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SUMMARY OF ADDENDUM SHEETS TO THE AUGUST 1990 WASTE PIT AREA STORMWATER RUN-OFF CONTROL ENGINEERING EVALUATION/COST ANALYSIS

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Addendum Item	Explanation	Page Number Affected
Page change	Typographical error corrected. (DOE change initiative)	IV of Table of Contents
Page change	Date ascribed to National Contingency Plan changed from April 8, 1990 to March 8, 1990. (response to OEPA comment)	Page ES-1
Page change	Date ascribed to National Contingency Plan changed from April 8, 1990 to March 8, 1990. (response to OEPA comment)	Page 1-1
Page change	Typographical error corrected. (response to OEPA comment)	Page 2-34
Figure revision	Added "accumulation trench" to figure legend (response to OEPA comment)	Page 4-7, figure 4-3
Page change	Changed cost estimate for waste removal from $1.1 billion to $740 million. (DOE change initiative)	Page 4-14
Page change	Comparison costs of Alternative 3 with 4 and 2, changed from 400 times to 200 times and 200 times to 100 times, respectively. (DOE change initiative)	Page 4-15
Page change	Added 1st sentence to paragraph 1 as an explanation for table 5-1. (response to OEPA comment)	Page 5-13

Addendum Item	Explanation	Page Number Affected
Page change	Paragraph added to bottom of Table 5-1 to explain data. (response to OEPA comment)	Page 5-14
Page change	Reference column added. (response to OEPA comment)	Page C-12
Page change	Reference column added. (response to OEPA comment)	Page C-14
Page change	Reference column added. (response to OEPA comment)	Page C-15
Page change	Reference column added. (response to OEPA comment)	Page C-16
Page change	Reference column added. (response to OEPA comment)	Page C-18
Page change	Additional reference added. (response to OEPA comment)	Page CR-2
Page change	Additional reference added. (response to OEPA comment)	Page CR-3
Page change	Additional reference added. (response to OEPA comment)	Page CR-4
Page change	Reference 6 at bottom of page changed. (DOE change initiative)	Page D-3
Page change	Cost estimates recalculated; reference 4 at bottom of page changed. (DOE change initiative)	Page D-6

Addendum Item	Explanation	Page Number Affected
Figure revision	Additional sample locations added to figure (response to OEPA comment)	Figure 2-6, blue print in end pocket
Figure revision	Modifications made to better illustrate drainage areas. (DOE change initiative)	Figure 4-4, blue print in end pocket

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EXECUTIVE SUMMARY

The U.S. Atomic Energy Commission (AEC), predecessor to the U.S. Department of Energy (DOE), established a production complex in the early 1950s for processing uranium and its compounds from natural uranium ore concentrates. This complex, known as the Feed Materials Production Center (FMPC), is located on 1050 acres in a rural area approximately 20 miles northwest of downtown Cincinnati, Ohio. The villages of Fernald, Ross, New Haven, and Shandon are all located within a few miles of the plant.

On July 18, 1986, a Federal Facility Compliance Agreement (FFCA) was jointly signed by DOE and the U.S. Environmental Protection Agency (EPA). This agreement pertains to environmental impacts associated with the extended years of operation at the FMPC. The FFCA is intended to ensure that environmental impacts associated with past and present activities at the FMPC are thoroughly and adequately investigated so that appropriate remedial response actions can be formulated, assessed, and implemented. In April 1990, DOE and EPA signed a CERCLA Consent Agreement that supercedes the FFCA.

In response to the FFCA and consistent with the modifications agreed to in April 1990, a Remedial Investigation/Feasibility Study (RI/FS) is in progress pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). The technical strategy adopted for the RI/FS is to issue distinct RI/FS reports for each of five identified operable units at the FMPC.

One of the operable units (Operable Unit 1) includes those facilities utilized for the storage/disposal of radiological and chemical wastes from FMPC operations. Related facilities that now contain similar waste types are also included. These facilities include Waste Pits 1, 2, 3, 4, 5, and 6; the burn pit; and the Clearwell. Analytical results indicate that elevated concentrations of uranium are present in the storm water runoff from the waste pit area and adjacent areas. Because of the associated potential threat to human health and the environment, DOE is pursuing a removal action to control the storm water runoff from these areas pending the outcome of the RI/FS and the implementation of a final remedial action for the waste storage units.

Removal actions, as described in the National Contingency Plan, (NCP) March 8, 1990 (55 Federal Register 8666), are primarily intended to abate, prevent, minimize, stabilize, mitigate, or eliminate a

1.0 INTRODUCTION

On July 18, 1986, a Federal Facility Compliance Agreement (FFCA) was jointly signed by the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (U.S. EPA) for DOE's Feed Materials Production Center (FMPC) in Fernald, Ohio. The FFCA is intended to ensure that environmental impacts associated with past and present activities at the FMPC are thoroughly and adequately investigated so that appropriate remedial response actions can be formulated, assessed, and implemented. In April 1990, DOE and EPA signed a CERCLA Consent Agreement that supersedes the FFCA.

In response to the FFCA and consistent with the modifications agreed to in April 1990, a Remedial Investigation/Feasibility Study (RI/FS) is in progress pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). The technical strategy adopted for the RI/FS is to issue distinct RI/FS reports for each of five identified operable units for the FMPC. By accommodating separate schedules for each operable unit, the remedial action decision process is proceeding to completion for the most problematic units while data collection and analysis continue for other operable units.

One of the operable units (Operable Unit 1) includes those facilities utilized for the storage/disposal of radiological and chemical wastes from FMPC operations. Related facilities that now contain similar waste types are also included. These facilities include Waste Pits 1, 2, 3, 4, 5, and 6; the burn pit; and the Clearwell. Analytical results indicate that elevated concentrations of uranium are present in the storm water runoff from the waste pit area and adjacent areas. Because of the associated potential threat to human health and the environment, DOE is pursuing a removal action to control the storm water runoff from these areas pending the outcome of the RI/FS and the implementation of a final remedial action for the waste storage units.

Removal actions, as described in the National Contingency Plan, (NCP) March 8, 1990 (55 Federal Register 8666), are primarily intended to abate, prevent, minimize, stabilize, mitigate, or eliminate a release or a threat of release prior to a final action if there is a threat to public health or welfare or the environment. A second reason for implementing a removal action is to mitigate contaminant migration pending final action if site conditions permit a straightforward mitigative action, and significant migration would occur in the interim if no action is taken. Additionally, removal actions are to be consistent with the anticipated long-term remedial action and to contribute to the efficient performance of the long-term remedy to the extent practicable.

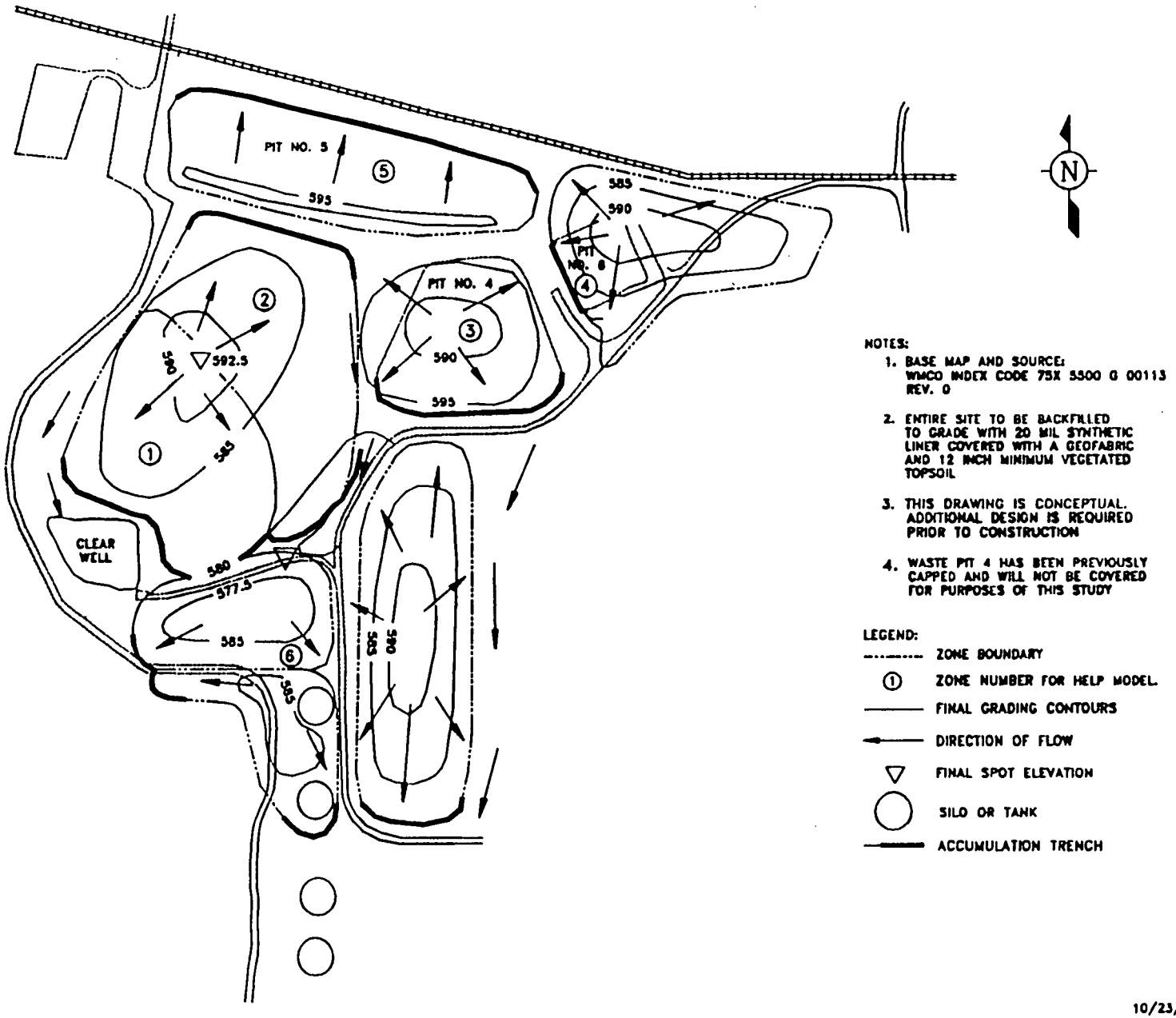
crops irrigated by the water, ingestion of beef from cattle exposed to uranium through water and crops, and ingestion of milk from cows exposed to uranium through water and crops.

Environmental receptors in Paddys Run include benthic macroinvertebrates and fish. The most common macroinvertebrates in Paddys Run are the non-biting midges (Chironomidae), riffle beetle (*Stenelmis* sp.), mayfly (*Caenis* sp.), and stonefly (*Allocapnia* sp.). Also common are isopods (*Lirceus fontinalis*), caddisflies (*Cheumatopsyche* sp. and *Hydropsyche* sp.), oligochaetes, and blackflies (*Simulium* sp.). The most abundant fish are the bluntnose minnow (*Pimephales notatus*), creek chub (*Semotilus atromaculatus*), and stoneroller minnow (*Campostoma anomalum*). Aquatic vascular plants (e.g., cattails [*Typha* sp.] and sedges [*Carex* sp.]), as well as algae also occur along Paddys Run.

The potential exposure pathways associated with the surface waters of the Great Miami River include direct ingestion as drinking water, ingestion of plants after use of the water for irrigation, and ingestion of meat or milk from livestock exposed to the surface water through direct intake or from irrigated crops. This secondary pathway is also considered in detail for the storm water runoff removal action.

2.4.3.3 Potential Receptors

There is no known use of groundwater with uranium levels exceeding the derived concentration limit of 30 µg/l from the area influenced by infiltration from Paddys Run into the Great Miami Aquifer for drinking water, feedstock watering, or crop irrigation. Residences along Paddys Run Road to the west reportedly use cisterns with imported water. Groundwater monitoring results from commercial and residential wells along New Haven Road in or near the Village of Fernald indicate no elevated levels of uranium in the water supply. These results indicate that the uranium plume either is not present at the level of aquifer pumping or has not yet migrated to these locations. The only known users of groundwater with uranium levels exceeding the derived concentration for uranium in drinking water are the industries located along Paddys Run Road southwest of the projected center of the plume. One of the two industries treats the water to remove uranium and other radionuclides and chemicals prior to its use. Untreated water at the two industries is not used for drinking water supplies or for other purposes that represent a significant risk to users.



NOTES:

1. BASE MAP AND SOURCE: WMCO INDEX CODE 75X 5500 G 00113 REV. 0
2. ENTIRE SITE TO BE BACKFILLED TO GRADE WITH 20 MIL SYNTHETIC LINER COVERED WITH A GEOFABRIC AND 12 INCH MINIMUM VEGETATED TOPSOIL
3. THIS DRAWING IS CONCEPTUAL. ADDITIONAL DESIGN IS REQUIRED PRIOR TO CONSTRUCTION
4. WASTE PIT 4 HAS BEEN PREVIOUSLY CAPPED AND WILL NOT BE COVERED FOR PURPOSES OF THIS STUDY

LEGEND:

- ZONE BOUNDARY
- ① ZONE NUMBER FOR HELP MODEL
- FINAL GRADING CONTOURS
- DIRECTION OF FLOW
- ▽ FINAL SPOT ELEVATION
- SILO OR TANK
- ACCUMULATION TRENCH

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FIGURE 4-3. ALTERNATIVE 3 - CAPPING WITH SUBSURFACE DRAINAGE COLLECTION

disposed waste and contaminated soil and regrading the site with clean fill. An estimated 444,500 cubic yards of waste and 58,900 cubic yards of contaminated soil would have to be excavated, packaged in waste disposal boxes, and disposed at an approved facility. The removal of the source would eliminate the threat of contaminated runoff entering Paddys Run via the waste pit area.

4.3 SCREENING OF ALTERNATIVES

The five alternatives for the storm water runoff removal action were subjected to an initial screening to ascertain if any could be eliminated from further consideration prior to the detailed evaluation phase. The capping alternative and the runoff collection and treatment alternative were judged to be sufficiently effective and implementable as removal actions to warrant further evaluation in this EE/CA. The no-action alternative was further evaluated as a baseline.

The increased effectiveness introduced by the lateral drainage collection system in Alternative 3 was not considered sufficient to offset the increased cost required for its implementation. In particular, there is no assurance that all infiltration through the cap would move horizontally to the collection system. Additionally, the contaminant loading to Paddys Run would not be significantly improved and probably would not justify the additional $1,490,000 in expenses. The implementation of this additional component could, therefore, be very inefficient in satisfying its primary objective of collecting the infiltrating water. Such flows will be addressed under Operable Unit 1 and possibly under Operable Unit 3 if a particular subsurface flow condition calls for a local action not affecting the final action at other locations. It is also noteworthy that construction of the collection trench would require the excavation of a large volume of material that could be contaminated. Current uncertainty in relation to the actual geographical limits of Waste Pits 1 through 3 and the burn pit would increase this concern since actual waste materials could be encountered, resulting in concern about meeting DOE's as low as reasonably achievable (ALARA) standards.

While fully effective in meeting the removal action objectives as defined in Section 3.0, the waste removal alternative exceeds the scope of the other removal action alternatives that have been developed to also satisfy the same objectives. Waste removal would also introduce far-reaching technical implications (e.g., removal technologies, stabilization technologies, storage facilities, etc.), public health and environmental implications (e.g., transportation and disposal requirements, worker exposure, etc.), administrative implications (e.g., impacts on the final remedial action decision process, and other administrative requirements, etc.), and high cost of implementation (Appendix D). The cost of implementing this alternative would be in excess of $740 million, which corresponds to

an increase of over 200 times the cost of Alternative 4 and over 100 times the cost of Alternative 2. This order of magnitude is not justified from a cost benefit standpoint. Although being eliminated from further consideration as a removal action, this same alternative remains a candidate for the long-term remediation of the waste storage area under the Operable Unit 1 feasibility study.

As a result of this initial screening, only Alternatives 1, 2, and 4 are retained for detailed evaluation in Section 5.0.

Surface water contributes to an exposure scenario resulting from the fact that uranium tends to migrate in solution (see Table 5-1 for an explanation). However, the calculated radiation dose for pathways from surface water from the Great Miami River is 0.05 mrem per year of intake. The radiation risk associated with this alternative for five years of the removal action is 3E-08. The HI for this alternative is 0.004. All of these values are in the acceptable range.

The alternative of runoff collection and treatment would increase the potential for direct contact with contaminated runoff because of the provision for temporary storage within the collection system. However, the entire system would be located within a controlled access area and the associated risk would be minimal. A future risk is associated with system breakdown since contaminated runoff could once again enter Paddys Run. However, as with the capping option, such a condition would be short-lived until maintenance is provided and would not result in continuous, long-term exposure.

Under this option, the potential exists for direct exposure to contaminants during construction due to the management of contaminated runoff throughout the period of construction and excavation into the contaminated area during construction of the new ditches. It is assumed that appropriate worker protection would be provided to negate any associated risk. Protection is also assumed against any exposure related to the K-65 silos or fugitive emissions from the waste pits during field construction.

5.4.2 Effectiveness: Environmental

By eliminating the discharge of runoff from the waste pit area to Paddys Run, Alternative 4 would totally satisfy the objective of reducing uranium loadings to the stream. The environmental conditions within Paddys Run would gradually improve as a result.

Any disruption of the local ecological communities during construction would be temporary and reestablishment of the communities would be expected. Construction of the collection ditches would disrupt the areas delineated as wetlands (Figure 2-5). However, these areas, excluding Paddys Run, are relatively small, with a total area of approximately eight acres, and are not considered critical habitat. It is expected that wetland communities would become reestablished in the areas not permanently altered and would develop in the newly constructed drainageways. Paddys Run would not be directly affected by construction activities and environmental conditions would gradually improve, as described above.

TABLE 5-1
URANIUM CONCENTRATIONS: FILTERED VERSUS UNFILTERED SAMPLES

	Total Uranium (µg/l)	
Sample Location	Filtered Sample	Unfiltered Sample
ASIT-001	21 ± 3	18 ± 3
ASIT-010	282 ± 46	231 ± 38
ASIT-018	700 ± 112	667 ± 106
ASIT-019	944 ± 156	930 ± 152
ASIT-020	538 ± 87	530 ± 86
ASIT-022	92 ± 15	54 ± 9
ASIT-023	465 ± 82	433 ± 72
ASIT-024	517 ± 83	576 ± 93
ASIT-027	8148 ± 1360	9318 ± 1499
ASIT-028	5067 ± 835	5779 ± 943
ASIT-029	1228 ± 201	1005 ± 163
ASIT-030	7030 ± 1127	8363 ± 1338
ASIT-031	6853 ± 1144	7380 ± 1210

Remarks: Data represent total uranium concentrations in both filtered and unfiltered samples from the drainages within the waste pit area. Within the range of uncertainty of the data, it may be concluded that the concentrations in the filtered and unfiltered samples are the same and that little (if any) uranium is bound up in suspended solids in the storm water runoff. This suggests that solids removed via settling would not be expected to correlate with uranium removal. Recent data collected by WMCO suggests less than 10 percent of the uranium in storm water runoff from the production area is bound to filterable solids. Consequently, it may be assumed that approximately 90 percent of the current uranium loading from the waste pit area storm water runoff will escape treatment via settling in the biodenitrification surge lagoon. The uranium removal efficiencies of the biodenitrification towers and effluent water treatment system are unknown at this time.

The values used for the parameters in this section are given below:

Parameter	Value	Reference
IR	2 l/day (maximum)	EPA 1989c
	1 l/day (average)	NRC 1977
EF	365 days/yr	assumed
ED	70 yrs.	EPA 1987a
FI	1.0	assumed
BW	70 kg	EPA 1989c
DCF	2.5E-04 mrem/pCi	DOE 1988

Substituting the parameter values into each equation yields the following:

I_{DW} (mg/kg/day) $\simeq$ C_w (mg/l) x 2.86E-02 (maximum)
I_{DW} (mg/kg/day) $\simeq$ C_w (mg/l) x 1.43E-02 (average)
CEDE (mrem) $\simeq$ C_w (pCi/l) x 1.83E-01 (maximum)
CEDE (mrem) $\simeq$ C_w (pCi/l) x 9.13E-02 (average)

Note that in each equation the intake or radiation dose is proportional to the uranium concentration in drinking water. Calculation of the intake or radiation dose is performed by multiplying the uranium concentration in drinking water (in appropriate units mg/l or pCi/l) by the factor in each equation.

C3.3.2 Ingestion of Irrigated Vegetables

Intake via ingestion of contaminated vegetables is calculated using the following equation:

$$I_v = (C_v)\ (IR)\ (EF)\ (ED)\ (FI)\ /\ (BW)\ (AT)$$

where

I_v = normalized daily intake of contaminated vegetables, (mg/kg/day),

C_v = concentration of uranium in vegetables, (mg/kg),

IR = ingestion rate, (kg/day), and

FI = fraction of ingested vegetables from contaminated source, (unitless)

The remaining parameters are the same as those defined in Section 3.3.1.

The values used for the parameters in this section are given below:

Parameter	Value	Reference
IR	0.219 kg/day (maximum), 0.079 kg/day (average)	NRC 1977
EF	365 days/yr	assumed
ED	70 yrs	EPA 1989a
FI	1.0	assumed
BW	70 kg	EPA 1989c
DCF	2.5E-04 mrem/pCi	DOE 1988
R	0.118 $l/m^2/hr$	NRC 1977
FC	0.25	NRC 1977
E	2.1E-03 1/hr	NRC 1977
TW	2160 hrs	NRC 1977
Y	2 kg/m^2	NRC 1977
FR	0.25	NRC 1977
B_v	2.0E-03	NCRP 1976
TS	8.8E+03 hrs	assumed
SD	240 kg/m^2	NRC 1977

Substituting these parameter values into each equation yields the following:

I_v (mg/kg/day) $\simeq$ C_w (mg/l) x 2.17E-02 (maximum)

I_v (mg/kg/day) $\simeq$ C_w (mg/l) x 8.08E-03 (average)

CEDE (mrem) $\simeq$ C_w (pCi/l) x 1.39E-01 (maximum)

CEDE (mrem) $\simeq$ C_w (pCi/l) x 5.03E-02 (average)

C3.3.3 Ingestion of Beef

Intake via ingestion of contaminated beef is calculated using the following equation:

$$I_B = C_B \text{ (IR) (EF) (ED) (FI) / (BW) (AT)}$$

where

I_B = normalized daily intake of contaminated beef, (mg/kg/day),

C_B = concentration of uranium in beef, (mg/kg),

IR = ingestion rate, (kg/day),

FI = fraction of ingested meat from contaminated beef, (unitless).

The remaining parameters are the same as those defined in Section 3.3.1.

The radiation dose received via ingestion of contaminated beef for one year is calculated using the following equation:

$$CEDE = (C_B)\ (DCF)\ (IR)\ (EF)\ (FI)$$

where

C_B = concentration of uranium in beef, (pCi/kg).

The remaining parameters are the same as those defined previously.

The value of C_B is calculated for uranium with the following equation:

$$C_B = (TC)\ [(C_v)\ (IF) + (C_w)\ (IW)]$$

where

TC = transfer coefficient for uranium, (mg/kg per mg/kg/day),

C_v = concentration of uranium in vegetation (forage) as calculated by the equation of Section 3.3.2, (mg/kg),

IF = ingestion rate of contaminated forage, (kg/day),

C_w = concentration of uranium in water as calculated by the equation of Section 3.3.1, (mg/l), and

IW = ingestion rate of contaminated water, (l/day).

The values used for these parameters in this section are:

Parameter	Value	Reference
IR	0.301 kg/day (maximum), 0.260 kg/day (average)	NRC 1977
EF	365 days/yr	assumed
ED	70 yrs	EPA 1989a
FI	1.0	NRC 1977
BW	70 kg	EPA 1989c
DCF	2.5E-04 mrem/pCi	DOE 1988
R	0.118 $l/m^2/hr$	NRC 1977
FC	0.25	NRC 1977
E	2.1E-03 1/hr	NRC 1977
TW	2160 hrs	NRC 1977
Y	2 kg/m^2	NRC 1977
FR	0.25	NRC 1977
B_v	2.0E-03	NCRP 1986
TS	8.8E+03 hr	assumed
SD	240 kg/m^2	NRC 1977
TC	1.0E-02 day/kg	NCRP 1986
IF	25 kg/day	NRC 1977
IW	50 l/day	NRC 1977

Substituting these parameters into each equation yields the following:

I_B (mg/kg/day)	$\simeq$	C_W (mg/l) x 9.64E-03	(maximum)
I_B (mg/kg/day)	$\simeq$	C_W (mg/l) x 8.35E-03	(average)
CEDE (mrem)	$\simeq$	C_W (pCi/l) x 6.15E-02	(maximum)
CEDE (mrem)	$\simeq$	C_W (pCi/l) x 5.33E-02	(average)

C3.3.4 Ingestion of Milk

Intake via ingestion of contaminated milk is calculated using the following equation:

$$I_M = C_M\ (IR)\ (EF)\ (ED)\ (FI)\ /\ (BW)\ (AT)$$

where the terms are analogous to the terms listed in Section 3.3.3.

The radiation dose received via ingestion of contaminated milk for one year is calculated using the following equation:

$$CEDE = (C_M)\ (DCF)\ (IR)\ (EF)\ (FI)$$

where the terms are analogous to the terms listed in Section 3.3.3.

The value of C_M is calculated for uranium with the following equation:

$$C_M = (TC)\ [(C_V)\ (IF) + (C_W)\ (IW)]$$

where the terms are analogous to the terms listed in Section 3.3.3.

The values used for these parameters are the same as those listed in Section 3.3.3, with the following exceptions:

Parameter	Value	Reference
IR	0.849 l/day (maximum) 0.301 l/day (average)	NRC 1977 NRC 1977
TC	6.0E-04 day/l	NCRP 1986
IW	60 l/day	NRC 1977

The remaining parameters are the same as in Section 3.3.1.

The radiation dose received via ingestion of contaminated sediment for one year is calculated using the following equation:

$$CEDE = (C_s)\ (DCF)\ (IR)\ (EF)\ (FI)$$

where

CEDE = committed effective dose equivalent, (mrem),

C_s = concentration of uranium in sediment, (pCi/g),

DCF = dose conversion factor for ingestion of uranium, (mrem/pCi),

IR = ingestion rate, (g/day),

EF = exposure frequency, (days/yr), and

FI = fraction of ingested sediment from contaminated source, (unitless).

The values used for the parameters in this section are given below:

Parameter	Value	Reference
IR	0.2 g/day (maximum)	EPA 1989c
EF	90 days/yr	assumed
ED	6 yrs.	assumed
FI	1.0	assumed
BW	36 kg (9 yr - 12 yr old)	EPA 1989c
DCF	2.5E-04 mrem/pCi	DOE 1988

Substituting the parameter values into each equation yields the following:

I_s (mg/kg/day) $\simeq$ C_s (mg/g) x 5.56E-03

CEDE (mrem) $\simeq$ C_s (pCi/g) x 4.5E-03

C3.3.7 Uranium Concentrations in Water Supplies

For each alternative, groundwater could be pumped from the Great Miami Aquifer or the Great Miami River and used as drinking water for humans and animals and for irrigation of food crops and forage. The concentration of uranium in groundwater as a consequence of charging of the Great Miami Aquifer along Paddys Run with surface water runoff from the waste pit area is based on the following assumptions for the no-action alternative:

APPENDIX C
REFERENCES

Berlin, M., and B. Rudell, 1979, "Uranium," Handbook on Toxicology of Metals, edited by L. Friberg et al., North-Holland Biomedical Press.

Hursh, J.B., W.R. Neuman, T. Toribara, H. Wilson, and C. Waterhouse, 1969, "Ingestion of Uranium by Man," Health Physics, Volume 17, pp. 619-621.

Hursh, J.B. and N.L. Spoor, 1973, "Data on Man," Uranium, Plutonium and the Transuranic Elements, edited by C.H. Hodge, J.N. Stannard and J.B. Hursh.

International Commission on Radiological Protection (ICRP), 1977, "Recommendations of the International Commission on Radiological Protection," Annals of the International Commission on Radiological Protection, Publication 26, Pergamon Press, New York.

Leggett, R.W., 1989, "The Behavior and Chemical Toxicity of U in the Kidney: A Reassessment," Health Physics, Volume 57:3, pp. 365-383.

Luessenhop, A.J., J.C. Gallimore, W.H. Sweet, E.G. Struxness, J. Robinson, 1958, "The Toxicity in Man of Hexavalent Uranium Following Intravenous Administration," American Journal of Roentgenology, Volume 79, pp. 83-100.

Maynard, E.A. and H.C. Hodge, 1949, "Studies of the Toxicity of Various Uranium Compounds When Fed to Experimental Animals," in: The Pharmacology and Toxicology of Uranium Compounds, Volume 1, edited by C. Voegtlin and H.C. Hodge.

National Council on Radiation Protection and Measurements (NCRP), 1986, "Screening Techniques for Determining Compliance with Environmental Standards," NCRP Commentary No. 3, Bethesda, Maryland.

National Council on Radiation Protection and Measurements (NCRP), 1987, "Recommendations on Limits for Exposure to Ionizing Radiation," Report 91, National Council on Radiation Protection and Measurements, Bethesda, Maryland.

Stokinger, H.E., 1982, "Uranium," Patty's Industrial Hygiene and Toxicology, third edition.

U.S. Department of Energy (DOE), 1988, "Internal Dose Conversion Factors for Calculation of Dose to the Public," DOE/EH-0071, Assistant Secretary for Environment, Safety and Health, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1989a, "Risk Assessment Guidance for Superfund, Human Health Evaluation Manual (Volume I), Interim Final," EPA 540/1-89/002, Office of Emergency and Remedial Response, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1989b, "Integrated Risk Information System (IRIS)," computer database, U.S. Environmental protection Agency, Washington D.C.

U.S. Environmental Protection Agency (EPA), 1989c, "Exposure Factors Handbook," EPA 600/8-89/043, July 1989, Office of Health and Environmental Assessment, Washington D.C.

U.S. Nuclear Regulatory Commission (NRC), 1977, "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," Regulatory Guide 1.109, U.S. Nuclear Regulatory Commission, Office of Standards Development, Washington D.C.

Westinghouse Materials Company of Ohio (WMCO), 1987, "Feed Materials Production Center Environmental Monitoring Report for 1986," FMPC-2076, UC-41, prepared by Westinghouse Materials Company of Ohio.

Westinghouse Materials Company of Ohio (WMCO), 1988a, "Feed Materials Production Center Environmental Monitoring Annual Report for 1987," FMPC-2135, UC-41, prepared by Westinghouse Materials Company of Ohio.

Westinghouse Materials Company of Ohio (WMCO), 1989a, "Feed Materials Production Center Environmental Monitoring Annual Report for 1988," FMPC-2173, UC-707, prepared by Westinghouse Materials Company of Ohio.

Westinghouse Materials Company of Ohio (WMCO), 1989b, "Engineering Evaluation/Cost Analysis for the Removal Action Waste Pit Area Stormwater Runoff Control," prepared by Westinghouse

Westinghouse Materials Company of Ohio (WMCO), 1989b, "Engineering Evaluation/Cost Analysis for the Removal Action Waste Pit Area Stormwater Runoff Control," prepared by Westinghouse Materials Company of Ohio for the U.S. Department of Energy, September 1989.

Wrenn, M.E., P.W. Durbin, B. Howard, J. Lipsztein, J. Rundo, E.T Still, D.L. Wilis, 1985, "Metabolism of Ingested U and Ra," Health Physics, Volume 48:5, pp. 601-633.

Wrenn, M.E., P.W. Durbin, D.L. Wilis, N.P. Singh, 1987, "The Potential Toxicity of U in Water," Journal of the American Water Works Association, Volume 79, pp. 177-184.

Yuile, C.L., 1973, "Animal Experiments (Chapter 3)," Uranium, Plutonium and the Transuranic Elements, edited by Hodge, Stannard and Hursh.

COST ESTIMATE FOR ALTERNATIVE 3
SURFACE CAPPING WITH LATERAL DRAINAGE

I. Excavation of Trench at Lower Elevations

Zone	Volume Required[1]	Length[2]	Profile of Cut[3]
1	3,537	600 ft	4 ft x 5 ft
2	3,792	500 ft	5 ft x 5 ft
3	162	400 ft	2 ft x 2 ft
4	747	125 ft	4 ft x 5 ft
5	3,379	525 ft	4.5 ft x 5 ft
6	4,500	600 ft	5 ft x 5 ft

Total Soil Excavated (length x profile)

Area			
1	600 x 4 x 5	=	444 cy
2	500 x 5 x 5	=	463 cy
3	400 x 2 x 2	=	59 cy
4	125 x 4 x 5	=	93 cy
5	525 x 4.5 x 5	=	438 cy
6	600 x 5 x 5	=	556 cy
			2,053 cy

Cost to excavate using a backhoe, 8 cy/hr x $100/hr[4]

2,053 cy/8 x $100 = $25,660

II. Disposal Costs[5]

2,053 cy/13.3 = 154 Containers

a. Cost of Containers - 154 x $600/each = $92,400

b. Transportation to NTS (4 containers/load) - 154/4 x $6,000 = $231,000

c. Disposal Cost of NTS - 2053 cy x $324/cy[6] = $665,170

[1]Infiltration from HELP output
[2]Length of base
[3]Void ratio estimated at 30%
[4]Building Construction Costs Data 1989," Means
[5]Final Environmental Impact Statement, "Long Term Management of the Existing Radioactive Waste and Residues at the Niagara Falls Storage Site," U.S. DOE, Washington, DC (April 1986)
[6]IT Telecon Report "Disposal Costs at NTS," January 1990

COST ESTIMATE FOR ALTERNATIVE 5
SOURCE REMOVAL

I.	Excavation Required[1] - 3.5 cy Dragline @ $2.00/cy[2]	
	503,400 cy x $2.00 =	$1,006,800
II.	Disposal Costs[3]	
	503,400 cy/13.3 = 37,850 containers	
	a. Cost of Containers	
	37,850 x $600/each =	22,710,000
	b. Transportation to NTS (4 containers/load)	
	37,850/4 = 9,463 x $6,000 =	56,775,000
	c. Disposal Cost at NTS	
	503,400 cy x $918/cy[4] =	$462,121,200
		$542,613,000
III.	Site Backfill	
	-Assume on-site borrow area	
	-$3.00/cy[2] transport, grading, and compaction w/503,400 cy	$1,510,200
	Mobilization/Demobilization	$5,000
IV.	Vegetation (Seed, Fertilizing & Mulch)	
	284,375 ft^2 0.10 ft^2 [2] =	28,438
	SUBTOTAL	$544,156,600
	CONSTRUCTION MANAGEMENT @ 24%, EXCLUDES DISPOSAL	612,105
	SUBTOTAL	$544,768,700
	CONTINGENCY @ 30%	163,430,600
	TOTAL	$708,199,300
	DESIGN @ 20% (EXCLUDING DISPOSAL)	$33,318,600
	TOTAL (PROJECT COST)	$741,517,900

[1]See Volume of Waste at Waste Pit Area Calculation
[2]"Building Construction Cost Data 1989," Means
[3]Final Environmental Impact Statement, "Long-Term Management Waste and Residues at the Niagara Falls Storage Site," U.S. DOE Washington, DC (April 1986)
[4]IT Telecon Report "Disposal Costs at NTS," January 1990

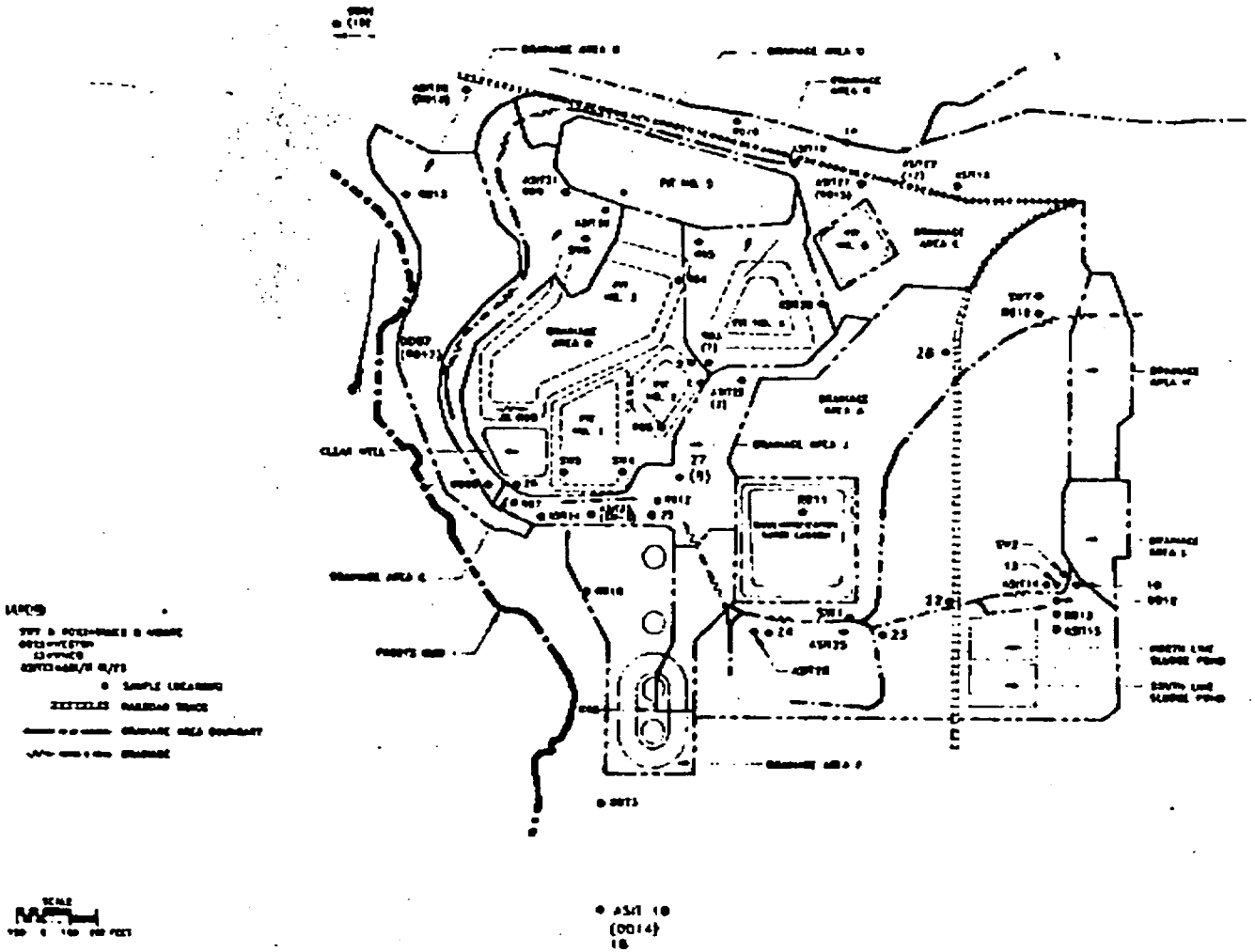


FIGURE 2-6
STORM WATER RUNOFF
SAMPLE LOCATIONS

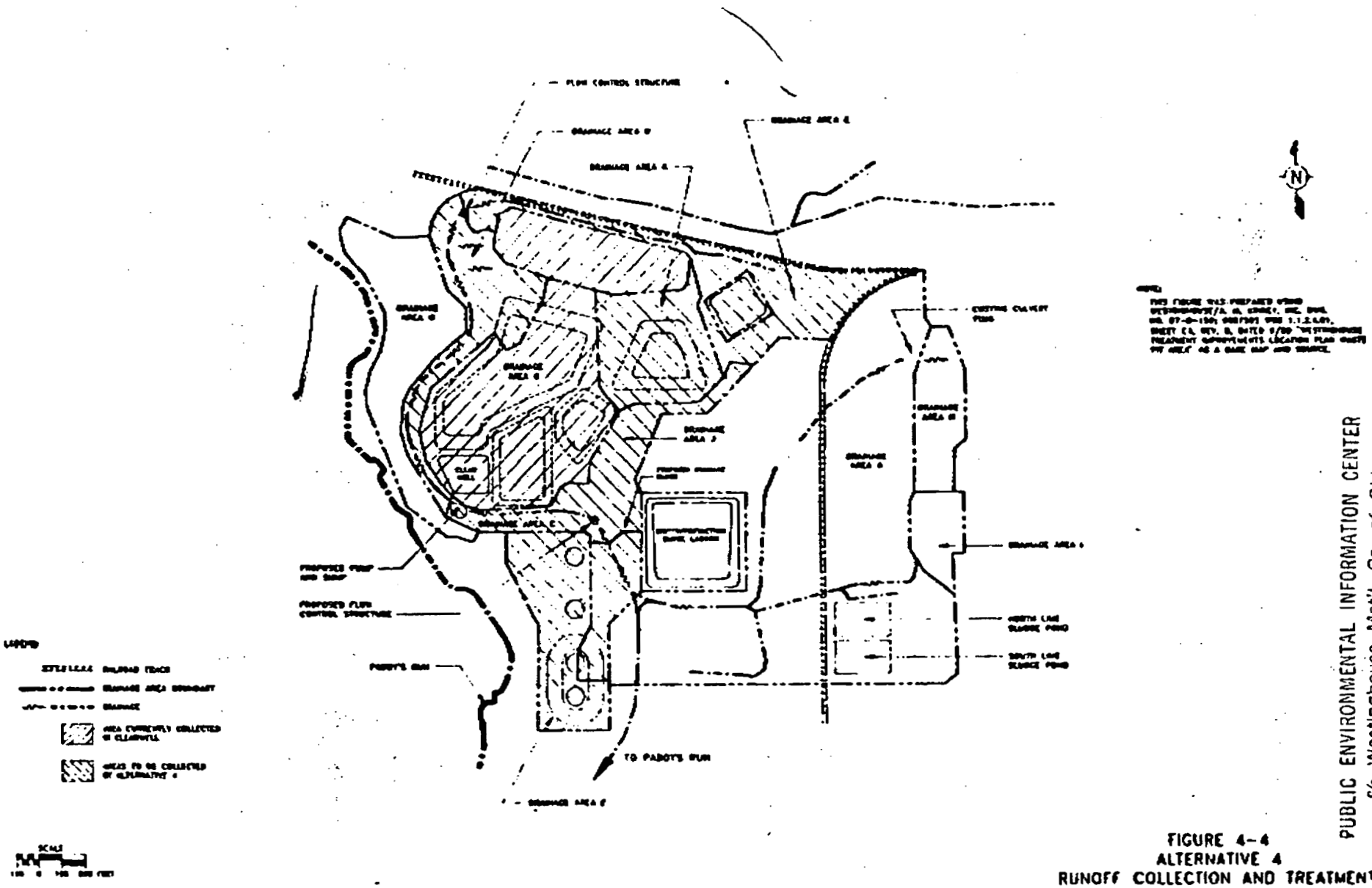
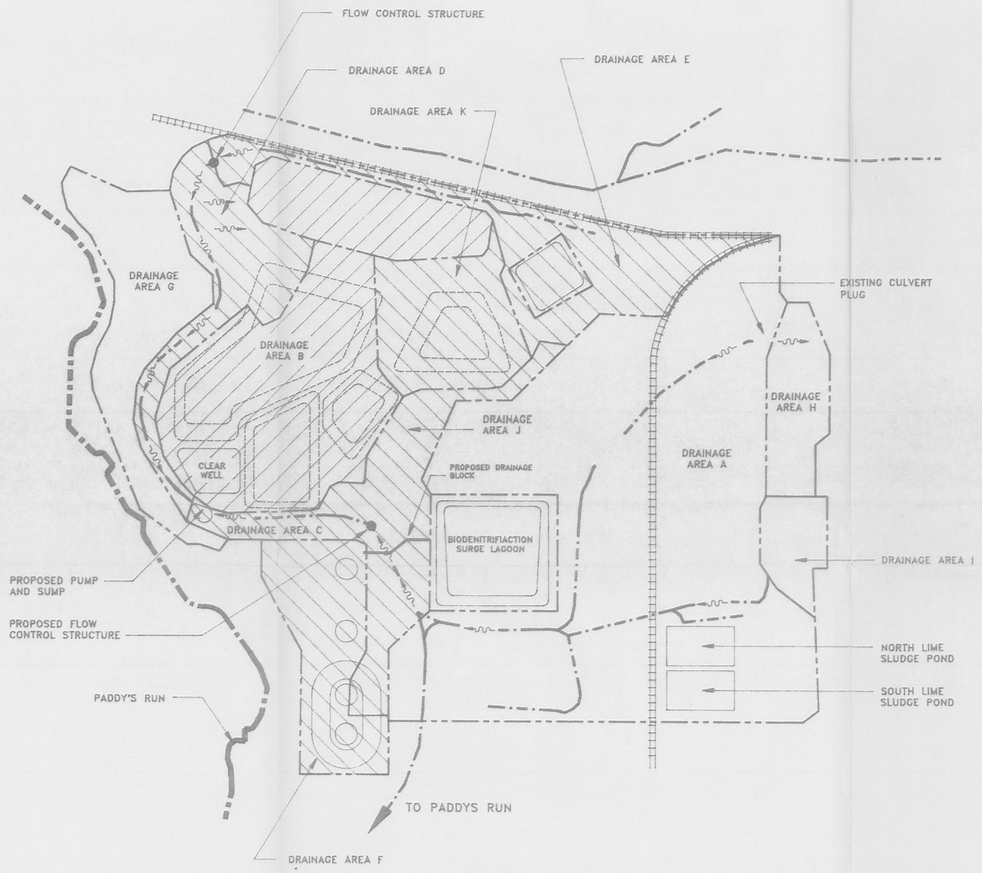


FIGURE 4-4
ALTERNATIVE 4
RUNOFF COLLECTION AND TREATMENT

PUBLIC ENVIRONMENTAL INFORMATION CENTER
% Westinghouse Mat'l. Co. of Ohio
P. O. Box 398704
Cincinnati, Ohio 45239-8704



NOTE:

THIS FIGURE WAS PREPARED USING WESTINGHOUSE/A. M. KINNEY, INC. DWG. NO. 87-D-159; 0087502 WBS 1.1.2.4.01, SHEET C4, REV. 0, DATED 6/89 "WESTINGHOUSE TREATMENT IMPROVEMENTS LOCATION PLAN WASTE PIT AREA" AS A BASE MAP AND SOURCE.

LEGEND:

- RAILROAD TRACK
- DRAINAGE AREA BOUNDARY
- DRAINAGE
- AREA CURRENTLY COLLECTED IN CLEARWELL
- AREAS TO BE COLLECTED BY ALTERNATIVE 4

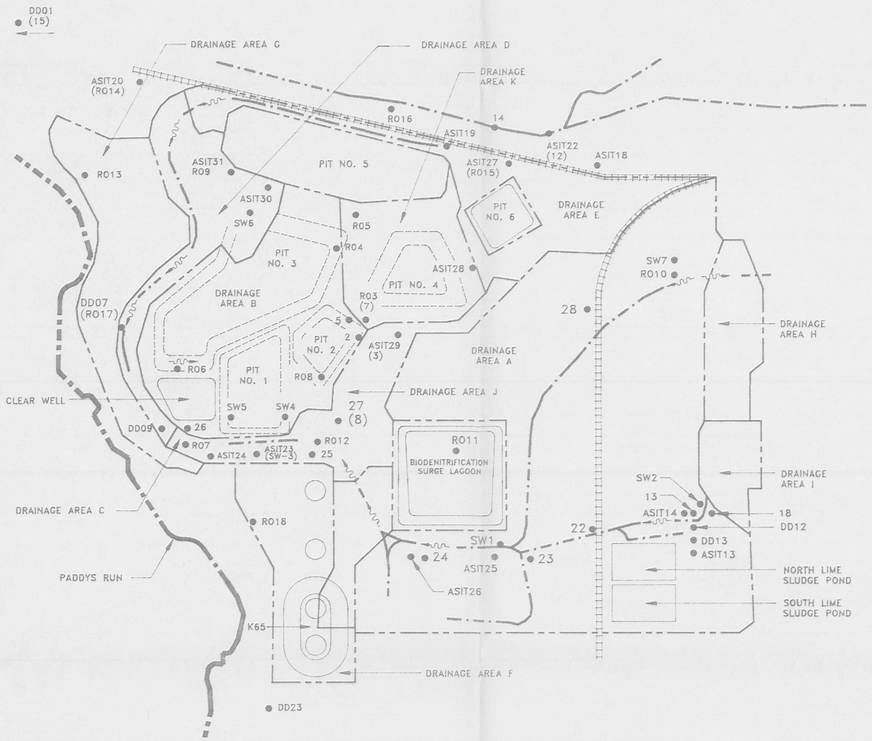
SCALE

100 0 100 200 FEET

FIGURE 4-4
ALTERNATIVE 4
RUNOFF COLLECTION AND TREATMENT

10/23/90

107254_1



NOTES:

1. LOCATION NUMBERS IN ( ) INDICATE SAME SAMPLE LOCATION BY DIFFERENT CONTRACTORS AT VARIOUS TIMES.
2. THIS FIGURE WAS PREPARED USING WESTINGHOUSE/A. M. KINNEY, INC. DWG. NO. 87-D-159; 0087502 WBS 1.1.2.4.01, SHEET C4, REV. 0, DATED 6/89 "WESTINGHOUSE TREATMENT IMPROVEMENTS LOCATION PLAN WASTE PIT AREA" AS A BASE MAP AND SOURCE.

FIGURE 2-6
STORM WATER RUNOFF
SAMPLE LOCATIONS

10/23/90

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