Critical evaluation of the Double Tracks Remediation Project

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Senior Thesis

Critical Evaluation of the

Double Tracks Remediation Project

Environmental Studies

Spring 1997
Double Tracks Remediation Project
EXECUTIVE SUMMARY

The U.S. Atomic Energy Commission (AEC) (now the U.S. Department of Energy), in testing the safety of nuclear weapons under many different conditions, detonated single plutonium bearing devices in such a fashion as to simulate an unintentional detonation of the high-explosive portion of nuclear weapons. This resulted in the uncontained spread of plutonium and other radionuclides, such as americium and depleted uranium, in the environment in the vicinity of these experiments. The Double Tracks site was one of these experiments on the Tonopah Test Range (TTR) which was contaminated in excess of 200 picocuries per gram (pCi/g). The Double Tracks site is located in Stonewall Flat on Range 71 North of the Nellis Air Force Range (NAFR), northwest of the NTS (see figure 1). The nearest town is Goldfield, Nevada, located approximately 14 miles west of the site. (DOE, EA for Double Tracks Test Site, 1995).

The DOE in compliance with the National Environmental Policy Act (NEPA), completed and issued an Environmental Assessment (EA), a Comment Response Document, and a Finding of no Significant Impact (FONSI) in April 1996 for the proposed Double Tracks Project. The remediation of the Double Tracks Site was completed in September 1996. (DOE, Finding of No Significant Impact, 1996)

Subsequent to the explosive test, a radiation exclusion zone was created to restrict access to the contaminated area. The exclusion zone was a five sided area roughly 3,000 feet in length and 750 feet in width (see photo No. 3). A wire strand fence was constructed around the zone to prevent inadvertent intrusion. The area characterized, excavated, and disposed of consisted of a smaller area within the original fenced area. (DOE, Double Tracks Sampling and Analysis Plan, 1995)
Total Transuranic Isotope Activity of Double Tracks Soil, Based on 1995 EG&G Ground Survey
ABBREVIATIONS AND ACRONYMS

DOE/NV  U.S. Department of Energy, Nevada Operations Office
DOT    U.S. Department of Transportation
EA     Environmental Assessment
EZ     Exclusion Zone
ft     Foot (feet)
ft³    Cubic foot (feet)
FIDLER Field Instrument for the Detection of Low-Energy Radiation
Ge     Germanium
GPS    Global Positioning System
GZ     Ground Zero
in     Inch
LLW    Low Level Waste
LSA    Low Specific Activity
m      Meter(s)
m³     Cubic Meter(s)
NAFR   Nellis Air Force Range
Nal    Sodium Iodide
NDEP   Nevada Division of Environmental Protection
NTS    Nevada Test Site
pCi/g  PicoCurie(s) per Gram (10⁻¹²)
Pu     Plutonium
RCRA   Resource Conservation and Recovery Act
RWMS   Radioactive Waste Management Site
TNT    Trinitrotoluene
TTR    Tonopah Test Range
yd³   Cubic Yard
LEGEND

- Primary highway
- State boundary
- County boundary
- City
- Region of influence

SCALE

0 15 30 Miles
0 25 50 Kilometers

DOUBLE TRACKS RESTORATION
REGION OF INFLUENCE
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1.0 PROBLEM - THESIS STATEMENT

This thesis will critically analyze the efforts of the Department of Energy (DOE) remediation of the Double Tracks Test Site. The thesis will try to answer: what were the goals of the remediation effort; what are the difficulties with establishing cleanup levels; methodology used in remediation; and whether the remediation was successful based on those goals.

2.0 INTRODUCTION

Double Tracks was one of four experiments that constituted Operation Roller Coaster. On May 15, 1963, a device composed of plutonium and depleted uranium was demolished on a 2.4- by 2.4-meter (m) (8- by 8-foot [ft]) steel plate using chemical explosives. No fission yield was detected; the total amount of plutonium deposited on the surface was between 980 and 1,600 grams (2.2 and 3.5 pounds). In addition, small amounts of americium and depleted uranium were spread around the test site. The objectives of the Double Tracks test were to evaluate the dispersal of radionuclides and assess the short-term uptake and fate of plutonium in several animal species. The detonation scattered plutonium, americium, depleted uranium, earth, concrete, and metal into the air. The debris and most of the dirt fell to earth at relatively short distances; however, some of the material was spread over larger areas downwind, south of ground zero. Contaminated concrete and metal were subsequently collected and buried in a mound at ground zero. The contaminated surface around ground zero was scraped to a depth of several inches.
and placed in a pit or mounded, covered with soil, compacted, and watered. Debris and
fragments that scattered to a radius of 1,500 ft were also collected and placed in the pit.
Post event sampling and surveying of surface soil were conducted to determine
contamination levels and distribution.

To evaluate the uptake and fate of plutonium in animals, 84 dogs, 84 burros, and 132
sheep were placed at various distances from ground zero and covered with muslin shrouds
to minimize external contamination. Following detonation of the chemical explosive and
the debris fall, the exposed animals were recovered and decontaminated. Of the 300
animals exposed, 18 were immediately sacrificed and autopsied. Radiation measurements
taken immediately after the experiment confirmed the presence of plutonium on the
shrouds that covered the animals during the experiment. The shrouds, decontaminants,
and the hides of the animals that were sacrificed immediately following the test were
buried. (Oak Ridge National Laboratory, Cleanup Procedures at the Nevada Test Site,
DOE, 1987.)

2.1 The Project

The remediation included the establishment of a staging area for on-site project
administration, operations, maintenance, and decontamination; excavation of soil
contaminated in excess of 200 pCi/g; transport of excavated soil through the TTR
and on public highways to the NTS; disposal of the waste at the NTS; and soil
stabilization. This included clearing of an area of 2.5 acres for the staging area, remediating a contaminated area of 7.4 acres, disturbing an area of up to 0.25 acres to search for and excavate the hide burial site, and using an area up to 2.5 acres for a well or sump. (DOE, Double Tracks Sampling and Analysis Plan, 1995) Costs associated with each of the five components of the project (staging site preparation, excavation, transportation, disposal, and soil stabilization) are discussed in general terms in Section 4.0 "Economic Analysis."

3.0 LITERATURE REVIEW

3.1 NEPA and the EA Process

In compliance with the National Environmental Policy Act, an Environmental Assessment (EA) for the Double Tracks project was completed by the DOE in April of 1996. As stated by the DOE in the FONSI issued April 30, 1996, based on the information and analyses in the EA, DOE has determined that the Proposed Action of Characterizing and Remediating the Double Tracks Plutonium-contaminated Soil Site on the Nellis Air Force Range (NAFR) would not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, DOE determined that an environmental impact statement was not required. In making this determination the DOE greatly reduced the costs of evaluating the site.
3.2 Early Surveys of the Site

At the time of the test, fallout collectors coated with a non-drying resin, hand
carried alpha detection instruments, and high volume air samplers were used to
determine the extent and concentration of the alpha contaminated debris. The
total amount of plutonium deposited on the soil surface was between 980 and
1600 grams.

No land decontamination experiments were reported, but the usual post-shot
cleanup activities took place. Metal and concrete debris in the vicinity of ground
zero and fragments out to a range of 2500 ft were collected and buried in a pit
inside the fenced ground zero area. The contaminated surface around ground zero
and areas contaminated by jetting were scraped to a depth of several inches. The
soil was placed in the pit or mounded, covered with dirt, compacted, and watered.
Both ground-based or Field Instrument for the Detection of Low-Energy
Radiation (FIDLER) and aerial radiological surveys of the shot sites have been
taken. While there is qualitative agreement between the FIDLER and aerial
survey maps, some discrepancies, perhaps because of redistribution during
intervening years, have been noted.

Previous semiannual ground-based surveys of the Double Tracks site were
conducted for several years after the tests. These surveys consisted of air samples,
surface swipes, and water examination, as well as gas proportional counter measurements made in the four compass directions at 100 ft intervals from the inner fence.

3.3 Recent Surveys of the Site

Since the original test conducted in 1963, several radiological surveys have been conducted at the site. The most recent was performed by EG&G Energy Measurements in April and June of 1995. The purpose of the April effort was to gather in-situ data regarding the radionuclides and activities present in the soil as well as field test equipment to determine the most accurate and efficient method for surveying the entire exclusion zone. The results of the April measurements were used to develop appropriate methods that could be used to assess the entire fenced area at the Double Tracks Site using mobile equipment.

3.4 Characterization of the Site

A sampling and analysis plan was developed and executed by the IT corporation, but the characterization and sampling was for hazardous waste constituents only (toxicity characteristic regulated metals, VOA's semi-VOA's, and pesticides), radiological characterization included in this analysis was performed on a "per package" basis as the soil was excavated and packaged. (DOE, Double Tracks Test Site Characterization Report, 1995.)
The information developed from the April 1995 experiments was used as a basis for the June 1995 survey. A vehicle (suburban) fitted with Sodium Iodide detectors was used to map the entire area at the Double Tracks site. The map developed from the June survey was used to determine the area, extent, and depth of soil that required excavation and disposal as radioactive waste.

3.5 Effects of Plutonium on Humans and the Environment

Some of the considerations that scientists and engineers had to analyze prior to the Double Tracks remediation project were associated with the isotopes in the soil. Although remote, each aspect had to be evaluated and documented prior to the execution of the project. Some of the considerations were: Radiation, Criticality, and Chemical.

3.5.1 Radiation

Plutonium gives off alpha, beta, gamma, and neutron radiation. Gamma and neutron radiation can penetrate skin and plutonium may be inhaled, absorbed, or ingested, so that all alpha and beta radiation can affect living tissue as well. Inhalation is the most dangerous type of exposure. High doses of radiation cause chemical changes in living tissue which can cause serious illness or death. At lower doses, radiation damages DNA which may lead to cancer and genetic mutation.
3.5.2 Criticality

Many of the materials in this category are fissile; they are capable of sustaining a nuclear reaction. Even a few kilograms of some of these fissile isotopes stored in close proximity may emit a burst of radiation, known as a "criticality event." An inadvertent criticality event would not cause a nuclear explosion; however, it would release an intense amount of radiation which could be lethal to nearby workers and may release small amounts of fission products to the environment.

3.5.3 Chemical Properties

Some forms of plutonium react with moisture and plastic to form hydrogen gas. If contained under pressure, this gas may rupture the container. In addition, hydrogen gas is flammable and explosive. Finely divided plutonium may ignite spontaneously if exposed to air above certain temperatures. Finally, plutonium in solution is corrosive and may degrade containers.

3.6 Scope and Methodology of the Cleanup

The geographical information used to establish the location of radiological readings within the fenced area was derived using Global Positioning System (GPS) equipment. Included in the area to be characterized and eventually excavated and disposed as radioactive waste is a mound of soil located at ground zero (GZ) of the test. This mound was created after the test when soil excavated
from a location near the test site was placed onto the concrete pad which had been used as the platform for conducting the test. This mound is approximately 4 feet in depth and was excavated and managed as radioactive waste destined for disposal. (DOE, Double Tracks Sampling and Analysis Plan, 1995)

The estimated quantity of soil excavated and disposed of at the NTS from the Double Tracks site was 43,740 cubic feet. A radioanalytical detection system mounted above a conveyor belt was used to assay the soil as it was conveyed into polypropylene super sacks. Each sack was sealed, banded to a pallet (a portable wooden platform for storing of moving cargo), loaded into sealand containers, and transported to the NTS on flatbed tractor trailers. The sealand containers were then unloaded at the NTS burial site, the sacks still banded to the pallets were then stacked in the burial trench.

3.6.1 Excavation of Soil

The limits for excavation were demarcated by a survey crew prior to beginning the excavation activities. The Pu-contaminated plume and GZ area were excavated using a motor grader and a paddle-wheel scraper. Excavation began by scraping a layer of soil from the entire plume area using the motor grader (see photo No. 4). The thickness of the layer varied from approximately 1 inch to 3 inches, given the slightly irregular surface of the site. The soil was bladed into a windrow, which
was picked up using the paddle-wheel scraper (see photo No. 5). A front-end loader was then used to push the soil into a mound. A total of approximately 2 inches to 5 inches of soil were removed from the northern half of the plume. Excavation began on June 24, 1996, and was completed by June 29, 1996. (DOE, Double Tracks Closure Report, January 1997)

3.6.2 In-process Survey
After the initial layer of soil had been removed, the area was surveyed using a Germanium (Ge) mast detector system to determine if the 200 pCi/g clean-up level had been achieved (see photo No. 11 & 12). A field instrument for the detection of low-energy radiation (FIDLER) was used, instead of the Ge mast detector, to check the activity level after successive cuts of soil were bladed. The FIDLER, although less precise than the Ge mast detector, can give a good approximation of the activity more quickly. (DOE, Double Tracks Closure Report, January 1997)

3.6.3 Ground Zero
The concrete pad at GZ, covered with approximately 3 ft to 4 ft of soil, was exhumed using a front-end loader. An attempt was made to break up the concrete pad using an air-driven, hand-held jack hammer. The pad was extremely hard and this equipment did not have the power to break it quickly and efficiently. A hoe-
A ram mounted on a tractor/front-end loader was then brought to the site to break up the pad. The broken concrete pad was placed in a Sealand container. Approximately 2 ft of soil was removed from beneath the pad to meet the 200 pCi/g clean up level. (see photo No. 15 & 16) (DOE, Double Tracks Closure Report, January 1997)

3.6.4 Dust Control

Very little visual dust was generated by the excavation process which was confirmed by the environmental air monitoring data collected down wind of the site. Dust was controlled by wetting the ground surface of the plume and G for several days prior to scraping. Additional water was applied during excavation and between successive cuts (see photo No. 6). The soil at the Double Tracks site is relatively sandy and could be over watered with little puddling. Water was also applied to the soil as the stockpile was being created.

Agri-lock, a water-soluble polymer dust suppressant, was applied to the excavated plume area and the soil stockpile on June 28, 1996. This material mitigated blowing dust by forming a relatively hard crust of soil 0.25 to 0.5 inches thick. (DOE, Double Tracks Closure Report, January 1997)
3.6.5 Bagging of the Soil

The bagging system consisted of a feed hopper and a series of conveyors which eventually discharged the soil into the supersacks (see photo No. 7 & 8). Soil was moved from the stockpile to the feed hopper of the conveyor/bagging equipment system using a front-end loader. Soil particles less than 0.75 inches in diameter continued through the conveyor system, bentonite was added (see photo No. 14), and the radioactivity level of the soil was counted using a sodium iodide (NaI) detector mounted above the final conveyor as the soil was discharged into supersack bags (see photo No. 1 & 2). The bag was weighed and radiation surveys (exposure rate and removeable contamination) were taken on the exterior of the bag. After each supersack had been filled, the bag was placed into a Sealand container for shipment to the disposal site (see photo No. 9). A total of 10 supersacks were placed in each Sealand container; four 15 ft3 supersacks in the front of the container and six 30 ft3 in the rear of the container. (DOE, Double Tracks Closure Report, January 1997)

3.6.6 NaI detector system

The Double Tracks work will use a NaI detector system to monitor the amount of radioactivity travelling along a conveyor belt to the "Supersack" packages for later disposal. The NaI detector has been calibrated for operation at a range of heights above a 1"-deep layer of soil on a 26"-wide conveyor belt.
The number of 60-keV $^{241}$Am gamma rays measured while the sack was being filled was directly related to the amount of activity which passed under the detector and into the sack. The americium activity loaded into each of the approximately 2000 Supersacks was measured and the plutonium activity will be calculated based on the americium:plutonium ratio calculated from the characterization work. The sacks were loaded onto trucks and hauled to the NTS.

The following criteria and assumptions were established for the NaI detector:

1) An earlier assessment of the activity at Double Tracks indicated that the activity was comprised of $^{241}$Am and several isotopes of plutonium as well as the naturally occurring radionuclides present in the soil. The ratio between the plutonium and americium isotopes was measured as 16:1. Therefore, the activity of the waste stream was monitored by measuring the $^{241}$Am isotope's gamma rays.

2) The NaI detector system had to be able to monitor the americium activity in a layer of soil passing underneath as it was loaded into the Supersacks for later disposal. The desired accuracy for these measurements changed as a function of activity. The goal was to not have any sacks with activities greater than the TRU waste limit of 100,000 pCi/g.

3) A normal-size Supersack contained approximately 30 ft$^3$ of material. The soil was assumed to have a density of 1 g/cm$^3$, then the mass of the material in the sack would be ~1900 pounds. To stay below the TRU waste limit, the sack could
contain 5,310 μCi of $^{241}$Am using the TRU:$^{241}$Am ratio of 16:1.

4) A smaller-size Supersack was used in some instances. This bag held 15 ft$^3$ of material (roughly 1/2 of the larger sack).

5) The americium activity was assumed to be dispersed throughout the soil mixture.

The NaI detector is a 3"-diameter by 6"-long cylindrical crystal. The long axis of the crystal was placed parallel to the width of the belt, so the detector would present a nearly rectangular cross section to the material it was measuring. It was surrounded by 0.040" sheets of cadmium to shield its field of view. The detector, preamplifier, and shielding were surrounded by several inches of foam packing and housed inside an American Tourister briefcase for protection from the weather (see photo No. 13).

The amount of activity in a Supersack was calculated by taking the total number of counts in the americium photopeak window, dividing by the time of the measurement, subtracting the background count rate (determined at the beginning of each day), and then dividing by the conversion factor. To compensate for the loss of gamma rays by attenuation in the 1"-thick layer of soil, this activity was divided by 79%.
3.6.8 Transportation

The contaminated soil was transported to the NTS Area 3 RWMS using a total of 10 tractor-trailer rigs at a rate of 100 bags per day. Shipping began on July 27 and was completed on August 20, 1996. A total of 113 loads were shipped, which included 2,229 bags of soil shipped in Sealand containers, seven B-25 boxes containing soil with concrete chips and material greater than 0.75 inches in diameter, and one Sealand container which contained the broken concrete pad.

Two 8 x 8 x 20-ft Sealand containers, containing a total of 20 supersack bags of soil, were loaded on each 48-ft trailer (see photo No. 10). The rigs traveled to the NTS using the route identified on the enclosed map (see figure 2). All material was shipped according to DOT regulations for shipping low-specific activity (LSA) material and all shipments were placarded as radioactive material.

4.0 ECONOMIC ANALYSIS

4.1 General

As is true with much of the environmental contamination in the U.S., the Double Tracks site was contaminated from past pollution activities. Much of the Nevada Test Site and the Tonopah Test Range have contamination and degradation problems which are complex and costly to correct. In evaluating the Double Tracks remediation effort, which includes cleaning the site by removing soil to a
background contamination level of 200 pCi/g and stabilizing the remaining soil, it
is necessary to look at both costs and benefits from the cleanup. I would argue
that the optimal cleanup level is where Marginal Costs (actual costs for
manpower, radiological support, capital equipment, transportation, and disposal
costs), meet Marginal Benefits. (see figure 3)

**The Optimal Cleanup Level**

![Figure 3](image)

In figure 3, MB = Marginal benefits of environmental cleanup, and MC =
Marginal costs of environmental cleanup. Both MB and MC are difficult to
measure, especially when we begin to try and establish monetary costs for things
such as future generations health, endangered species, and eco-system health.
Some of the methods that economists have developed for evaluating non-market value are discussed in section 3.2. $X^*$ represents the optimal level of cleanup, where $MB = MC$. $X_1$ represents the maximum level of cleanup and the maximum costs associated with cleanup. Careful consideration must be given when deciding the level of cleanup for a particular site, future land use, future generations health, benefits derived, and the costs for each increase in the level of desired cleanliness. Perception of optimal cleanup level and costs differ depending on who pays for the cleanup.

The marginal costs of environmental cleanup include actual costs and the opportunity costs of other environmental projects not pursued because of part of the budget for managing environmental resources is dedicated to cleanup. The money spent on the cleanup of Double Tracks cannot be used for clean air, clean water, or (desert tortoise) endangered species programs. The net benefits forgone as a result of not pursuing these other programs is part of the marginal cost of pursuing environmental cleanup.

It's also very important when evaluating the cleanup effort at the Double Tracks site to consider the Land Use Type. Marginal benefits for remediating the land vary greatly depending on whether the land use type is residential, industrial, or in our case continued military (defense) use. (see figure 4)
Optimal Cleanup Level Varies with Land Use Type

In figure 4, MB, MC, and the optimal level of cleanup are represented graphically considering land use as a variable, where MBR = Marginal benefit of cleanup on residential land, MBI = Marginal benefit of cleanup on industrial land, MBM = Marginal benefit of cleanup at Double Tracks, and X*R = Optimal cleanup level on residential land, X*I = Optimal cleanup level on industrial land, X*M = Optimal cleanup level at Double Tracks, XM = Maximum level of cleanup and the maximum costs associated with the cleanup. Notice that X*R > X*I > X*M.

Thus, land use may cause the optimal level of cleanup to differ across land use types. Therefore, based on the intended use of the Double Tracks site, (continued support of U.S. defense) the optimal cleanup level is well below that of both
industrial and residential land types, and I would argue that status quo would be
the optimal level of cleanup.

4.2 Cost Benefit Analysis

Use benefit is the utility arising from direct use of a resource, including
commercial use, recreational use, and aesthetic use. There are two subcategories:
Consumptive Use Benefits such as farming, forestry, fishing, grazing, hunting,
mining, and Nonconsumptive Use Benefits, such as swimming, boating, hiking,
camping, wildlife viewing, viewing of scenic forests, mountains, etc. One could
argue that weapons testing would constitute a consumptive use because the
Double Tracks site involved the consumption of a portion of a resource, the land.
Eventually, such activities may lead to resource depletion, if the activities are
carried out at unsustainable levels. Activities that generate nonconsumptive use
benefits typically do not involve the consumption of a portion of a resource.
Hence, such activities are less likely to result in resource depletion. (DOE,
Cost/Risk/Benefit Analysis of Alternative Cleanup Requirements for Plutonium-
Contaminated Soils On and Near the Nevada Test Site, 1995) However, I would
argue that the resource was not depleted, the land can be used for additional
testing and still provides the original resource, and that Double Tracks is a pure
public good and therefore a non-use benefit. Nonuse benefits arise in situations in
which individuals derive utility from resources without physically interacting with
the resources. As is true with Double Tracks, benefits associated with preserving environmental resources, benefits from improvements made to environmental resources, and costs associated with environmental resource degradation may be uncertain.

Because no resource at Double Tracks was a traded resource, the Market Values method could not be used to evaluate the project. It was also clear that no characteristic at Double Tracks could be used to perform an analysis to determine marginal value, so the Hedonic Price Method could not be used. The Travel Cost Method could not be used because there is no value of a recreational facility, so opportunity cost of time and travel cost spent on the way cannot be measured.

In support of the argument that the Double Tracks site, and remediation is a nonuse benefit, the Contingent Valuation Method (CVM), would be the only method adaptable for analysis of the project. The CVM is a survey method used to obtain information from people (by mail, telephone, or in person). Individuals are asked directly how much they value a given resource or how much they would value some kind of change in a resource. Although this method was not employed directly for Double Tracks, inferences can be made from a review of public comments from the EA and the FONSI, which indicated that people were unsure of the reason for, and not supportive of conducting the remediation, leading to a
Interviewing techniques may be used to place economic values on all kinds of environmental and resource benefits. Furthermore, at present these techniques are the only available methods for placing values on nonuse benefits. Hence, interviewing techniques are very important for measuring nonuse benefits such as option value, and existence value.

5.0 CONCLUSION

5.1 Goals of the Double Tracks Remediation Project

The purpose of the interim action was to reduce the potential risk to human health and the environment and to demonstrate technically viable and cost-effective excavation, transportation, and disposal methods of Pu-contaminated soil. An additional objective was for the U.S. DOE, Nevada Operations Office to return institutional control of the Double Tracks Test Site back to the U.S. Air Force.

Other DOE sites are contaminated with plutonium (Pu), americium (Am), uranium (U), other transuranic elements and fission products. These are present at low levels in water, sediment, and soil. The detection and long-term monitoring of the contaminants requires the installation of wells and the collection of samples for analysis. Techniques that can determine these elements and/or their isotopes
isobars, in-situ and in real time are needed. Also needed are the technologies to provide a field analytical method to expedite sampling and analysis of non-contaminated samples and to eliminate costly delays caused by sample collection, sample transportation, and lengthy laboratory procedures. Technologies that would avoid physical sampling, providing immediate results on an as-needed basis would substantially improve the detection and monitoring of contamination.

In support of the enforceable deadlines that will be established in the soon-to-be-approved agreement, technologies for remediating those plutonium-contaminated sites that require corrective actions need to be evaluated, developed, and improved. Technically viable and cost-effective excavation, transportation, and disposal methods need to be demonstrated while removing contaminated soils and all soils containing transuranic contamination exceeding 200 pCi/g. This level is conservatively estimated to be within the final cleanup level expected to be established in the future.

The DOE's purpose at Double Tracks was to demonstrate and evaluate technologies for excavating contaminated soil while protecting human health and the environment. The Double Tracks site was selected because it is the smallest of the plutonium-contaminated sites, it is the closest to off-site receptors, and the extent of contamination at the site is readily manageable.
5.2 **Difficulties in Establishing Cleanup Levels**

Although no RCRA constituents have been identified at the site and thus, no clear external regulatory driver for an investigation/remediation, DOE has undertaken this investigation because of its commitment to state and federal regulators and to the public to address the radioactive contamination.

"State officials contend that any final strategy to address surface soil contamination at the NTS must be developed in the context of future land uses that embrace the concept of how clean is clean and for what use. Department officials in Nevada are establishing an approach to embrace this concept by developing a site-wide Resource Management Plan as part of the NTS Site Wide Environmental Impact Statement" (Letter from the State of Nevada to Carl Gertz, Acting Assistant Manager for Environmental Restoration and Waste Management Division, Nov. 22, 1995)

The current cleanup strategy calls for reducing contaminated soils by excavation and disposal in existing subsidence craters. This strategy proposes to increase radionuclide concentration action levels from 40 picocuries per gram to a negotiated 200 picocuries per gram. The State has only concurred that this higher level is acceptable as interim action level. The U.S. DOE, Nevada Operations Office is proposing to establish Land Withdraw Zones to provide containment of
these contaminants at these levels, which would be preemptive of the future decisions in the Resource Management Planning process. (Letter from the State of Nevada to Carl Gertz, Acting Assistant Manager for Environmental Restoration and Waste Management Division, Nov. 22, 1995)

Remedial actions will be based on applicable regulatory standards or proposed cleanup levels, if no standards apply. Proposed levels will be based on pertinent factors, including but not limited to assessment of risk, current and projected land use, resource management, and technical and cost feasibility. Where sufficient information is available, the Department will use a more Streamlined Approach for the Environmental Restoration process.

Although the DOE is actively engaged in remediation, they have encountered the same dilemma as others, how clean is clean? To this end the DOE recognizes that many of the remediation projects are interim actions and further remediation may be necessary in the future.

5.3 Effectiveness of the Cleanup

To document that the corrective action objective of 200 pCi/g had been achieved, a post-excavation, radiological survey was conducted using the Kiwi detector system. The Kiwi system is a Chevrolet Suburban vehicle which has six
2-x4-x16-in NaI detectors mounted in a frame at the rear of the vehicle. A global positioning system (GPS) receiver is mounted above the NaI detectors to obtain accurate location data corresponding with the radiological survey data. GPS data and the radiological data are recorded on instruments located inside the vehicle. This data was processed later by computers to generate total transuranic activity maps of the surface soil.

The entire fenced area of the site, and approximately 30 ft around the perimeter of the fence, was surveyed using the Kiwi NaI detector system from August 21-23, 1996. This survey, conducted after the bagging/processing equipment had been removed from the Excavation Zone, was run to determine if the clean-up objective had been met before all excavation equipment had been demobilized from the project area. The entire fenced area of the Double Tracks site has been surveyed using the Kiwi system twice, once in 1995 and once in 1996. The possibility that undetected fragments remain on the site is very remote.

The GZ, plume, and work pad areas were ripped and disced in November 1996, in preparation for revegetation according to the Revegetation Plan. A final Kiwi survey was run over these areas after the discing had been completed and before seeding. This final radiological survey data verifies that the activity is below the 200 pCi/g averaged over any one hectare with no 10 x 10 meter area above 600
pCi/g. The interim cleanup of the site has been achieved by the remedial actions.

(DOE, Double Tracks Closure Report, January 1997)
Bibliography:


Battelle Memorial Institute, Pacific Northwest Laboratory. *Revised Total Amounts of 239, 240 Pu in Surface Soil at Double Tracks.* Richland, WA: D.O.E. 1977
Bibliography (cont):


Photo Number 7

Photo Number 8