

JEFFERSON COUNTY REMEDY LANDS

SEMI-ANNUAL REPORT

SUMMER, 1991

ADMIN RECORD

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Date 7/20/91

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Date 8/5/91

A-DU03-000018

JEFFERSON COUNTY REMEDY LANDS  
SEMI-ANNUAL REPORT - SUMMER 1991

1 INTRODUCTION

This report summarizes the current status of land management activities planned for 1991 on the Jefferson County Remedy Lands. This report includes results of soil samples analyzed for plutonium and americium, and the current status of revegetation activities.

Soil samples were taken during February 1991 from both tilled and untilled strips of land on the two areas, north and south, of the Jefferson County Remedy Lands. All soil samples were analyzed for plutonium 238, plutonium 239+240, and americium 241. All soil sample results are shown in Table 1. The 1985 Settlement Agreement requires soil tilling to reduce surface plutonium contamination to below the Colorado Department of Health (CDH) plutonium-in-soil construction standard of 0.9 pCi/g. Several previously-tilled strips are greater than the 0.9 pCi/g requirement and under the Settlement Agreement require additional tilling. Several untilled strips, previously thought to require tilling, are less than 0.9 pCi/g and will not require tilling. Tilling activities will not occur until successful revegetation of currently tilled strips. Soil analysis results are detailed in Section 2 of this report.

Revegetation activities outlined in the "January 1991 Jefferson County Remedial Action Lands Report" began with mowing of the tilled strip vegetation for weed control. Seeding and mulching will follow in the fall of 1991. Adjustments to the revegetation plan outlined in the "Jefferson County Remedial Action Lands January 1991 Report" have been made following further consultation with revegetation specialists. Adjustments include expanding the seed mix composition, broadcasting the seed mix rather than drilling or hydroseeding, and not planting a spring-seeded cover crop. Explanation for these adjustments are found in Section 3 of this report.

The Environmental Protection Agency (EPA) and the Colorado Department of Health (CDH) recently granted approval to the "Past Remedy Report" specific to the Jefferson County Remedy Lands. The "Past Remedy Report" provides an historical information summary and a preliminary health risk assessment for plutonium-contaminated soils found outside the boundaries of the Rocky Flats Plant (RFP). This information summary includes all historical studies of offsite soil contamination originating from RFP, including the Remedy Lands. The document also contains a human health risk assessment to evaluate the risks posed by offsite plutonium soil contamination. Direction for the "Past Remedy Report" was provided by the Interagency Agreement (IAG) between DOE, EPA and CDH.

2 SOIL SAMPLING RESULTS

As discussed in the "Jefferson County Remedial Action Lands January 1991 Report", soil samples were collected from both tilled and untilled strips in both areas of the remedy lands. Two areas are included in the Jefferson County Remedy Lands, the north area in Section 7 (T2S,R69W) and the south area in Section 18 (T2S,R69W). Tilled strips are those strips tilled in 1986 (north area) and 1987 (south area). Untilled strips, not included in the 1986 and 1987 tilling operations, are scheduled for future tilling and occur alternately with the

TABLE 1

SOIL SAMPLE RESULTS  
JEFFERSON COUNTY REMEDY ACRES  
July, 1991

Page 1 of 3

North area (Section 7)

Sample number (see map for location)	Pu 239,240	Am 241	Pu 238
	-----pCi/g-----		
T1A	0 952	0 224	0 00744
T1A	0 859	0 156	0 0167
T1B	1 47	0 272	0 0246
U1A	6 47	0 944	0 110
U1B	2 67	0 648	0 0312
T2A	0 757	0 125	0 0125
T2B	0 680	0 178	0 0107
T2C	1 60	0 290	0 0384
U2A	3 59	0 567	0 0586
U2B	1 22	0 453	0 00951
T3A	0 923	0 199	0 0114
T3B	0 734	0 115	0 00710
T3B	0 575	0 0928	0 00969
T3C	0 655	0 107	0 00999
U3A	1 70	0 279	0 0155
U3A	1 47	0 320	0 0146
U3B	1 19	0 260	0 0143
T4A	0 808	0 161	0 00
T4B	0 365	0 0784	0 00676
T5	0 566	0 128	0 00851
U4	0 178	0 0990	0 00
T6	0 476	0 0603	0 00299
U5	0 412	0 118	0 00318
T7	0 162	0 0564	0 00
U6	0 424	0 101	0 00714

## North Area (continued)

Sample number	Pu 239,240	Am 241	Pu 238
	----- p C i / g -----		
T8	0 225	0 0406	0 00628
U7	1 15	0 26	0 0304
T9	0 591	0 114	0 00343
T9	0 203	0 0439	0 00226
T9	0 171	0 0337	0 00273
U8	0 201	0 150	0 00226
T10	0 249	0 0532	0 00423
U9	1 86	0 306	0 0300
U9	1 64	0 250	0 0308
T11	0 480	0 0647	0 0164

## South Area (Section 18)

U10A	1 74	0 363	0 0507
U10B	1 09	0 229	0 0145
T12A	0 288	0 0487	0 00
T12B	0 356	0 0483	0 0127
U11A	0 718	0 112	0 0178
U11B	0 771	0 141	0 0191
T13A	0 891	0 200	0 00385
T13B	0 686	0 0951	0 0195
T13B	0 445	0 0426	0 00397
U12A	0 972	0 195	0 00592
U12B	0 742	0 122	0 0216
T14A	0 608	0 100	0 00500
T14B	0 432	0 0882	0 0123

## South Area (continued)

Sample Number	Pu 239,240	Am 241	Pu 238
	-----pCi/g-----		
U13A	1 27	0 197	0 0202
U13A	1 23	0 178	0 0147
U13B	0 762	0 158	0 00661
T15A	1 34	0 213	0 0290
T15B	1 08	0 140	0 0176
T15B	0 332	0 0624	0 00587
U14A	0 683	0 138	0 0160
U14B	0 989	0 161	0 0183

tilled strips The detailed soil sampling plan containing 1991 sampling methodology is included in Appendix A of this report All soil samples were analyzed for plutonium 238, plutonium 239+240, and americium 241 The soil sample analysis data contained in this report are preliminary because they are undergoing Quality Assurance (QA) procedures Although changes in the reported data are not expected, Jefferson County will be notified if significant changes are made during the QA evaluation

#### TILLED STRIP SOIL SAMPLE RESULTS

All soil sample results from both north and south areas of the Remedy Lands are shown in Table 1 Table 2 compares results of 1991 soil samples with results of soil samples following tilling operations in 1987 and 1988 Some 1991 strip soil sampling areas were averaged in Table 2 to make the comparison with soil results obtained in 1987 and 1988 Figure 1 shows sample location and plutonium 239+240 concentrations for north area tilled strips Figure 2 shows the sample location and results of south area tilled strips All duplicate samples in Table 1 were averaged for Figures 1 to 4

As shown in Figure 1, tilled strips T1A, T1B, T2C, T3A, and T15A are above the 0.9 pCi/g requirement set by the Settlement Agreement Sample number T15B has duplicate samples that differ widely with values above and below 0.9 pCi/g The average of the two duplicate samples is 0.70 pCi/g Following the QA evaluation, a determination will be made if additional sampling of T15B is needed All sample results following tilling in 1986 and 1987 were lower than the 0.9 pCi/g requirement Table 2 compares 1991 results with 1987/88 results over similar tilled strip areas To make the direct comparison between sampling years in Table 2, three 1991 strip areas were averaged Table 2 shows results of three strips greater than the 0.9 pCi/g requirement, T1A/T1B, T2C and T15A Averaging strips T3A and T3B reduces the overall value below 0.9 pCi/g

The variability of results observed between sampling years can occur from several factors During laboratory analysis, soil blanks are included with the soil samples to assess analytical accuracy During 1987 and 1988 it was common practice to subtract soil blank results from sample results Soil blank results were not subtracted from sample results reported for 1991 Soil blank results for the 1987/88 data range from +0.13 to -0.11 pCi/g Variation between labs is another source of uncertainty Two different laboratories and a five-year time period separate the sampling years thus variation in technique and equipment sensitivity could be significant An indication of analytical variability within the same lab can be shown using the two data sets Several duplicate samples were included in both data sets Ideally, duplicate samples should yield identical results The differences between duplicate samples from the 1987/88 data range as high as 1.3 pCi/g Differences between duplicates in the 1991 data range as high as 0.75 pCi/g This inherent variation within the sampling and analysis process must be considered when evaluating the data

#### UNTILLED STRIP SOIL SAMPLE RESULTS

Figure 3 shows sample locations and plutonium 239+240 concentrations for north area untilled strips Figure 4 shows the sample locations and results of south area untilled strips Untilled strips U4, U5, U6, U8, U11, U13B, and U14A are below the 0.9 pCi/g requirement These strips were originally scheduled for tilling following successful revegetation of the tilled strips The results show that tilling will not be required for these untilled strips The highest

TABLE 2 Comparison of 1991 soil sample results with results following tilling operations in 1987 and 1988

Strip Sample Number	Results Following Tilling Operations in 1987 and 1988	1991 Results
	----- p C i / g -----	
T1A/T1B	0 83	1 19
T2A/T2B	0 63	0 72
T2C	0 45	1 60
T3A/T3B	0 66	0 79
T3C	0 35	0 66
T4A	0 48	0 81
T4B	0 32	0 36
T5	0 15	0 57
T6	0 10	0 48
T7	0 36	0 16
T8	0 27	0 22
T9	0 26	0 32
T10	0 20	0 25
T11	0 72	0 48
T12A	0 04	0 29
T12B	0 25	0 36
T13A	0 44	0 89
T13B	0 71	0 56
T14A	0 14	0 61
T14B	0 46	0 43
T15A	0 25	1 34
T15B	0 10	0 71

# MAP LEGEND

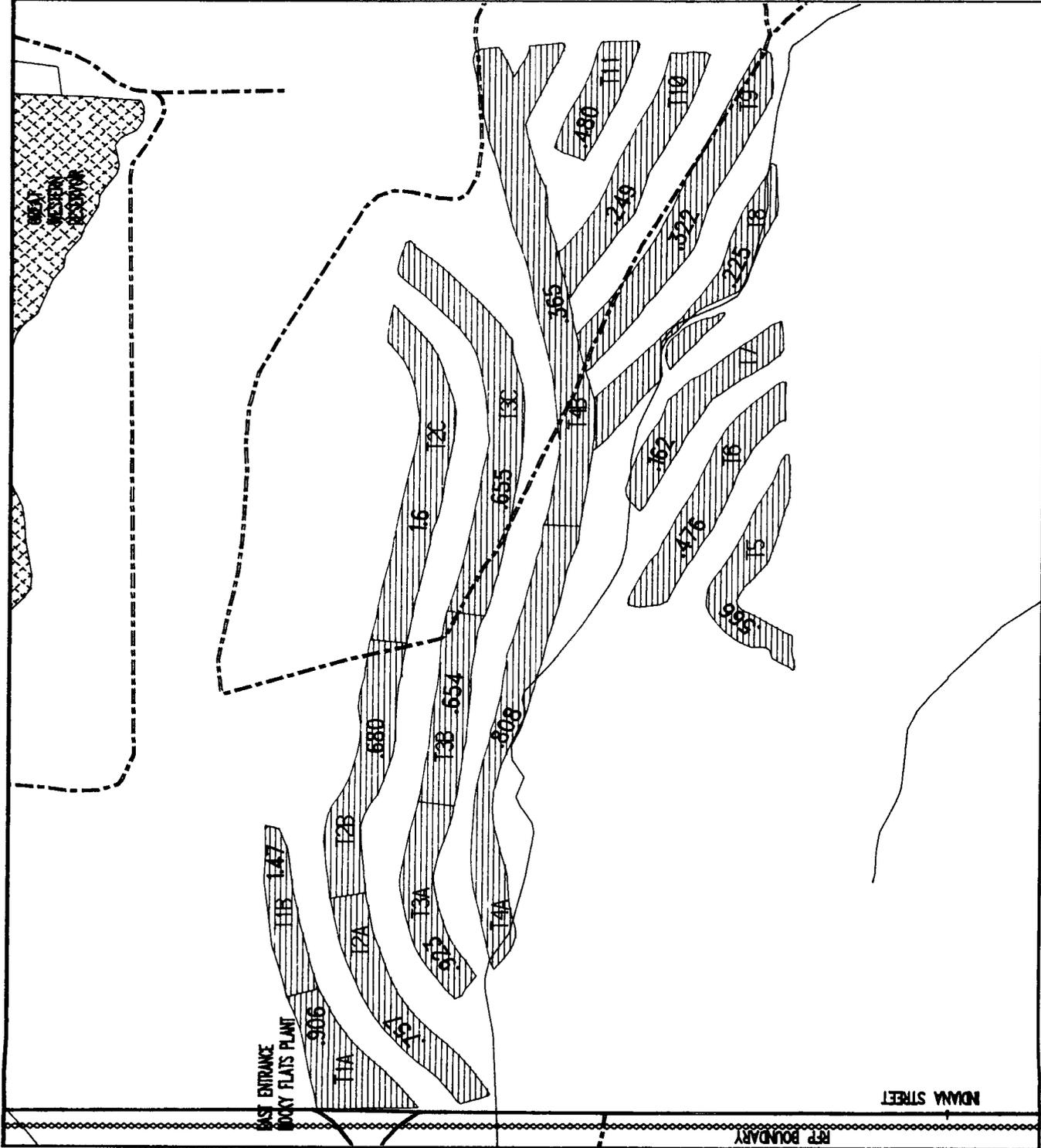
- RFP BOUNDARY
- STREAMS, DITCHES AND DRAINAGE FEATURES
- MEDIUM DUTY ROADS
- - - UNIMPROVED DIRT ROADS
- [Hatched Box] TILLED AREAS (VALUES IN p.c./G)
- [Cross-hatched Box] SURFACE WATER IMPOUNDMENTS

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of ENERGY  
Rocky Flats Plant  
Golden, Colorado



MAP OF NORTH AREA  
TILLED STRIPS OF  
REMEDY LAND SHOWING  
SOIL SAMPLE LOCATION,  
SAMPLE NUMBER AND  
RESULTS OF Pu 239,  
240 ANALYSIS

FIGURE 1



**MAP LEGEND**

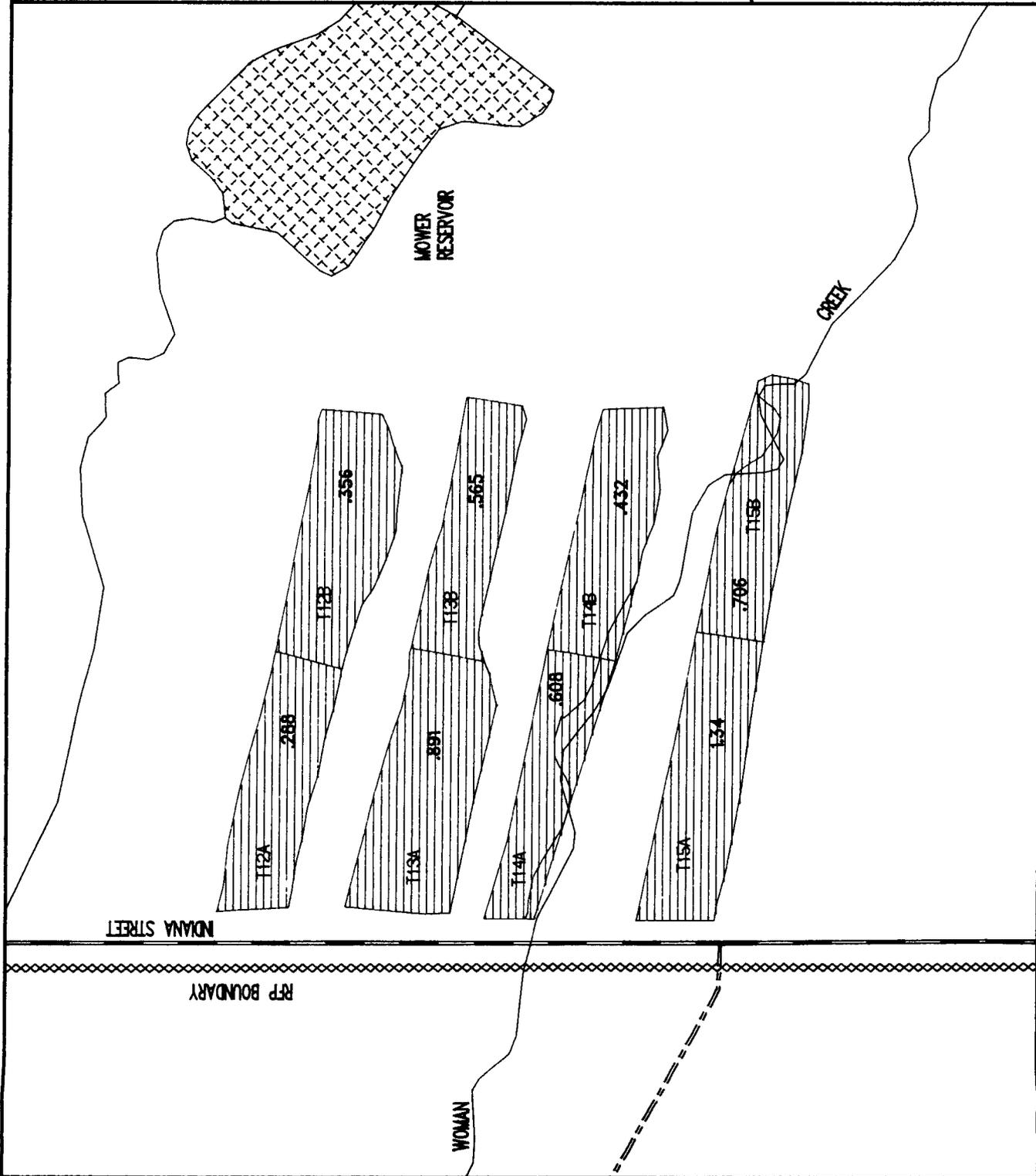
- o-o-o-o RFP BOUNDARY
- STREAMS, DITCHES AND DRAINAGE FEATURES
- MEDIUM DUTY ROADS
- UNIMPROVED DIRT ROADS
- ▨ TILLED AREAS (VALUES IN pCi/G)
- ▩ SURFACE WATER IMPOUNDMENTS

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MAP OF SOUTH AREA  
TILLED STRIPS OF  
REMEDY LAND  
SHOWING SOIL  
SAMPLE LOCATION,  
SAMPLE NUMBER AND  
RESULTS OF Pu 239,  
240 ANALYSIS

FIGURE 2



# MAP LEGEND

o-----o RFP BOUNDARY

— STREAMS, DITCHES AND DRAINAGE FEATURES

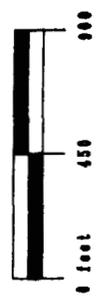
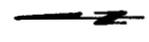
— MEDIUM DUTY ROADS

- - - - - UNIMPROVED DIRT ROADS

▨ UNTILLED AREAS (VALUES IN PC1/G)

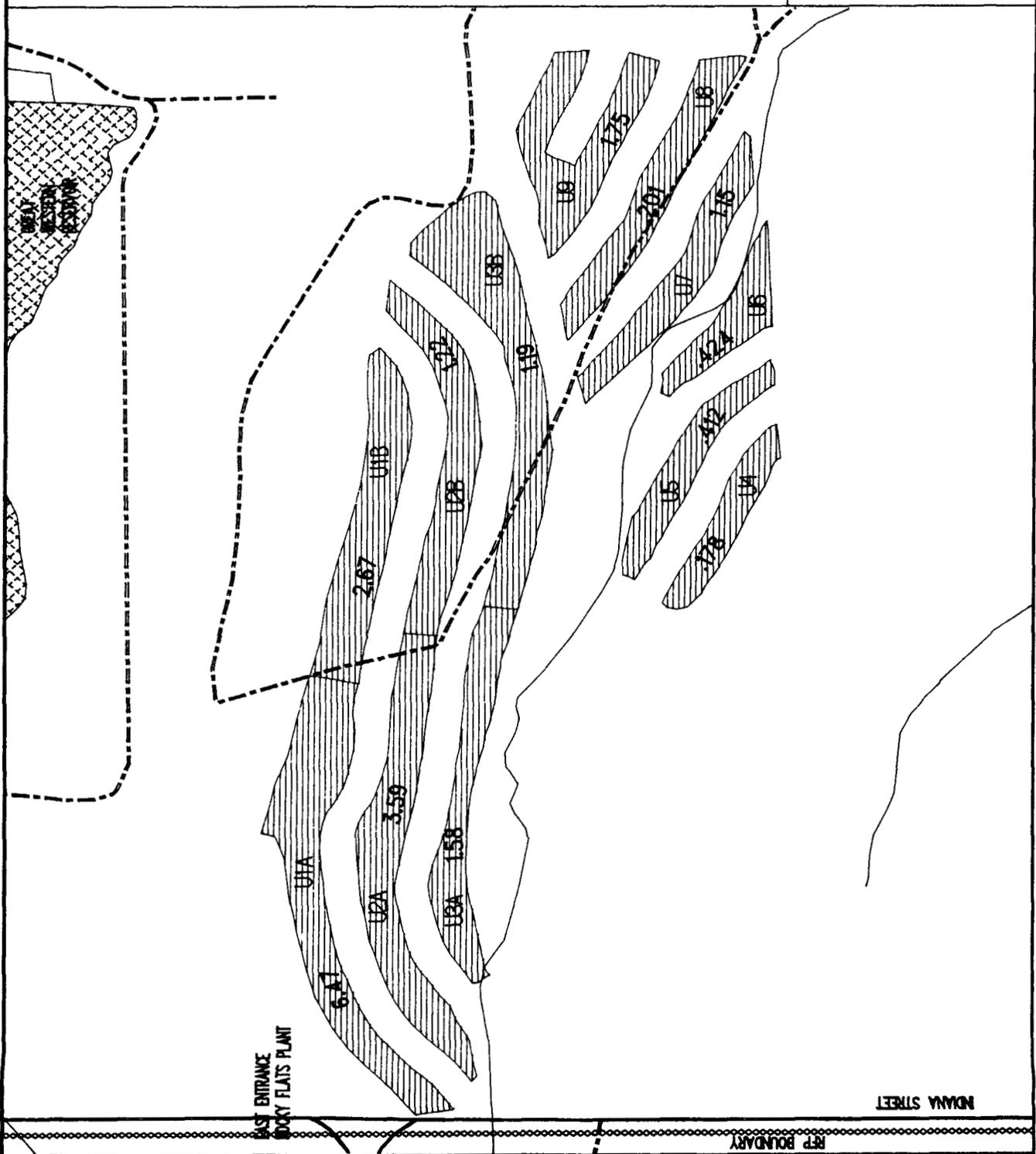
▣ SURFACE WATER IMPOUNDMENTS

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MAP OF NORTH AREA  
UNTILLED STRIPS OF  
REMEDY LAND SHOWING  
SOIL SAMPLE LOCATION,  
SAMPLE NUMBER AND  
RESULTS OF Pu 239,  
240 ANALYSIS

FIGURE 3



**MAP LEGEND**

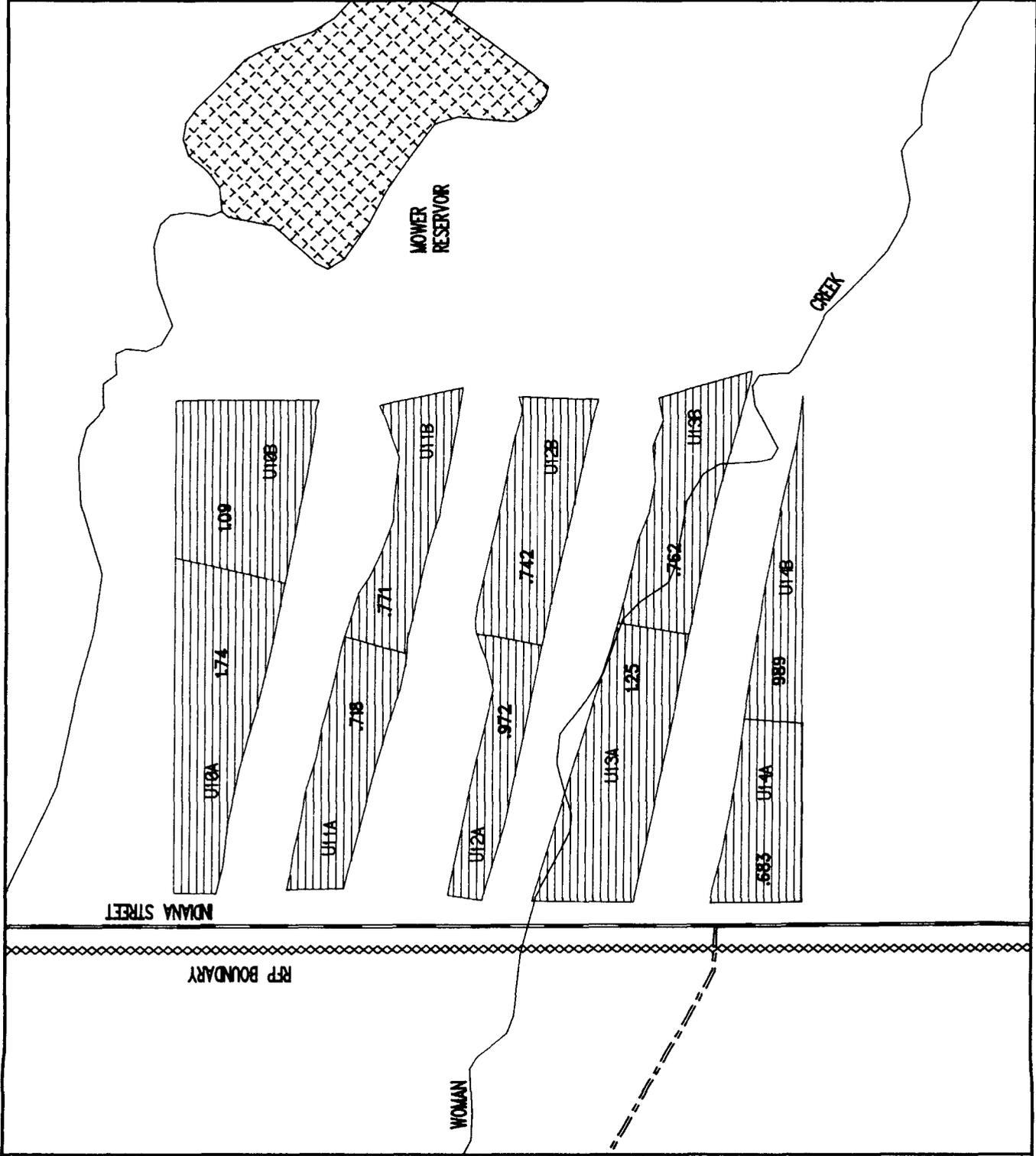
- ◊◊◊◊ RFP BOUNDARY
- STREAMS, DITCHES AND DRAINAGE FEATURES
- MEDIUM DUTY ROADS
- == UNIMPROVED DIRT ROADS
- ▨ UNTILLED AREAS (VALUES IN P.C.I./G)
- ▩ SURFACE WATER IMPOUNDMENTS

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MAP OF SOUTH AREA  
UNTILLED STRIPS OF  
REMEDY LAND  
SHOWING SOIL  
SAMPLE LOCATION,  
SAMPLE NUMBER AND  
RESULTS OF Pu 239,  
240 ANALYSIS

FIGURE 4



plutonium 239+240 values are found in the north area closest to RFP and decrease with distance to the southeast as expected. The overall average of 14 untilled north area plutonium 239+240 soil samples and duplicates is 1.73 pCi/g with a range of 0.647 to 0.178 pCi/g. This average is less than the average of 12 soil samples collected in 1977 and 1985 of 2.76 pCi/g with a range of 0.77 to 0.82. The overall average of 11 untilled south area plutonium 239, 240 soil samples and duplicates is 0.997 pCi/g with a range of 0.174 to 0.683 pCi/g. The average of five soil samples collected in the south area in 1977 and 1985 was 1.14 pCi/g with a range of 0.86 to 1.7 pCi/g. Data for 1977 and 1985 were obtained from the "Remedial Action Program on Jefferson County Open Space, January 1987."

### 3 REVEGETATION OF REMEDY LANDS

The tilled strips will be mowed to impede weed growth as outlined in the "Jefferson County Remedial Action Lands January, 1991 Report". One mowing operation has been accomplished and a second will follow in the fall, followed by seeding and mulching. Results of the fall seeding activities will be included in the January 1992 report to Jefferson County.

RFP monitors the Remedy Lands during the year for total vegetative ground cover and perennial grass ground cover. Data from 1990 and 1991 show the Remedy Lands were protected from wind and water erosion by a fair-to-good total vegetative ground cover. This total ground cover includes, however, many undesirable weed species which may not provide long-term erosion protection. The "Jefferson County Remedial Action Lands, January 1991 Report" provides a detailed discussion of desirable vegetation and current problems to successful revegetation. Vegetative ground cover composed of perennial grass species is needed for long-term protection. Key problems to successful revegetation include weed infestations and prairie dog activity.

Further review of the proposed revegetation activities outlined in the "Jefferson County Remedial Action Lands, January 1991 Report" by RFP, prompted changes in the program. Adjustments to the revegetation activities were made by RFP personnel and Dr. Sam Bamberg, a Ph.D. ecologist in consultation with Mr. Gary Finstad, District Conservationist with the Soil Conservation Service (SCS). A memorandum from Dr. Bamberg to Michael Guillaume of EG&G Rocky Flats dated May 23, 1991 is found in Appendix B of this report which outlines the general approach, evaluates the present condition, and recommends revegetation procedures for 1991. Also found in Appendix B is a letter from Mr. Finstad in support of these recommendations. A detailed discussion of the changes and reasons for the changes can be found in Dr. Bamberg's memorandum. A summary of the changes to the January 1991 revegetation plan include the following:

- The cover crop of forage sorghum will not be seeded in the spring. Successful sorghum seeding requires a prepared seedbed. This tillage activity would destroy existing vegetation and increase potential soil resuspension. The intent of the sorghum seeding was to provide protection from soil movement. The remedy lands are currently covered with a fair-to-good ground cover, thus sorghum seeding is unnecessary and detrimental to existing vegetation.
- The seed mix will be broadcast rather than drilled or hydroseeded. Broadcasting is more effective on extremely rocky areas such as those found on the site. The

seeding rate will be increased and the seeding followed by a harrow to promote intimate seed contact with the soil

- Two seed mixes will be used to compliment the varying soil conditions. The composition of the seed mixes will be expanded to include other native species. This expanded seeding will provide greater plant diversity because of improved germination on the more difficult revegetation sites. The proposed seed mix is found in Table 1 of Dr. Bamberg's memorandum of July 30, 1991 found in Appendix C.

A summation of field activities to date is contained in Dr. Bamberg's memorandum of July 30, 1991 found in Appendix C.

The ability to schedule future tilling operations is limited by lack of success in revegetating the currently tilled strips. Previous reports to Jefferson County have outlined the poor revegetation results. The Settlement Agreement states that work on the alternate set of strips shall not begin until the first set is successfully reestablished in grass. Tilling of the alternate strips will not occur until grass species are reestablished. An aggressive revegetation program was initiated in 1991 and will continue.

SOIL SAMPLING PLAN FOR  
JEFFERSON COUNTY REMEDIATION LANDS  
1990

Prepared by

Environmental Restoration Program  
Remediation Programs Division  
EG&G Rocky Flats  
Golden, Colo 80402  
October, 1990

## **1 INTRODUCTION**

Deposition of wind dispersed plutonium from the 903 Pad area contaminated soils on offsite lands east of Indiana Street. In 1985, as part of the offsite remediation project (Operable Unit #3), plutonium contaminated soil was mixed by tilling to reduce plutonium concentration to below the Colorado Department of Health (CDH) construction standard of 0.9 picocuries per gram (pCi/g). Soil samples taken in 1986 to assess the effectiveness of remediation, do not stand up to current data validation standards. New samples are needed to insure the effectiveness of past remedial actions and determine future work plans.

A 1985 out-of-court Lawsuit Settlement directs the remediation and revegetation of approximately 200 acres of land owned by Jefferson County. Soil samples taken in 1985, prior to remediation, show plutonium concentrations in the 0.03 to 3.0 pCi/g range. As part of the Settlement Agreement, soil containing total plutonium concentrations greater than the Colorado Department of Health (CDH) construction standard of 0.9 pCi/g were tilled to reduce surface deposited plutonium. Remediation of the Jefferson County land was started in 1986 by tilling and revegetating approximately half of the 200 acre area. Tilling operations were performed on contour strips as presented in figures 1 and 2. 1986 data indicate that tilling was successful in reducing plutonium concentrations to below the CDH standard.

Influences from other Individual Hazardous Substance Sites (IHSS's) will not be a factor in this sampling procedure due to the distance to the offsite areas. Soil samples taken by this sampling plan could exceed the CDH construction standard of 0.9 pCi/g for protection of earthmovers working with contaminated soil.

The Jefferson County remediation lands are directly east of the Plant boundary and divided into two areas, the north area in Section 7 (T2S, R69W) and the south area in Section 18 (same T&R). This sampling plan addresses both areas.

## **2 PURPOSE FOR SAMPLING**

2.1 Sampling is necessary to document the attempts to reduce soil plutonium concentrations as mandated by the 1985 Settlement Agreement, McKay vs The United States. It is necessary to measure the soil plutonium levels and report the status of the remediation effort to Jefferson County.

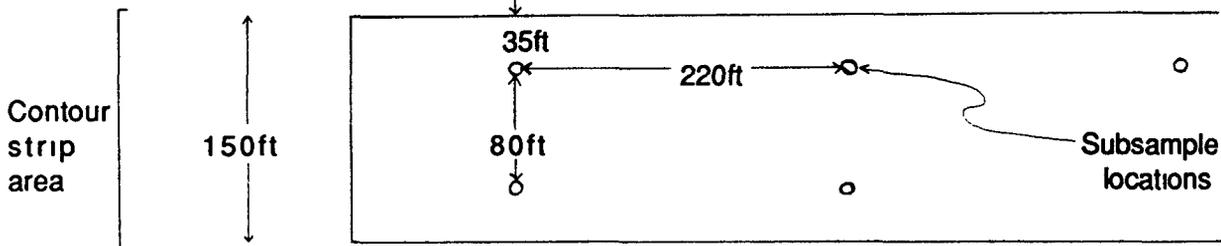
2.2 As part of the ongoing offsite remediation project, current soil plutonium levels are needed to determine actions for 1991. The Offsite Remediation Project involves mixing the surface soil layer to a depth of 12 inches to reduce the plutonium concentration. The resulting soil disturbance must then be revegetated to control water and wind erosion. Sampling in 1985 indicated that tilling reduced plutonium concentrations but these data do not stand up to present data validation standards. Soil from areas where sample analyses yield plutonium levels greater than the CDH standard will be tilled again to reduce the plutonium concentration. Validatable soil analyses must be performed to determine if further tilling is necessary. Soil plutonium concentrations are also needed on the untilled strips to monitor possible changes from the 1985 data.

## **3 SAMPLING AND ANALYSIS**

3.1 The sampling technique will follow the Colorado Department of Health (CDH)

protocol as outlined in the Rocky Flats ER Program Standard Operating Procedure (SOP) No 3 8

3 2 Soil sampling will be conducted on tilled and untilled contour strips in Sections 7 and 18, as shown in figures 1 and 2. Systematic subsamples will be taken across the strip area and composited to make one sample per sampling area. Subsample sites will be located on the strips based on the following dimensions:



This distribution of subsample sites across a strip will provide a ratio of 26 sites per 10 acres. Table 1 presents the sample number designation, approximate acreage per strip sample area, and number of subsamples to be composited per sample area for the tilled contour strips. Table 2 presents the same information for the untilled contour strips. Sample number designation begins with a T or U to designate tilled or untilled contour strips.

3 3 The CDH standard of compositing 25 subsamples per 10 acres into one sample is prorated to calculate the number of subsamples per strip area (example: 13 subsamples per 5 acres). Each map shows the sample number designation for each strip sampling area. The longest strips in Section 7 are larger than 10 acres; thus, they are divided in half. Three tilled strip areas are further divided because they had greater soil plutonium concentrations in 1985 and required a greater number of tillage passes to reduce the plutonium level below the 0.9 pCi/g standard. The sampling density is much greater than required by CDH to minimize future tilling if found necessary.

3 4 Transportation of the samples to an offsite laboratory under contract by ER will be the responsibility of the contractor. The contractor will follow ER health and safety plan, and QA/QC procedures. Soil samples shall be analyzed for plutonium 239, 240, and americium 241.

#### 4 DATA ANALYSIS AND INTERPRETATION

4 1 Data will be analyzed for adherence to the CDH plutonium in soil construction standard of 0.9 pCi/g. Land areas with soil plutonium values less than 0.9 pCi/g will not require further tilling. Those contour strips tilled in 1985 with soil plutonium values greater than 0.9 pCi/g will require more tilling. If tilling is required, the area will be sampled after tilling using the sampling procedure outlined above. Tilling and subsequent sampling would continue until the soil plutonium values were below 0.9 pCi/g. Soil plutonium concentrations on untilled contour strips will be compared with 1985 values.

Figure 1 Jefferson County land in Section 7 undergoing remedial action, showing location of tilled and untilled contour strips and soil sample number designation

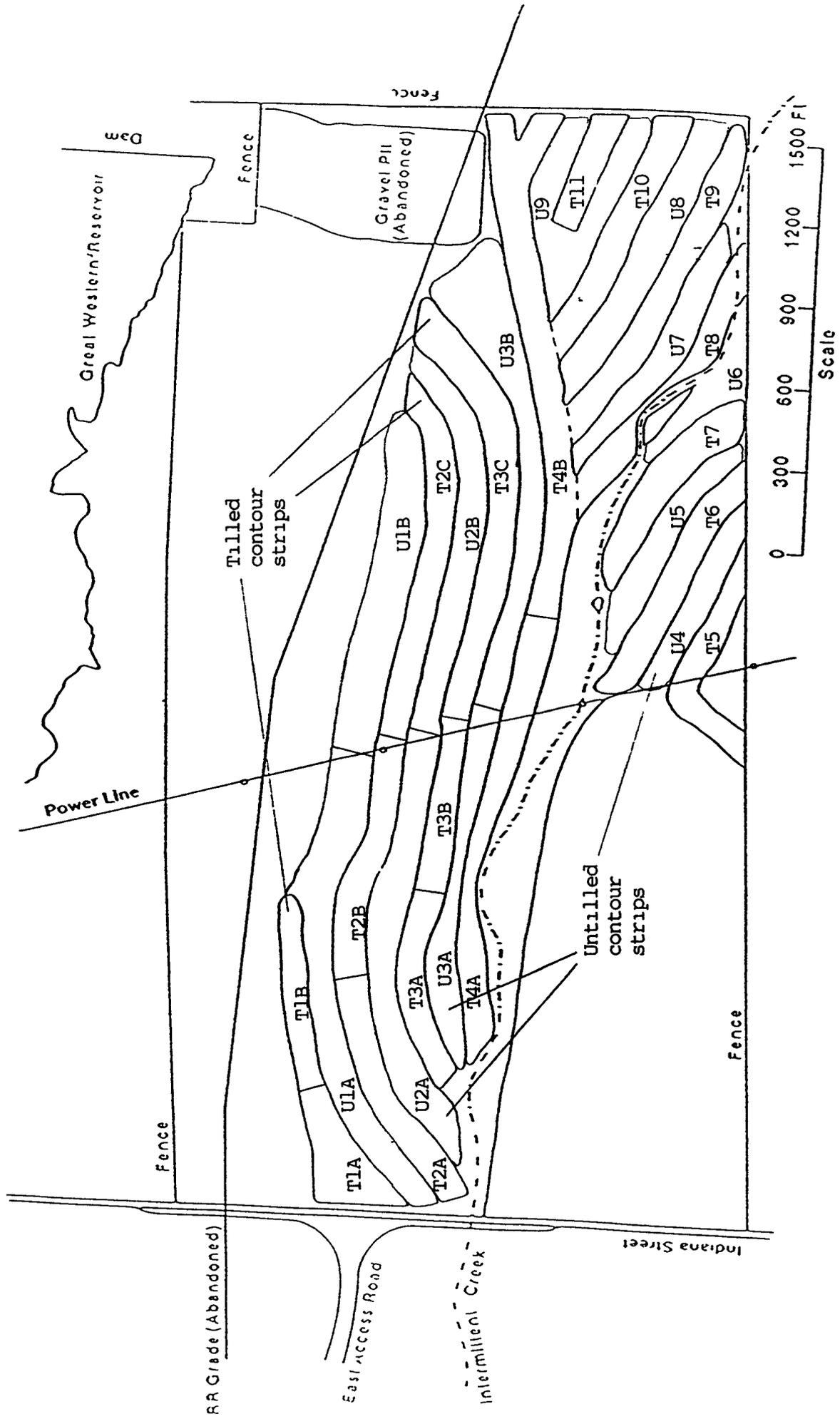
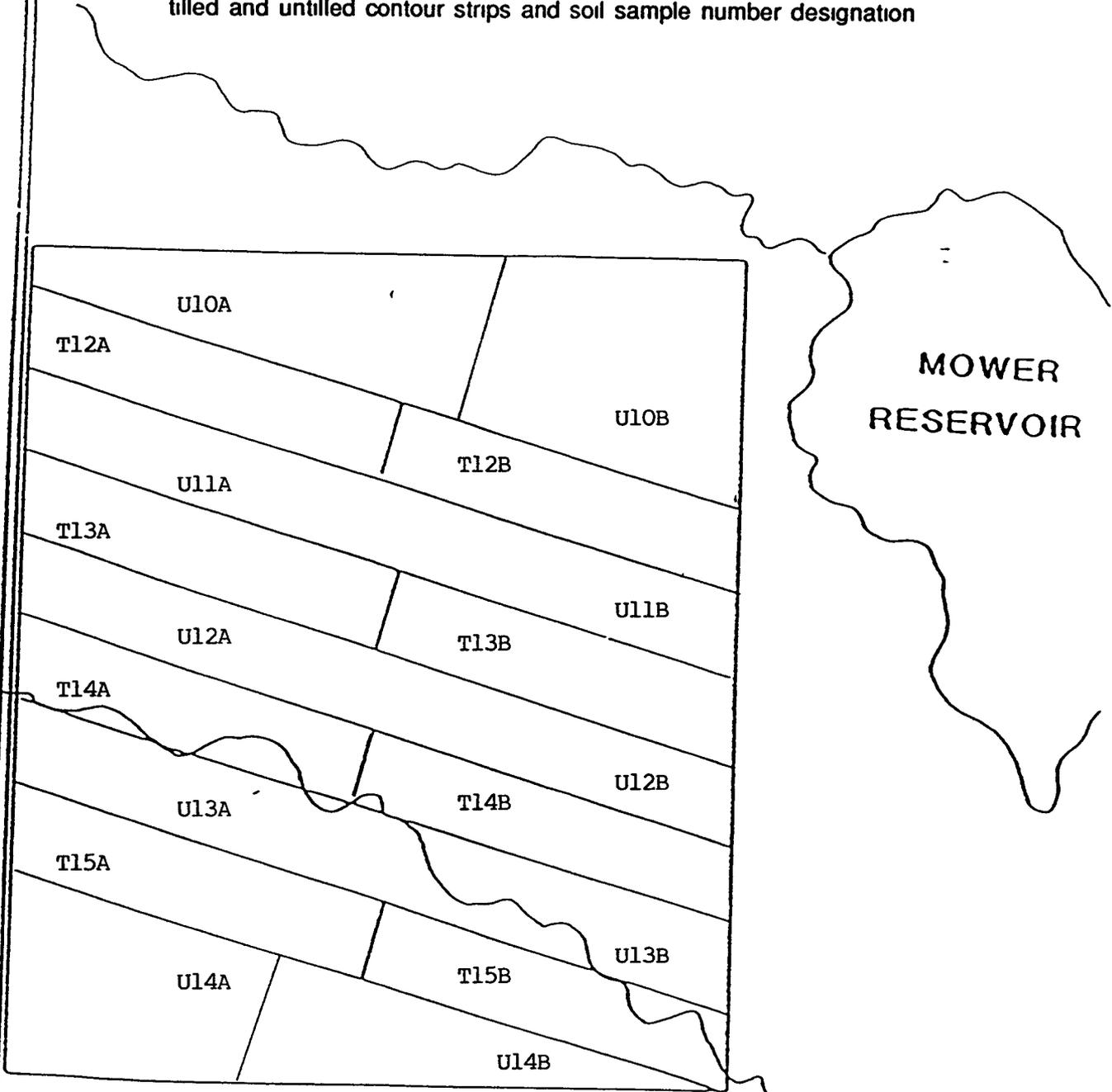


Figure 2 Jefferson County land in Section 18 undergoing remedial action, showing location of tilled and untilled contour strips and soil sample number designation



MOWER  
RESERVOIR

WOMAN CREEK

INDIANA STREET

300 ft      600 ft

Table 1 The following table presents the sample number designation, approximate acreage per tiled strip sample area and number of subsamples to be composited per sample area in Sections 7 and 18

	Sample number designation	Approximate acreage	Number of samples
Sec 7	T1a	3	8
	T1b	3	8
	T2a	7	18
	T2b	4	10
	T2c	4	10
	T3a	8	20
	T3b	3	8
	T3c	3	8
	T4a	8	20
	T4b	8	20
	T5	5	13
T6	5	13	
T7	4	10	
T8	5	13	
T9	6	15	
T10	5	13	
T11	3	8	
Sec 18	T12a	4	10
	T12b	4	10
	T13a	5	13
	T13b	5	13
	T14a	4	10
	T14b	4	10
	T15a	4	10
T15b	4	10	

Total number of tiled strip samples to be analyzed = 25

Table 2 The following table presents the sample number designation, approximate acreage per untilled strip sample area and number of subsamples to be composited per sample area in Sections 7 and 18

	Sample number designation	Approximate acreage	Number of samples
Sec 7	U1A	10	25
	U1B	6	15
	U2A	8	20
	U2B	7	18
	U3A	6	15
	U3B	8	20
	U4	4	10
	U5	4	10
	U6	3	8
	U7	5	13
	U8	5	13
	U9	5	13
Sec 18	U10A	8	20
	U10B	8	20
	U11A	5	13
	U11B	5	13
	U12A	5	13
	U12B	5	13
	U13A	5	13
	U13B	5	13
	U14A	6	15
	U14B	6	15

Total number of untilled strip samples to be analyzed = 22

April 30, 1991  
(Revised May 23, 1991)

Memorandum

To Michael Guillaume

From Samuel A Bamberg *ABB*

Re Remedial Action Program on Jefferson County Open Space Land and recommendation for 1991 revegetation scope of work

The purpose of this memo is to summarize the results of field surveys on the present condition of the remediation lands, coordination meetings, and the recommendations for revegetation activities for this coming 1991 field season. The important items to be addressed are the type of vegetation that is to be reestablished, and the procedures and activities to ensure the establishment of this vegetation.

#### General approach

It was determined in a meeting with the EG&G representative, Michael Guillaume, and the SCS soil conservationist, Gary Finstad, that the goal and aim of revegetation during the Remedial Action Program on Jefferson County Open Space Land is to revegetate the remediated areas to native grassland species that will be compatible with the other natural high plain grasslands in the vicinity. The land is considered as open space by Jefferson County and, before remediation, was a natural grassland vegetation type that had been used as rangeland. Based on an evaluation of present conditions, this goal of establishment of a native grassland will require a revision of some procedures used in the past.

An evaluation of the species composition and diversity will help determine that a native grassland with acceptable cover and productivity has been achieved within certain time frames. Due to the nature of the disturbance of tilling of the soil surface and total disruption of the native vegetation, completion of immediate revegetation goals of vegetation establishment will require a two to five year time frame. Long range goals should include management and control of the area to produce a diverse vegetation with cover and productivity approaching the natural vegetation.

The two year time frame will involve an evaluation of the 1991 reseeding program's attainment of seed germination and survival, and weed control. The five year time frame should evaluate species composition and productivity. A ten year follow up of species diversity, cover and productivity is advised. Additional actions during any of these time frames, if necessary, will include additional reseeding, weed control, and/or prairie dog control.

Several constraints and factors have been included in scoping this work and include

- 1 The surface will be disturbed as little as possible,
- 2 Fertilization is not necessary for the native species in this climate and soil conditions, however this may be altered based on the results of soil tests,
3. Hydroseeding is not an appropriate procedure, and
- 4 Flexibility should be maintained in time frames, procedures used, and the results of ongoing monitoring for plant species established and conditions.

#### Present conditions

The present conditions on the remediated acreage was assessed for:

- 1 Establishment and growth of species previously seeded,
- 2 Acreages of various conditions of the revegetation,
- 3 Weed infestations,
- 4 Erosion that has occurred or is occurring, and

- 5 Conditions of the soil surface such as rockiness and prairie dog colonies that will affect efforts at reseeding and methods of sowing seed.

The assessment determined that less than 10 percent of the revegetated area had seeded grass species in a good stand in the northern area. The principal grasses that grew were smooth brome and pubescent wheatgrass, the two introduced species in the original seed mixture, and a few areas of sideoats grama in low abundance. Weed species were prevalent over much of the tilled soil. Erosion-control was adequate except where prairie dogs kept the area bare and dug burrows. The surface of the soil was rocky in the northern portion of the remediated acreage such that range drilling was impractical, and could have contributed to the poor germination. The southern area had better cover by grass species, principally western wheatgrass, blue grama, and big bluestem, that has survived the tilling and has reproduced by clumps and rhizomes.

The remediated land has three general types of soil/topographic situations or range sites with typically different native species of grasses, shrubs and forbs. These are, (1) rocky upland slopes and ridges or cobbly foothills range site, (2) deeper or finer textured soils on sideslopes and flats or clayey foothills range sites (covers most of the area), and (3) broad drainage or overflow range sites in the southern portion. Moisture conditions also vary on these sites.

Activities and procedures recommended for 1991 year:

Revegetation activities recommended for this summer are based on the assessment of present onsite conditions, and experience in reclamation and revegetation along the Colorado Front Range. The two important site factors that limited grass establishment and growth were the growth of weeds in the rocky, disturbed soil and a series of years with poor growing conditions. Weeds have become dominant and prevented the establishment of grasses, or have grown where seeded grasses did not become established. The weeds have in many places become dominant and have taken both soil moisture and nutrients from grass productivity.

The following are recommended procedures with the rationale for the choice:

- Mowing is recommended to control the height of weeds and other plants growth, and to provide mulch for soil cover. The mowing is necessary for controlling weed growth and height to allow the grasses that have germinated to grow, an additional advantage is the addition of mulch to control wind and water erosion.
- Use of selected herbicides in specific areas and during appropriate seasons for persistent weed infestations. Weeds can only be partially controlled with mowing and the proper, careful use of herbicides provides an effective means of additional control.
- Seeding in late fall using a broadcast method. The broadcast method is recommended based on the large amount of the soil covered by rocks, and by the roughness of the soil surfaces. Rangeland drilling has not been successful and is not recommended in these rocky soils.
- Harrow the seeded areas lightly with specialized equipment to promote seed contact with the ground.
- Mulch with hay already on the site following the seeding and harrowing to protect the soil surface.

Procedures and activities not recommended are; (1) a spring seeding of sorghum since this activity requires tilled and prepared surfaces, (2) hydroseeding and mulching on areas of high rock content since the mixture does not penetrate well through the rock for ground contact of seeds, and is not an efficient method for rocky soils on this site, and (3) rangeland drilling is felt to be impractical except in small areas, and the use of two methods is not warranted since the broadcast method will be used on the majority of the site.

The reseeding program for this fall is being designed to take into account the current conditions of the site and variability of the substrate. Two seed mixes are recommended depending on topography, soil and substrate conditions, each mix will contain approximately five grasses, three forbs, and three shrub species. These will be derived from the following list:

Grasses recommended - Western wheatgrass, thickspike wheatgrass, blue grama, sideoats grama, big and little bluestem, blue grama, buffalo grass, Indian ricegrass, needle and thread, green needle-grass, buffalo grass, switchgrass, alkali sacaton, Canby bluegrass

forbs recommended - yarrow, penstemon, blue flax, prairie coneflower, scarlet globemallow, lupine, purple prairie clover, wild sunflower

shrubs recommended - winterfat, four-wing saltbush, rubber rabbitbrush, American plum, chokecherry, skunkbrush sumac, snowberry, wildrose

The recommended two seed mixes for the two predominant range sites, cobbly foothills and clayey foothills, is given in the accompanying Table 1. These are specific seed mixes for this site in its current condition.

Mulching this year will include spreading the mountain meadow hay remaining on-site and leaving mowed vegetation in place.

#### Monitoring and management.

Revegetation requires monitoring and management for an effective return to native species. Proposed future work and management practices will include monitoring species composition and productivity, weed control, and if necessary, additional seeding.

cc Gary D Finstad, SCS District Conservationist

Table 1 Recommended seed mixes for Remedial Action Program on Jefferson County Open Space land The seeding mixes are given as a seeding rate on a Pure Live Seed per acre basis, species epithet and common name and variety

COBBLY FOOTHILL AREAS

<u>Species</u>	<u>Common name -variety</u>	<u>Seeding rate</u> <u>(PLS lb/ac)*</u>
<b>Grasses</b>		
<i>Agropyron smithii</i>	Western wheatgrass - Arriba	4 0
<i>Bouteloua gracilis</i>	Blue gramma - Lovington	5 0
<i>Bouteloua curtipendula</i>	Sideoats grama - Vaughn	4 0
<i>Stipa comata</i>	Needle-and-thread - native	3 0
<i>Andropogon garardii</i>	Big bluestem - native or Kaw	4.0
<i>Schyzachyrium scoparium</i>	Little bluestem - Blaze or Pastura	3 0
<i>Panicum virgatum</i>	Switchgrass - Blackwell or Nebraska 28	1 0
<b>Shrubs</b>		
<i>Ceratoides lanata</i>	Winterfat - native or Hatch	0 3
<i>Chrysothamnus nauseosus</i>	Rabbitbrush - green plume, native	0 1
<i>Atriplex canescens</i>	Fourwing saltbush - native	0.5
<b>Forbs</b>		
<i>Linum lewisii</i>	Blue flax - Appar	0 2
<i>Penstemon strictus</i>	Rocky Mtn penstemon - Bandera	0 2
<i>Dalea purpurea</i>	Purple prairie clover - native or Kaneb	0 5

CLAYEY FOOTHILL AREAS

<u>Species</u>	<u>Common name -variety</u>	<u>Seeding rate</u> <u>(PLS lb/ac)*</u>
<b>Grasses</b>		
<i>Agropyron smithii</i>	Western wheatgrass - Arriba	6 0
<i>Stipa viridula</i>	Green needlegrass - Lodorm	4 0
<i>Bouteloua gracilis</i>	Blue gramma - Lovington	4.0
<i>Stipa comata</i>	Needle-and-thread - native	2 0
<i>Bouteloua curtipendula</i>	Sideoats grama - Vaughn	4 0
<i>Oryzopsis hymenoides</i>	Indian rice grass - Nezpar	1 0
<b>Shrubs</b>		
<i>Ceratoides lanata</i>	Winterfat - native or Hatach	0 4
<i>Chrysothamnus nauseosus</i>	Rabbitbrush - green plume, native	0 2
<i>Atriplex canescens</i>	Fourwing saltbush - native	0 3
<b>Forbs:</b>		
<i>Penstemon strictus</i>	Rocky Mtn penstemon - Bandera	0 1
<i>Dalea purpurea</i>	Purple prairie clover - native or Kaneb	0 5
<i>Sphaeralcea coccinea</i>	Scarlet globemallow - native	0 3

\* Pure live seed in pounds per acre

United States  
Department of  
Agriculture

Soil  
Conservation  
Service

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June 7, 1991

Michael Guillaume  
EG&G  
Rocky Flats Plant  
P.O. Box 464  
Golden, CO 80401

RE: Revegetation Recommendations for Remedial Action Program

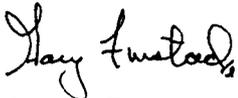
Dear Michael,

Just a quick note to convey general support for the revegetation strategy described in Sam Bamberg's proposal of May 23, 1991. Mr. Bamberg's recommendations are premised, in part, on the notion that the soil surface should be disturbed as little as possible. This is partly due to areas with troublesome volumes of rock and partly due to a desire to maintain what vegetative cover there is, albeit weedy.

I can support broadcast seeding given the nature of the tilled ground remaining to be reestablished to grass cover. Some of it can be drill seeded, but it may be impractical to do so in this phase. I heartily recommend that drill seeding be done (with a properly equipped grassland drill) when the other set of strips have been prepared for revegetation--sometime in the future.

Please, call if you have any questions.

Sincerely,



Gary Finstad  
District Conservationist

copy: Sam Bamberg

July 30, 1991

Memorandum

To: Michael Guillaume

From: Samuel A. Bamberg

Re: Revegetation activities on the Remedial Action Program areas on Jefferson County Open Space Land.

This is a progress report on the results of field activities conducted to date on the remediation lands and some additional recommendations. These are based on the detailed evaluation of the area conducted during the walking and staking for the first mowing conducted the middle of July, and for the mowing and seeding this Fall. The seeding mixes should also be slightly altered based on seed availability and cost for the current 1991 season's crop as determined by the contractor, Mark Phillips.

During the walkthrough of the edges of the remediated ground surface for staking the first mowing we made fairly comprehensive observations on the status of the vegetation. Two factors were evident:

1. The prairie dog population is dense and covers most of the north area and portions of the south area. The effects of the prairie dogs on the vegetation has been to clear large areas around dens, both in remediated and unremediated portions. Their grazing and digging has removed any grass or seedling growth in the revegetated areas and the adjacent native vegetation and resulted in bare ground and weeds. The dens are moved periodically when most of the vegetation has been removed so that much of the area has been affected. Over most of the area, it was difficult to tell differences between the revegetated strip areas and the adjacent unremediated native vegetation due to lack of native species, and the prevalence of weeds. Those few areas without prairie dogs are in better conditions with more grasses and less weeds. Without some effective prairie dog control or removal, the present reseeding and revegetation efforts will have little success in reestablishing a grass/forb grassland and the associated shrubs.

2. The weeds have become so securely established that mowing will only be partially successful in controlling weed growth and allowing a more native grass/forb/shrub grassland to become established. The prevalence of weeds is due to the original soil tilling, the rocky substrate left on the surface, and the dense prairie dog population that has invaded the area and selectively removed desirable grassland species. In order for the seeds sown this Fall to germinate and become established weeds must also be controlled. There is no method for removing the large amount of rocks and cobbles brought to the surface that won't cause additional soil disturbance and create a disposal problem.

It is our firm belief and recommendation that without effective control of the prairie dog population and weed removal the effectiveness of the proposed program of mowing and broadcast seeding this Fall will have little chance of succeeding.

The recommended seeding mixes have been changed in the amount of seeds of each species based on present availability and costs. Needle-and-thread is expensive and difficult to obtain, and amounts in the mixes have been reduced. Scarlet globemallow is already seeding into the revegetated areas and was dropped from the mixture. The altered recommended seed mixes were discussed with Gary Finstad, SCS, and he concurs that the mixes as given in the following table are proper for this area, and recommended some additional grass varieties that will grow in this area.

cc: Gary Finstad  
Phil Tscheschke  
Mark Phillips

Table 1. Recommended seed mixes for Remedial Action Program on Jefferson County Open Space land. The seeding mixes are given as a seeding rate on a Pure Live Seed per acre basis, species epithet and common name and variety. (Alterations on August 14, 1991)

COBBLY FOOTHILL AREAS

<u>Species</u>	<u>Common name -variety</u>	<u>Seeding rate (PLS lb/ac)*</u>
<b>Grasses:</b>		
<i>Agropyron smithii</i>	Western wheatgrass - Arriba	8.0
<i>Bouteloua gracilis</i>	Blue gramma - Lovington	6.0
<i>Bouteloua curtipendula</i>	Sideoats grama - Vaughn	5.5
<i>Stipa comata</i>	Needle-and-thread - native	0.5
<i>Andropogon garardii</i>	Big bluestem - native, Kaw or Champ	2.0
<i>Schyzachyrium scoparium</i>	Little bluestem - Blaze, Pastura, Aldous, or Cimmaron	1.0
<i>Panicum virgatum</i>	Switchgrass - Blackwell or Nebraska 28	1.0
<b>Shrubs:</b>		
<i>Ceratoides lanata</i>	Winterfat - native or Hatch	0.3
<i>Chrysothamnus nauseosus</i>	Rabbitbrush - green plume, native	0.1
<i>Atriplex canescens</i>	Fourwing saltbush - native	0.5
<b>Forbs:</b>		
<i>Linum lewisii</i>	Blue flax - Appar	0.2
<i>Penstemon strictus</i>	Rocky Mtn. penstemon - Bandera	0.2
<i>Dalea purpurea</i>	Purple prairie clover - native or Kaneb	0.5

CLAYEY FOOTHILL AREAS

<u>Species</u>	<u>Common name -variety</u>	<u>Seeding rate (PLS lb/ac)*</u>
<b>Grasses:</b>		
<i>Agropyron smithii</i>	Western wheatgrass - Arriba	6.0
<i>Stipa viridula</i>	Green needlegrass - Lodorm	5.0
<i>Bouteloua gracilis</i>	Blue gramma - Lovington	5.0
<i>Stipa comata</i>	Needle-and-thread - native	0.5
<i>Bouteloua curtipendula</i>	Sideoats grama - Vaughn	4.0
<i>Oryzopsis hymenoides</i>	Indian rice grass - Nezpar	1.0
<b>Shrubs:</b>		
<i>Ceratoides lanata</i>	Winterfat - native or Hatach	0.4
<i>Chrysothamnus nauseosus</i>	Rabbitbrush - green plume, native	0.2
<i>Atriplex canescens</i>	Fourwing saltbush - native	0.3
<b>Forbs:</b>		
<i>Penstemon strictus</i>	Rocky Mtn. penstemon - Bandera	0.1
<i>Dalea purpurea</i>	Purple prairie clover - native or Kaneb	0.5
<i>Linum lewisii</i>	Blue flax - Appar	0.3

\* Pure live seed in pounds per acre