0.11	0.017	0.073	0.039	0.082	0.016	
Bone	1.2	0.17	0.76	0.40	0.84	0;17	
Lung	1.2	0.18	0.80	0.42	0.87	0.17	
Liver	0.59	0.086	0.38	0.20	0.42	0.084	
⁹⁰ Sr							
Whole body	b	Ь	4.0×10^{-5}	ь	1.4×10^{-3}	1.2×10^{-3}	
Bone	b	Ь	6.0×10^{-4}	ь	$2.2 imes 10^{-2}$	2.0×10^{-2}	
Lung	b	b	6.3 × 10 ⁻⁵	Ь	$2.2 imes 10^{-3}$	2.0×10^{-3}	
¹³⁷ Cs							
Whole body	3.8×10^{-5}	1.2×10^{-6}	1.0×10^{-5}	8.7 × 10 ⁻⁶	6.9×10^{-5}	5.2 × 10 ⁻⁵	
Bone	4.2×10^{-5}	1.3 × 10 ⁻⁶	1.1 × 10 ⁻⁵	9.4 × 10 ⁻⁶	$7.5 imes 10^{-5}$	5.7 × 10 ⁻⁵	
Lung	6.5 × 10 ⁶	2.0×10^{-7}	$1.7 imes 10^{-6}$	1.4 × 10 ⁻⁶	$1.1 imes 10^{-5}$	8.7 × 10 ⁻⁶	
Totals							
Whole body	0.11	0.017	0.073	0.039	0.083	0.017	
Bone	1.2	0.17	0.76	0.40	0.86	0.19	
Lung	1.2	0.18	0.80	0.42	0.87	0.17	
Liver	0.59	0.086	0.38	0.20	0.42	0.086	

^aAssumptions are breathing rate of 43 ℓ /min for 30 h/yr. ^bNot calculated.

REFERENCES

- D1. W. D. Purtymun, R. J. Peters, and A. K. Stoker, "Radioactivity in Soils and Sediments in and Adjacent to the Los Alamos Area, 1974-1977," Los Alamos Scientific Laboratory report LA-8234-MS (February 1980).
- D2. Environmental Surveillance Group, "Environmental Surveillance at Los Alamos During 1978," Los Alamos Scientific Laboratory report LA-7800-ENV (April 1979).
- D3. U.S. Department of Energy, "Radiological Survey of the Bayo Canyon, Los Alamos, New Mexico," Los Alamos National Laboratory report DOE/EV-0005/15 (June 1979).
- D4. A. J. Ahlquist, A. K. Stoker, and L. K. Trocki, compilers, "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico," Los Alamos Scientific Laboratory report LA-6887 (December 1977).
- D5. L. D. P. King, "Ground Activity After the Trinity Shot," Los Alamos Scientific Laboratory report LA-658-MS (December 1947).
- D6. P. Aebersold and P. B. Moon, "July 16th Nuclear Explosion: Radiation Survey of Trinity Site Four Weeks after Explosion," Los Alamos Scientific Laboratory report LA-359 (September 1945).
- D7. F. Reines, "July 16th Nuclear Explosion: Examination of Tower Footing," Los Alamos Scientific Laboratory report LA-365A (November 1945).
- D8. Charles D. Blackwell, memorandum to Dean D. Meyer, "Preliminary Report of Surveys and Cleanup Program at Trinity Site from March 14, 1967 through April 17, 1967," Los Alamos Scientific Laboratory (April 17, 1967).
- D9. G. P. Kraker, memorandum: "Decontamination of Trinity Site," U.S. Atomic Energy Commission (June 1951).

- D10. F. L. Fey, Jr., "Health Physics Survey of Trinity Site," Los Alamos Scientific Laboratory report LA-3719 (July 1967).
- D11. U.S. Department of Energy, "Radiological Guidelines for Application to DOE's Formerly Utilized Sites Remedial Action Program," U.S. DOE, Oak Ridge Operations report ORO-831 (March 1983).
- D12. U.S. Environmental Protection Agency, "Persons Exposed to Transuranium Elements in the Environment: Federal Radiation Protection Guidance on Dose Limits," *Federal Register*, Vol. 42, No. 230, November 30, 1977, pp. 60956-60959 (1977).
- D13. J. W. Nyhan, F. R. Miera, Jr., and R. E. Neher, "Distribution of Plutonium in Trinity Soils after 28 Years," *Journal of Environmental Quality*, Vol. 5, No. 4, pp. 431-437 (1976).
- D14. Richard L. Douglas, "Level and Distribution of Environmental Plutonium Around the Trinity Site," U.S. Environmental Protection Agency, Office of Radiation Programs report ORP/LV-78-3 (October 1978).
- D15. W. J. Wenzel and A. F. Gallegos, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Long-Term Radiological Risk Assessment for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-O (December 1982).
- D16. U.S. Environmental Protection Agency, "Proposed Guidance on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment," U.S. Environmental Protection Agency, Office of Radiation Programs report EPA 540/4-77-016 (September 1977).
- D17. International Commission on Radiological Protection, "Report of the Task Group on Reference Man," International Commission on Radiological Protection Publication 23 (October 1974).

- D18. T. Buhl, J. Dewart, T. Gunderson, D. Talley, J. Wenzel, R. Romero, J. Salazar, and D. Van Etten, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Radiation Monitoring and Radiological Assessment of Routine Releases," Los Alamos National Laboratory report LA-9445-PNTX-C (December 1982).
- D19. Alan K. Stoker, "Radiological Survey of the Site of a Former Radioactive Liquid Waste Treatment Plant (TA-45) and the Effluent Receiving Areas of Acid, Pueblo, and Los Alamos Canyons, Los Alamos, New Mexico," Los Alamos National Laboratory report DOE/EV-0005/30, LA-8890-ENV (May 1981).
- D20. Y. C. Ng, C. S. Colsher, and S. E. Thompson, "Soil to Plant Concentration Factors for Radiological Assessments," U.S. Nuclear Regulatory Commission report NUREG/CR-2975, UCID-19463 (November 1982).
- D21. R. E. Moore, C. F. Baes III, L. M. McDowell-Boyer, A. P. Watson, F. O. Hoffman, J. C. Pleasant, and C. W. Miller, "AIRDOS-EPA, A Computerized Methodology for Estimating Environmental Concentrations and Dose to Man from Airborne Releases of Radionuclides," Oak Ridge National Laboratory report ORNL-5532 (1979).
- D22. U.S. Nuclear Regulatory Commission, "Calculational Models for Estimating Radiation Doses to Man from Airborne Radioactive Materials Resulting from Uranium Milling Operations," U.S. Nuclear Regulatory Commission Regulatory Guide 3.51 (March 1982).
- D23. Y. C. Ng, C. S. Colsher, D. J. Quinn, and S. E. Thompson, "Transfer Coefficients for the Prediction of the Dose to Man via the Forage-Cow-Milk Pathway from Radionuclides Released to the Biosphere," Lawrence Livermore National Laboratory report UCRL-51939 (July 1977).

- D24. W. E. Martin and S. G. Bloom, "Nevada Applied Ecology Group Model for Estimating Plutonium Transport and Dose to Man," in "Transuranics in Natural Environments," M. G. White and P. B. Dunaway, eds., Energy Research and Development Administration report NVO-178, pp. 621-706 (October 1976).
- D25. R. W. Shor, C. F. Baes III, and R. D. Sharp, "Agricultural Production in the United States by County: A Compilation of Information from the 1974 Census of Agriculture for Use in Terrestrial Food-Chain Transport and Assessment Models," Oak Ridge National Laboratory report ORNL-5768 (January 1982).
- D26. Y. C. Ng, C. S. Colsher, and S. E. Thompson, "Transfer Factors for Assessing the Dose from Radionuclides in Agricultural Products," Lawrence Livermore National Laboratory preprint UCRL-82545 (June 1979).
- D27. T. E. Hakonson and J. W. Nyhan, "Ecological Relationships of Plutonium in Southwest Ecosystems," in "Transuranic Elements in the Environment," W. C. Hanson, ed., U.S. Department of Energy report DOE/TIC-22800, pp. 403-419 (1980).
- D28. J. W. Healy, J. C. Rodgers, and C. L. Wienke, "Interim Limits for D&D Projects," Los Alamos National Laboratory document LA-UR-79-1865 Rev (September 1979).
- D29. U.S. Nuclear Regulatory Commission, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," U.S. Nuclear Regulatory Commission Regulatory Guide 1.109 (October 1977).
- D30. J. W. Healy, "Review of Resuspension Models," in "Tranuranic Elements in the Environment," W. C. Hanson, ed., U.S. Department of Energy report DOE/TIC-22800, pp. 209-235 (1980).

- D31. G. R. Hoenes and J. K. Soldat, "Age Specific Radiation Dose Commitment Factors for a One-Year Chronic Intake," U.S. Nuclear Regulatory Commission report NUREG-0172 (November 1977).
- D32. G. G. Killough, D. E. Dunning, Jr., S. R. Bernard, and J. C. Pleasant, "Estimates of Internal Dose Equivalent to 22 Target Organs for Radionuclides Occurring in Routine Releases from Nuclear Fuel Cycle Facilities," Vol. I, Oak Ridge National Laboratory report NUREG/CR-0150, ORNL/-NUREG/TM-190 (June 1978).

APPENDIX E

SOURCES AND EVALUATION OF RADIATION EXPOSURES

I. INTRODUCTION

This appendix provides additional background on some of the technical aspects of radiation and its effects. It will familiarize the interested reader with the concepts and terminology used in the evaluations presented in the main body of this report and other appendixes. It is not comprehensive in that other concepts and terminology applicable to other circumstances are not included. A short bibliography is included at the end for those desiring to read further.

II. RADIATION

Radiation is the transmission of energy through space. There are many kinds of radiation including visible light, microwaves, radio and radar waves, and x rays. All of these are electromagnetic radiations because they consist of a combined electrical and a magnetic impulse traveling through space. Much of this radiation is vital to us. For example, light is necessary so that we can see. These radiations can also be harmful: too much ultraviolet radiation from the sun can cause sunburn or even skin cancer on prolonged exposure. Energy can also be transmitted through space by particulate radiations by virtue of their motion. Some of the most common particulate radiations include alpha particles, beta particles, and neutrons. The first two were given names of the first letters of the Greek alphabet by their discoverers as a convenient way of designating them. It turns out that the beta particle is an electron. The electron is the fundamental negative charge in all matter and is responsible for electric currents. However, beta particles are electrons moving at very high speeds, even approaching the speed of light. The other particulate radiations are also fundamental particles from atoms.

The class of radiation important to this report is ionizing radiation. Ionizing radiations are either waves or particles with sufficient energy to knock electrons out of the atoms or molecules in matter. This disruption is termed "ionization."

The simplest example is the ionization of a single atom. The nucleus, or center of the atom, is composed of particles called protons and neutrons. The proton has a positive charge and the *neutron* has no charge. Negatively charged particles called electrons orbit around the nucleus and are held in place by the attraction between the positive and negative charges. A simple analogy to this is the planets in orbit around the sun held in place by gravitational attraction. In a neutral atom there are exactly the same number of electrons as protons and the positive and negative charges are balanced. When ionizing radiation knocks an electron out of an atom, the atom is left with a positive charge, and the free electron is negatively charged. These two are referred to as an "ion pair." Ion pairs are chemically active and will react with neighboring atoms or molecules. The resulting chemical reactions are responsible for causing changes or damage to matter, including living tissue.

This brief description covers the basic concepts of radiation and its effects. The rest of the discussion will elaborate on particular aspects: the types and sources of ionizing radiation, the basic units for measuring energy deposited in matter by ionization, ways to estimate the amount of biological effect and its significance, and the nature of radiation standards.

III. TYPES OF IONIZING RADIATION

The most common types of ionizing radiation are x rays, gamma rays, alpha particles, beta particles, and neutrons.

A. X and Gamma Radiation

X rays are pure energy having no mass. They are part of the electromagnetic spectrum, as are light and microwaves, but with much shorter wavelengths and, therefore, the ability to transmit larger amounts of energy. Gamma rays are identical to x rays except that they originate in the nucleus of an atom, whereas x rays are produced by interactions of electrons. An x or gamma ray, having no electrical charge to attract or repel it from the protons or electrons, can pass through the free space in many atoms and, hence, through relatively thick materials before interacting. The most likely interaction occurs when the x or gamma ray encounters an electron. When this occurs, some or all of the energy of the x or gamma ray will be transferred to the electron, which then will be ejected from the atom. The electron may have enough energy that it can, in turn, produce additional ionizations in other atoms it passes through. The electron, once its energy is spent, becomes a free electron (an electron not directly associated with an atom) like those found in all matter.

B. Alpha Radiation

Alpha particles are made up of two neutrons and two protons. This combination is the same as the nucleus of a helium atom. Because of the two protons, with no negative electrons to balance their positive charge, the alpha particle is positively charged. Alpha particles transmit energy as kinetic energy, or the energy of motion. The faster they move, the more energy they carry.

The comparatively large size and the positive charge of an alpha particle mean that it interacts readily with electrons and will not slip through the spaces between the atoms easily. It causes many ionizations in a short distance of travel. Because each of these ionizations dissipates energy, the alpha particle travels only a very short distance. For example, most alpha particles will not pass through a piece of paper or the protective layer of a person's skin. However, if an alpha particle is produced by radioactive material inside the body, it may cause many ionizations in more sensitive tissue.

C. Beta Radiation

Beta particles are electrons moving at high speeds. They transmit energy as kinetic energy. High-energy electrons approach the speed of light. They have comparatively small mass and a negative charge, so their penetration through matter is intermediate between the alpha particle and the gamma ray. They produce fewer ionizations along their path than the alpha particle, but more than gamma radiation. They can be absorbed by a sheet of rigid plastic or a piece of plywood. However, they can pass through the protective outer layer of the skin and reach the more sensitive skin cells in lower layers. They can irradiate internal tissues if produced by radioactive materials inside the body.

D. Neutrons

Neutrons are the particles that, with protons, form the nuclei of atoms. When free from the nucleus, they can transmit energy as kinetic energy. There are two major types of neutrons, fast and slow. Fast neutrons are moving rapidly and, when they strike a nucleus of an atom, they will give up some of their energy. With heavy nuclei such as those of lead, little energy is lost because the neutron rebounds. However, with light nuclei, such as those of hydrogen (hydrogen has one proton with the same mass as a neutron), the neutron undergoes a "billiard ball" type of collision with considerable energy transferred to the proton. The proton then moves through surrounding matter, producing less ionization than an alpha particle but more than a beta particle.

Slow neutrons do not have enough energy to cause ionization. But, because they have no charge, they can penetrate into the nucleus of an atom. This disrupts the balance in the nucleus and can result in the emission of radiations that produce ionization in the surrounding matter. One example of this is the transmutation of certain atoms of uranium into atoms of plutonium.

IV. SOURCES OF RADIATION

Radiation arises from radioactivity, both natural and manmade, cosmic sources, and radiation-producing machines. In this report, the sources of interest include cosmic radiation and natural radioactivity, which both contribute to normal background, and manmade or technologically enhanced radioactivity, which contribute radiation in addition to background. This report does not address the production of radiation by devices such as xray machines or accelerators.

A. Radioactivity

The atoms of most familiar things are structurally the same as when they were formed and have little prospect of changing. Thus, most atoms of carbon in a tree or in our bodies will remain atoms of carbon. In time, an atom may change its association with other atoms in chemical reactions and become part of other compounds, but it will still be a carbon atom.

There is a class of atoms, however, which are not stable and will spontaneously emit radiation and change to another type of atom or element. These atoms are said to be *radioactive*.

Many radioactive atoms such as isotopes of uranium and radium, ⁴⁰K (potassium-40), and ¹⁴C (carbon-14) occur naturally. In the cases of potassium and carbon, only certain proportions of the naturally occurring elements are radioactive and are known as *radioactive isotopes*. (The radioactive isotopes have the same number of protons in the nucleus as do the stable isotopes and, therefore the same chemical properties. However, the radioactive isotopes have a different number of neutrons than the stable atoms. A particular radioactive isotope is symbolized by the letter symbol for the chemical element with a numerical superscript representing the total number of protons and neutrons in the nucleus. See Table E-I for the symbols and names of isotopes of concern in this report.)

Many radioactive atoms can also be "manmade" in the sense that ¹³⁷Cs, ⁹⁰Sr, and radioactive isotopes of plutonium can be produced in large quantities during nuclear fission of uranium in a reactor. However, these isotopes are also produced during the normal spontaneous fissioning of uranium in nature. The difference is that in nature the reaction happens at a slow enough rate that the number of naturally produced radioactive atoms of cesium, strontium, and plutonium is small and dispersed. Other manmade radioactive elements produced in nuclear reactors or by accelerators are not normally present in nature.

Radioactive atoms attempt to achieve a more stable state by spontaneously *decaying* to alter the ratio of protons and neutrons in the nucleus toward a more stable condition.

Radioactive atoms decay at a characteristic rate dependent upon the degree of stability of the individual atom. The rate is characterized by a period of time called the *half-life*. In one half-life, one-half of the initial number of atoms decay. The amount of radiation emitted also decreases by one-half in the same period. In the next halflife, the number of atoms and the amount of radiation will again decrease by one-half, down to one-quarter of the original amount. Half-lives are unique for each particular type of radioactive atom: that is, each isotope has its own half-life that cannot be changed by man. Half-lives for different radioactive materials range from a fraction of a second to billions of years. In fact, some are so long that certain radioactive materials made at the time of the formation of the universe are still around. Examples include some isotopes of thorium and uranium.

When an atom decays, radiation may be emitted from the nucleus as alpha particles, beta particles, neutrons, or gamma rays. This changes the character of the nucleus, and the atom changes to an atom of a new element. (One particular type of decay, known as fission, results in the production of two new atoms.) Each type of radioactive atom decays with emission of characteristic types of radiation, each carrying specific amounts of energy. For example, natural ²³⁴U always emits alpha particles with energies of about 4.8 relative energy units, and manmade ²³⁹Pu emits alpha particles with energies of about 5.1 relative energy units. Other than the slight difference in the initial amount of energy, the alpha particles are indistinguishable.

Atoms resulting from radioactive decay are called "daughter" atoms, whereas the original atom is called the "parent" atom. In some cases, the daughter atom resulting from the decay of a radioactive atom is, itself, radioactive. For naturally occurring uranium and thorium, there may be a sequence of as many as 12-14 radioactive daughters before the original uranium or thorium atom finally reaches stability as an atom of lead.

Table E-I lists the radioactive materials of primary importance to this report giving the half-lives and the principal types of radiation they emit during decay.

B. Cosmic Radiation

The high-energy radiations that enter the earth's atmosphere from outer space are known as *primary cosmic rays.* The origin of primary cosmic rays is still not completely determined, but most of the observed radiation originates in our galaxy. Some is produced by solar flares. Primary galactic cosmic rays are largely highenergy protons. Primary solar cosmic rays have relatively low energy and have little effect at the earth's surface.

When primary cosmic ray particles enter the atmosphere, a complex variety of reactions occur, especially with oxygen and nitrogen nuclei. These reactions result in the continuous production of radioactive elements including tritium, ⁷Be, ¹⁴C, and ²²Na among many others. The reactions also result in the production of neutron and beta particle radiation, referred to as secondary cosmic radiation. The amount of radioactivity

TABLE E-I

RADIOACTIVE MATERIALS OF PRIMARY INTEREST IN THE RADIOLOGICAL SURVEY

Isotope Approximate Half-Life Principal Types of Radiation

Natural Radioactivity of Interest as Background

²³⁴ U (Uranium-234)	247 000 years	alpha, gamma
²³⁵ U (Uranium-235)	710 000 000 years	alpha, beta, gamma
²³⁰ U (Uranium-238)	4 500 000 000 years	alpha, beta, gamma
²³² Th (Thorium-232)	14 100 000 000 years	alpha
²²⁶ Ra (Radium-226)	1 600 years	alpha, gamma
²²² Rn (Radon-222)	3.8 days	alpha, gamma
⁴⁰ K (Potassium-40)	1 300 000 000 years	beta, gamma

Radioactivity of Interest as Residual Contaminants or Worldwide Fallout from Atmospheric Testing

²³⁹ Pu (Plutonium-239)	24 000 years	alpha, gamma
²³⁸ Pu (Plutonium-238)	87 years	alpha, gamma
²⁴¹ Pu (Plutonium-241)	15 years	beta
²⁴¹ Am (Americium-241)	458 years	alpha, gamma
¹³⁷ Cs (Cesium-137)	30 years	beta, gamma
••Sr (Strontium-90)	28 years	beta
³ H (Hydrogen-3 or Tritium)	13 years	beta
Uranium and radium as given above	ve	

and radiation from cosmic rays increases significantly with altitude above sea level because of the decreasing thickness of the atmosphere. The influence of the earth's magnetic field results in more cosmic radiation in polar latitudes responsible for the so-called northern and southern lights.

V. UNITS FOR RADIATION AND RADIOAC-TIVITY

Units to quantify radiation or radioactivity provide for uniformity in measurements or comparisons and permit the establishment of standards specifying the amount of radiation allowable under various circumstances. Radiation units may initially seem obscure and difficult to understand. However, as in the case of the pound or kilogram, familiarity with the units makes them understandable and useful.

A. Radiation Units

The basic unit for measuring radiation is the *rad*. It is the amount of radiation that deposits a specified amount of energy by ionization in each gram of material (about 1/28 of an ounce). The amount of energy released in the material is small; it increases the temperature of the gram of material by a few billionths of a degree. However, it is not the amount of heat liberated or the temperature rise that is important. Rather, it is the ionization that induces chemical changes. The rad applies to all radiations and all materials that absorb the radiation.

The most commonly used radiation unit is the rem. The rem quantifies the biological response to radiation rather than the amount of energy delivered to the tissue. To understand this, remember that different types of radiation produce ionizations at different rates as they pass through tissue. The alpha particle travels only a short distance, causing intense closely spaced ionization along its track. The beta particle travels much farther, causing much less ionization in each portion of its track. Therefore, the alpha particle is more damaging to tissue than the beta particle for the same number of ionizations because the damage to cells in the tissue is localized. The biological effectiveness of the alpha particle is greater than that of the beta particle for the same total amount (rads) of energy deposited, and this difference is accounted for by the use of appropriate factors. In general, the factors used are 1 for x or gamma radiations and most beta particles, 5 to 10 for neutrons, and 10 to 20 for alpha particles. The rem is defined as the amount of radiation (in rads) from a given type of radiation multiplied by the factor appropriate for that type of radiation to approximate the biological damage that it causes. Thus, 1 rad of energy from gamma rays would result in 1 rem, and 1 rad from alpha particles would result in 10 to 20 rem of dose. Because the approximate relative degree of damage from each of the types of radiation is known, the rem can be used to estimate the approximate biological effect. Within these limits of uncertainty, the rem permits evaluation of potential effects without regard to the type of radiation or its source. One rem of exposure from natural cosmic radiation results in the same biological consequences as 1 rem from medical x rays or 1 rem from radiation produced by decay of either natural or manmade radioactivity.

A frequent source of confusion encountered in the use of radiation units is their application to a standard weight of tissue, rather than all of the tissue irradiated. Thus, a person can receive 1 rad or 1 rem of radiation from an x ray of the teeth, where little tissue is irradiated; from a chest x ray, where a moderate amount of tissue is irradiated; or from full-body radiation, where all tissue in the body is irradiated. Although these are all 1 rem of radiation, the effects will be different depending upon the organs involved. Thus, one must always keep in mind the portion of the body or organs involved and make comparisons only for corresponding exposures. In this report, radiation doses were evaluated for the whole body, for the lungs, and for bone. Whole-body doses must be compared only with other whole-body doses or to whole-body dose standards, and so on.

Because many of the radiation doses discussed in this report were small, the metric prefixes *milli* for "one-thousandth" (1/1000 or 0.001, symbolized as "m") or as *micro* for "one-millionth" (1/1000 000 or 0.000001, symbolized " μ ") were often used. One million microrem (μ rem) = 1000 millirem (mrem) = 1 rem. Millirems are used exclusively in the rest of this appendix to simplify comparisons.

In some cases, radiation measurements are expressed as a dose rate, or the amount of radiation received in a unit of time. For example, some instrument measurements of background are reported in "microrem per hour" or μ rem/h. To get total dose, the rate is multiplied by the time of exposure. This is conceptually similar to multiplying speed (rate of travel, say in miles per hour) by time to get total distance travelled.

Dose or *dose rate* may be expressed using rads or rems, depending on whether the reference is to energy deposited or to biological effect.

B. Radioactivity Units

The basic unit for measuring the amount of radioactivity or quantity of radioactive material is the curie, named in honor of Madame Curie. The curie (Ci) is the amount of radioactive material in which 37 000 000 000 (37 billion) atoms are decaying each second. This apparently peculiar number is the approximate number of atoms decaying each second in 1 gram of pure radium, the element discovered by Madame Curie. The mass of material in a curie varies from one isotope to another. The different half-lives of each radioactive material are the main cause for this variation. For materials with short half-lives, a large fraction of the atoms present are decaying in any given second, and the weight of 1 curie is small. For radioactive materials with long half-lives, the weight of 1 curie will be large. For example, the weight of 1 curie of naturally occurring ⁴⁰K is about 310 pounds, or about 140 000 times as much as 1 curie of radium.

The curie is a relatively large quantity of radioactivity for most purposes of this report. Accordingly, the metric prefixes are used to indicate units in fractional parts of a curie, such as microcurie or picocurie. The units used most often in the report are summarized in Table E-II.

TABLE E-II

Unit	Abbreviation	Disintegrations per Second	Equivalent Value in Other Time Units
curie	Ci .	37 000 000 000	
millicurie	mCi	37 000 000	
microcurie	μCi	37 000	
picocurie	pCi	0.037	2.22 per minute
attocurie	aCi	0.00000037	1.2 per year

UNITS OF RADIOACTIVITY USED IN THE RADIOLOGICAL SURVEY

The text often discusses radioactivity in environmental media, such as air or soil. In these cases, radioactivity is reported as a concentration, or the amount of radioactivity in or associated with a certain amount of air or soil. Much of the information on radioactivity in soils is reported as *picocuries per gram* (pCi/g) of some particular radioactive isotope. This means that there are a certain number of picocuries of the isotope associated with each gram (454 grams = 1 pound) of soil. For example, a value of 1 pCi/g means that each gram of soil has an associated radioactivity of about 2.2 decays each minute. Concentrations of radioactivity in air are generally reported as *attocuries per cubic meter* (aCi/m³). This means that there are a certain number of attocuries of a radioactive isotope dispersed throughout the volume of air equivalent to a cube 1 meter on each side (1 meter = 1.09 yards). For example, a value of 3 aCi/m³ would mean that a cubic meter of air contains radioactivity of about 3.6 decays in a year.

VI. DETERMINING HOW MUCH RADIATION IS RECEIVED

Radiation doses can be received from sources external to the body, such as cosmic radiation or radiation produced by radioactivity in the earth. Radiation doses can also be received from radiation produced by radioactivity taken into the body by inhalation or ingestion. These two modes of exposure are important in this study in terms of both normal doses from background radiation or radioactivity and incremental doses attributable to residual contaminants. The important distinction between radiation and radioactivity must be emphasized at this time to avoid confusion. When radiation interacts with a person's body, it is quickly dissipated as ionization and eventually heat. However, radioactive materials can enter a person's body and remain there for some period of time, emitting radiation. Thus, it is incorrect to say that there is "radiation in a person's body." It is correct to say the person has radioactive materials in his body and radiation is emitted from these radioactive materials.

A. External Penetrating Radiation

Normal external penetrating radiation doses come primarily from natural terrestrial sources or natural cosmic sources. These doses affect the entire body, including all internal organs.

1. Natural Terrestrial Sources. The radioactivity in rocks, soils, and other natural materials arises primarily from three sources: uranium and its daughters (such as radium), thorium and its daughters, and potassium. There are many other natural radioactive materials, but their contributions to human dose are small. The amount of gamma radiation from these sources varies in different parts of the country depending upon the amounts of natural radioactivity in the soil. The average for the coastal plain is about 15 mrem per year; for the non-coastal plain, excluding the Colorado plateau area, it is about 30 mrem per year; and for the Colorado plateau area, it is about 60 mrem per year. There are, however, variations within these averages, with higher values in

given localities. For example, radiation up to 100 mrem per year from soils and rocks has been measured in central Florida and in the granitic regions of New England. In India and Brazil, terrestrial radiation reaches several hundred mrem per year over large regions and even higher values in smaller parts of these regions.

Measurements in the Los Alamos, New Mexico, area indicate an average of about 57 mrem per year from natural terrestrial sources. Because of the variety of geologic formations in the area, the range is from about 30 to 90 mrem per year. Thus, the average is about 40% higher than for the U.S., as a whole, but the range is less than for the U.S.

The same natural radioactive materials, especially uranium and thorium, are responsible for penetrating radiation doses from masonry structures. A United Nations study reports that doses average about 30% higher inside masonry structures than outdoors. Conversely, structures of wood or metal materials afford some shielding and may reduce indoor doses from natural terrestrial radioctivity by 25% compared with outdoor doses.

2. Natural Cosmic Sources. As previously discussed, cosmic radiation arises primarily from space outside of our solar system. The atmosphere provides some shielding, but there is a definite increase in cosmic ray intensity as one goes to higher altitudes. At sea level, cosmic rays, including cosmic neutrons, produce about 30 mrem a year. At the altitude of Denver, Colorado (5000 ft), they produce about 55 mrem per year, and at Leadville, Colorado (10 000 ft), they produce about 120 mrem per year.

Airline travel at higher altitudes can result in doses of 0.2 to 0.3 mrem per hour or 1.5 to 2 mrem total for a single transcontinental trip.

3. Medical Diagnostic X Rays and Other Manmade Radiation. People receive manmade radiation from a number of sources. By far, the most important are medical procedures, including diagnostic x rays and the medical use of radioactive isotopes. The average annual whole-body dose to a resident of the U.S. from diagnostic medical procedures is estimated at 70 to 90 mrem per year, or an amount about equal to normal background radiation.

Other sources of manmade or man-enhanced radiation, including television, smoke detectors, luminous-dial watches, mining and milling of phosphate, and burning coal and natural gas, add 2 to 5 mrem per year.

B. Radiation from Internally Deposited Radioactivity

Many radioactive materials, both natural and manmade, can be incorporated into tissues because their chemical properties are identical or similar to those of isotopes in the tissues. For example, 0.012% of natural potassium is the radioactive isotope ⁴⁰K. The radioactive portion of potassium is incorporated into plant and animal tissues in the same manner as the stable potassium isotopes because the chemical properties are identical. Radioactive ⁹⁰Sr, which results from nuclear fission, can be incorporated in tissues because its chemical behavior is similar to that of calcium. Once such radioactive isotopes are deposited in biological tissue, they emit radiation that results in an internal dose to the organ or organism. An important point is that internally deposited alpha emitters can be significant because the alpha particle radiation is emitted directly into tissue, whereas external alpha particle radiation is stopped by the outermost skin layers.

1. Pathways. Although radiation from internally deposited radioactive materials may cause the same ultimate effects as external penetrating radiation, the evaluation is more complex. This is because the physical and chemical processes that govern movements of the materials in nature and biological systems must be considered. The evaluation of movements of materials by such processes as dispersion in the atmosphere, transport in water, uptake in plants or animals, and ultimately, the biochemistry of the human body is often termed *pathway analysis*. There is nothing unique to pathway analysis of radioactive materials; the methods and principles are equally applicable to movements of natural substances and nonradioactive pollutants.

The major types of environmental pathway analyses considered in the radiological survey were resuspension, hydrologic transport, and food chains. These are all ways of transporting contaminants to the human body.

Resuspension encompasses various mechanisms, such as wind or mechanical disturbance, for making particles of dust and soil airborne. Once airborne, the particles and any contaminants on them are potentially available for inhalation. *Hydrologic transport* encompasses movement of materials dissolved in water and movement of materials attached to sediments. Such movements can make contaminants available for ingestion with drinking water and uptake in plants or animals or can redistribute sediments to different locations.

Food chains encompass the movement of materials through natural biological systems. A typical sequence starts with plants taking up materials from soil or water during natural plant growth or gardening. The next step could be ingestion of plant materials by cattle or fish, followed by ingestion of beef or fish by humans.

Once environmental pathways have made materials available for entry into the human body, the analysis must determine how the substances of concern will be assimilated within the body. This requires an understanding of the complex biochemistry of the body to determine where particular substances will be deposited and how long they will be retained. For example, both strontium and plutonium can ultimately be preferentially deposited in bone and are then retained for long periods. However, the amount deposited depends strongly on the chemical form of the element and whether the materials gain entry by inhalation or ingestion. For the same amounts of radioactivity, strontium is deposited to a greater degree when ingested, and plutonium is deposited to a greater degree when inhaled.

Internally deposited radioactivity gives off radiation and thereby produces doses as long as it is in the body. Accordingly, doses delivered must be accounted for over a period of time beyond the period during which the radioactivity was ingested or inhaled.

The 50-year dose commitments represent the total dose accumulated in the body or specific organs over a 50year period because of ingestion or inhalation of radioactivity during the first year. The 50-year commitments are always as large as or larger than first-year doses. In this summary, only the 50-year commitments are compared with the standards.

Conceptually, this is in agreement with the recommendations of the International Commission on Radiological Protection (ICRP), and, in effect, for regulatory purposes charges the entire dose commitment against the year in which exposure occurs. The use of the 50-year dose commitment also permits making estimates of risk over a lifetime from the given exposure and simplifies comparisons between different exposure situations.

The dose commitments were calculated using published factors from references currently used in regulation. The mathematical dose models employed in the derivation of these factors were based primarily upon recommendations of the International Commission on Radiological Protection.

Other methods of computing doses are available, and some are considered more up-to-date in terms of utilizing the best current understanding of the behavior of isotopes within the body. Additionally, there are conceptually different approaches that emphasize the dose at the time of maximum dose rate following exposure as the basis for comparison with standards. This is significant for isotopes such as plutonium that accumulate in certain parts of the body and can lead to a constantly increasing dose rate under conditions of chronic exposure. One such approach has been proposed by the EPA as guidance for Federal agencies in regard to plutonium.

These other approaches do not result in dose estimates or comparisons with standards for the radionuclides of concern sufficiently different from the methods used in this report to make any significant difference in the conclusions drawn. For example, under conditions of chronic exposure to airborne ²³⁹Pu, the dose in the year of maximum dose rate (taken to be the 70th year) calculated by alternate methods gave estimates ranging from about 1.4 (for bone) to 2.6 (for lung) times the 50-year dose commitment. These differences are of about the same magnitude as other uncertainties in field data and are smaller than some of the intentionally overestimated assumptions incorporated into these evaluation. Thus, there would be no significant changes in the relative ranking or general magnitude of estimated doses and risks if other methodologies were used.

2. Radiation from Natural Radioactivity. The most prominant internal natural radioactive material in the body is a radioactive isotope of potassium. Potassium-40 is distributed throughout the body and contributes about 17 mrem per year to the whole body. Other natural radioactivity taken in with food or air adds enough radiation to bring the total whole-body dose to about 27 mrem per year.

Some natural radioactive materials tend to concentrate in particular parts of the body. For example, radium and its daughters concentrate in bone and contribute a major part of the approximately 47-mrem-per-year bone dose.

Radon, a natural radioactive gas given off by all terrestrial materials including soil and masonry products, is the largest contributor to internal lung doses. Radon is inhaled with air and decays by alpha-particle radiation through a chain of other radioactive daughters that contribute doses as they, in turn, decay. Concentrations of natural radon in the air can be greatly increased in masonry structures or in tightly sealed structures where dilution by ventilation air exchange is low.

3. Radiation from Worldwide Fallout Radioactivity. Radioactive materials released by atmospheric nuclear weapons testing have been dispersed worldwide and deposited on soils everywhere. By various pathways, including resuspension and food chains, small amounts of such radioactivity are incorporated into every human body. The average dose from worldwide fallout radioactivity to the population in the U.S. for the whole body is about 4.4 mrem a year. For lungs and bones, the doses are less than 1% of doses from natural materials.

VII. POTENTIAL HARM OR RISK FROM RADIA-TION

The damage done by radiation results from the way it affects molecules essential to the normal function of body cells. Four things may happen when radiation strikes a cell.

- 1. It may pass through the cell without doing any damage.
- 2. It may damage the cell, but the cell partially repairs the damage. (The ability of a cell to repair some of the damage from radiation explains why a given dose of radiation delivered in small amounts over a long period of time is generally believed to be less damaging than the same total dose given all at once.)
- 3. It may damage the cell so that the cell fails to repair itself and reproduces in damaged form over a period of years.
- 4. It may kill the cell.

The death of a single cell may not be harmful, but serious problems occur if so many cells are killed in a particular organ that the organ no longer can function properly. Incompletely or incorrectly repaired cells may, over a period of time, produce delayed health effects such as cancer, genetic mutations, or birth defects.

Radiation at high enough doses will kill in a short time. The lethal dose is estimated to be 400 000 to 500 000 mrem for gamma radiation with death occurring in 10-30 days. However, the public is seldom, if ever, subjected to such high doses. We will, therefore, concentrate our attention on the effects that occur later, cancer and genetic effects.

A. Cancer

Information on the induction of cancer in humans arises from several sources. The most important data on external radiation are for the Japanese who survived the blast effects but received radiation at Hiroshima and Nagasaki and for the people who were exposed to radiation during medical therapy. Information on internal emitters comes from the radium dial painters who ingested radium while painting dials in the early 1920s, from a group of patients who were administered radium as a tonic, and from uranium miners who were exposed to radon and its daughter products. Evaluations of such data have led to estimates of the likelihood of radiationinduced cancer. These estimates are accepted by the vast majority of scientists working nationally and internationally with radiation.

Before discussing the actual risks, there are several points that are fundamental in interpreting the values. First, cancers or genetic changes caused by radiation cannot be distinguished from those that are occurring every day spontaneously or caused by other carcinogenic chemicals. About 400 000 deaths occur from cancers in the U.S. each year, or about 15 to 20 per 10 000 people. We can infer an effect from radiation only if the total number of cancers (or of a particular type of cancer) is increased by an amount we can detect. Valid comparisons are made even more difficult because some population groups have higher normal rates of cancer than others. This may be due to differences in the way they live and the possible carcinogens in their environment. Cancer also occurs more often in older people than in younger people. Thus, to detect increases in effects, a comparison (or control) group that is the same as the exposed group is necessary.

This all leads to the fact that there have been no direct measurements of increased cancer for low-level radiation exposures (1000-5000 mrem). Data exist only for much higher exposures (100 000 mrem and above delivered in a short time). Thus, scientists have estimated risks for the lower doses by assuming that any dose results in some effect (no threshold for effect) and that the relation between the radiation dose and the effect (cancer) is linear. That is, for each doubling of the dose there will be a doubling of the effect. This is an assumption that is generally believed to provide an overestimate of any effects. In fact, many scientists are now using a more complex mathematical relation between dose and effect that estimates risks at 2 to 10 times lower than the values given in this report.

Second, another characteristic of cancer or genetic effects from any cause is that they are statistical in nature. That is, not all of the individuals will be affected. Rather, a few individuals in the population will get cancer or have genetic defects and the remainder will not be affected. Therefore, we express the risk as the likely number of effects in a given population. For example, 30 cancers per million people means we expect 30 cancers out of this group of 1 000 000 people, but cannot tell which of the 30 will get cancer. Or, this example could also be stated that an average individual in that population has a risk of cancer of 30 chances in a million.

Cancers of many types can result from radiation or other carcinogens. These cancers do not occur for some period of time after exposure, usually 5 to 25 years. This period of time is called the latent period. For example, there is information from the Japanese survivors that the latent period for the first leukemia to appear is 1 to 4 years. The risk of leukemia is limited to about 25 years after the exposure. After this time, the risk of leukemia goes down to the normal incidence. For other cancers, the latent period is longer, about 10 to 20 years. However, information is incomplete.

Estimates have been made of the number of cancers that could result from a given radiation exposure, using the data for humans. These estimates generally are considered to be high because of the use of the linear, nothreshold assumption in extrapolating from the high levels at which people actually were exposed. In spite of this, these estimates are useful for illustrating the amount of additional cancer that could be induced in a population exposed to radiation (or conversely, the chance that an individual exposed to radiation will get cancer).

The estimates of health effects *risks* given in this report were based on the factors recommended by the National Academy of Science and the International Commission on Radiological Protection. Multiplying an estimated dose by the appropriate risk factor gives an estimate of the probability of injury to the individual as a result of that exposure. The risk factors used are

For uniform whole-body dose

Cancer mortality

0.0000001 per mrem whole body,

For specific organ doses	
Lung cancer	0.0000002 per mrem to lung,
Bone cancer	0.000000005 per mrem to bone.

As an example, a whole-body dose of 10 mrem per year would be estimated to add a risk of cancer mortality to the exposed individual of one chance in a million $(1/1\ 000\ 000)$ per year of exposure.

Such risk estimates must be placed in appropriate contexts to be useful as a decision-making tool. A useful comparison is an estimate of the risk that can be attributed to natural background radiation. Radiation from various natural external and internal sources results in exactly the same types of interactions with body tissues as that from so-called "manmade" radioactivity. Thus, the risks from a given dose are the same regardless of the source.

Natural background radiation for people in the Los Alamos, New Mexico, area consists of the external penetrating dose from cosmic and terrestrial sources, cosmic neutron radiation, and self-irradiation from natural isotopes in the body. These sources give a combined whole-body dose averaging about 158 mrem per year. This can be interpreted using the ICRP risk factors to represent a contribution to the risk of cancer mortality of 15 chances in a million for each year of exposure or a risk of 8 chances in 10 000 for 50 years of exposure to natural background radiation. As perspective, the overall U.S. population lifetime risk of mortality from cancer induced by all causes is currently estimated at about 2 chances in 10.

B. Genetic Effects

One of the concerns of many people is the possible effect of their exposure to radiation on future children. An effect on the reproductive cells of the body that can be inherited by children is called a genetic effect and the change itself is called a mutation. Many of these mutations are unnoticeable or barely noticeable.

There is no information based on human exposure that will allow an estimate of the risk of mutations. Thus, data from animals such as fruit flies and mice, along with known abnormalities in human births and general knowledge of genetics, have been used to arrive at an estimate of the risks. Careful study of the survivors of the Hiroshima and Nagasaki bombs and their descendents has shown that these estimates are reasonable. The information available is not sufficient to provide a precise estimate, but a range of values will illustrate the magnitude of the risk.

About 10% of all births are estimated to have some form of genetic mutation. These range in importance from the trivial, such as a change in eye color, to the serious, such as a stillbirth or a deformity in the body of the child. Exposure to 1000 mrem of radiation during the childbearing years is estimated to result in 6 to 100 additional changes per million births in the first generation. This may be compared with the 100 000 estimated to occur in the same group without above-background radiation. Continued exposure to 1000 mrem for generation after generation is estimated to eventually lead to 10 to 150 additional births with genetic mutations per million births. If the actual radiation received is higher or lower, the numbers given above will change in proportion.

C. Effects on the Fetus

You will often see signs in the x-ray departments of hospitals asking women to see the doctor if they have reason to believe they are pregnant. The reason is that the fetus, particularly in the first three months, is especially sensitive to radiation and may be damaged if exposed to excessive radiation. The doctor, therefore, may wish to re-evaluate his procedure.

Animal information on single exposures to radiation indicates that some changes detectable by sophisticated tests have occurred with a few rems. At present, no specific relationship between dose and the likelihood of damage has been developed. Because of this and the relatively low doses attributable to residual contaminants, no estimates of effects were made in this report.

VIII. STANDARDS FOR EXPOSURE TO RADIA-TION

There are a number of organizations that provide standards or regulations governing the amount of radiation people should receive. Voluntary standards, or recommendations, are provided by the International Commission on Radiological Protection (ICRP) and the U.S. National Council on Radiation Protection and Measurements (NCRP). These are both groups of scientists knowledgeable about radiation who study the available data and recommend appropriate limitations on the maximum amount of exposure that should be received. They also make recommendations on appropriate equipment and procedures. Their recommendations are nonbinding but have been accepted by many of the regulatory agencies.

The principal regulatory agencies in the U.S., which provide regulations on radiation exposure, are the Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission (NRC). Other agencies that provide regulations in their own areas of interest include the Food and Drug Administration (FDA) and the Occupational Safety and Health Administration (OSHA).

The EPA is the lead agency in the sense that it provides basic guidance to be used by all Federal agencies. The EPA has the responsibility to provide general environmental standards for the Nuclear Regulatory Commission and specific responsibilities to produce standards under the Clean Air Act, the Clear Water Act, and the Resources Recovery and Conservation Act. The EPA has adopted a policy of setting standards at as low a level as is believed economically feasible. For this reason, the EPA standards are frequently lower than those from the ICRP or the NCRP.

The Nuclear Regulatory Commission provides regulations to cover nuclear reactors and all products associated with reactors, including the radioactive materials used for medicine. Because the Nuclear Regulatory Commission does not regulate natural radioactive materials or x rays, the states have taken responsibility, usually using the recommendations of the NCRP.

The standards and regulations, or guides, fall into two general categories: (1) the primary radiation protection standards and (2) the secondary standards for intake of radioactive materials. Within each category there are generally two sets of values, one applicable to occupationally exposed persons and the second applicable to members of the public. All comparisons in this report are made with the standards appropriate for the general public.

An important principle in all radiation protection recommendations and regulations is that the amount of radiation received by people should be kept as far below the actual dose limit as is reasonably achievable. That is, the goal of a radiation protection program is not to see that everyone is kept at or just below the limits; instead, the goal is to see that working conditions and practices are such that both the workers and the public receive the smallest amount of radiation that can practically be achieved.

A. Primary Radiation Protection Standards

Primary radiation protection standards give limits for total exposure to external and internal radiation for the whole body or for specific organs. The standards, or upper limits, for the public are basically one-tenth of the values permitted for occupationally exposed workers. The standards apply to increments of exposure in addition to natural background and in addition to medical exposures.

The upper limit adopted by all Federal agencies, including the Department of Energy, for whole-body radiation to an individual member of the public is 500 millirem per year. For average radiation doses to an exposed population, the Federal Radiation Council (which has been incorporated into the EPA) recommended that the average exposure to that portion of the population receiving the highest annual dose be limited to 170 millirem in addition to natural or medical radiation exposure. (This average limit was set to minimize potential genetic damage and was derived from a limit of 5000 millirem over 30 years for large populations.)

The basic radiation standards as used by the Department of Energy are shown in Table E-III. These include both whole-body limits and specific organ limits. The EPA has proposed Federal guidance for exposure to transuranium elements, also shown in Table E-III.

A final word about these standards and their meaning is appropriate. Exposure to more radiation than permitted by the standards is not analogous to stepping off a cliff. That is, there is no sharp line between doses causing excessive harm and doses causing little or no harm. The opposite situation is true for many chemical poisons. An additional exposure of 1 millirem increases a person's risk to cancer or genetic mutation by the same amount whether it is a millirem of background radiation, the first millirem above background radiation, or the first millirem above the 500 millirem limit.

All of the doses evaluated in this radiological survey under current conditions of land use were small fractions of those permitted above natural background and medical exposure by the DOE Radiation Protection Standards. The highest dose, from the unlikely circumstance of a full-year occupancy of a small portion of the former waste treatment plant site, was estimated at about 12% of the standard. All other doses were less than 2% of the standard.

For projected possible land use conditions, the maximum dose estimates were for hypothetical home gardeners in one of the canyon areas (about 1.5% of the standard) and construction workers (about 6% of the standard). Continuous exposure to resuspended dust in the canyons was estimated to result in less than 1.3% of the EPA proposed guidance for persons exposed to transuranium elements in the general environment.

The various doses evaluated are summarized in Chapter 1 and described more completely in Chapter 5, Sections II and III.

B. Secondary Standards for Intake of Radioactive Materials

Secondary standards to be used in control of exposure by limiting the intake of radioactive materials are calculated from the primary standards using knowledge of the fate of the particular radioactive material in the body and the time it remains in individual organs. These standards are estimated for ingestion of water and inhalation of air. They are expressed as concentrations and are generally calculated so that the doses received from internal radioactivity will not exceed the primary standard under conditions of continuous exposure to the contaminants in air or water.

The assumption of continuous inhalation of air or ingestion of water, upon which the secondary limits are based, leads to a problem in their use. A frequent misinterpretation is that the secondary standards represent maximum concentrations to which a person can be exposed regardless of the time of exposure. This is not true. The total *intake* of radioactivity determines the dose received, not the particular concentration in air or water at any given time. The secondary standards are calculated as annual averages. Thus, a person could be exposed to 10 times the secondary standard concentration for a week and receive only about 20% of the annual intake permitted by the secondary standard.

The secondary standards account for the fact that some radioactive materials have a short half-life or are rapidly eliminated from the body. Tritium is eliminated from the body with a half-life of 12 to 13 days. Thus, the radiation received from a single drink at the secondary limit will be only a fraction of the annual limit that is calculated for continuous intake. Another example, plutonium, which is very well retained in the body and has a

TABLE E-III

STANDARDS AND GUIDES FOR RADIATION AND RADIOACTIVITY

DOE Radiation Protection Standards for External and Internal Exposures

Individuals and Population Groups in Uncontrolled Areas

	Annual Dose Equivalent or Dose Commitment					
Type of Exposure	Based on Dose to Individuals at Points of Maximum Probable Exposure	Based on an Average Dose to a Suitable Sample of the Exposed Population				
Whole body, gonads, or bone marrow	0.5 rem (or 500 mrem)	0.17 rem (or 170 mrem)				
Other organs	1.5 rem (or 1500 mrem)	0.5 mrem (or 500 mrem)				

EPA Maximum Contaminant Levels from Natural Interim Primary Drinking Water Regulation

Isotope	Media	Concentration		
Gross Alpha (including ²²⁰ Ra but	Water	15 pCi/ l		
excluding radon and uranium)				

long half-life, will reach the annual radiation limit only after continuous inhalation or ingestion at the secondary limits for 50 years. Thus, intake at or above this limit for days, weeks, or even months will not result in reaching or even approaching the primary standard dose limit.

The secondary standards are usually stated as concentrations of radioactivity in air or in water, as defined in Section V.B of this Appendix. The values used for comparison in this report are presented in Table E-III. The DOE secondary standards are called Concentration

Guides. The EPA secondary standards for drinking water are called Maximum Contaminant Levels, and for airborne transuranics are called Derived Air Concentrations. None of the relevant secondary standards was exceeded by any measured or theoretically estimated concentrations. Evaluations in the radiological survey were carried through to estimates of doses to permit comparison with the primary standards. Accordingly, no emphasis was placed on comparisons with the secondary standards.

BIBLIOGRAPHY

Natural and Background Radiation in the U.S.

D. T. Oakley, "Natural Radiation Exposure in the United States," U.S. Environmental Protection Agency report ORP/SID 721 (June 1972).

A. W. Klement, Jr., C. R. Miller, R. P. Minx, and B. Shleien, "Estimates of Ionizing Radiation Doses in the United States 1960-2000," U.S. Environmental Protection Agency report ORP/CSD 72-1 (August 1972).

National Council on Radiation Protection and Measurements, "Natural Background Radiation in the United States," NCRP report No. 45 (November 1975). Sources and Effects of Radiation

United Nations Scientific Committee on the Effects of Atomic Radiation, "Sources and Effects of Ionizing Radiation, 1977 Report to the General Assembly," United Nations Publication E.77.IX.1 (1977).

M. Eisenbud, *Environmental Radioactivity*, 2nd ed. (Academic Press, New York, 1973).

International Commission on Radiological Protection, Annals of the ICRP, Vol. 1, No. 3, ICRP Publication 26, Pergamon Press, New York (1977).

Committee on the Biological Effects of Ionizing Radiations, National Research Council, *The Effects on Populations of Exposures to Low Levels of Ionizing Radiation:* 1980, National Academy Press, Washington, D.C. (1980).

Printed in the United States of America Available from National Technical Information Service US Department of Commerce 5285 Port Royal Road Springfield, VA 22161

.

Microfiche (A01)

Page Range	NTIS Price Code						
001-025	A02	151-175	A08	301-325	A14	451-475	A 20
026-050	A03	176-200	A09	326-350	A15	476-500	A21
051-075	A04	201-225	A10	351-375	A 16	501-525	A22
076-100	A05	226-250	A11	376-400	A17	526-550	A 23
101-125	A06	251-275	A12	401-425	A18	551-575	A24
126 150	A07	276-300	A13	426-450	A19	576-600	A25
						601-up*	A 99

*Contact NTIS for a price quote.

.

LEVENED LEVENED

- - -

