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INVESTIGATION OF DEATHS OF HORSES AT ORR SPRINGS.(U)
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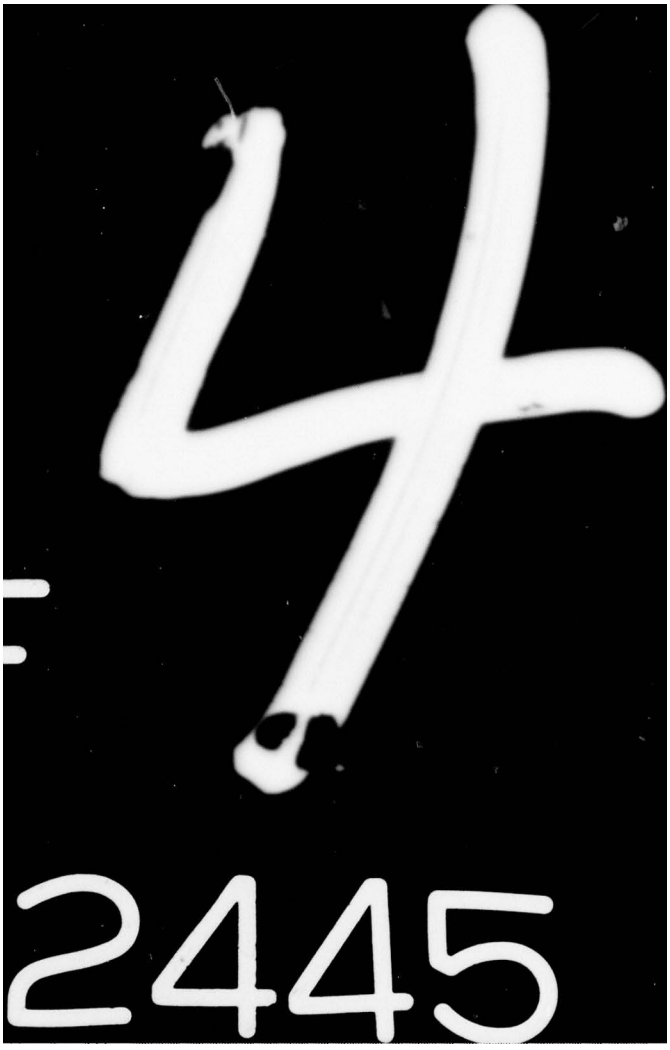
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(9) FINAL REPORT,

(6) INVESTIGATION OF DEATHS OF HORSES AT ORR SPRINGS.

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(11) SEPTEMBER 1976

(12) 297 P.

U.S. ARMY DUGWAY PROVING GROUND
Dugway, Utah 84022

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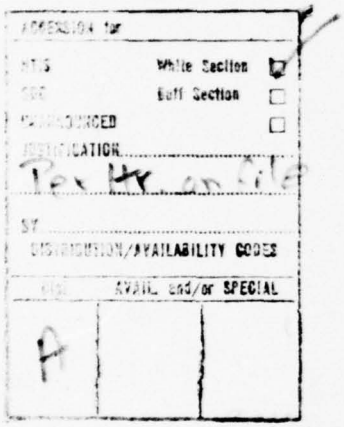
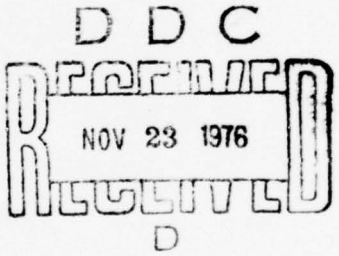




RÉSUMÉ OF FINDINGS AND CONCLUSIONS

1. On 4 July 1976, it was reported that numerous horses had died in the Orr Springs area of Dugway Proving Ground. Since then, other horses were found dead or suffering from a disabling malady. The area in which these horses roamed is rugged and arid. The margin between survival and death is probably not wide.

2. Investigations were instituted promptly upon discovery of the problem (the first specimens were taken on 4 July 1976) aimed at shedding light on the cause of the illness. A number of independent laboratories were requested to assist (without limitation on use of data) to preclude the potential of criticism for secretiveness, and to serve as an independent check on the Army's results. In addition to these efforts, the Bureau of Land Management and its veterinary medical and scientific consultants, and veterinary medical experts and laboratories of the State of Utah cooperated in the investigation. The Bureau of Land Management has ultimate responsibility for management and protection of wild horses.

3. The following observations and information were collected:

a. The weather had been exceptionally hot and dry prior to, and during, the incident. No precipitation had been recorded since 21 May 1976. Water holes normally available to the horses were drying or had dried up. The population of horses had increased in recent years, presumably intensifying the competition for the remaining water.

b. The water hole at Orr Springs used by ~~this particular herd of~~ horses had been modified by the Bureau of Land Management in an effort to provide improved water supply ~~(Figure 1)~~. However, the new water supply eliminated the customary water source; low stakes with flags surrounded the new supply ~~(a trough and overflow pond)~~; in close proximity to the new supply were two large piles of creosoted poles which emitted a strong odor, undoubtedly increased by the unremitting heat. There was no evidence of use by horses of a newly installed watering trough, judged by absence of hoofprints. Hoofprints were seen at the overflow pond, but were considered to be "old," and may have originated from a time prior to installation of stakes and flags and the time the logs were brought in, or from domestic horses.

An analogous installation was observed at Cochran Springs, on the eastern slope of the Cedar Range. Although few ribbons remained on the stakes and there were no creosoted logs, the water trough and overflow trough showed no recent use by horses (on 29 August 1976), while a natural pond at White Rock Springs five miles southeast was being used extensively (Figures 2 to 5).

c. An artificial water supply, installed by Dugway personnel after the incident, consisting of water tanks recessed into and level with the ground, remained unused. Enlarged natural water holes, filled spontaneously or filled by Dugway personnel, were being used by the horses.

d. The evident attempts of the horses to obtain water is illustrated in Figure 6 which indicates that, preceding death, the horse had dug out moist soil to reach water from a natural source.

e. Suspicion had been expressed that military and/or unauthorized human activities in the vicinity of the horses caused harassment and initiated a series of events leading to their death. No evidence of military activity exists which would have interfered with the horses, either because of the nature, scope, locality or timing of the event. The Orr Springs area is sufficiently rugged that horses could have avoided or escaped from ground-based interference, including motor vehicles, without major difficulty. Bureau of Land Management personnel worked at the Orr Springs area several days preceding the incident.

f. Water from various sources in the Orr Springs area appeared to be brackish, which can be an advantage to herbivores lacking access to salt licks. Aside from a high content of the common ions, the water composition was not exceptional. No toxic substances were found; the water was not toxic when fed to rats; no organophosphorus substances or substances inhibitory to acetylcholinesterase were detectable; there appeared to be no bacterial contamination relatable to deaths in horses; and no toxic algae were found.

g. None of the chemical and microbiological examinations of soil suggested unusual properties causing or contributing to the demise of the horses.

h. On-site inspection of plants showing evidence of having been grazed upon as well as examination of gastrointestinal contents verified that the horses had not consumed a significant amount of toxic plants. There were adequate normal forage plants; the horses were in a satisfactory state of nutrition.

i. No ticks were found on the horses, plants or ground. Very few mosquitoes occurred in the Orr Springs area. Both findings were consistent with expectations for this time of the year and weather. Mosquitoes appeared free of microorganisms fatal to suckling mice by intracerebral inoculation. Thus, these potential disease vectors were evidently not involved in the horse incident.

j. The rodent population in the Orr Springs area had not suffered from a catastrophe analogous or identical to that which affected the horses. The population density seemed normal; trapped animals neither

showed unusual behavior in captivity nor exhibited signs of disease on autopsy.

k. The tissues of horses were examined microbiologically; no cause of illness in the horses was disclosed.

l. Microbiological screening of blood also failed to provide evidence for an infectious disease. Hematocrits of the affected horses were grossly elevated. Total serum proteins were also significantly above normal. Cations presented a diagnostically less useful picture. There was no evidence of the toxic ions of arsenic, selenium or lead. (These ions also did not occur in detectable amounts in gastrointestinal contents.) Above-normal hematocrits and serum proteins are the expected consequences of hemoconcentration caused by water deficit. Progressive severe hemoconcentration may lead to shock and death.

4. Speculations were made that the horses were poisoned by Compound 1080, sodium fluoroacetate. This highly toxic substance, banned a number of years ago and now practically unavailable except for research purposes, has not been used for predator control in the Cedar Mountains. The symptomatology of poisoning by Compound 1080 is inconsistent with that exhibited by the horses.

5. It was concluded that the wild horses died as a result of dehydration. No remarkable finding has been made by Dugway Proving Ground, nor reported by others, which proposes alternate substantive reasons for the death of the majority of horses. There is circumstantial evidence showing that horses did not have access to accustomed water sources at a time when an increased water requirement existed because of environmental conditions. Man-made sources of water were available, but indications are that these were avoided, perhaps partly because the animals were confused by the odor of creosote masking that of water, or because they were repelled by the creosote and/or flags near the water trough. The poor physical condition of the horses may have prevented those that finally succumbed from seeking out more distant water sources. While specific circumstances leading to that debilitated condition and preceding the deaths cannot be established with the same degree of certainty as laboratory findings, there is no evidence that deliberate or accidental molestation was a contributing factor. It is possible that a few of the horses died because of excessive intake of water during attempts to rescue them. If so, these animals represented the exception.

Figure 1. Watering Trough for Wild Horses, Orr Springs

Figure 2. Watering Trough for Wild Horses, Cochran Spring

Figure 3. Soil Around Watering Trough, Cochran Spring. Note Imprints of Footsteps, Absence of Hoofprints

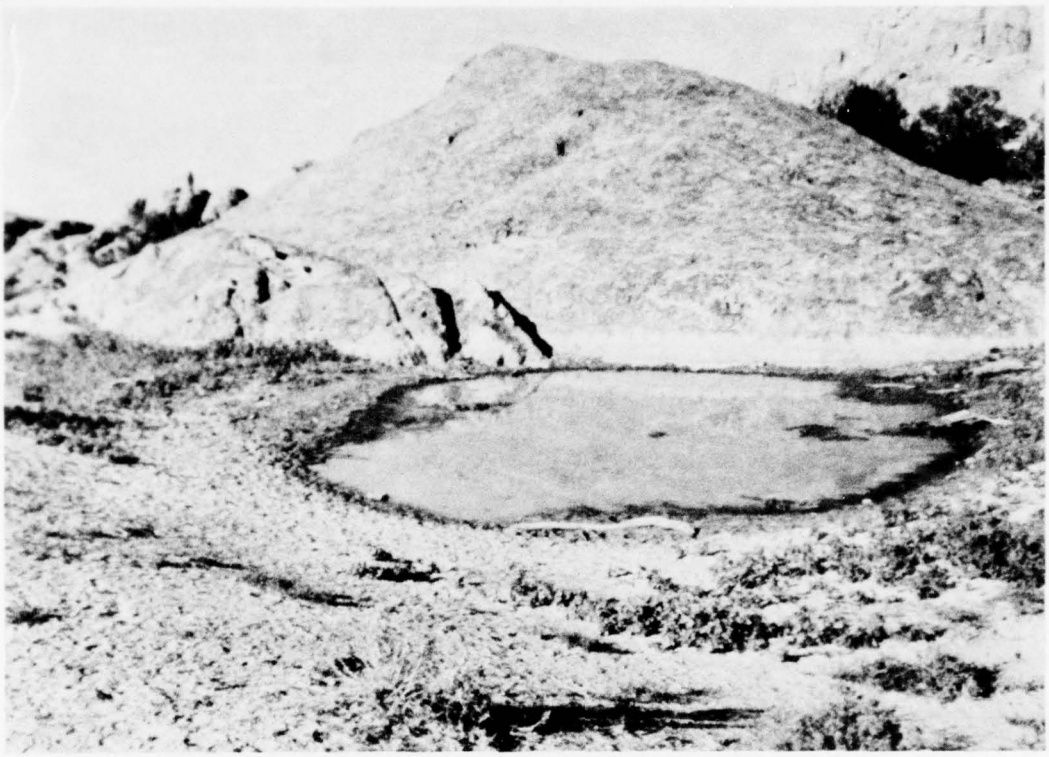


Figure 4. Pond at White Rock, with Hoofprints

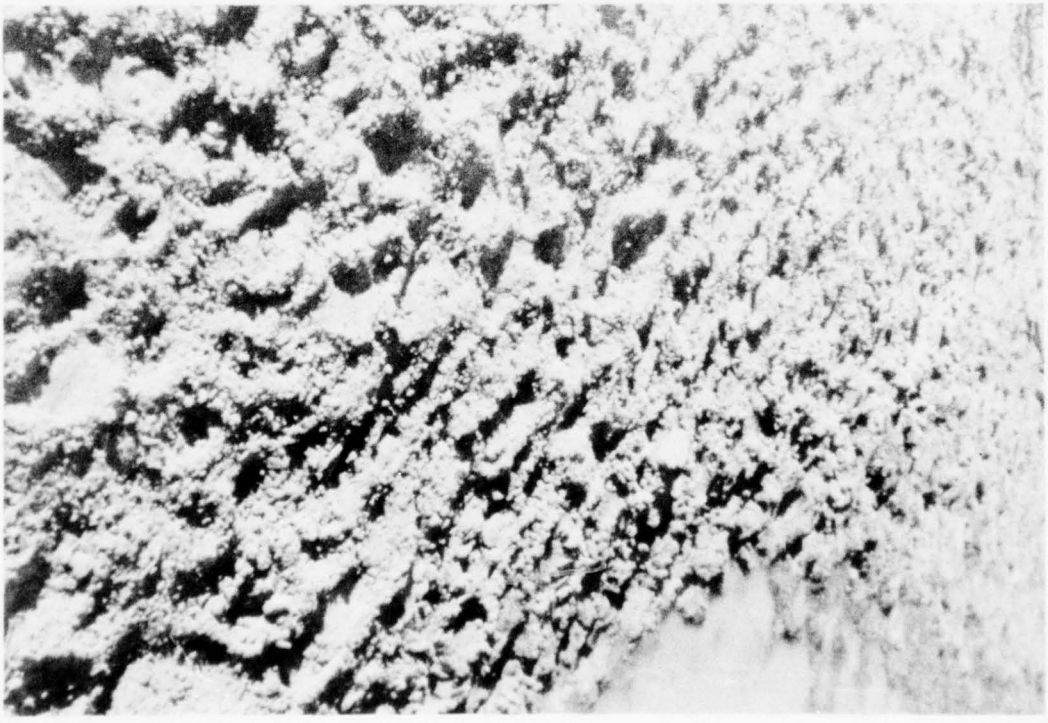


Figure 5. Close-up of Hoofprints, Pond at White Rock

Figure 6. Dead Horses at Dried Seep, Orr Springs Area

A. INTRODUCTION

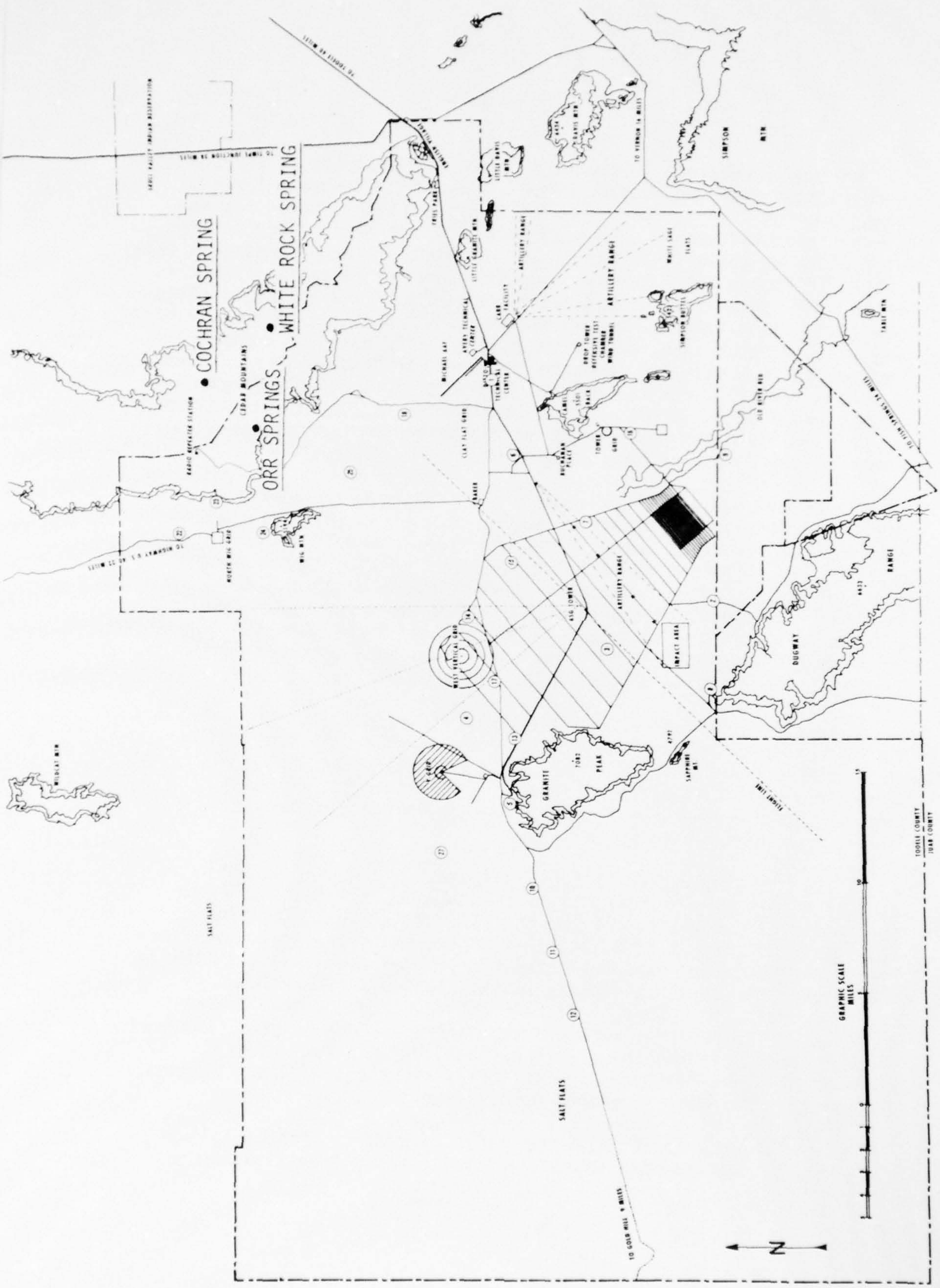
On Sunday evening, 4 July 1976, a routine security flight was made by helicopter over the western slope of the Cedar Mountain Range of Dugway Proving Ground, Utah. During this overflight, the pilot and observer reported seeing dead wild horses in the area of Orr Springs watering hole, which is 17 air miles northwest of the Headquarters area, as seen in Figure A-1. Dugway scientists and the installation veterinarian were immediately dispatched to the site of the incident, where they found approximately 20 dead horses in the vicinity of the spring. They were, at that time, unable to ascertain the cause of death. However, since Dugway had conducted no open-air tests with toxic substances since 1969, adverse effects attributable to agents of chemical warfare could be ruled out. The sole significant recent activity in the area involved the development of the water sources for the wild horses by the Bureau of Land Management.

On Monday, 5 July 1976, Bureau of Land Management and State professional consultants joined the Dugway scientists in an attempt to determine the cause of death in the wild horse herd. On-site inspection revealed 26 deaths and approximately 16 sick animals in the herd of 90-100 animals. It was decided to haul fresh water to the area, at least until analysis of the spring was made and the water determined to be safe. Army life scientists, Bureau of Land Management and Utah State Department of Agriculture personnel collected samples required for laboratory analyses to determine the cause of death.

Dugway is inhabited by approximately 250 wild horses which are being managed under a cooperative agreement between the U.S. Army and Bureau of Land Management. These horses are not wild mustangs, but are more accurately described as feral horses. The wild horse herds which normally inhabit the Granite Mountain area, North Wig and Rydalch Canyon area appeared to be healthy.

State of Utah, Bureau of Land Management and Dugway scientists conducted intensive investigations to determine the cause of death and monitor the condition of the other herds on the Dugway ranges. This report describes investigations conducted by the Army. In virtually every instance, specimens collected by the Army were also provided to other laboratories for independent evaluation without restriction on use of data, to ensure credibility of findings and conclusions. Cooperating laboratories included those of the State of Utah, University of Utah School of Medicine, Colorado State University, University of Montana Biological Station, Center for Disease Control (Fort Collins), and the Utah Mosquito Abatement Association.

In the absence of striking and definitive overt symptomatology exhibited by ill and dead horses, a broadly-based investigation was



COCHRAN SPRING
ORR SPRINGS
WHITE ROCK SPRING
CEDAR MOUNTAINS
ARTILLERY RANGE
IMPACT AREA
GRANITE PEAK
DUGWAY RANGE
SIMPSON MTN
SALT FLATS
SALT FLATS
GRAPHIC SCALE MILES
TOOELE COUNTY
JUAB COUNTY

Figure A-1

designed involving studies of water, soil, plants, animal ecology, and mosquitoes and ticks. Furthermore, a diagnostic survey was undertaken on tissues and blood of the animals, and historical weather data were compared to conditions just preceding the incident. Description of the behavior of ill animals, particularly that following ingestion of water suggested severe dehydration. Therefore, immediate emphasis was given to the determination of changes in blood diagnostic of lack/loss of water and electrolytes. These, to date, have provided the sole substantive laboratory findings.

In this investigation, the laboratories of Dugway Proving Ground responded promptly and effectively. The first samples were taken on 4 July 1976. Ecological studies were started on 6 July 1976. All tests, chemical and biological, were in progress by 9 July 1976, the last of these as soon as proper test animals were available. Necessarily, tests performed by cooperating organizations could be less tightly controlled, in part because suitable laboratories had to be identified and samples provided. Reports from these laboratories are shown in the appropriate sections.

B. GENERAL EXPERIMENTAL APPROACH

On 6 July 1976, a group of scientists was convened at DPG to review observations made at the site of the incident and to lay plans for relevant investigations. The list of studies shown below is the result of this meeting and subsequent refinements and additions. In the absence of definitive indications, it was deemed necessary to approach the problem from a variety of aspects in an attempt to determine the cause(s) of the death of the horses and to positively eliminate possible questions regarding complicating factors.

It was decided to undertake the following studies:

1. Weather factors will be examined against the historical climatological record.

2. Human activities in the Orr Springs area immediately preceding the deaths of the horses will be reviewed.

3. Water from water sources and seeps in the Orr Springs area will be examined in regard to:

a. Toxicity in rats on prolonged ingestion (3 weeks) including acetylcholinesterase inhibition in rats drinking water from Orr Springs.

b. Gross pathology of rats if sick or dead as a result of drinking the water.

c. Bacterial contamination.

d. Identification of algae found in the water.

e. Chemical composition: pH, suspended solids, soluble solids, Cl, NO_3, NO_2, As, Se, Be, Hg, Pb, Cd, Cr, Cu, Na, K, Mg, Ca, Ni, GB, VX, decomposition products of GB and VX, and inhibition of acetylcholinesterase; pesticide analyses by Utah State Division of Health, Bureau of Laboratories.

4. Soil from areas around the water sources and seeps at Orr Springs will be examined in regard to:

a. Presence of possibly lethal bacteria.

b. Chemical composition (of aqueous soil extracts) as for water.

5. Plants ingested by the horses and found in the Orr Springs area will be studied to ascertain potential involvement in the incident by:

a. Analysis of gastrointestinal contents and feces for identification of forage plant species.

b. A survey of plants and identification of plants showing evidence of having been grazed upon.

c. Collection of plants of interest in relation to subparagraph a. and those showing evidence of having served as forage species but not identified in subparagraph a.; conduct of chemical assays and laboratory animal feeding studies if findings on consumption of toxic plants and literature surveys so require.

5. Mosquito and Tick Surveys in the Orr Springs area will be conducted aimed at:

a. Trapping, identification and pooling of mosquitoes; inoculation of extracts into suckling mice for viral assays.

b. Trapping, identification and pooling of ticks with emphasis on ticks found on sick horses; inoculation into mice.

6. Animal Surveys in the Orr Springs area will involve:

a. Wildlife trapping program to collect evidence of catastrophic changes (if any) in populations of small wildlife.

b. Observation of some of trapped small wildlife in laboratory for two weeks for evidence of morbidity; autopsy of sick/dead animals.

c. Collection of blood from trapped animals and preparation/storage for possible later analysis of red cell acetylcholinesterase and for serologies.

7. Diagnostic Survey in affected horses will aim at:

a. Collection of blood for hematocrits, serum protein, Na, K, Ca, Mg and oxalate (if advisable based on autopsy reports and factors of paragraph 3), red cell acetylcholinesterase and arbovirology.

b. Collection of various tissues, especially brain, for arbovirology.

c. Study of enterobacteria in gastrointestinal contents and feces.

Wherever possible, investigations of DPG were to be duplicated by parallel studies in laboratories independent of DPG to assure reliability and credibility of results.

Some studies could not be performed at DPG because of lack of relevant expertise, e.g., analysis of gastrointestinal contents and feces for identification of forage plants, and identification of algae. Detailed

histopathological examination of horse tissues and complete blood chemistry were to be performed by veterinary personnel serving as consultants to the Bureau of Land Management.

C. WEATHER

A summary of weather data is seen in inclosure C-1. Cogent features are the occurrence of elevated temperatures during the period 27 June to 4 July 1976, unusually low relative humidities, absence of measurable precipitation from 21 May 1976 to the time of the incident (and beyond), and significantly lower-than-normal precipitation from 1 January 1976 to the time of the incident, compared to a 20-year climatological base.

The horses undoubtedly experienced high temperatures in the open (higher than those recorded by protected temperature sensors), which may have made them unusually susceptible to the effects of lack of water. Water requirements for regulation of body temperature are greatly increased during hot periods. Ground temperatures during the day normally exceed recorded air temperatures. This fact, the low relative humidities, and subnormal precipitation together explain sufficiently why various sources of water normally used by the horses were effectively dried up. Horses were seen dead in tight groups concentrated in spots that previously furnished water. There is a lack of water holes in the immediate vicinity which might serve as alternatives to the Orr Springs area.

In general, it may be concluded that horses must always be in a precarious state with respect to water during the summer months. This year, they may have experienced a problem sooner than in past years, partly because of the weather, and partly because the herd had increased in size. Nevertheless, it is pertinent to inquire why they coped with the scarcity of water so dramatically less successfully in 1976 than before. The answer is suggested in the following sections.

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
STEDP-MT-T-M	Weather Summary for Portion of 1976

~~XX~~ THRU: Dir, MT FROM Ch, MT-T DATE 16 Jul 76 CMT 1
Mr. Walker/ts/5606

TO: SC

1. Weather data observed at the Ditto Technical Area has been tabulated and compared with a 20-year climatological base. These data are listed in para 2. It appears that the temperatures have been reasonably close to the normal. Relative humidity for June was somewhat below normal. Precipitation from 1 Jan through 30 Jun 1976 was 2.99 inches, compared to the normal of 3.91 inches. No measurable precipitation has been observed from 21 May through 4 July 1976. In approximately one out of six years the month of June receives no rainfall.

2. The weather summary follows:

Weather Element	Period of Time			
	April	May	June	27 June-4 July 76
Mean daily maximum temp (^{O}F)	62	74	83	92
observed 1976	63	78	84	96
Mean daily minimum temp (^{O}F)	36	46	54	
observed 1976	34	45	49	
Mean no. days max. temp. $\geq 90^{O}$F	0	1	10	
observed 1976	0	2	8	
Mean total precipitation (in.)	0.77	0.68	0.68	
observed 1976	0.81	0.95	Trace	
Mean no. days of measurable precipitation	5	5	5	
observed 1976	8	3	0	
Mean 3-hr. avg. max. relative humidity (%)	63	58	52	
observed 1976	M	55	39	
Mean 3-hr. avg. min. relative humidity (%)	34	27	24	
observed 1976	M	20	17	

MELVIN J. BUSHNELL
Chief
Technical Support Division

CF:
MT (Dr. Salomon)

MT (Dr. Salomon)

Incl C-1

DA FORM 1 FEB 67 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE.

D. SUMMARY OF SAMPLES COLLECTED

Following is Table D-1, showing the specimens collected for this investigation and their disposition. A map of the area, Figure D-1 is also provided to assist in identification of the various locations mentioned in this section and subsequent sections.

TABLE D-1. SUMMARY OF SAMPLES COLLECTED

DATE COLLECTED (1976)	SOURCE	TYPE SAMPLE	ORIGIN/REMARKS	CDC	CSU	DPG	LAIR	USDH
4 July	Horse Colt #2 found dead in Ravine #1 Orr Springs Area	Tissues						
		Lung	DPG				Histopathology (13Jul)	
		Kidney	DPG				Histopathology (13Jul)	
		Liver	DPG				Histopathology (13Jul)	
		Spleen	DPG	Arbovirology (8Jul)		Arbovirology (9, 12Jul)	Histopathology (13Jul)	Arbovirology (9Jul)
		Stomach Cont.	DPG		Forage Analysis (8Jul)	Chem Lab (9Jul)		
		Colon Cont.	DPG		Forage Analysis (8Jul)			
		Blood						
			DPG/Serum U of U			Bacteriology (9Jul)		
						Arbovirology (19Jul)		
		Serum				Quantity Insuf.		
4 July	Diarrhetic soil specimen near Horse #2	Soil				Enterobact. (8Jul)		
5 July	Ravine #1	Feces A	DPG		Forage Analysis (8Jul)	Enterobact. (8Jul)		
		Feces B	DPG		Forage Analysis (8Jul)	Enterobact. (8Jul)		
		Feces C	DPG		Forage Analysis (8Jul)	Enterobact. (8Jul)		

(Con't)

NOTE: Horse spedimens labeled EC-1, EC-2, etc. originate from Horse #1, Horse #2, etc.

DATE COLLECTED (1976)	SOURCE	TYPE SAMPLE	ORIGIN/REMARKS	CDC	CSU	DPG	LAIR	USDH
5 July	Pipe uphill of Orr Springs	Water A	DPG			Enterobact. (8Jul)		
		Water B	DPG			Enterobact. (8Jul)		
5 July	Seep in Ravine #1	Water Seep	DPG			Enterobact (8Jul)		
5 July	Horse Colt #1, 3 week old bay female	Blood	DPG/Serum U of U	Arbovirology (8Jul)		AChE (8,13Jul) Serum Prot. (9Jul)		
5 July	Horse Colt #3, 1½ month old female	Tissues						
		Kidney	DPG			Serum prot. (9Jul)	Histopathology (13Jul)	
		Liver	DPG				Histopathology (13Jul)	
		Spleen		Arbovirology (8Jul)		Arbovirology (9Jul)	Histopathology (13Jul)	Arbovirology (9Jul)
		Blood	DPG/Serum U of U	Arbovirology (8Jul)		Arbovirology (19Jul)		Arbovirology (9Jul)
		Heparin-ized	DPG			AChE (9,13Jul)		
5 July	Horse Colt #5 female	Tissues						
		Brain	Formalized to IML					
		Liver	Formalized to IML					
		Spleen	Formalized to IML					
		Stomach						
		Colon Cont.						
		Blood	DPG/Serum U of U	Arbovirology (8Jul)		Arbovirology (19Jul) Serum Prot. (9Jul)		Arbovirology (9Jul)

(Con't)

DATE COLLECTED (1976)	SOURCE	TYPE SAMPLE	ORIGIN/REMARKS	CDC	CSU	DPG	LAIR	USDH
5 July	Horse Colt #9	Entire Animal	To IML					
5 July	Horse Mare #4	Blood, Heparinized	Serum U of U			AChE (9, 13Jul) Arbovirology (19Jul) Serum Prod. (9Jul)		
5 July	Horse Colt #6 Live	Blood, Heparinized and Serum	Serum U of U			AChE (9, 13Jul) Hematocrit (9Jul) Serum Prod. (9Jul)		
5 July	Horse Colt #11 Palomino	Blood Heparinized	Serum U of U					Arbovirology Serology (6Jul)
6 July	Horse Mare #7	Blood Heparinized Clot	Serum U of U	Arbovirology (8Jul)		Arbovirology (19Jul) AChE (9, 12 July) Serum Prot (9Jul) Hematrocrit (9Jul)		Arbovirology (9Jul)
		Brain		Arbovirology (8Jul)		Arbovirology (9, 12Jul)		Arbovirology (9Jul)

(Con't)

DATE COLLECTED (1976)	SOURCE	TYPE SAMPLE	ORIGIN/REMARKS	CDC	CSU	DPG	LAIR	USDH
6 July	Horse Mare #8	Blood Heparinized Clot	Serum U of U	Arbovirology (8Jul)		AChE (12Jul) Hematocrit (9Jul) Serum Prod. (9Jul) Arbovirology (19Jul)		Arbovirology (9Jul)
6 July	Water Trough	Algae	UMBS for identification (10Jul)					
6 July	Orr Springs Area Fill Dirt, Ravine #1	Soil	DPG			Chemical & Anthrax (8Jul)		Chemical & Anthrax (7Jul)
	Dozer Digging	Soil	DPG			Chemical & Anthrax (8Jul)		Chemical & Anthrax (7Jul)
	Cover Dirt Ravine #2	Soil	DPG			Chemical & Anthrax (8Jul)		Chemical & Anthrax (7Jul)
	Road Cut Ravine #2	Soil	DPG			Chemical & Anthrax (8Jul)		Chemical & Anthrax (7Jul)
	Road Cut Ravine #2	Soil	DPG			Chemical & Anthrax (8Jul)		Chemical & Anthrax (7Jul)
	Tamarisks, below trough	Soil	DPG			Chemical (8Jul)		Chemical (7Jul)

(Con't)

DATE COLLECTED (1976)	SOURCE	TYPE SAMPLE	ORIGIN/REMARKS	CDC	CSU	DPG	LAIR	USDH
6 July	Orr Springs Area con't							
	Moist Soil, Ravine #1	Soil	DPG			Chemical (8Jul)		Chemical (7Jul)
	Moist Soil, Ravine #2	Soil	DPG			Chemical (8Jul)		Chemical (7Jul)
	Mesa, Ravine #1	Soil	DPG			Chemical (8Jul)		Chemical (7Jul)
	Dry Pool, Ravine #1	Soil	DPG			Chemical (8Jul)		Chemical (7Jul)
	Moist Soil, Ravine #1	Soil	DPG			Chemical & Anthrax (8Jul)		Chemical (7Jul)
	Dry Creekbed, Ravine #1	Soil	DPG			Chemical & Anthrax (8Jul)		Chemical (7Jul)
	Grass on Mesa, Ravine #1	Soil	DPG			Chemical & Anthrax (8Jul)		Chemical (7Jul)
	Seep in Ravine #1	Soil	DPG			Chemical & Anthrax (8Jul)		Chemical (7Jul)
7 July	Orr Springs Area							
	Pond Below Trough	Water	DPG			Chemical & Toxicity (7Jul)		Chemical (7Jul)
	Cistern, Ravine #1	Water	DPG			Chemical & Toxicity (7Jul)		Chemical (7Jul)
	Trough	Water	DPG			Chemical & Toxicity (7Jul)		Chemical (7Jul)
	Lower Seep, Ravine #1	Water	DPG			Chemical (7Jul)		Chemical (7Jul)

(Con't)

DATE COLLECTED (1976)	SOURCE	TYPE SAMPLE	ORIGIN/REMARKS	CDC	CSU	DPG	LAIR	USDH
7 July	Orr Springs Area con't Cistern, Ravine #2	Water	DPG			Chemical & Toxicity (7Jul)		Chemical (7Jul)
	Seep, Ravine #1					Chemical (7Jul)		Chemical (7Jul)
7 July	Old Water Hole - Wig Mountain	Soil	DPG			Chemical (7Jul)		Chemical (7Jul
7 July	Tamarisk Wash Below Horse Trough	Feces				Enterobact. (14Jul)		
7 July	Light Traps	Mosquitoes	7 traps/2 mosquitoes			Arbovirology (14Jul)		
7 July	Can Traps	Rodents	120 traps/17 rodents			Serum(7Jul) Caged		
7 July	Horse Colt #10 female	Tissues Lymph nodes				Bacteriology (7Jul)	Histopath (13Jul)	
		Heart Blood	Serum U of U			Bacteriology (7Jul) Arbovirology (19Jul)		
		Liver						
		Spinal fluid		Arbovirology (8Jul)		Arbovirology & Bacteriology (9Jul)	Histopath (13Jul)	Arbovirology (9Jul)
		Spleen		Arbovirology (8Jul)		Arbovirology & Bacteriology (9Jul)	Histopath (13Jul)	Arbovirology (9Jul)

(Con't)

DATE COLLECTED (1976)	SOURCE	TYPE SAMPLE	ORIGIN/REMARKS	CDC	CSU	DPG	LAIR	USDH
7 July	Horse Colt #10 female con't	Tissues Heart Kidney Colon Cont. Trachea Small intestine Brain Colon Stomach contents		Arbovirology (8Jul)	Forage Analysis (8Jul) Forage Analysis (8Jul) Forage Analysis (8Jul)	Arbovirology & Bacteriology (9Jul)	Histopath (13Jul) Histopath (13Jul) Histopath (13Jul) Histopath (13Jul) Histopath (13Jul) Histopath (13Jul) Histopath (13Jul)	Arbovirology (9Jul)
7 July	Domestic Horses	Control Blood	DPG - 7 horses			AChE & Hematocrit (9, 13 Jul)		
8 July	Light Traps	Mosquitoes	10 traps/4 mosquitoes			Arbovirology (19Jul)		
8 July	Can Traps	Rodents	120 traps/13 rodents			Serum(8Jul) Caged		
9 July	Horse Colt #6 dead (See 5 Jul)	Blood	Hep & Serum Serum U of U			AChE & Hematocrit (9Jul) Arbovirology (19Jul)		

(Con't)

DATE COLLECTED (1976)	SOURCE	TYPE SAMPLE	ORIGIN/REMARKS	CDC	CSU	DPG	LAIR	USDH
9 July	Horse Colt #6 Dead (see 5 Jul) Con't	Brain				Arbovirology (12, 19 Jul) Bacteriology (13Jul)	Histopath (13Jul)	
9 July	Horse Palomino Colt #11 (listed as 7 by BLM)	Tissues Liver Kidney Lung Heart Brain Blood Colon Cont.	 Serum U of U Stored			 Arbovirology	Histopath (13Jul) Histopath (13Jul) Histopath (13Jul) Histopath (13Jul) Histopath (13Jul)	
9 July	Domestic Horses	Normal blood	10 horses - Serum U of U			Serum protein (14Jul)		
9 July	Light Traps	Mosquitoes	Not operating					
9 July	Can Traps	Rodents	120 traps/5 rodents			Caged		
10 July	Light Traps	Mosquitoes	6 traps/10 mosquitoes			See 13 Jul		
10 July	Can Traps	Rodents	120 traps/4 rodents			Caged		
11 July	Light Traps	Mosquitoes	5 traps/11 mosquitoes			See 13 Jul		
11 July	Can Traps	Rodents	120 traps/5 rodents			Caged		

(Con't)

DATE COLLECTED (1976)	SOURCE	TYPE SAMPLE	ORIGIN/REMARKS	CDC	CSU	DPG	LAIR	USDH
12 July	Light Traps	Mosquitoes	6 traps/0 mosquitoes					
12 July	Can Traps	Rodents	120 traps/12 rodents			Caged		
13 July	Light Traps	Mosquitoes	5 traps/0 mosquitoes			All to date, identified, 6 pools into suckling mice		
13 July	Can Traps	Rodents	120 traps/9 rodents			Caged		
14 July	Light Traps	Mosquitoes	6 traps/1 mosquitoe			See 19 July		
14 July	Can Traps	Rodents	120 traps/11 rodents			Caged		
15 July	Light Traps	Mosquitoes	6 traps/15 mosquitoes			See 19 July		
15 July	Can Traps	Rodents	120 traps/6 rodents			Caged		
16 July	Light Traps	Mosquitoes	6 traps/8 mosquitoes			See 19 July		
16 July	Can Traps	Rodents	120 traps/6 rodents			Caged		
17 July	Light Traps	Mosquitoes	6 traps/0 mosquitoes			See 19 July		
17 July	Can Traps	Rodents	120 traps/8 rodents			Caged		
18 July	Light Traps	Mosquitoes	6 traps/10 mosquitoes			See 19 July		
18 July	Can Traps	Rodents	120 traps/8 rodents			Caged		
19 July	Light Traps	Mosquitoes	6 traps/9 mosquiotes			All to date, identified, 3 pools into suckling mice		
19 July	Can Traps	Rodents	120 traps/4 rodents			Caged		

(Concluded)

RECIPIENTS OF SAMPLES COLLECTED FROM HORSE SPECIMENS AT ORR SPRINGS

CDC. . . . . Center for Disease Control
U.S. Public Health Service
(Dr. Charles Calisher)
Fort Collins, Colorado 80522
Tel: 303-482-0213

CSU. . . . . Natural Resources Laboratory
Colorado State University
(Dr. Richard Hansen)
Fort Collins, Colorado 80522
Tel: 303-491-1101, ext. 6410 or 5577

DPG. . . . . U.S. Army Dugway Proving Ground
DPG-B (Baker Lab)
DPG-C (Chemical Lab) - as indicated by test performed
Dugway, Utah

IML. . . . . Intermountain Laboratory
870 East 7145 South
(Dr. Jack Taylor)
Salt Lake City, Utah 84120
Tel: 801-561-2223

LAIR . . . . . Letterman Army Institute of Research
Health Services
(COL James L. Fowler)
Presidio, San Francisco, California 94129
AUTOVON: 586-2878

UMBS . . . . . University of Montana
Biological Station
(Dr. Gerald Prescott)
Bigfork, Montana
Tel: 406-982-3201

USDH . . . . . Utah State Division of Health
(Dr. Althea Bailey & Mr. Merlin Smith)
44 Medical Drive
Salt Lake City, Utah 84112
Tel: 801-533-6131

U of U . . . . . University of Utah
Department of Biology
(Dr. William R. Gray)
Salt Lake City, UT 84112
Tel: 581-6517

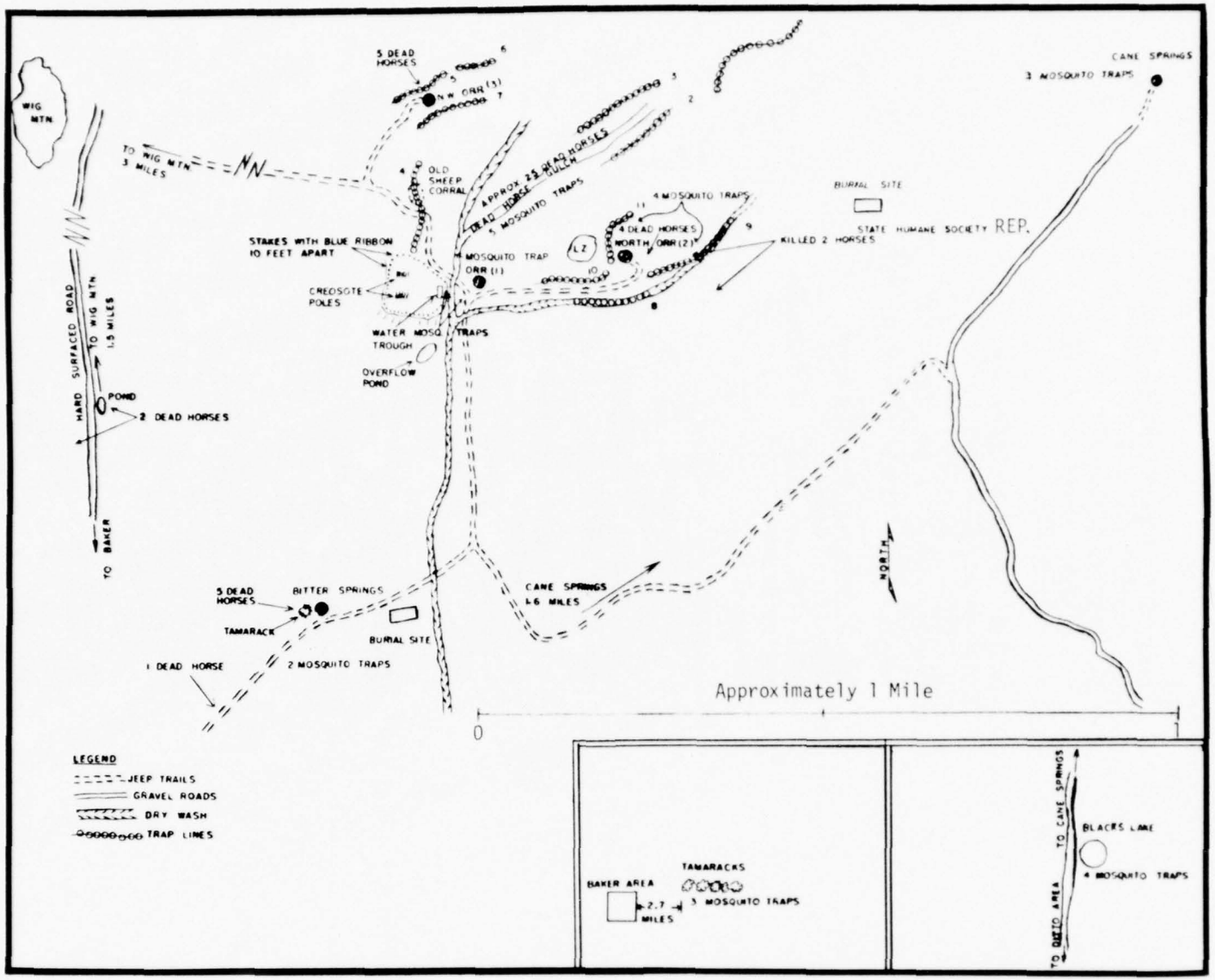

WIG MTN
TO WIG MTN 3 MILES
5 DEAD HORSES
N.W. ORR (3)
OLD SHEEP CORRAL
APPROX 22 DEAD HORSES
DEAD HORSE GULCH
5 MOSQUITO TRAPS
4 MOSQUITO TRAPS
4 DEAD HORSES NORTH ORR (2)
KILLED 2 HORSES
BURIAL SITE
STATE HUMANE SOCIETY REP.
CANE SPRINGS
3 MOSQUITO TRAPS
STAKES WITH BLUE RIBBON 10 FEET APART
MOSQUITO TRAP ORR (1)
LZ
CREOSOTE POLES
WATER MOSQ TRAPS
TROUGH
OVERFLOW POND
HARD SURFACED ROAD
TO WIG MTN 1.5 MILES
POND
2 DEAD HORSES
TO BAKER
5 DEAD HORSES
BITTER SPRINGS
TAMARACK
BURIAL SITE
CANE SPRINGS 1.6 MILES
NORTH
1 DEAD HORSE
2 MOSQUITO TRAPS
Approximately 1 Mile
0
1
LEGEND
JEEP TRAILS
GRAVEL ROADS
DRY WASH
TRAP LINES
BAKER AREA
2.7 MILES
TAMARACKS
3 MOSQUITO TRAPS
TO CANE SPRINGS
BLACKS LAKE
4 MOSQUITO TRAPS
TO BAKER AREA

Figure D-1

E. WATER

1. Objective. It was the objective of this study to determine whether water specimens obtained from the Orr Springs area contain substances deleterious to mammals. For this purpose, Orr Springs waters were provided as the sole source of drinking water of rats to determine general toxicity and effect on activity of acetylcholinesterase; extensive chemical analyses were conducted; and algae and bacterial examinations were made, in the latter case to test for the presence of enteric pathogens.

Note: In view of the similarity of bacterial investigations of water, soil and feces, these subjects are all covered in Section E. Mention will also be made of this in the section on soil to direct the reader to the appropriate pages.

2. Toxicity Studies.

a. Experimental. On the morning of 7 July 1976, four sources of drinking water for the affected horses in the Orr Springs area were collected in 10-gallon quantities and refrigerated. Specifically, sites where water was collected were the new BLM cistern in the eastern section of Orr Springs (see Figure D-1), the new cistern in the western section, the trough supplied by the latter cistern, and the dirt basin filled with overflow water from the trough.

Water from other minor sources could not be collected in sufficient quantities to furnish drinking water for adequate numbers of experimental animals during a three-week period of observation.

(1) Procedures at Dugway Proving Ground. Female rats, weighing from 200 to 275 grams, were randomly divided into five groups of 20 animals each upon receipt from the West Coast supplier on 7 July. Each group was provided with one and only one of the water sources detailed above. The fifth group of rats was given tap water to serve as a control. Commercial rat chow was provided as feed. All animals were observed daily for evidence of illness or deaths. Ten rats were bled by cardiac puncture at weekly intervals for three weeks, and their erythrocytes examined manometrically (Warburg technique) for acetylcholinesterase activity.

(2) Procedure at the Utah State Division of Health, Bureau of Laboratories, 44 Medical Drive, Salt Lake City, by Mr. M. A. Smith, Chief, Environmental Microbiology. Half the water collected (5 gallons) on 7 July was supplied to State Division of Health Laboratories, where personnel conducted essentially the same test of toxicity by ingestion as described above. Exceptions to the details given above included the initiation of the test on 8 July with 10 rats per group instead of the 20 animals per group studied at DPG.

The larger number of animals employed by DPG personnel was to provide test animals for the investigation of inhibitors of acetylcholinesterase in the various water sources.

b. Results. After three weeks, to the end of the study, no overt signs of illness or deaths occurred in rats caged at DPG or at the State Division of Health (inclosures E-1 and E-2), except that several rats died as a result of cardiac puncture. Results of measurements of acetylcholinesterase in rats drinking Orr Springs water are given in Table E-1. Inspection of the data reveals that no significant differences exist between the groups, and that the Orr Springs waters had no adverse effect on acetylcholinesterase activity.

c. Conclusions. The fact that no signs of illness or deaths were observed in rats given water from each of four sites in the Orr Springs area for a period of 21 days shows the absence of significant quantities of any type of noxious chemical.

Similarly, during the same period, there was no decrease in activity of erythrocytic acetylcholinesterase as a result of consumption of Orr Springs water. This agrees with chemical analytical data obtained at DPG (see this section, Chemical Composition) indicating the absence of nerve agents and decomposition products. An absence of pesticides, which includes organophosphorus agents, was also reported by the State Division of Health (inclosure E-3).

3. Study of Algae in Orr Springs Water. Algae from the springs where water was flowing were sent on 9 July 1976 to Dr. Gerald Prescott, University of Montana Biological Station, Bigfork, Montana for identification. A written report is appended as inclosure E-4. Dr. Prescott stated that only one alga was present and it was an innocuous species.

4. Examination of Water, Soil and Horse Feces for Pathogens of Enterobacteriaceae.

a. Experimental. The following specimens* were inoculated at approximately 10% volume (or weight in the case of feces) to Selenite-F enrichment broth and incubated for 20 hours at 37°C.

(1) Water - Orr Springs West - collected 4 July

(2) Water - Orr Springs West Drainage Ditch - 5 July

(3) Water - Pipe Uphill on Orr Springs "A" - 5 July

(4) Water - Pipe Uphill on Orr Springs "B" - 5 July

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*See Figure D-1 for locations of origin.

TABLE E-1

EFFECT OF ORR SPRINGS WATER ON ACETYLCHOLINESTERASE OF RATS IN VIVO*

Water No.	Acetylcholinesterase Activity in Erythrocytes (Percent of Tap Water Control)		
	7 Days	14 Days	21 Days
West Orr Springs Cistern 1	100 (10)†	96 (10)	114 (8)
East Orr Springs Cistern 2	102 (10)	97 (9)	99 (10)
West Orr Springs Trough 3	106 (10)	116 (10)	112 (10)
West Orr Springs Trough 4 Overflow	93 (10)	97 (10)	122 (10)
Tap Water Control	100 (9)	100 (10)	100 (9)

*Orr Springs water was the sole source of drinking water for these rats.

†Number of rats shown in parentheses. Where number is less than 10, blood sample clotted or quantity was insufficient.

NOTE: Rats dead as a result of cardiac puncture: 5 on 14 July, 3 on 21 July, 1 on 28 July.

(5) Water - Seep in "Dead Horse Seep" - 5 July

(6) Horse Feces - Fresh Feces at Tamarisks well below Horse Trough - 7 July

(7) Horse Feces - Dry from Orr Springs West - 5 July

(8) Horse Feces - Dry from Orr Springs West - 5 July

(9) Soil - Moist with Horse Diarrhea - Orr Springs West - 4 July

After initial enrichment, specimens were streaked to three selective bacteriologic media; viz., Endo, Hektoen, and Salmonella/Shigella (SS) agars and incubated at 37°C overnight. Colonies arising after incubation were examined for absence of lactose fermentation (i.e., colorless colonies) and picked to diagnostic "Enterotubes" (Hoffman-LaRoche). Those readings that indicated possible enteric pathogens were streaked to slants and taken to the Bureau of Laboratories, Utah State Division of Health in Salt Lake City on 10 July 1976 for further study and possible serological typing.

b. Results. The following table shows specimen origin, isolation medium, "Enterotube" results and classification. See also inclosure

c. Conclusions. No isolations of Salmonella and Shigella have been made in the Orr Springs water and soil. Arizona Group 2 organisms were isolated, and are known to be responsible for infant diarrhea. They are not known to be pathogenic for horses. Particularly important is the fact that these locations presumably provide water for rodents and reptiles that normally harbor enteric pathogens and may contaminate open watering areas with their excreta.

5. Chemical Composition.(1)

a. Preparation of Samples for Chemical Analysis. Water samples used for trace element analysis were filtered through Millipore 0.45 micron filters prior to analysis. All filtered water samples were stored in polyethylene bottles.

b. Determination of pH. The pH of water samples was measured using a Beckman model 76 pH meter equipped with a combination electrode. The pH meter was standardized using a pH 7.0 buffer solution.

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(1) Analysis procedures identified with the notation (EPA) are those prescribed by "Methods of Chemical Analysis of Water and Wastes," U.S. E.P.A., EPA-625/6-74-003, 1974.

TABLE E-2

BACTERIAL ISOLATES FROM WATER AND SOIL

Spec. Origin	Isolation Medium	"Enterotube" Results											Tentative Classification
		Dex	Gas	Lys	Ornithine	H_2S	Indole	Lactose	P/A*	Dulcitol	Urea	Citrate	
1. Feces (4)†	SS	+	+	-	-	-	+	-	-	-	+	-	Aeromonas hydrophilia
2. Water (5)	Hekt	+	-	+	+	-	-	-	-	-	+	+	Group 2 Arizona
3. Water (3)	SS	+	-	-	-	-	-	+	+	-	+	+	Enterobacter agglomerans
4. Water (5)	SS	+	-	+	+	-	-	-	-	-	+	+	Group 2 Arizona
5. Water (4)	Endo	+	-	-	+	-	-	+	-	-	-	+	Citrobacter freundii
6. Water (1)	Endo	+	+	-	+	-	-	-	-	-	+	+	Citrobacter freundii
7. Soil (9)	Endo	+	-	-	-	+	-	-	-	-	-	-	Flavobacterium sp. Group 2B

*Phenylalanine

†See Section 4.a. for specimen identification.

c. Determination of Solids.

(1) Suspended Solids. The original samples were allowed to stand so that the sediment could settle out. Measured amounts of the supernatant solutions were poured through dried and weighed gooch crucibles containing fluted glass fiber filters. The filtration was done under vacuum. The crucibles and their contents were dried overnight at 135°C, and re-weighed. The amount of suspended solids was calculated as follows:

$$\text{Suspended solids, mg/l} = \frac{(A-B) \times 100}{C}$$

where:

A = weight of filter and residue

B = weight of filter

C = ml of sample filtered

(2) Soluble Solids. To a clean and weighed dry beaker, 50 ml of a filtered water sample was added. The contents were evaporated and the beaker was placed in a drying oven set at 135°C overnight. The sample was removed from the drying oven and cooled. The beakers were re-weighed. The filterable (soluble) solids content was calculated as follows:

$$\text{Filterable solids, mg/l} = \frac{(A-B) \times 1000}{C}$$

where:

A = weight of dried residue and dish

B = weight of dish

C = volume of filtrate used

d. Analysis of Chlorides (Mercuric Nitrate Method).

(1) Principle. Chloride can be titrated with mercuric nitrate because of the formation of soluble, slightly dissociated mercuric chloride. In the pH range 2.3 - 2.8, diphenylcarbazone indicates the end point of this titration by formation of a purple complex with excess mercuric ions. The error in titration is about 1% of the volume of titrant used per change of 0.1 pH unit in the pH range 2.1 - 2.8. Since exact pH adjustment is not feasible except by use of a pH meter, it is felt that keeping within a range of ± 0.1 pH unit is sufficient for most water analyses. Therefore, in this method, a specific mixture

of nitric acid and diphenylcarbazone is added to a water sample automatically adjusting the pH of most potable waters to pH 2.5 ± 0.1. A third substance in this indicator mixture, xylene cyanol FF, is used as a pH indicator and as a background color to facilitate end-point detection. The introduction of 10 mg sodium bicarbonate to both the blank and the standard titration provides a pH of 2.5 ± 0.3; then 0.1 ml indicator-acidifier reagent[2] is added. Increasing the strength of the titrant and modifying the indicator mixture enable determination of the higher chloride concentrations common in wastewater.

(2) Interference. Bromide and iodide are titrated with mercuric nitrate in the same manner as chloride. Chromate, ferric, and sulfite ions interfere when present in excess of 10 mg/l.

(3) Reagents.

(a) Standard sodium chloride, 0.0141 N

(b) Nitric acid, 0.1 N

(c) Sodium hydroxide, 0.1 N

(d) Reagents for low-chloride titrations

(e) Indicator-acidifier reagent. The nitric acid concentration of this reagent is an important factor in the success of the determination and can be varied to suit the alkalinity range of the sample being titrated. The reagent contains sufficient nitric acid to neutralize a total alkalinity of 150 mg/l as $CaCO_3$ to the proper pH in a 100-ml sample.

Dissolve, in the order named, 250 mg s-diphenylcarbazone, 4.0 ml concentrated nitric acid, and 30 mg xylene cyanol FF in 100 ml of 95% ethyl alcohol or isopropyl alcohol. Store in a dark bottle in a refrigerator. This agent is not stable indefinitely. Deterioration causes a slow end point and high results. Inasmuch as pH control plays a critical role in this method, adjust the pH of highly alkaline or acid samples to 2.5 ± 0.1 with 0.1 N nitric acid or sodium hydroxide, not with sodium bicarbonate. Use a pH meter with a non-chloride type of reference electrode for the pH adjustment. If only the usual chloride type reference electrode is available for the pH adjustment, determine the amount of acid or alkali required to achieve a pH of 2.5 ± 0.1 and discard this particular sample portion. Then treat a separate sample portion with the determined amount of acid or alkali and continue the analysis to its prescribed end. Under these circumstances, omit the nitric acid from the indicator reagent to maintain the proper sample pH. Alternatively, vary the nitric acid concentration of the indicator-acidifier reagent to accommodate conditions wherein water samples of very high or very low alkalinity are being analyzed.

(f) Standard mercuric nitrate titrant, 0.0141N. Dissolve 2.3 g $Hg(NO_3)_2$, or 2.5 g $Hg(NO_3)_2 \cdot H_2O$, in 100 ml of distilled water containing 0.25 ml concentrated HNO_3. Dilute to just under 1 liter and perform a preliminary standardization. Use replicates containing 5.00 ml standard 0.0141 N NaCl solution and 10 mg $NaHCO_3$ diluted to 100 ml with distilled water. Adjust the mercuric nitrate titrant to exactly 0.0141 N and perform a final standardization. Store away from light in a dark bottle. Standard mercuric nitrate titrant, exactly 0.0141 N, is equivalent to 500 µg Cl per 1.00 ml.

(g) Reagents for high-chloride titrations.

(1) Mixed indicator reagent. Dissolve 5 g diphenylcarbazone powder and 0.5 g bromphenol blue powder in 750 mg 95% ethyl or isopropyl alcohol and dilute to 1 liter with ethyl or isopropyl alcohol.

(2) Strong standard mercuric nitrate titrant, 0.141 N. Dissolve 25 g $Hg(NO_3)_2 \cdot H_2O$ in 900 ml distilled water containing 5.0 ml concentrated HNO_3. Dilute to just under 1 liter, and perform a preliminary standardization. Use replicates containing 25.00 ml standard 0.0141 N NaCl solution and 25 ml distilled water. Adjust the titrant to exactly 0.141 N and perform a final standardization. The chloride equivalence of the titrant is 5.00 mg Cl per 1.00 ml.

(4) Procedure.

(a) Titration of low-chloride concentrations prevailing in drinking water. Use a 100-ml sample or smaller aliquot so that the chloride content is less than 10 mg.

Add 1.0 ml of indicator-acidifier reagent to the sample. (The color of the solution should be green-blue at this point. A light green indicates a pH of less than 2.0; a pure blue indicates a pH of more than 3.8. For most potable waters, the pH after this addition will be 2.5 $\pm$ 0.1. When highly alkaline or acid waters are encountered, a preliminary pH adjustment to about pH 8 will be necessary before the indicator-acidifier reagent is added.)

Titrate the treated sample with 0.0141 N mercuric nitrate titrant to a definite purple end point. The solution will turn from green-blue to blue a few drops from the end point.

Determine the blank by titration of 100 ml distilled water containing 10 mg $NaHCO_3$.

(b) Titration of high-chloride concentrations. Place 50.0 ml sample in a 150 ml beaker (5.00 ml sample may be used when more than 5 ml titrant are needed). Add approximately 0.5 ml mixed indicator reagent and mix well. The color should be purple. Add 0.1 N HNO_3 dropwise

until the color just turns yellow. Titrate with 0.141 N mercuric nitrate titrant to the first permanent dark purple color. Titrate a distilled water blank using the same procedure.

(c) Calculation:

$$\text{mg Cl/l} = \frac{(A-B) \times N \times 35{,}450}{\text{ml sample}}$$

where A = ml titration for sample

B = ml titration for blank

N = normality of $Hg(NO_3)_2$

e. Analysis of Nitrogen, Nitrate-Nitrite (Cadmium Reduction Method) (EPA)

(1) General Discussion. The analysis was made as soon as possible after receiving the samples. This method pertains to the determination of nitrate singly, or nitrite and nitrate combined in drinking, surface, and saline waters, domestic and industrial wastes. The applicable range of this method is 0.01 to 1.0 mg/l nitrate-nitrite nitrogen. The range may be extended with sample dilution.

A filtered sample is passed through a column containing granulated copper-cadmium to reduce nitrate to nitrite. The nitrite (that orignally present plus reduced nitrate) is determined by diazotizing with sulfanilamide and coupling with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye which is measured spectrophotometrically. Separate, rather than combined nitrate-nitrite values, are readily obtained by carrying out the procedure first with, and then without, the initial Cu-Cd reduction step.

(2) Interferences. Build-up of suspended matter in the reduction column restricts sample flow. The samples were pre-filtered through a 0.45 μ membrane filter.

Low results might be obtained from samples that contain high concentrations of iron, copper, or other metals. EDTA was added to the samples to eliminate this interference.

(3) Apparatus.

(a) A reduction column was constructed from a 50-ml pipet by removing the top portion.

(b) A Cary Model 15 Spectrophotometer at 540 nm using 1-cm cell was used to quantitate the nitrite content of the samples.

(4) Reagents.

(a) Granulated cadmium 40-60 mesh

(b) Copper-Cadmium. The cadmium granules (new or used) were cleaned with dilute HCl and copperized with 2% solution of copper sulfate in the following manner:

Wash the cadmium with dilute HCl and rinse with distilled water.

Swirl 25 g cadmium in 100-ml potions of a 2% solution of copper sulfate for 5 minutes or until blue color partially fades, decant and repeat with fresh copper sulfate until a brown colloidal precipitate forms.

Wash the copper-cadmium with distilled water (at least 10 times) to remove all the precipitated copper.

(c) Preparation of reaction column. Insert a glass wool plug into the bottom of the reduction column and fill with distilled water. Add sufficient copper-cadmium granules to produce a column 18.5 cm in length. Maintain a level of distilled water above the copper-cadmium granules to eliminate entrapment of air. Wash the column with 200 ml of dilute ammonium chloride solution. The column is then activated by passing through the column 100 ml of a solution composed of 25 ml of a 1.0 mg/l NO_3-N standard and 75 ml of ammonium chloride - EDTA solution. Use a flow rate between 7 and 10 ml per minute.

(d) Ammonium chloride - EDTA solution. Dissolve 13 g ammonium chloride and 1.7 g disodium ethylenediamine tetracetate in 900 ml of distilled water. Adjust the pH to 8.5 with concentrated ammonium hydroxide and dilute to 1 liter.

(e) Dilute ammonium chloride-EDTA solution. Dilute 300 ml of ammonium chloride-EDTA solution to 500 ml with distilled water.

(f) Color reagent. Dissolve 10 g sulfanilamide and 1 g N-(1-naphthyl)-ethylenediamine dihydrochloride in a mixture of 100 ml concentrated phosphoric acid and 800 ml of distilled water and dilute to 1 liter with distilled water.

(g) Zinc sulfate solution. Dissolve 100 g $ZnSO_4.7H_2O$ in distilled water and dilute to 1 liter.

(h) Sodium hydroxide colution, 6N. Dissolve 240 g NaOH in 500 ml distilled water, cool and dilute to 1 liter.

(i) Ammonium hydroxide, concentrated.

(j) Dilute hydrochloric acid, 6N. Dilute 50 ml of concentrated HCl to 100 ml with distilled water.

(k) Copper sulfate solution, 2%. Dissolve 20 g of $CuSO_4.5H_2O$ in 500 ml of distilled water and dilute to 1 liter.

(l) Stock nitrate solution. Dissolve 7.218 g KNO_3 in distilled water and dilute to 1000 ml. Preserve with 2 ml of chloroform per liter. This solution is stable for at least 6 months. 1.0 ml = 1.00 mg NO_3-N.

(m) Standard nitrate solution. Dilute 10.0 ml of nitrate stock solution to 1000 ml with distilled water. 1.0 ml = 0.01 mg NO_3-N.

(n) Stock nitrite solution. Dissolve 6.072 g KNO_2 in 500 ml of distilled water and dilute to 1000 ml. Preserve with 2 ml of chloroform and keep under refrigeration. It is stable for approximately 3 months. 1.0 ml - 1.00 mg NO_2-N.

(o) Standard nitrite solution. Dilute 10.0 ml of stock nitrite solution to 1000 ml with distilled water. 1.0 ml - 0.1 mg NO_2-N.

(p) Using standard nitrate solution prepared the following standards in 100 ml volumetric flasks:

Concentration (mg NO_3-N/l)	ml of Standard Solution/100.0 ml
0.00	0.0
0.05	0.5
0.10	1.0
0.20	2.0
0.50	5.0
1.00	10.0

(5) Procedure

(a) If the pH of the sample is below 5 or above 9, adjust to between 5 and 9 with either concentrated HCl or concentrated NH_4OH.

(b) To 25.0 ml of sample or an aliquot diluted to 25.0 ml, add 75 ml of ammonium chloride-EDTA solution and mix.

(c) Pour sample into column and collect sample at a rate of 7-10 ml per minute.

(d) Discard the first 25 ml, collect the rest of the sample (approximately 70 ml) in the original sample flask.

(e) Add 2.0 ml of color reagent to 50.0 ml of sample. Allow 10 minutes for color development. Within 2 hours measure the absorbance at 540 nm against a reagent blank.

NOTE: If the concentration of sample exceeds 1.0 mg NO_3-N/l, the remainder of the reduced sample may be used to make an appropriate dilution before proceeding with this step.

(f) Standards. Carry out the reduction of standards exactly as described for the samples. At least one nitrite standard should be compared to a reduced nitrate standard at the same concentration to verify the efficiency of the reduction column.

(g) Calculation. Obtain a standard curve by plotting the absorbance of standards run by the above procedure against NO_3-N in mg/l. Compute concentration of samples by comparing sample absorbance with the standard curve.

If less than 25 ml of sample is used for the analysis the following equation should be used:

$$\text{mg } NO_2 + NO_3\text{-N/l} = \frac{A \times 25}{\text{ml sample used}}$$

where A = concentration of nitrate from standard curve

f. Analysis of Arsenic*

(1) Equipment. A Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer Model 2100 Heater Graphite Atomizer and a Perkin-Elmer Model 56 Strip Chart Recorder was used to record the response in absorbance. The atomic absorption spectrophotometer is fitted with a deuterium arc background corrector.

(2) Wavelength. 193.7 nm UV range

(3) Slit Setting. 4 (0.7 nm)

(4) Light Source. Perkin-Elmer electrodeless discharge lamp

(5) Drying Temperature. 95°C for 60 seconds.

(6) Charring Temperature. 230°C for 60 seconds.

*In these procedures the instrument settings recommended by the manufacturer(s) were used. Special sample handling procedures to provide enhanced sensitivity were not deemed necessary for this purpose.

(7) Atomization Temperature. 2000°C for 10 seconds.

(8) Purge Gas. Argon in interrupt mode.

(9) Aliquot. 100 microliters

Standards were made from Harleco stock standard solution containing 1000 mg As/l by diluting appropriate aliquots with distilled water containing one percent nitric acid. Detection limit: 0.05 mg/l (ppm).[3]

g. Analysis of Beryllium.

(1) Equipment. Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer Model 56 strip chart recorder. Equipment was operated in the concentration mode using three-second integration for calibration of the digital readout and analysis of samples.

(2) Wavelength. 234.9 nm UV range.

(3) Slit Setting. 4 (0.7 nm).

(4) Light Source. Perkin-Elmer hollow cathode lamp.

(5) Burner Type. Nitrous oxide, single slot, 2-inch slot.

(6) Fuel. Acetylene; flow rate at 6l on burner control box.

(7) Oxidant. Nitrous oxide; flow rate at 34 on burner control box.

Standards were made from Harleco stock standard solution containing 1000 mg Be/l by diluting appropriate aliquots with distilled water containing one per cent nitric acid and 1000 mg Na/l. Detection limit: 0.02 mg/l (ppm).

h. Analysis of Cadmium.

(1) Equipment. Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer Model 56 Strip Chart Recorder. Equipment was operated in the concentration mode using three-second integration for calibration of the digital readout and analysis of samples.

(2) Wavelength. 228.8 nm UV range.

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[3] Analytical Methods for Atomic Absorption Spectrophotometry, Perkin-Elmer Corp., Norwalk, Conn., March 1973.

(3) Slit Setting. 4 (0.7 nm)

(4) Light Source. Perkin-Elmer hollow cathode lamp.

(5) Burner Type. Air-acetylene, single slot, 4-inch slot.

(6) Fuel. Acetylene; flow rate at 32 on burner control box.

(7) Oxidant. Air; flow rate at 40 on burner control box.

Standards were made from Harleco stock standards solution containing 1000 mg Cd/l by diluting appropriate aliquots with distilled water containing one per cent nitric acid. Detection limit: 0.02 mg/l (ppm).

i. Analysis of Calcium.

(1) Equipment. Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer Model 56 Strip Chart Recorder. The equipment was operated in the concentration mode using three-second integration for calibration of the digital readout and analysis of samples.

(2) Wavelength. 422.7 nm visible range.

(3) Slit Setting. 4 (1.4 nm)

(4) Light Source. Perkin-Elmer hollow cathode lamp.

(5) Burner Type. Air-acetylene, single slot, 4-inch long slot

(6) Fuel. Acetylene, flow rate 32 on burner control box.

(7) Oxidant. Air; flow rate at 40 on burner control box

Standards were made from Harleco stock standard solutions containing 1000 mg Ca/l by diluting appropriate aliquots with distilled water containig one per cent nitric acid.

j. Analysis of Chromium.

(1) Equipment. Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer Model 56 Strip Chart Recorder. Equipmnet was operated in the concentration mode using three-second integration for calibration of the digital readout and analysis of samples.

(2) Wavelength. 357.9 nm UV range

(3) Slit Setting. 4 (0.7 nm)

(4) Light Source. Perkin-Elmer hollow cathode lamp.

(5) Burner Type. Air-acetylene, single slot, 4-inch slot.

(6) Fuel. Acetylene; flow rate at 40 on burner control box.

(7) Oxidant. Air; flow rate at 43 on burner control box.

Standards were made from Harleco stock standard solution containing 1000 mg Cr/l by diluting appropriate aliquots with distilled water containing one percent nitric acid. Detection limit: 0.05 mg/l (ppm).

k. Analysis of Copper.

(1) Equipment. Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer 56 Strip Chart Recorder. Equipment was operated in the concentration mode using three-second integration for calibration of the digital readout and analysis of samples.

(2) Wavelength. 324.7 nm UV range.

(3) Slit Setting. 4 (0.7 nm).

(4) Light Source. Perkin-Elmer hollow cathode lamp.

(5) Burner Type. Air-acetylene, single slot, 4-inch slot.

(6) Fuel. Acetylene; flow rate at 32 on burner control box.

(7) Oxidant. Air; flow rate at 40 on burner control box.

Standards were made from Harleco stock standard solution containing 1000 mg Cu/l by diluting appropriate aliquots with distilled water containing one per cent nitric acid. Detection limit: 0.02 mg/l (ppm).

l. Analysis of Lead.

(1) Equipment. Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer Model 56 Strip Chart Recorder. Equipment was operated in the concentration mode using three-second integration for calibration of the digital readout and analysis of samples.

(2) Wavelength. 283.3 nm UV range.

(3) Slit Setting. 4 (0.7 nm).

(4) Light Source. Perkin-Elmer electrodeless discharge lamp.

(5) Burner Type. Air-acetylene, single slot, 4-inch slot.

(6) Fuel. Acetylene, flow rate at 30 on burner control box.

(7) Oxidant. Air, flow rate at 35 on burner control box.

Standards were made from Harleco stock standard solution containing 1000 mg Pb/l by diluting appropriate aliquots with distilled water containing one per cent nitric acid. Detection limit: 0.1 mg/l (ppm).

m. Analysis of Magnesium.

(1) Equipment. Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer Model 56 Strip Chart Recorder. Equipment was operated in the concentration mode using three-second integration for calibration of the digital readout and analysis of samples.

(2) Wavelength. 285 nm UV range.

(3) Slit Setting. 4 (1.4 nm)

(4) Light Source. Perkin-Elmer hollow cathode lamp.

(5) Burner Type. Air-acetylene, single slot, 4-inch slot.

(6) Fuel. Acetylene; flow rate at 32 on burner control box.

(7) Oxidant. Air; flow rate at 40 on burner control box.

Standards were made from Harleco stock standard solution containing 1000 mg Mg/l by diluting appropriate aliquots with distilled water containing one per cent nitric acid.

n. Analysis of Mercury.

(1) Equipment. Perkin-Elmer Model 303 Atomic Absorption Spectrophotometer equipped with the Perkin-Elmer Model 56 Strip Chart Recorder and the Perkin-Elmer Flameless Mercury Analysis System.

(2) Wavelength. 253.7 UV range.

(3) Slit Setting. Perkin-Elmer hollow cathode lamp.

Stock standard solution for mercury was made by dissolving 1.080 g of mercury (II) oxide, HgO, in a minimum amount of (1:1) HCl and distilled water. Diluted to one liter with distilled water, this equals 1000 mg/l Hg.

The Perkin-Elmer Mercury Analysis System is based on the Hatch and Ott procedure. The procedure was published in Analytical Chemistry, 40, 14, pp. 2085-2087, Dec 1968. Basically the system operates as follows:

A 100-ml or smaller sample which is adjusted to 100 ml is treated with permanganate to oxidize all of the mercury present to the mercuric (Hg^{2+}) form. The excess permanganate is reduced with hydrochloride, and then the mercury is reduced to metallic mercury with stannous chloride. An aerator is placed in the sample solution. A circulating pump moves the air, which is trapped in the system, through the solution, thus evaporating the mercury and carrying the vapor through the absorption cell. Mercury vapor in atomic form absorbs the 253.7 nm radiation emitted from the light source (hence the term, flameless atomic absorption). The change in energy is then detected and read out in the usual way on the atomic absorption spectrophotometer. The detection limit is 0.02 μg Hg in 100 ml.

o. Analysis of Nickel.

(1) Equipment. Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer Model 56 Strip Chart Recorder. Equipment was operated in the concentration mode using three-second integration for calibration of the digital readout and analysis of samples.

(2) Wavelength. 232.0 nm UV range.

(3) Slit Source. 3 (0.2 nm).

(4) Light Source. Perkin-Elmer hollow cathode lamp.

(5) Burner Type. Air-acetylene, single slot, 4-inch slot.

(6) Fuel. Acetylene; flow rate at 32 on burner control box.

(7) Oxidant. Air; flow rate at 40 on burner control box.

Standards were made from Harleco stock standard solution containing 1000 mg Ni/l by diluting appropriate aliquots with distilled water containing one per cent nitric acid. Detection limit: 0.05mg/l (ppm).

p. Analysis of Potassium.

(1) Equipment. Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer Model 56 Strip Chart Recorder. Equipment was operated in the concentration mode using three-second integration for calibration of the digital readout and analysis of samples.

(2) Wavelength. 383 nm visible range and red filter.

(3) Slit Setting. 4 (1.4 nm).

(4) Light Source. Perkin-Elmer hollow cathode lamp.

(5) Burner Type. Air-acetylene, single slot, 4-inch slot

(6) Fuel. Acetylene; flow rate at 32 on burner control box.

(7) Oxidant. Air, flow rate at 40 on burner control box.

Standards were made from Harleco stock standard solution containing 1000 mg K/l by diluting appropriate aliquots with distilled water containing one per cent nitric acid.

q. Analysis of Selenium.

(1) Equipment. Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer Model 2100 Heated Graphite Atomizer and the Perkin-Elmer Model 56 Strip Chart Recorder was used to record the response in absorbance. The atomic absorption spectrophotometer is also fitted with a deuterium arc background corrector.

(2) Wavelength. 196.0 nm UV range.

(3) Slit Setting. 4 (0.7 nm).

(4) Drying Temperature. 95°C for 60 seconds.

(5) Charring Temperature. 330° for 60 seconds.

(6) Atomization Temperature. 2200°C for 10 seconds.

(7) Purge Gas. Argon in interrupt mode.

(8) Aliquot. 100 microliters.

Standards were made from a stock standard solution containing 1000 mg Se/l. Stock solution was made by dissolving 1.000 g of selenium metal in a minimum volume of nitric acid; evaporate to dryness. Two ml water was added and evaporated to dryness 2 or 3 additional times. The residue was finally dissolved in ten per cent (v/v) hydrochloric acid and diluted to one liter with distilled water containing ten per cent hydrochloric acid. Stock solution = 1000 mg Se/l. Detection limit: 0.1 mg/l (ppm).

r. Analysis of Sodium.

(1) Equipment. Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer with the Perkin-Elmer Model 56 Strip Chart Recorder. The equipment was operated in the concentration mode using three-second integration for calibration of the digital readout and analysis of samples.

(2) Wavelength. 294.8 nm visible range.

(2) Wavelength. 294.8 nm visible range

(3) Slit. 4 (1.4 nm)

(4) Light Source. Perkin-Elmer hollow cathode lamp

(5) Burner. Air-acetylene, single slot, 4-inch slot

(6) Fuel. Acetylene; flow rate at 29 on burner control box

(7) Oxidant. Air; flow rate at 35 on burner control box

Standards were made from Harleco stock standard solution containing 1000 mg Na/l by diluting appropriate aliquots with distilled water containing one percent nitric acid.

s. Analysis of Agents GB and VX. The following methods were used to detect and measure by gas chromatography O-isopropyl methylphosphonofluoridate (GB) and O-ethyl s-(2-diisopropylaminoethyl)methylphosphonothioate (VX) in water.

(1) Extraction. A 10-ml aliquot of the sample is pipetted into a 15-ml centrifuge tube. Two grams NaCl is dissolved in the sample, one tenth (0.1) ml of chloroform added, the centrifuge tube stoppered and shaken for one minute and then centrifuged three minutes. After the chloroform layer settles out, a 10-µl syringe is inserted through the aqueous phase into the chloroform layer, 7-8 µl are drawn into the syringe, the volume adjusted to 5 µl and injected into a gas chromatograph.

Sample concentrations are calculated by comparing the peak area obtained for the sample to the peak areas obtained from GB and VX standards of known concentration in chloroform. The agent concentration in the brine is determined by dividing by the extracting efficiency factor, 60.

Using 100:1 ratio of water sample to chloroform and an extraction efficiency of 60%, the lower detection limit for GB is 0.3 ng GB/ml H_2O and 3 ng/ml H_2O for VX.

(2) Analysis. The chloroform extracts were analyzed for GB or VX by a Varian Aerograph Model 2100 Gas Chromatograph (GC). The operational parameters are listed below for each agent. The gas chromatograph was equipped with a Microtek Flame Photometric Detector (FPD), equipped with an interference filter passing light at a wavelength of 532 nm.

t. Analysis for Cholinesterase Inhibitors. Cholinesterase inhibitors, i.e., organophosphorus nerve agents and insecticides, can be detected and quantitated by measuring their inhibitory effect on cholinesterase or acetylcholinesterase acting upon acetylcholine or acetylthiocholine as substrate.

TABLE E-3

GC OPERATIONAL PARAMETERS

	GB	VX
Column:	5' x 2 mm ID glass	6' x 2 mm ID glass
Column Packing:	Carbowax 400 on Porasil F 80/100 mesh (Durapak - Waters Associates Part No. 27929)	5% SP2100 on Chromasorb 750
Column Temp:	120°C	180°C
Detector Temp:	175°C	175°C
Inlet TempL	160°C	160°C

Flow rates: N_2 -- 15 ml/min

O_2 -- 5 ml/min

H_2 -- 100 ml/min

Air -- 60 ml/min

(1) Reagents

(a) Enzyme working solution. Prepare 0.25 M phosphate buffer by dissolving 68.0 g KH_2PO_4 and 348 g of K_2HPO_4 in 10 liters of distilled water. Prepare a stock enzyme solution by dissolving the contents of one vial of bovine erythrocyte acetylcholinesterase (20,000 units, Winthrop Laboratories, Special Chemicals Department) in 50 ml of isotonic saline solution (9 g NaCl in one liter of distilled water). To two liters of the phosphate buffer solution, add 100 mg of 5,5'-dithiobis-(2-nitrobenzoic acid) (DTNB) and 5 ml of the enzyme solution in isotonic saline.

(b) Substrate solution. Dissolve 1 g of acetylthiocholine iodide in 500 ml of distilled water. Refrigerate all reagents when not in use.

(c) Standards. Prepare standard solutions of agent GB at concentrations of 0, 0.0005, 0.001, 0.0015, 0.002, 0.004, 0.006, and

0.008 µg GB/ml water.

(2) Procedure.

(a) Pipet duplicate 2.5-ml aliquots of each sample and 0.3 ml of distilled water into test tubes in a water bath at 37°C.

(b) Add 2.0 ml of enzyme solution, mix well, and incubate for 15 minutes.

(c) Add 1 ml of the substrate solution, mix well, and incubate for 4.5 minutes.

(d) Measure the absorbance of the sample with a spectrophotometer set at a wavelength of 412 nm.

(e) Analyze a set of standards by the above procedure, and prepare a plot of absorbance vs. concentration. Draw a "best fit" curve through the data points.

(f) Determine the apparent GB concentrations of the samples by reading from the calibration curve the equivalent GB concentrations of the samples.

u. Analysis for Agent Decomposition Products. The following method was used to detect and measure agent decomposition products methylphosphonic acid (YN), isopropyl methylphosphonic acid (IMP), ethyl methylphosphonic acid (YL), and diisopropyl methylphosphonate (DIMP). Before analysis, the decomposition products (except DIMP) must be derivatized. One ml of water is pipetted into a test tube and nine ml isopropanol is added. The contents of the tube are thoroughly mixed and the sample acidified to pH 6 by dropwise addition of concentrated HCl. The solution is propylated by dropwise addition of diazopropane in ether until a yellow color persists. The samples are allowed to stand overnight to destroy the excess diazopropane. The propylation step is 80 percent efficient. The derivatized sample is analyzed by GC. The diazopropane solution was prepared using the methods of McKay.(4) Diazopropane is used instead of the more commonly used diazomethane because phosphates form trimethyl phosphate which is difficult to separate from dimethyl methylphosphonate (methyl derivative of YN).

The GC operational parameters are the same as those described for GB in Section S except that the column temperature was set at 150°C. A 5-µl sample volume was injected into the GC.

Sample concentrations are calculated by comparing the peak areas obtained for the sample to the peak areas obtained from derivatized IMP,

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(4)A. F. McKay et al., Can. J. Res. 28 683 (1950).

YN, and YL standards of known concentrations. It is best to use processed standards where known amounts of IMP, YN and YL are added to control water samples and treated the same as the samples. However, comparison with standards of esterified IMP, YN and YL in isopropyl alcohol should show an efficiency of approximately 80 percent.

v. Results. The results obtained by DPG are given in Tables E-4 through E-10. Also listed in these tables are results obtained by the laboratories at the Utah State Division of Health, as first verbally reported by Dr. M. Gortatowski. The samples were delivered to the Division of Health on 7 July 1976. A formal report of the results has since been provided by the Division of Health (inclosure E-3).

The results shown in Tables E-4 through E-9 are expressed in units of mg/l. This is a commonly-used unit in water quality analysis. To avoid confusion and to assist with the interpretation of the results, mg/l can be converted to µg/l by multiplying mg/l by 1000.

w. Conclusions.

(1) Chemical agents GB and VX and their hydrolytic decomposition products were not detected in any of the water samples; neither was any other inhibitor of acetylcholinesterase.

(2) The concentrations of dissolved metals and chloride found in the water samples are not considered to be abnormal for the area or at toxic levels.

A comparison of the results obtained by DPG with the preliminary results received from the Utah State Division of Health shows reasonable agreement. The atomic absorption methods used at DPG are intended for rapid screening of samples utilizing the recommended instrumental settings of the manufacturer. No attempt was made to increase the sensitivities for each metal through extraction or special sampling techniques because the results obtained by using routine instrumental setting yielded in most cases, sensitivities at or near the proposed drinking water standards. These standards are "safe-side" levels and sensitivities of the methods used at DPG are such that, if a contamination problem existed in the water samples, it would have been detected, particularly at concentrations posing toxic hazards to mammals.

The methods used for metals analyses at the Utah State Division of Health are significantly more sensitive. However, their results verify our findings of very low and acceptable levels of toxic metal contamination in the water samples.

(3) Federal standards for drinking water have been published. Extracts of these standards are given in Tables E-11 and E-12.

TABLE E-4

ANALYTICAL RESULTS WATER SAMPLE #1
Pond Below Trough - Orr Spring West
Sample Time: 1050 hrs
Date: 7 July 1976

Element	Dugway Proving Ground	Utah State Dept. of Health
pH	8.0	--
Suspended Solids	11 mg/l	--
Dissolved Solids	2600 mg/l	2500 mg/l
Chloride	1050 mg/l	--
NO_2	0.0	0.0
NO_3	0.82 mg/l	0.41 mg/l
As	< 0.05 mg/l	1.2 µg/l
Se	0.1 mg/l	0.1 µg/l
Be	0.02 mg/l	< 5.0 µg/l
Hg	50 µg/l	0.0
Pb	<0.1 mg/l	50.0 µg/l
Cd	<0.02 mg/l	5.0 µg/l
Cr	<0.05 mg/l	--
Cu	<0.02 mg/l	--
Na	370 mg/l	--
K	9.2 mg/l	--
Mg	101 mg/l	--
Ca	270 mg/l	--
Ni	< 0.05 mg/l	--

TABLE E-5

ANALYTICAL RESULTS WATER SAMPLE #2
Orr Spring - West Cistern
Sample Time: 1030 hrs
Date: 7 July 1976

Element	Dugway Proving Ground	Utah State Dept. of Health
pH	7.8	--
Suspended Solids	2.6 mg/l	--
Dissolved Solids	2600 mg/l	--
Chloride	950 mg/l	--
NO_2	0.0	0.0
NO_3	1.2 mg/l	0.38 μg/l
As	< 0.05 mg/l	0.0
Se	< 0.1 mg/l	0.1 μg/l
Be	< 0.02 mg/l	< 5.0 μg/l
Hg	<50 μg/l	0.0
Pb	< 0.1 mg/l	30.0 μg/l
Cd	< 0.02 mg/l	3.0 μg/l
Cr	< 0.05 mg/l	--
Cu	< 0.02 mg/l	--
Na	320 mg/l	--
K	7.4 mg/l	--
Mg	102 mg/l	--
Ca	265 mg/l	--
Ni	< 0.05 mg/l	--

TABLE E-6

ANALYTICAL RESULTS WATER SAMPLE #3
Orr Spring - West Trough
Sample Time: 1045 hrs
Date: 7 July 1976

Element	Dugway Proving Ground	Utah State Dept. of Health
pH	7.7	--
Suspended Solids	1.0 mg/l	--
Dissolved Solids	2600 mg/l	--
Chloride	1025 mg/l	--
NO_2	0.0	0.0
NO_3	0.80 mg/l	0.48 mg/l
As	<0.05 mg/l	0.8 µg/l
Se	<0.1 mg/l	0.0
Be	<0.02 mg/l	<5.0 µg/l
Hg	<50 mg/l	0.0
Pb	<0.1 mg/l	40.0 µg/l
Cd	<0.02 mg/l	2.0 µg/l
Cr	<0.05 mg/l	--
Cu	<0.02 mg/l	--
Na	350 mg/l	--
K	8.0 mg/l	--
Mg	99 mg/l	--
Ca	270 mg/l	--
Ni	<0.05 mg/l	--

TABLE E-7

ANALYTICAL RESULTS WATER SAMPLE #4
Lower Seep - Tamarack Area
Sample Time: 1130 hrs
Date: 7 July 1976

Element	Dugway Proving Ground	Utah State Dept. of Health
pH	7.4	--
Suspended Solids	164 mg/l	No sample
Dissolved Solids	5200 mg/l	No sample
Chloride	1780 mg/l	--
NO_2	0.19 mg/l	0.0
NO_3	0.33 mg/l	0.80 mg/l
As	0.080 mg/l	16.0 µg/l
Se	< 0.1 mg/l	1.7 µg/l
Be	< 0.02 mg/l	<5.0 µg/l
Hg	<50 µg/l	0.0
Pb	< 0.1 mg/l	150 µg/l
Cd	< 0.02 mg/l	15.0 µg/l
Cr	< 0.05 mg/l	--
Cu	0.02 mg/l	--
Na	590 mg/l	--
K	25 mg/l	--
Mg	178 mg/l	--
Ca	595 mg/l	--
Ni	0.60 mg/l	--

TABLE E-8

ANALYTICAL RESULTS WATER SAMPLE #5
Orr Spring East
Sample Time: 1000 hrs
Date: 7 July 1976

Element	Dugway Proving Ground	Utah State Dept. of Health
pH	7.7	--
Suspended Solids	17 mg/l	--
Dissolved Solids	2400 mg/l	2380 mg/l
Chloride	1000 mg/l	--
NO_2	0.0	0.0
NO_3	0.88 mg/l	0.64 mg/l
As	< 0.05 mg/l	< 1.8 µg/l
Se	0.1 mg/l	0.0
Be	< 0.02 mg/l	< 5.0 µg/l
Hg	< 50 ug/l	0.0
Pb	< 0.1 mg/l	30.0 µg/l
Cd	< 0.02 mg/l	5.0 µg/l
Cr	< 0.05 mg/l	--
Cu	< 0.02 mg/l	--
Na	360 mg/l	--
K	8.1 mg/l	--
Mg	91 mg/l	--
Ca	255 mg/l	--
Ni	0.07 mg/l	--

TABLE E-9

ANALYTICAL RESULTS WATER SAMPLE #6
SEEP
Sample Time: 1025 hrs
Date: 7 July 1976

Element	Dugway Proving Ground	Utah State Dept. of Health
pH	8.0	--
Suspended Solids	140 mg/l	--
Dissolved Solids	3000 mg/l	2970 mg/l
Chloride	1150 mg/l	--
NO_2	0.0	0.0
NO_3	0.38 mg/l	0.26 mg/l
As	0.055 mg/l	16.0 µg/l
Se	<0.1 mg/l	0.6 µg/l
Be	<0.02 mg/l	<5.0 µg/l
Hg	< 50 µg/l	0.0
Pb	<0.1 mg/l	50.0 µg/l
Cd	<0.02 mg/l	5.0 µg/l
Cr	<0.05 mg/l	--
Cu	<0.02 mg/l	--
Na	420 mg/l	--
K	35 mg/l	--
Mg	115 mg/l	--
Ca	280 mg/l	--
Ni	<0.05 mg/l	--

TABLE E-10

AGENT AND AGENT DECOMPOSITION PRODUCT CONTENT
IN WATER SAMPLES

Sample No.	GB	VX	Enz. Inhib.	YN	YL	IMP	DIMP
1	<0.3 ng/ml	<3 ng/ml	<0.0005 ug/ml	<2.0 ug/ml	<2.0 ug/ml	<2.0 ug/ml	<2.0 ug/ml
2	"	"	"	"	"	"	"
3	"	"	"	"	"	"	"
4	"	"	"	"	"	"	"
5	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"

TABLE E-11. PROPOSED INTERIM STANDARDS FOR PRIMARY DRINKING WATER
(40 CFR Part 141, 15 March 1975)

Element	Maximum Concentration (mg/l)
As	0.05
Cd	0.01
Cr	0.05
Pb	0.05
Hg	0.002
Se	0.01
Nitrate	10.0

TABLE E-12. ADDITIONAL SUGGESTED MAXIMUM CONCENTRATIONS FOR DRINKING WATER
(42 CFR Part 72.205, 1 October 1973)

Element	Suggested Maximum Concentration (mg/l)
Cu	1.0
Fe	0.3
Chloride	250
Total Dissolved Solids	500

STATE OF UTAH–DEPARTMENT OF SOCIAL SERVICES

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Board of Health
Air Conservation Committee
Health Facilities Council
Medical Examiner Committee
Nursing Home Advisory Council
Water Pollution Committee

BUREAU OF LABORATORIES

LYMAN J. OLSEN, M.D., M.P.H.
Director of Health

July 26, 1976

Horace B. Rees Jr., Ph.D Microbiologist
Environmental and Life Sciences Division
Material Test Directorate
U.S.Army Dugway Proving Grounds
Dugway, Utah 84022

Dear Dr. Rees:

The following are the results of tests performed on samples and cultures taken in the Orr Spring area during July 1976.

Water Toxicity
Water from the following sources was fed to each of four groups of 10 rats beginning July 8, 1976 and still continuing as of the date of this report.

No. I Orr Spring West trough

No. 2 Orr Spring East Cistern

No. 3 Orr Spring West Cistern

No. 4 Orr Spring West pond below trough

No. 5 Laboratory Control

Each group of ten(10) rats consumed between 150 and 400 ml per group per day of each of the respective spring samples. To date there has not been any indication of abnormality or illness in any of the animals in the 5 groups under test.

Soil
Examinations were performed on soils to determine the presence of aerobic sporeforming Bacillus anthracis.
Method
Determination of the presence of Anthrax spores was by the Method used by Rees et al(Public Health Reports in press)

Results:

Group	Soil Source	Mortality	Isolate *
1.	Orr Spring west-fill over Spring "Dead Horsedraw"	2/2	

Group	Soil Source	Mortality	Isolate*
2.	Orr Spring west-Seep at Dead"Horsedraw"	2/2	
3.	Orr Spring east-RoadCut	0/2	
4.	Orr Spring west-Mesa with Distichilis Stricta	0/2	
5.	Orr Spring west-Creek Bed of "Dead Horsedraw"	0/2	
6.	Orr Spring east-Dozer digging and fill	0/2	

* Biochemical testing and evaluation of isolates from the spleen and livers of the Guinea pigs indicate they are not B. anthracis. Reactions are similar and compatible with those for B. cereus.

Identification of Cultural Isolates:

No.	Source	Identification
1.	Feces B Orr Spring west	Aeromonas hydrophilia
2.	Water - Deep Draw Seep	Arizona Group 2
3.	Water 3 Pipe uphill Orr Sp.A	Coliform Enterobacter
4.	Water 4 Death Draw - Seep	Arizona Group 2
5.	Water 5 pipe uphill Orr Sp.B	Citrobacter fruendii
6.	Water 6 Orr Spring west	Enterobacter cloacae
7.	Soil Orr Spring west	Flavobacterium Sp. Group #B

All of the testing performed by Env. Microbiology on water samples, soil samples and identification of cultural isolates, failed to produce any biological entity that would be life threatening to the animals in the Orr Spring area.

If I can be of further assistance please call.

Sincerely,

Merlin A. Smith, Chief
Env. microbiology

MAS/bjh

STATE OF UTAH—DEPARTMENT OF SOCIAL SERVICES

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Board of Health
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Health Facilities Council
Medical Examiner Committee
Nursing Home Advisory Council
Water Pollution Committee

BUREAU OF LABORATORIES

August 19, 1976

Dr. L.L.Salomon
Acting Assistant
Materiel Test Directorate
U.S.Army Dugway Proving Grounds
Dugway, Utah 84022

Dear Dr. Salomon:

The water toxicity test conducted by the Utah State Division of Health began July 8, 1976 and was concluded July 29, 1976. Water from the Orr Spring Area was fed to each of four groups of 10 rats and a control group was watered with Salt Lake City tap water.

All of the rats in all groups appeared normal and gave no indication of illness or abnormality.

If I can be of further assistance please call.

Sincerely,

Merlin A. Smith, Chief
Environmental Microbiology

MAS/bjh

STATE OF UTAH–DEPARTMENT OF SOCIAL SERVICES

CALVIN L. RAMPTON
Governor

PAUL S. ROSE
Executive Director

DIVISION OF HEALTH
44 MEDICAL DRIVE
SALT LAKE CITY, UTAH 84113
AREA CODE 801
PHONE 533-6131

LYMAN J. OLSEN, M.D., M.P.H.
Director of Health

Board of Health
Air Conservation Committee
Health Facilities Council
Medical Examiner Committee
Nursing Home Advisory Council
Water Pollution Committee

BUREAU OF LABORATORIES

August 5, 1976

Dr. Lowel Solomon
Deputy Director
STEDP - MT
Dugway Proving Grounds
Dugway, Utah 84022

Dear Dr. Solomon:

Enclosed please find the reports for analytical work on water specimens for the wild horse incident.

If you have any questions, please don't hesitate to call.

Sincerely yours,

Melvin J. Gortatowski

Melvin J. Gortatowski, Ph.D.
Chief, Chemistry Section

MJG:es
Enc.

cc: Lt. Theodore Prociv

Inclosure E-3

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY
CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

1

Field	Code	Entry
Lab. Sample No.	701	
Storet No.	702	
Date Collected (mo. dy. yr.)	711	7 7 76
Time Collected	710	1025
Water Syst. No.	703	
Source No.	704	
Water Rights No.	707	
Supply Owned by	712	
River Mile Code	705	
Nrd. Township Range Section QTRSC QTRQTR	706	
Sample Collected by	713	
Exact Description of Sampling Point	616, 647, 714	SEEP

SEND REPORT TO:

Name 715

Address 648, 717

Phone No. 718

TYPE OF SOURCE TABLE

01 Spring, 02 Well, 03 Stream, 04 Lake, 05 Canal, 06 Dist. syst., 07 Effluent, 08 Storm sewer, 09 Irrigation, 10 River, 11 Creek, 12 Pond, 13 Street gutter, 14 Other, 15 Tunnel, 16 Reservoir, 17 Surface, 18 Artesian well, 19 Swimming pool

719 Sample Source

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current
709 Proposed

COUNTY CODE TABLE

01 Beaver, 02 Box Elder, 03 Cache, 04 Carbon, 05 Daggett, 06 Davis, 07 Duchesne, 08 Emery, 09 Garfield, 10 Grand, 11 Iron, 12 Juab, 13 Kane, 14 Millard, 15 Morgan, 16 Piute, 17 Rich, 18 Salt Lake, 19 San Juan, 20 Sanpete, 21 Sevier, 22 Summit, 23 Tooele, 24 Uintah, 25 Utah, 26 Wasatch, 27 Washington, 28 Wayne, 29 Weber

611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	✓ Arsenic		160	723
	Barium			724
	Boron			725
	✓ Cadmium		50	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	✓ Iron		2600	733
	✓ Lead		500	734
	Magnesium			737
	Manganese			738
	✓ Mercury, Total		00	739
	Nickel			740
	Potassium			742
	✓ Selenium		06	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS			

me/l	ANIONS	mg/l	Code
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	✓ Nitrate as N	0.26	605
	✓ Nitrite as N	0.00	606
	✓ Phosphorus, Ortho as P	0.40	607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

Item	Value	Code
Turbidity, as JTU		757
Sampling Depth, m		609
✓ Specific Gravity		608
✓ Specific Cond. @ 25° C, μ mhos/cm	4370	762

Item	Value	Code
pH		782
✓ TDS @ 180° C	2970	786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755
Beryllium	<5 ug/l	

R E Isaacs July 9, 76

PESTICIDES

Pesticide	(ug/l)	Code
Aldrin	See separate sheet	641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		611
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l	Code	Sp. Act.	Code
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
$^{226}Radium$		627		628
$^{228}Radium$		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

Inclosure E-3

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY
CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS 2

Lab. Sample No. 701 | Storet No. 702 | Date Collected 7 7 76 (mo. dy. yr.) 714 | Time Collected 1030 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 721

Supply Owned by 712 | River Mile Code 706 | Mer. | Township | Range | Section | QTRSC | QTRQTR 705

Sample Collected by 713

Exact Description of Sampling Point 647 710
ORR SPRINGS WEST CISTERN

TYPE OF SOURCE TABLE		WATER USE TABLE	COUNTY CODE TABLE	
01 Spring	11 Creek	1. Culinary	01 Beaver	16 Piute
02 Well	12 Pond	2. Agriculture	02 Box Elder	17 Rich
03 Stream	13 Street gutter	3. Industrial	03 Cache	18 Salt Lake
04 Lake	15 Tunnel	4. Other	04 Carbon	19 San Juan
05 Canal	16 Reservoir		05 Daggett	20 Sanpete
06 Dist. syst.	17 Surface		06 Davis	21 Sevier
07 Effluent	18 Artesian well		07 Duchesne	22 Summit
08 Storm sewer	19 Swimming pool		08 Emery	23 Tooele
09 Irrigation	14 Other		09 Garfield	24 Uintah
10 River			10 Grand	25 Utah
			11 Iron	26 Wasatch
			12 Juab	27 Washington
			13 Kane	28 Wayne
			14 Millard	29 Weber
			15 Morgan	

719 Sample Source | 708 Current | 709 Proposed | 611 County

SEND REPORT TO:
Name 715
Address 648 717
Phone No. 718

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	✓Arsenic		00	723
	Barium		~~00~~	724
	Boron			725
	✓Cadmium		30	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	✓Iron		00	733
	✓Lead		300	734
	Magnesium			737
	Manganese			738
	✓Mercury, Total		00	739
	Nickel			740
	Potassium			742
	✓Selenium		01	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS			

me/l	ANIONS	mg/l	Code
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	✓Nitrate as N	038	605
	✓Nitrite as N	000	606
	✓Phosphorus, Ortho as P	002	607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

	Value	Code
pH		782
✓TDS @ 180° C	2340	786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755
Beryllium	< 5 µg/l	

	Value	Code
Turbidity, as JTU		757
Sampling Depth, m		809
Specific Gravity		608
✓Specific Cond. @ 25° C, µ mhos/cm	3350	762

R Ebaaw July 9 76

PESTICIDES	(ug/l)	Code
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS	pc/l	Code	Sp. Act.	Code
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

3

Field	Code	Entry
No.	701	
Storet No.	702	
Date Collected (mo. dy. yr.)	714	7 7 76
Time Collected	610	1000
Water Syst. No.	703	
Source No.	704	
Water Rights No.	707	
Analysed by	712	
River Mile Code	705	
Mrd., Township, Range, Section, QTRSC, QTRQTR	706	
Collected by	713	
Description of Sampling Point	646, 647, 710	SPRINGS EAST
SEND REPORT TO: Name	715	
Address	648, 717	
Phone No.	718	

TYPE OF SOURCE TABLE

01 Spring, 02 Well, 03 Stream, 04 Lake, 05 Canal, 06 Dist. syst., 07 Effluent, 08 Storm sewer, 09 Irrigation, 10 River, 11 Creek, 12 Pond, 13 Street gutter, 14 Other, 15 Tunnel, 16 Reservoir, 17 Surface, 18 Artesian well, 19 Swimming pool

719 Sample Source

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current
709 Proposed

COUNTY CODE TABLE

01 Beaver, 02 Box Elder, 03 Cache, 04 Carbon, 05 Daggett, 06 Davis, 07 Duchesne, 08 Emery, 09 Garfield, 10 Grand, 11 Iron, 12 Juab, 13 Kane, 14 Millard, 15 Morgan, 16 Piute, 17 Rich, 18 Salt Lake, 19 San Juan, 20 Sanpete, 21 Sevier, 22 Summit, 23 Tooele, 24 Uintah, 25 Utah, 26 Wasatch, 27 Washington, 28 Wayne, 29 Weber

611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	✓Arsenic		1.8	723
	Barium			724
	Boron			725
	✓Cadmium		5.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	✓Iron		66.0	733
	✓Lead		30.0	734
	Magnesium			737
	Manganese			738
	✓Mercury, Total		.00	739
	Nickel			740
	Potassium			742
	✓Selenium		0.0	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS			

me/l	ANIONS	mg/l	Code
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	✓Nitrate as N	0.64	605
	✓Nitrite as N	0.00	606
	✓Phosphorus, Ortho as P	0.02	607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

Parameter	Value	Code
Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, µ mhos/cm	3480	762

Parameter	mg/l	Code
pH		782
✓TDS @ 180° C	2380	786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755
Beryllium	< 5 µg/l	

RE Leary July 4 76

PESTICIDES

Pesticide	(ug/l)	Code
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

Radiologic	pc/l	Code	Sp. Act.	Code
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

1-12-76

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

4

Lab. Sample No. 701 | Storet No. 702 | Date Collected: mo. 7 dy. 7 yr. 76 714 | Time Collected 1045 610 | Water Syst. No. 703 | Source No. 704 | Water Right's No. 707

Supply Name 712 | River Mile Code 705 | Mer. | Township | Range | Section | QTR SEC | QTR QTR 706

Sample Collected By 713

Exact Description of Sampling Point: CRS WEST TROUGH 646 647 710

Name (SEND REPORT TO:) 715

Address 648 717 | Phone No. 718

TYPE OF SOURCE TABLE

01 Spring	11 Creek		
02 Well	12 Pond		
03 Stream	13 Street gutter		
04 Lake	15 Tunnel		
05 Canal	16 Reservoir		
06 Dist. syst.	17 Surface		
07 Effluent	18 Artesian well		
08 Storm sewer	19 Swimming pool		
09 Irrigation	14 Other		
10 River			

719 Sample Source

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current
709 Proposed

COUNTY CODE TABLE

01 Beaver	16 Piute		
02 Box Elder	17 Rich		
03 Cache	18 Salt Lake		
04 Carbon	19 San Juan		
05 Daggett	20 Sanpete		
06 Davis	21 Sevier		
07 Duchesne	22 Summit		
08 Emery	23 Tooele		
09 Garfield	24 Uintah		
10 Grand	25 Utah		
11 Iron	26 Wasatch		
12 Juab	27 Washington		
13 Kane	28 Wayne		
14 Millard	29 Weber		
15 Morgan			

611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	
	Ammonia as N			722
✓	Arsenic		0.8	723
	Barium			724
	Boron			725
✓	Cadmium		2.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
✓	Iron		0.0	733
✓	Lead		4.0.0	734
	Magnesium			737
	Manganese			738
✓	Mercury, Total		0.0	739
	Nickel			740
	Potassium			742
✓	Selenium		0.0	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS			

me/l	ANIONS	mg/l	
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
✓	Nitrate as N	0.4.8	605
✓	Nitrite as N	0.0.0	606
✓	Phosphorus, Ortho as P	0.0.2	607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

	Turbidity, as JTU		737
	Sampling Depth, m		609
	Specific Gravity		608
✓	Specific Cond. @ 25° C, μ mhos/cm	3700	762

✓	pH		782
✓	TDS @ 180° C	2480	786
	Phosphorus, Tot.		785
	Sufactant as MBAS		773
	Total Alk. as $CaCO_3$		752
	Total Hardness as $CaCO_3$		754
	Iron, Total		755
✓	Beryllium	<5 ug/l	

RS Isaacs July 9 76

PESTICIDES

	(ug/l)	
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l		Sq. Act.	
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

1-12-76

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

5

Lab. Sample No. (701) | Storet No. (702) | Date Collected (mo. dy. yr. 711): 2 7 76 | Time Collected (610): 1050 | Water Syst. No. (703) | Source No. (704) | Water Rights No.

Supply Owned by (712) | River Mile Code (706) | Merd. | Township | Range | Section | QTRSC | QTR QTR

Sample Collected by (713)

Exact Description of Sampling Point: POND BELOW TROUGH ORR SPRINGS WEST

SEND REPORT TO:

Name (715)

Address (648, 717)

Phone No. (718)

TYPE OF SOURCE TABLE		WATER USE TABLE	COUNTY CODE TABLE	
01 Spring	11 Creek	1. Culinary	01 Beaver	16 Piute
02 Well	12 Pond	2. Agriculture	02 Box Elder	17 Rich
03 Stream	13 Street gutter	3. Industrial	03 Cache	18 Salt Lake
04 Lake	15 Tunnel	4. Other	04 Carbon	19 San Juan
05 Canal	16 Reservoir		05 Daggett	20 Sanpete
06 Dist. syst.	17 Surface		06 Davis	21 Sevier
07 Effluent	18 Artesian well		07 Duchesne	22 Summit
08 Storm sewer	19 Swimming pool		08 Emery	23 Tooele
09 Irrigation	14 Other		09 Garfield	24 Uintah
10 River			10 Grand	25 Utah
			11 Iron	26 Wasatch
			12 Juab	27 Washington
			13 Kane	28 Wayne
			14 Millard	29 Weber
			15 Morgan	
719 Sample Source		708 Current / 709 Proposed	611 County	

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	✓Arsenic		12	723
	Barium			724
	Boron			725
	✓Cadmium		5.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	✓Iron		66.0	733
	✓Lead		50.0	734
	Magnesium			737
	Manganese			738
	✓Mercury, Total		.00	739
	Nickel			740
	Potassium			742
	✓Selenium		0.1	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS			

		Value	Code
	Turbidity, as JTU		757
	Sampling Depth, m		609
✓	Specific Gravity		608
✓	Specific Cond. @ 25° C, μ mhos/cm	3600	762

me/l	ANIONS	mg/l	Code
	Bicarbonate		756
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	✓Nitrate as N	0.41	605
	✓Nitrite as N	0.00	606
	Phosphorus, Ortho as P	0.00	607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

	Value	Code
pH		782
✓TDS @ 180° C	2500	736
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755
✓Beryllium	< 5 µg/l	

R E Isaacs July 9 76

PESTICIDES (ug/l)

Pesticide	ug/l	Code
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l	Code	Sp. Act.	Code
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^{3}H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY
CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS 6

Lab. Sample No. 701 | Storet No. 702 | Date Collected 7 7 76 (mo. dy. yr 714) | Time Collected 1130 (610) | Water Syst. No. 703 | Source No. 704 | Water Rights No.

Supply Owned by 712 | River Mile Code 706 | Merd. | Township | Range | Section | QTRSC | QTRQTR 705

Sample Collected by 713

Exact Description of Sampling Point 716 647 710: LOWER SEEP (TAMARACK

SEND REPORT TO:
Name 715
Address 548 717
Phone No. 718

TYPE OF SOURCE TABLE
01 Spring 02 Well 03 Stream 04 Lake 05 Canal 06 Dist. syst. 07 Effluent 08 Storm sewer 09 Irrigation 10 River 11 Creek 12 Pond 13 Street gutter 14 Other 15 Tunnel 16 Reservoir 17 Surface 18 Artesian well 19 Swimming pool
719 Sample Source

WATER USE TABLE
1. Culinary 2. Agriculture 3. Industrial 4. Other
708 Current
709 Proposed

COUNTY CODE TABLE
01 Beaver 02 Box Elder 03 Cache 04 Carbon 05 Daggett 06 Davis 07 Duchesne 08 Emery 09 Garfield 10 Grand 11 Iron 12 Juab 13 Kane 14 Millard 15 Morgan 16 Piute 17 Rich 18 Salt Lake 19 San Juan 20 Sanpete 21 Sevier 22 Summit 23 Tooele 24 Uintah 25 Utah 26 Wasatch 27 Washington 28 Wayne 29 Weber
611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	✓Arsenic		160	723
	Barium			724
	Boron			725
	✓Cadmium		150	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	✓Iron		2000	733
	✓Lead		1500	734
	Magnesium			737
	Manganese			738
	✓Mercury, Total		00	739
	Nickel			740
	Potassium			742
	✓Selenium		17	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS			

		Code
Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
✓Specific Cond. @ 25° C, µ mhos/cm	ins. Sample	762

me/l	ANIONS	mg/l	Code
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	✓Nitrate as N	0.80	605
	✓Nitrite as N	0.00	606
	✓Phosphorus, Ortho as P	0.41	607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

		Code
pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755
Beryllium	< 5 ug/l	

REbauer July 9 76

PESTICIDES (ug/l)

Pesticide	ug/l	Code
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l	Code	Sp. Act.	Code
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

[redacted] L RECORD This form contains [redacted] 552 (b)(6), 45 CFR Part 5

ENVIRONMENTAL PROTECTION AGENCY
DIVISION OF PESTICIDE COMMUNITY STUDIES
Chamblee, Georgia 30341

FORM APPROVED
OMB NO. 57 R0050

PESTICIDE RESIDUE RECORD

PARTICIPANT'S NAME	PARTICIPANT'S ADDRESS	INTERVIEWER'S NAME
ORR SPRING WATER	(DUGWAY UTAH)	

Form ID H | Card Code 1 | Project Code | File ID | AMA ID | Interview Date | Visit ID

Date Collected 0 7 0 7 7 6 | Date Tested | Standard Procedure Yes ☐ No ☐ | Lab Code | LABORATORY NAME: UTAH STATE HEALTH LAB

Use one sheet for each "Type of Specimen" checked X

Type of Specimen:

1 ☐ Participant | 2 ☐ Human (non-participant) | 3 ☐ Animal
4 ☐ Fish | 5 ☐ Fowl | 6 [X] Environmental

If 1-5 in "Type of Specimen" is checked, use this section.

53-4	53-4	53-4
01 Whole blood	08 Other fat	15 Lung
02 Serum	09 Brain	16 Marrow
03 Plasma	10 Heart	17 Cord blood
04 Urine	11 Adrenals	18 Placenta
05 Subcutaneous fat	12 Liver	19 Amniotic fluid
06 Mesenteric fat	13 Kidney	20 Skin (inc. prepuce)
07 Perirenal fat	14 Gonad	21 Other

If 6 in "Type of Specimen" is checked, use this section

53-4	53-4	53-4
		35 Dust
30 Soil	33 Post-spray air	37 Food
31 Pre-spray air	(34) Water (circled)	38 Other
32 Spray air	35 Plant	39 Other Air

2 Circle code and record results of pesticide residue analyses in appropriate boxes. Place an X in proper unit field (ppb or ppm). If additional tests are run which are not listed, record the name, code and results.

Code	Pesticide Residue	<	Value	ppm 10^{-6}	ppb 10^{-9}	Code	Pesticide Residue	<	Value	ppm 10^{-6}	ppb 10^{-9}
37	p, p' DDT						FROM THE FOLLOWING				
38	o, p' DDT						LOCATIONS, ANALYSIS WAS				
39	p, p' DDE						DONE FOR CHLORINATED				
40	o, p' DDE						HYDROCARBONS AND				
41	p, p' DDD						HERBICIDES AND ORGANO-				
42	o, p' DDD						PHOSPHATES				
43	DDT + 1.114 (DDE + DDD)						1. ORR SPRINGS EAST		0		
44	α-BHC						1000 HRS				
45	β-BHC						2 SEEP 1025 HRS		0		
46	γ-BHC						3 ORR SPRINGS WEST		0		
47	δ-BHC						CISTERN 1030				
48	Aldrin						4 LOWER SEEP 1030		0		
49	Dieldrin						5 ORR SPRING WEST		0		
50	Endrin						TROUGH 1045				
51	Heptachlor						6 POND BELOW TROUGH		0		
52	Hept. Epoxide						ORR SPRING WEST 1050 HRS				
53	2, 4-D						7 LOWER SEEP 1130 HRS		0		
54	Parathion		0								
	Malathion										
--	Diazinon						RESULTS OF ALL OF				
57	DDA						THE ABOVE TESTS WERE				
58	Pentachlorophenol (PCP)						NEGATIVE				
59	Paranitrophenol (PNP)										
60	α-naphthal										

EPA 8510-7

University of Montana
Missoula, Montana 59801
(406) 243-0211

July 13, 1976

Mr. H. E. Stark,
Environmental & Ecology Branch,
Dugway, Utah 84022

Dear Mr. Stark:

The algal sample from Orr Springs arrived today. The green alga is an innocuous species which has the name of Ulothrix tenerrima. There was considerable sand and suspended matter along with the filamentous growth, but I found no other algae in this. If you have other questions please let me know.

Yours truly,

G. W. Prescott
Univ. Mont. Biol. Sta.
Bigfork, Montana 59911

Inclosure E-4

F. SOIL

1. Objectives. To examine soils of the Orr Springs area for the presence of bacterial pathogens. In addition, chemical assays are to be conducted to determine if the soils contain unusual levels of ions potentially toxic to horses, and/or if the soils contain nerve agents or their decomposition products or any substance inhibitory to acetylcholinesterase activity.

2. Microbiologic Examination of Soils for Anthrax Spores.

a. Note. Data on an investigation of enteric pathogens in soil are reported in the section on water, pp. E-2 through E-4. Tests for anthrax spores in soil only are described below.

b. Experimental. Six of the thirteen soil samples collected on 6 July were examined for the presence of anthrax spores by the method described by Rees, et al. (Public Health Reports, in press), on 8 July at DPG and at State Division of Health on 10 July. Selection of the six soils was based on the soils collected in the immediate area of Orr Springs where most of the carcasses had been found.

(1) At DPG. Eighty grams of each soil were homogenized as 20% suspensions, the suspensions centrifuged at 400 x g for five minutes, the supernatant fluid from the initial centrifugation decanted and centrifuged at 6000 x g for 30 minutes. The sediments from the last centrifugation were resuspended in 20 ml of 3 millimolar phosphate buffer, the suspension divided and either heat shocked at 70°C for 10 minutes or autoclaved (controls) for 15 minutes at 15 psi. Five ml of these suspensions was injected subcutaneously into guinea pigs (two animals per soil tested plus two animals per each control) at several sites on the abdomen. Guinea pigs were observed daily for 10 days for any signs of illness.

(s) At State Division of Health, Bureau of Laboratories, Environmental Microbiology, Mr. M. A. Smith, Chief. The same procedure detailed above was duplicated by personnel in the Bureau of Laboratories, except that sample size was 20 grams of soil per sample because centrifuges were not adaptable to any larger size sample. Each test animal therefore received one-fourth the soil inoculum employed at DPG.

b. Results.

TABLE F-1

MORTALITY IN GUINEA PIGS INOCULATED WITH HEAT SHOCKED SOIL EXTRACTS

Soil Source*	Mortality Rate** (8 days post inoculation)	Description of Isolates
Orr Springs East, Road Cut	0/2	
Autoclaved Control	0/2	
Orr Springs West, Mesa Area of Distichilis stricta	0/2	
Autoclaved Control	0/2	
Orr Springs West, Seep at "Dead Horse Draw"	2/2	Gr + rods, but motile and hemolytic on 5% blood agar
Autoclaved Control	0/2	
Orr Springs West, Creek Bed of "Dead Horse Draw"	0/2	
Autoclaved Control	0/2	
Orr Springs East, Dozer Diggings and Fill	0/2	
Autoclaved Control	0/2	
Orr Springs West, Fill Dirt over Spring of "Dead Horse Draw"	2/2	Gr + rods, but hemolytic on 5% blood agar
Autoclaved Control	0/2	

*See map for location of soils collected (Figure D-1).
**Numerator denotes GP deaths occurring; denominator, the number of animals tested.

Anthrax bacilli demonstrate no hemolysis when grown on 5% blood agar (sheep) for 24 hours. All isolates made from tissues of guinea pigs produced zones of hemolysis when grown at 37°C on blood agar. Likewise, one isolate (noted in the table above) was motile, which anthrax bacilli are not. The two specimens which did cause deaths undoubtedly did so because they represented large amounts of soil extract and, therefore, high concentrations of anaerobic spores found abundantly in horse feces. Additionally, guinea pigs do not readily tolerate grossly contaminated inocula subcutaneously. Deaths were not primarily due to anaerobic contamination alone, because the carcasses did not demonstrate the bloating or smell of anaerobes, nor did smears show the morphology of anaerobic spores.

A report of 26 July from Mr. M. Smith of the State Division of Health revealed that the same two specimens produced deaths in inoculated animals within the first 24 hours post injection at the Bureau of Laboratories. His effort likewise produced no isolation of bacilli that possessed the characteristics of anthrax microorganisms (see incl E-1).

c. Conclusions. Attempts to isolate anthrax spores from soils collected in the immediate vicinity of the horse deaths failed to yield positive evidence. The validity of this finding is enhanced by the sensitivity of the isolation method, which permits the detection of as few as 13 anthrax spores in 10 grams of soil. It should be noted that the gross pathology of the horses, as shown in veterinary reports, did not suggest anthrax as the cause of death.

3. Chemical Investigation of Soils.

a. Experimental.

(1) Preparation of Samples. Dry "as is" soil samples were mixed well, and stones and roots removed. Two hundred grams of each soil sample were weighed into liter glass jars and 400 ml of water added. The jars were capped and shaken for three hours. The samples were allowed to settle and the supernatant fluid was filtered through Whatman No. 42 filter paper. The filtrates were filtered a second time through Millipore 0.45 micron filters. This was necessary because fine clay particles pass through the Whatman No. 42 filter paper. The final filtrate was stored in polyethylene bottles.

(2) Analysis. Chloride, pH, metals, and enzyme inhibition on the aqueous soil extracts were measured by the procedures described in Section E.

The soil samples were tested for agents GB and VX and their decomposition products by the following methods.

(a) Extraction Procedure for Agents GB and VX. Ten grams of soil was extracted with 15 ml of isopropyl alcohol by shaking for one hour in a capped test tube. Solids were allowed to settle and fluid was sampled directly by withdrawing 5 µl with a microliter syringe. The sample was injected into a GC. The same GC operational parameters described in Section E were used. Sample concentrations are calculated by comparing the peak areas obtained for the sample to the peak areas obtained from GB and DIMP standards of know concentration in isopropyl alcohol. The extraction efficiency is 90-100 percent from most soil.

The above extraction procedure has also been found effective for the extraction of DIMP from soil. Thus, this agent GB decomposition product is extracted concurrently with the agents. It is also measured concurrently on the same GC column as used for GB.

(b) Agent Decomposition Products. Agent decomposition products YN, YL, and IMP were extracted from soil samples as follows:

Ten grams of soil was extracted with 10 ml of 1.5 N aqueous NH_4OH by shaking for one hour in a capped tube. The mixture was centrifuged for one minute and one ml of the supernatant solution was diluted to 10 ml with isopropyl alcohol. The solution was acidified by dropwise addition of concentrated HCl and the pH checked to make sure that it was less than pH 6. The resulting solution was propylated by dropwise addition of a solution of diazopropane in ether until a yellow color persisted. The sample was allowed to stand overnight to destroy excess diazopropane. Propylation efficiency was found to be 80 percent. The content of decomposition products was measured by injecting 5 µl of the solution into a GC with the parameters listed in the water section except that the column temperature must be 150°C. Table F-2 lists the detection limits and retention time of IMP. YN, and DIMP in soil extracts using the specified GC operational parameters.

TABLE F-2

DETECTION LIMITS AND RETENTION TIMES
FOR SOME AGENT DECOMPOSITION PRODUCTS

Decomposition Product	Retention Time (minutes)	Lower Detection Level (ng/g soil)
1. n-propyl ester of IMP	5.4	600
2. di-n-propyl ester of YN	7.0	600
3. DIMP	4.0	600

b. Results. The results obtained from the analyses of the soil extracts are listed in Tables F-3 through F-18. Samples of these extracts were delivered to the Utah State Division of Health on 15 July 1976. Results confirmed those obtained at DPG (inclosure F-1).

c. Conclusions.

(1) Chemical agents GB and VX and their hydrolytic decomposition products were not detected in any of the soil samples and neither was any other inhibitor of acetylcholinesterase.

(2) The concentration of the dissolved metals and chlorides found in water extracts of the soil samples are not considered to be

at toxic levels. The wide variation in concentration of each element of interest in each soil is as expected from soils collected from different environmental settings (e.g., pond soil where considerable leaching occurs versus dry surface soil).

TABLE F-3

ANALYTICAL RESULTS SOIL SAMPLE #7
Wet Mud Near Wig Mountain
Date: 7 July 1976

Element	Dugway Proving Ground
pH	8.3
Dissolved Solids	100 mg/l
Chloride	Not determined
As	< 0.05 mg/l
Se	< 0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50 μg/l
Pb	< 0.1 mg/l
Cd	< 0.02 mg/l
Cr	< 0.05 mg/l
Cu	0.3 mg/l
Na	66 mg/l
K	3.2 mg/l
Mg	2.1 mg/l
Ca	2.8 mg/l
Ni	0.07 mg/l

TABLE F-4

ANALYTICAL RESULTS SOIL SAMPLE #8
Fill Dirt Over Spring "Dead Horse Draw"
Orr Springs West
Date: 6 July 1976

Element	Dugway Proving Ground
pH	8.1
Dissolved Solids	2400 mg/l
Chloride	700 mg/l
As	0.065 mg/l
Se	<0.1 mg/l
Be	<0.02 mg/l
Hg	< 50 µg/l
Pb	<0.1 mg/l
Cd	<0.02 mg/l
Cr	<0.05 mg/l
Cu	0.06 mg/l
Na	240 mg/l
K	195 mg/l
Mg	41 mg/l
Ca	105 mg/l
Ni	0.06 mg/l

TABLE F-5

ANALYTICAL RESULTS SOIL SAMPLE #9
Dozer Digging and Fill
Orr Springs East
Date: 6 July 1976

Element	Dugway Proving Ground
pH	7.7
Dissolved Solids	2800 mg/l
Chloride	625 mg/l
As	< 0.05 mg/l
Se	< 0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50 µg/l
Pb	<0.1 mg/l
Cd	0.04 mg/l
Cr	0.05 mg/l
Cu	0.4 mg/l
Na	260 mg/l
K	36 mg/l
Mg	75 mg/l
Ca	320 mg/l
Ni	<0.05 mg/l

TABLE F-6

ANALYTICAL RESULTS SOIL SAMPLE #10
Cover Dirt
Orr Spring East
Date: 6 July 1976

Element	Dugway Proving Ground
pH	7.9
Dissolved Solids	1900 mg/l
Chloride	475 mg/l
As	< 0.05 mg/l
Se	< 0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50 µ g/l
Pb	< 0.1 mg/l
Cd	< 0.02 mg/l
Cr	< 0.05 mg/l
Cu	0.02 mg/l
Na	210 mg/l
K	115 mg/l
Mg	38 mg/l
Ca	150 mg/l
Ni	< 0.05 mg/l

TABLE F-7

ANALYTICAL RESULTS SOIL SAMPLE #11
Road Cut Soil
Orr Spring East
Date: 6 July 1976

Element	Dugway Proving Ground
pH	7.6
Dissolved Solids	4600 mg/l
Chloride	800 mg/l
As	< 0.05 mg/l
Se	< 0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50 μg/l
Pb	< 0.1 mg/l
Cd	< 0.02 mg/l
Cr	< 0.05 mg/l
Cu	0.03 mg/l
Na	425 mg/l
K	75 mg/l
Mg	65 mg/l
Ca	590 mg/l
Ni	0.08 mg/l

TABLE F-8

ANALYTICAL RESULTS SOIL SAMPLE #12
Road Cut Soil
Orr Spring East
Date: 6 July 1976

Element	Dugway Proving Ground
pH	7.9
Dissolved Solids	1100 mg/l
Chloride	325 mg/l
As	< 0.05 mg/l
Se	< 0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50µ g/l
Pb	< 0.1 mg/l
Cd	< 0.02 mg/l
Cr	< 0.05 mg/l
Cu	< 0.02 mg/l
Na	230 mg/l
K	21 mg/l
Mg	19.5 mg/l
Ca	70 mg/l
Ni	< 0.05 mg/l

TABLE F-9

ANALYTICAL RESULTS SOIL SAMPLE # 13
Orr Spring Tamarisks Below Trough
Date: 7 July 1976

Element	Dugway Proving Ground
pH	7.7
Dissolved Solids	5600 mg/l
Chloride	2250 mg/l
As	0.10 mg/l
Se	< 0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50$_{U}$ g/l
Pb	< 0.1 mg/l
Cd	< 0.02 mg/l
Cr	< 0.05 mg/l
Cu	0.03 mg/l
Na	970 mg/l
K	98 mg/l
Mg	167 mg/l
Ca	455 mg/l
Ni	< 0.05 mg/l

TABLE F-10

ANALYTICAL RESULTS SOIL SAMPLE #14
Moist Soil "Dead Horse Draw"
Orr Spring West
Date: 6 July 1976

Element	Dugway Proving Ground
pH	7.7
Dissolved Solids	3700 mg/l
Chloride	400 mg/l
As	< 0.05 mg/l
Se	< 0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50 ug/l
Pb	<0.1 mg/l
Cd	<0.02 mg/l
Cr	<0.05 mg/l
Cu	0.03 mg/l
Na	445 mg/l
K	127 mg/l
Mg	58 mg/l
Ca	518 mg/l
Ni	0.07 mg/l

TABLE F-11

ANALYTICAL RESULTS SOIL SAMPLE #15
Moist Soil "Dead Horse Draw"
Orr Spring East
Date: 6 July 1976

Element	Dugway Proving Ground
pH	8.0
Dissolved Solids	590 mg/l
Chloride	150 mg/l
As	<0.05 mg/l
Se	<0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50 µg/l
Pb	< 0.1 mg/l
Cd	< 0.02 mg/l
Cr	< 0.05 mg/l
Cu	< 0.02 mg/l
Na	130 mg/l
K	8.9 mg/l
Mg	16 mg/l
Ca	47 mg/l
Ni	< 0.05 mg/l

TABLE F-12

ANALYTICAL RESULTS SOIL SAMPLE #16
Place on Mesa Frequented by Horses
Orr West "Dead Horse Draw"
Date: 6 July 1976

Element	Dugway Proving Ground
pH	8.1
Dissolved Solids	320 mg/l
Chloride	100 mg/l
As	< 0.05 mg/l
Se	< 0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50 µg/l
Pb	< 0.1 mg/l
Cd	< 0.02 mg/l
Cr	< 0.05 mg/l
Cu	0.03 mg/l
Na	97 mg/l
K	8.7 mg/l
Mg	4.4 mg/l
Ca	31 mg/l
Ni	< 0.05 mg/l

TABLE F-13

ANALYTICAL RESULTS SOIL SAMPLE #17
Old Pool Bottom
Orr Spring West
Date: 6 July 1976

Element	Dugway Proving Ground
pH	7.7
Dissolved Solids	1300 mg/l
Chloride	250 mg/l
As	< 0.05 mg/l
Se	< 0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50 µg/l
Pb	< 0.1 mg/l
Cd	< 0.02 mg/l
Cr	< 0.05 mg/l
Cu	0.03 mg/l
Na	225 mg/l
K	15 mg/l
Mg	22 mg/l
Ca	180 mg/l
Ni	< 0.05 mg/l

TABLE F-14

ANALYTICAL RESULTS SOIL SAMPLE #18
Moist Soil in Bank
Orr Spring West "Dead Horse Draw"
Date: 6 July 1976

Element	Dugway Proving Ground
pH	7.7
Dissolved Solids	290 mg/l
Chloride	50 mg/l
As	< 0.05 mg/l
Se	< 0.1 mg/l
Be	< 0.05 mg/l
Hg	< 50 µg/l
Pb	< 0.1 mg/l
Cd	< 0.02 mg/l
Cr	< 0.05 mg/l
Cu	< 0.02 mg/l
Na	110 mg/l
K	2.7 mg/l
Mg	8.6 mg/l
Ca	25 mg/l
Ni	< 0.05 mg/l

TABLE F-15

ANALYTICAL RESULTS SOIL SAMPLE #19
Creek Bed
Orr Spring West "Dead Horse Draw"
Date: 6 July 1976

Element	Dugway Proving Ground
pH	7.9
Dissolved Solids	300 mg/l
Chloride	50 mg/l
As	< 0.05 mg/l
Se	< 0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50 μ g/l
Pb	< 0.1 mg/l
Cd	< 0.02 mg/l
Cr	< 0.05 mg/l
Cu	< 0.02 mg/l
Na	98 mg/l
K	6.0 mg/l
Mg	3.0 mg/l
Ca	7.3 mg/l
Ni	< 0.05 mg/l

TABLE F-16

ANALYTICAL RESULTS SOIL SAMPLE #20
Area on Mesa with Distichilis stricta
Orr Spring West
Date: 6 July 1976

Element	Dugway Proving Ground
pH	7.7
Dissolved Solids	12,000 mg/l
Chloride	4850 mg/l
As	0.09 mg/l
Se	<0.1 mg/l
Be	< 0.02 mg/l
Hg	< 50 µg/l
Pb	<0.1 mg/l
Cd	< 0.02 mg/l
Cr	0.06 mg/l
Cu	0.04 mg/l
Na	1380 mg/l
K	51 mg/l
Mg	595 mg/l
Ca	1050 mg/l
Ni	< 0.05 mg/l

TABLE F-17
ANALYTICAL RESULTS SOIL SAMPLE #21
Seep at "Dead Horse Draw"
Orr Spring West
Date: 6 July 1976

Element	Dugway Proving Ground
pH	8.3
Dissolved Solids	1000 mg/l
Chloride	not determined
As	<0.05 mg/l
Se	<0.1 mg/l
Be	<0.02 mg/l
Hg	< 50 µg/l
Pb	<0.1 mg/l
Cd	< 0.02 mg/l
Cr	< 0.05 mg/l
Cu	0.05 mg/l
Na	210 mg/l
K	45 mg/l
Mg	10.2 mg/l
Ca	11 mg/l
Ni	< 0.05 mg/l

TABLE F-18

AGENT AND AGENT DECOMPOSITION PRODUCT CONTENT IN SOIL EXTRACTS

Sample No.	GB	VX	Enz. Inhib.	YN	YL	IMP	DIMP
7.	<0.02 µg/ml	<0.2 µg/ml	<0.002 µg/ml	<2.0 µg/ml	<2.0 µg/ml	<2.0 µg/ml	<2.0 µg/ml
8.	"	"	"	"	"	"	"
9.	"	"	"	"	"	"	"
10.	"	"	"	"	"	"	"
11.	"	"	"	"	"	"	"
12.	"	"	"	"	"	"	"
13.	"	"	"	"	"	"	"
14.	"	"	"	"	"	"	"
15.	"	"	"	"	"	"	"
16.	"	"	"	"	"	"	"
17.	"	"	"	"	"	"	"
18.	"	"	"	"	"	"	"
19.	"	"	"	"	"	"	"
20.	"	"	"	"	"	"	"
21.	"	"	"	"	"	"	"

Water Extract of Soils #7

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo dy yr 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 706 | Merd. | Township | Range | Section | QTR SC | QTR QTR 705

Sample Collected by 713

Exact Description of Sampling Point 646 / 647 / 710

Name | SEND REPORT TO: 715

Address 648 / 717 | Phone No. 718

TYPE OF SOURCE TABLE

01 Spring	11 Creek
02 Well	12 Pond
03 Stream	13 Street gutter
04 Lake	
05 Canal	15 Tunnel
06 Dist. syst.	16 Reservoir
07 Effluent	17 Surface
08 Storm sewer	18 Artesian well
09 Irrigation	19 Swimming pool
10 River	14 Other

719 Sample Source

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current
709 Proposed

COUNTY CODE TABLE

01 Beaver	16 Piute
02 Box Elder	17 Rich
03 Cache	18 Salt Lake
04 Carbon	19 San Juan
05 Daggett	20 Sanpete
06 Davis	21 Sevier
07 Duchesne	22 Summit
08 Emery	23 Tooele
09 Garfield	24 Uintah
10 Grand	25 Utah
11 Iron	26 Wasatch
12 Juab	27 Washington
13 Kane	28 Wayne
14 Millard	29 Weber
15 Morgan	

611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	
	Ammonia as N			722
	Arsenic		5 1.0	723
	Barium			724
	Boron			725
	Cadmium		0.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		0.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.0	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	RE shown /mg/l		

me/l	ANIONS	mg/l	
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

	Turbidity, as JTU	757
	Sampling Depth, m	609
	Specific Gravity	608
	Specific Cond. @ 25° C, μ mhos/cm	762

	pH	782
	TDS @ 180° C	786
	Phosphorus, Tot.	785
	Sufactant as MBAS	773
	Total Alk. as $CaCO_3$	752
	Total Hardness as $CaCO_3$	734
	Iron, Total	755

PESTICIDES (ug/l)

Aldrin	641
Chlordane (cis and trans)	612
DDT (Total)	642
Dieldrin	643
Endrin	613
Heptachlor	614
Heptachlor Epoxide	615
Lindane	616
Methoxychlor	617
Toxaphene	618
Other	644
2,4-D	619
2,4,5-T	645
2,4,5-TP (Silvex)	620

RADIOLOGICS

	pc/l		Sp. Act.	
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

#8

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Stored No. 702 | Date Collected mo. dy. yr. 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 706 | Mgd. | Township | Range | Section | QTRSC | QTRQTR 705

Sample Collected by 713

Exact Description of Sampling Point 646 647 714

Name SEND REPORT TO: 715

Address 648 717

Phone No. 718

TYPE OF SOURCE TABLE		WATER USE TABLE	COUNTY CODE TABLE	
01 Spring	11 Creek	1. Culinary	01 Beaver	16 Piute
02 Well	12 Pond	2. Agriculture	02 Box Elder	17 Rich
03 Stream	13 Street gutter	3. Industrial	03 Cache	18 Salt Lake
04 Lake	14 Other	4. Other	04 Carbon	19 San Juan
05 Canal	15 Tunnel		05 Daggett	20 Sanpete
06 Dist. syst.	16 Reservoir		06 Davis	21 Sevier
07 Effluent	17 Surface		07 Duchesne	22 Summit
08 Storm sewer	18 Artesian well		08 Emery	23 Tooele
09 Irrigation	19 Swimming pool		09 Garfield	24 Uintah
10 River			10 Grand	25 Utah
			11 Iron	26 Wasatch
			12 Juab	27 Washington
			13 Kane	28 Wayne
			14 Millard	29 Weber
			15 Morgan	
719 Sample Source		708 Current / 709 Proposed	611 County	

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	
	Ammonia as N			722
	Arsenic		30	723
	Barium			724
	Boron			725
	Cadmium		200	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		700	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		1.6	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	RE Issues Info		

me/l	ANIONS	mg/l	
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762

pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755

PESTICIDES (ug/l)

Aldrin	641
Chlordane (cis and trans)	642
DDT (Total)	642
Dieldrin	643
Endrin	613
Heptachlor	614
Heptachlor Epoxide	615
Lindane	616
Methoxychlor	617
Toxaphene	618
Other _____	644
2,4-D	619
2,4,5-T	645
2,4,5-TP (Silvex)	620

RADIOLOGICS

	pc/l		Sp. Act.	
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

F-22

#9

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr. 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 706 | Mer. | Township | Range | Section | QTR SC | QTR QTR 705

Sample Collected by 713

Exact Description of Sampling Point 646 / 647 / 710

Name | SEND REPORT TO: 715

Address 648 / 717

Phone No. 718

TYPE OF SOURCE TABLE

01 Spring	11 Creek		
02 Well	12 Pond		
03 Stream	13 Street gutter		
04 Lake			
05 Canal	15 Tunnel		
06 Dist. syst.	16 Reservoir		
07 Effluent	17 Surface		
08 Storm sewer	18 Artesian well		
09 Irrigation	19 Swimming pool		
10 River	14 Other		

719 Sample Source

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current
709 Proposed

COUNTY CODE TABLE

01 Beaver	16 Piute		
02 Box Elder	17 Rich		
03 Cache	18 Salt Lake		
04 Carbon	19 San Juan		
05 Daggett	20 Sanpete		
06 Davis	21 Sevier		
07 Duchesne	22 Summit		
08 Emery	23 Tooele		
09 Garfield	24 Uintah		
10 Grand	25 Utah		
11 Iron	26 Wasatch		
12 Juab	27 Washington		
13 Kane	28 Wayne		
14 Millard	29 Weber		
15 Morgan			

611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	
	Ammonia as N			722
	Arsenic		15.0	723
	Barium			724
	Boron			725
	Cadmium		45.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		70.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		1.5	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	RE Issue / mg/l		

me/l	ANIONS	mg/l	
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762

pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Surfactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		753
Iron, Total		755

PESTICIDES (ug/l)

Aldrin	641
Chlordane (cis and trans)	612
DDT (Total)	642
Dieldrin	643
Endrin	613
Heptachlor	614
Heptachlor Epoxide	615
Lindane	616
Methoxychlor	617
Toxaphene	618
Other _____	644
2,4-D	619
2,4,5-T	645
2,4,5-TP (Silvex)	620

RADIOLOGICS

	pc/l		Sp. Act.	
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

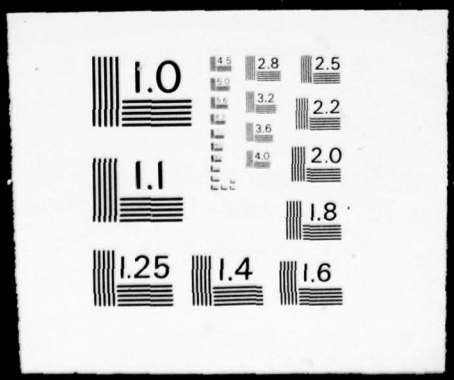
AD-A032 445 ARMY DUGWAY PROVING GROUND UTAH F/G 6/3
INVESTIGATION OF DEATHS OF HORSES AT ORR SPRINGS.(U)
SEP 76 L L SALOMON

UNCLASSIFIED NL

2 OF 4
ADA032445

2 OF 4

ADA032445



#10

UTAH STATE DIVISION OF HEALTH

BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr. 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 706 | Merd. | Township | Range | Section | QTRSC | QTRQTR 705

Sample Collected by 713

Exact Description of Sampling Point 646, 647, 710

SEND REPORT TO:

Name 715

Address 648, 717

Phone No. 718

TYPE OF SOURCE TABLE	WATER USE TABLE	COUNTY CODE TABLE
01 Spring, 02 Well, 03 Stream, 04 Lake, 05 Canal, 06 Dist. syst., 07 Effluent, 08 Storm sewer, 09 Irrigation, 10 River, 11 Creek, 12 Pond, 13 Street gutter, 15 Tunnel, 16 Reservoir, 17 Surface, 18 Artesian well, 19 Swimming pool, 14 Other	1. Culinary, 2. Agriculture, 3. Industrial, 4. Other	01 Beaver, 02 Box Elder, 03 Cache, 04 Carbon, 05 Daggett, 06 Davis, 07 Duchesne, 08 Emery, 09 Garfield, 10 Grand, 11 Iron, 12 Juab, 13 Kane, 14 Millard, 15 Morgan, 16 Piute, 17 Rich, 18 Salt Lake, 19 San Juan, 20 Sanpete, 21 Sevier, 22 Summit, 23 Tooele, 24 Uintah, 25 Utah, 26 Wasatch, 27 Washington, 28 Wayne, 29 Weber
719 Sample Source	708 Current; 709 Proposed	611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	Arsenic		29.0	723
	Barium			724
	Boron			725
	Cadmium		5.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		40.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.3	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	R. E. [illegible]		
	Turbidity, as JTU			757
	Sampling Depth, m			609
	Specific Gravity			608
	Specific Cond. @ 25° C, μ mhos/cm			762

me/l	ANIONS	mg/l	Code
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		
	pH		782
	TDS @ 180° C		786
	Phosphorus, Tot.		785
	Sufactant as MBAS		773
	Total Alk. as $CaCO_3$		752
	Total Hardness as $CaCO_3$		754
	Iron, Total		755

PESTICIDES (ug/l)

Pesticide	ug/l	Code
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l	Code	Sp. Act.	Code
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
$^{226}Radium$		627		628
$^{228}Radium$		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

\#11

UTAH STATE DIVISION OF HEALTH

BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Field	Code
Lab. Sample No.	701
Storet No.	702
Date Collected (mo. dy. yr.)	714
Time Collected	610
Water Syst. No.	703
Source No.	704
Water Rights No.	707
Supply Owned by	712
River Mile Code	706
Mer'd. / Township / Range / Section / QTRSC / QTRQTR	705
Sample Collected by	713
Exact Description of Sampling Point	646, 647, 710
SEND REPORT TO: Name	715
Address	648, 717
Phone No.	718

TYPE OF SOURCE TABLE

01 Spring, 02 Well, 03 Stream, 04 Lake, 05 Canal, 06 Dist. syst., 07 Effluent, 08 Storm sewer, 09 Irrigation, 10 River, 11 Creek, 12 Pond, 13 Street gutter, 15 Tunnel, 16 Reservoir, 17 Surface, 18 Artesian well, 19 Swimming pool, 14 Other

719 Sample Source

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current

709 Proposed

COUNTY CODE TABLE

01 Beaver, 02 Box Elder, 03 Cache, 04 Carbon, 05 Daggett, 06 Davis, 07 Duchesne, 08 Emery, 09 Garfield, 10 Grand, 11 Iron, 12 Juab, 13 Kane, 14 Millard, 15 Morgan, 16 Piute, 17 Rich, 18 Salt Lake, 19 San Juan, 20 Sanpete, 21 Sevier, 22 Summit, 23 Tooele, 24 Uintah, 25 Utah, 26 Wasatch, 27 Washington, 28 Wayne, 29 Weber

611 County

C H E M I C A L   A N A L Y S I S

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	Arsenic		36.0	723
	Barium			724
	Boron			725
	Cadmium		10.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		100.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.2	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	RE [illegible] 1 mg/l		
	Turbidity, as JTU			757
	Sampling Depth, m			609
	Specific Gravity			608
	Specific Cond. @ 25° C, μ mhos/cm			762

me/l	ANIONS	mg/l	Code
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		
	pH		782
	TDS @ 180° C		786
	Phosphorus, Tot.		785
	Sufactant as MBAS		773
	Total Alk. as $CaCO_3$		752
	Total Hardness as $CaCO_3$		754
	Iron, Total		755

P E S T I C I D E S (ug/l)

Pesticide	ug/l	Code
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

R A D I O L O G I C S

Radiologic	pc/l	Code	Sp. Act.	Code
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
$^{226}Radium$		627		628
$^{228}Radium$		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

F-25

#12

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr. 711 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Right's No. 705

Supply Owned by 712 | River Mile Code 706 | Mer. | Township | Range | Section | QTRSC | QTR QTR 708

Sample Collected by 713

Exact Description of Sampling Point 646 647 710

Name SEND REPORT TO: 715

Address 648 717 | Phone No. 718

TYPE OF SOURCE TABLE

01 Spring	11 Creek		
02 Well	12 Pond		
03 Stream	13 Street gutter		
04 Lake			
05 Canal	15 Tunnel		
06 Dist. syst.	16 Reservoir		
07 Effluent	17 Surface		
08 Storm sewer	18 Artesian well		
09 Irrigation	19 Swimming pool		
10 River	14 Other		

719 Sample Source

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current
709 Proposed

COUNTY CODE TABLE

01 Beaver	16 Piute		
02 Box Elder	17 Rich		
03 Cache	18 Salt Lake		
04 Carbon	19 San Juan		
05 Daggett	20 Sanpete		
06 Davis	21 Sevier		
07 Duchesne	22 Summit		
08 Emery	23 Tooele		
09 Garfield	24 Uintah		
10 Grand	25 Utah		
11 Iron	26 Wasatch		
12 Juab	27 Washington		
13 Kane	28 Wayne		
14 Millard	29 Weber		
15 Morgan			

611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	
	Ammonia as N			722
	Arsenic		6.6	723
	Barium			724
	Boron			725
	Cadmium		5.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		0.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.2	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	R.E. Jones / Mgr		

me/l	ANIONS	mg/l	
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762

pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		734
Iron, Total		755

PESTICIDES

	ug/l	
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l		Sp. Act.	
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

#13

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr. 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 706 | Mer. | Township | Range | Section | QTRSC | QTRQTR 705

Sample Collected by 713

Exact Description of Sampling Point 646 647 710

SEND REPORT TO:
Name 715
Address 648 717
Phone No. 718

TYPE OF SOURCE TABLE
01 Spring, 02 Well, 03 Stream, 04 Lake, 05 Canal, 06 Dist. syst., 07 Effluent, 08 Storm sewer, 09 Irrigation, 10 River, 11 Creek, 12 Pond, 13 Street gutter, 15 Tunnel, 16 Reservoir, 17 Surface, 18 Artesian well, 19 Swimming pool, 14 Other
719 Sample Source

WATER USE TABLE
1. Culinary
2. Agriculture
3. Industrial
4. Other
708 Current
709 Proposed

COUNTY CODE TABLE
01 Beaver, 02 Box Elder, 03 Cache, 04 Carbon, 05 Daggett, 06 Davis, 07 Duchesne, 08 Emery, 09 Garfield, 10 Grand, 11 Iron, 12 Juab, 13 Kane, 14 Millard, 15 Morgan, 16 Piute, 17 Rich, 18 Salt Lake, 19 San Juan, 20 Sanpete, 21 Sevier, 22 Summit, 23 Tooele, 24 Uintah, 25 Utah, 26 Wasatch, 27 Washington, 28 Wayne, 29 Weber
611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	Arsenic		280	723
	Barium			724
	Boron			725
	Cadmium		200	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		700	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		03	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	R.E. Isaacs/mf4		

me/l	ANIONS	mg/l	Code
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

Item	Value	Code
Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762
pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755

PESTICIDES

Pesticide	(ug/l)	Code
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l	Code	Sp. Act.	Code
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

F-27

#14

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 705 | Merd. | Township | Range | Section | QTRSC | QTRQTR 705

Sample Collected by 713

Exact Description of Sampling Point 646 647 710

SEND REPORT TO:

Name 715

Address 648 717

Phone No. 718

TYPE OF SOURCE TABLE		WATER USE TABLE	COUNTY CODE TABLE	
01 Spring	11 Creek	1. Culinary	01 Beaver	16 Piute
02 Well	12 Pond	2. Agriculture	02 Box Elder	17 Rich
03 Stream	13 Street gutter	3. Industrial	03 Cache	18 Salt Lake
04 Lake	15 Tunnel	4. Other	04 Carbon	19 San Juan
05 Canal	16 Reservoir		05 Daggett	20 Sanpete
06 Dist. syst.	17 Surface		06 Davis	21 Sevier
07 Effluent	18 Artesian well		07 Duchesne	22 Summit
08 Storm sewer	19 Swimming pool		08 Emery	23 Tooele
09 Irrigation	14 Other		09 Garfield	24 Uintah
10 River			10 Grand	25 Utah
			11 Iron	26 Wasatch
			12 Juab	27 Washington
			13 Kane	28 Wayne
			14 Millard	29 Weber
			15 Morgan	
719 Sample Source		708 Current / 709 Proposed	611 County	

C H E M I C A L   A N A L Y S I S

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	Arsenic		46.0	723
	Barium			724
	Boron			725
	Cadmium		20.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		80.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.6	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	R.E. [illegible]		

		Code
Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762

me/l	ANIONS	mg/l	Code
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

		Code
pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		751
Iron, Total		755

P E S T I C I D E S (ug/l)

Pesticide	Value	Code
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

R A D I O L O G I C S

	pc/l	Code	Sp. Act.	Code
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

#15

UTAH STATE DIVISION OF HEALTH

BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr. 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 706 | Merd. | Township | Range | Section | QTRSC | QTRQTR 705

Sample Collected by 713

Exact Description of Sampling Point 646 647 710

SEND REPORT TO:

Name 715

Address 648 717

Phone No. 718

TYPE OF SOURCE TABLE

01 Spring	11 Creek
02 Well	12 Pond
03 Stream	13 Street gutter
04 Lake	14 Other
05 Canal	15 Tunnel
06 Dist. syst.	16 Reservoir
07 Effluent	17 Surface
08 Storm sewer	18 Artesian well
09 Irrigation	19 Swimming pool
10 River	

719 Sample Source

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current

709 Proposed

COUNTY CODE TABLE

01 Beaver	16 Piute
02 Box Elder	17 Rich
03 Cache	18 Salt Lake
04 Carbon	19 San Juan
05 Daggett	20 Sanpete
06 Davis	21 Sevier
07 Duchesne	22 Summit
08 Emery	23 Tooele
09 Garfield	24 Uintah
10 Grand	25 Utah
11 Iron	26 Wasatch
12 Juab	27 Washington
13 Kane	28 Wayne
14 Millard	29 Weber
15 Morgan	

611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	Arsenic		6.0	723
	Barium			724
	Boron			725
	Cadmium		0.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		0.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.0	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	R E [illegible] | mgl		

		Code
Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762

me/l	ANIONS	mg/l	Code
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

		Code
pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755

PESTICIDES (ug/l)

Pesticide	ug/l	Code
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other ______		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l	Code	Sp. Act.	Code
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

#16

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. da. yr. 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Right's No. 707

Supply Owned By 712 | River Mile Code 705 | Mer. | Township | Range | Section | QTR SC | QTR QTR 706

Sample Collected by 713

Exact Description of Sampling Point 646 647 710

Name SEND REPORT TO: 715

Address 648 717

Phone No. 718

TYPE OF SOURCE TABLE

01 Spring	11 Creek	719 Sample Source	
02 Well	12 Pond		
03 Stream	13 Street gutter		
04 Lake	15 Tunnel		
05 Canal	16 Reservoir		
06 Dist. syst.	17 Surface		
07 Effluent	18 Artesian well		
08 Storm sewer	19 Swimming pool		
09 Irrigation	14 Other		
10 River			

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current
709 Proposed

COUNTY CODE TABLE

01 Beaver	16 Piute
02 Box Elder	17 Rich
03 Cache	18 Salt Lake
04 Carbon	19 San Juan
05 Daggett	20 Sanpete
06 Davis	21 Sevier
07 Duchesne	22 Summit
08 Emery	23 Tooele
09 Garfield	24 Uintah
10 Grand	25 Utah
11 Iron	26 Wasatch
12 Juab	27 Washington
13 Kane	28 Wayne
14 Millard	29 Weber
15 Morgan	

611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	
	Ammonia as N			722
	Arsenic		160	723
	Barium			724
	Boron			725
	Cadmium		0.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		0.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.4	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	R.E. Season Supt		

me/l	ANIONS	mg/l	
	Bicarbonate		756
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762

pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755

PESTICIDES

	(ug/l)	
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l		So. Act.	
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

#17

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 706 | Mer. | Township | Range | Section | QTRSC | QTRQTR 705

Sample Collected by 713

Exact Description of Sampling Point 646 / 647 / 710

Name SEND REPORT TO: 715

Address 648 / 717

Phone No. 718

TYPE OF SOURCE TABLE

01 Spring	11 Creek		
02 Well	12 Pond		
03 Stream	13 Street gutter		
04 Lake			
05 Canal	15 Tunnel		
06 Dist. syst.	16 Reservoir		
07 Effluent	17 Surface		
08 Storm sewer	18 Artesian well		
09 Irrigation	19 Swimming pool		
10 River	14 Other		

719 Sample Source

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current
709 Proposed

COUNTY CODE TABLE

01 Beaver	16 Piute		
02 Box Elder	17 Rich		
03 Cache	18 Salt Lake		
04 Carbon	19 San Juan		
05 Daggett	20 Sanpete		
06 Davis	21 Sevier		
07 Duchesne	22 Summit		
08 Emery	23 Tooele		
09 Garfield	24 Uintah		
10 Grand	25 Utah		
11 Iron	26 Wasatch		
12 Juab	27 Washington		
13 Kane	28 Wayne		
14 Millard	29 Weber		
15 Morgan			

611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	
	Ammonia as N			722
	Arsenic		5.1	723
	Barium			724
	Boron			725
	Cadmium		0.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		3.0.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.0	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	R.E. Jones 1/14/84		

me/l	ANIONS	mg/l	
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755

Turbidity, as JTU	1	757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762

PESTICIDES

	ug/l	
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other _____		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l		Sp. Act.	
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

#18

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr. 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 706 | Med. | Township | Range | Section | QTRSC | QTRQTR 705

Sample Collected by 713

Exact Description of Sampling Point 646 647 710

Name SEND REPORT TO: 715

Address 648 717

Phone No. 718

TYPE OF SOURCE TABLE		WATER USE TABLE	COUNTY CODE TABLE	
01 Spring	11 Creek	1. Culinary	01 Beaver	16 Piute
02 Well	12 Pond	2. Agriculture	02 Box Elder	17 Rich
03 Stream	13 Street gutter	3. Industrial	03 Cache	18 Salt Lake
04 Lake		4. Other	04 Carbon	19 San Juan
05 Canal	15 Tunnel		05 Daggett	20 Sanpete
06 Dist. syst.	16 Reservoir		06 Davis	21 Sevier
07 Effluent	17 Surface		07 Duchesne	22 Summit
08 Storm sewer	18 Artesian well		08 Emery	23 Tooele
09 Irrigation	19 Swimming pool		09 Garfield	24 Uintah
10 River	14 Other		10 Grand	25 Utah
			11 Iron	26 Wasatch
			12 Juab	27 Washington
			13 Kane	28 Wayne
			14 Millard	29 Weber
			15 Morgan	
719 Sample Source		708 Current / 709 Proposed	611 County	

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	
	Ammonia as N			722
	Arsenic		1.1	723
	Barium			724
	Boron			725
	Cadmium		0.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		0.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.0	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	R.E. Jones / Mfg		

me/l	ANIONS	mg/l	
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		753
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		900
Iron, Total		755

Turbidity, as JTU		767
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762

PESTICIDES (ug/l)

Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other _____		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l		Sp. Act.	
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

Rev. 1/76

#19

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr. 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 705 | Med. | Township | Range | Section | QTRSC | QTRQTR 706

Sample Collected by 713

Exact Description of Sampling Point 642 643 710

Name SEND REPORT TO: 715

Address 648

Phone No. 717 716

TYPE OF SOURCE TABLE

01 Spring	11 Creek
02 Well	12 Pond
03 Stream	13 Street gutter
04 Lake	
05 Canal	15 Tunnel
06 Dist. syst.	16 Reservoir
07 Effluent	17 Surface
08 Storm sewer	18 Artesian well
09 Irrigation	19 Swimming pool
10 River	14 Other

710 Sample Source

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current
709 Proposed

COUNTY CODE TABLE

01 Beaver	16 Piute
02 Box Elder	17 Rich
03 Cache	18 Salt Lake
04 Carbon	19 San Juan
05 Daggett	20 Sanpete
06 Davis	21 Sevier
07 Duchesne	22 Summit
08 Emery	23 Tooele
09 Garfield	24 Uintah
10 Grand	25 Utah
11 Iron	26 Wasatch
12 Juab	27 Washington
13 Kane	28 Wayne
14 Millard	29 Weber
15 Morgan	

611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	
	Ammonia as N			722
	Arsenic		1.0	723
	Barium			724
	Boron			725
	Cadmium		0.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		0.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.0	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	R.C Jones / mpH		

me/l	ANIONS	mg/l	
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755

Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762

PESTICIDES

	(ug/l)	
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other _____		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l		Sp. Act.	
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

Rev. 1/76

#20

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr. 711 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 706 | Mrd. | Township | Range | Section | QTRSC | QTRQTR 705

Sample Collected by 713

Exact Description of Sampling Point 646 647 710

SEND REPORT TO:
Name 714
Address 648 717
Phone No. 718

TYPE OF SOURCE TABLE		WATER USE TABLE	COUNTY CODE TABLE	
01 Spring	11 Creek	1. Culinary	01 Beaver	16 Piute
02 Well	12 Pond	2. Agriculture	02 Box Elder	17 Rich
03 Stream	13 Street gutter	3. Industrial	03 Cache	18 Salt Lake
04 Lake	15 Tunnel	4. Other	04 Carbon	19 San Juan
05 Canal	16 Reservoir		05 Daggett	20 Sanpete
06 Dist. syst.	17 Surface		06 Davis	21 Sevier
07 Effluent	18 Artesian well		07 Duchesne	22 Summit
08 Storm sewer	19 Swimming pool		08 Emery	23 Tooele
09 Irrigation	14 Other		09 Garfield	24 Uintah
10 River			10 Grand	25 Utah
			11 Iron	26 Wasatch
			12 Juab	27 Washington
			13 Kane	28 Wayne
			14 Millard	29 Weber
			15 Morgan	
719 Sample Source		708 Current / 709 Proposed	611 County	

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	Arsenic		7.4	723
	Barium			724
	Boron			725
	Cadmium		30.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		180.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		1.4	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	R.E. [illegible] / mft		

me/l	ANIONS	mg/l	Code
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

		Code
Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762

		Code
pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755

PESTICIDES (ug/l)

Pesticide	ug/l	Code
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other		641
2,4-D		619
2,4,5-T		635
2,4,5-T (Silvex)		620

RADIOLOGICS

	pc/l	Code	Sp. Act.	Code
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
$^{226}Radium$		627		628
$^{228}Radium$		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

Rev. 1/76

H21

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr. 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 705 | Mer. | Township | Range | Section | QTRSC | QTRQTR 706

Sample Collected by 713

Exact Description of Sampling Point 646 647 710

Name SEND REPORT TO: 715

Address 648 717

Phone No. 718

TYPE OF SOURCE TABLE		WATER USE TABLE	COUNTY CODE TABLE	
01 Spring	11 Creek	1. Culinary	01 Beaver	16 Piute
02 Well	12 Pond	2. Agriculture	02 Box Elder	17 Rich
03 Stream	13 Street gutter	3. Industrial	03 Cache	18 Salt Lake
04 Lake	14 Other	4. Other	04 Carbon	19 San Juan
05 Canal	15 Tunnel		05 Daggett	20 Sanpete
06 Dist. syst.	16 Reservoir		06 Davis	21 Sevier
07 Effluent	17 Surface		07 Duchesne	22 Summit
08 Storm sewer	18 Artesian well		08 Emery	23 Tooele
09 Irrigation	19 Swimming pool		09 Garfield	24 Uintah
10 River			10 Grand	25 Utah
			11 Iron	26 Wasatch
			12 Juab	27 Washington
			13 Kane	28 Wayne
			14 Millard	29 Weber
			15 Morgan	
719 Sample Source		708 Current	611 County	
		709 Proposed		

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	Code
	Ammonia as N			722
	Arsenic		90.0	723
	Barium			724
	Boron			725
	Cadmium		5.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		15.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.0	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	R. E. [illegible] /[illegible]		

me/l	ANIONS	mg/l	Code
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

Parameter	Value	Code
Turbidity, as JTU		757
Sampling Depth, m		609
Specific Gravity		608
Specific Cond. @ 25° C, μ mhos/cm		762

Parameter	mg/l	Code
pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755

PESTICIDES (ug/l)

Pesticide	ug/l	Code
Aldrin		641
Chlordane (cis and trans)		612
DDT (Total)		642
Dieldrin		643
Endrin		613
Heptachlor		614
Heptachlor Epoxide		615
Lindane		616
Methoxychlor		617
Toxaphene		618
Other ______		644
2,4-D		619
2,4,5-T		645
2,4,5-TP (Silvex)		620

RADIOLOGICS

	pc/l	Code	Sp. Act.	Code
Alpha gross		621		622
Beta, gross		623		624
Tritium, ^3H		625		626
^{226}Radium		627		628
^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

Rev. 1/76

UTAH STATE DIVISION OF HEALTH
BUREAU OF WATER QUALITY

CHEMICAL, RADIOLOGIC & PESTICIDES ANALYSIS

Lab. Sample No. 701 | Storet No. 702 | Date Collected mo. dy. yr. 714 | Time Collected 610 | Water Syst. No. 703 | Source No. 704 | Water Rights No. 707

Supply Owned by 712 | River Mile Code 706 | Nrd. | Township | Range | Section | QTR SC | QTR QTR 705

Sample Collected by 713

Exact Description of Sampling Point 646 647 710

Name SEND REPORT TO: 716

Address 648 717

Phone No. 718

TYPE OF SOURCE TABLE

01 Spring	11 Creek
02 Well	12 Pond
03 Stream	13 Street gutter
04 Lake	15 Tunnel
05 Canal	16 Reservoir
06 Dist. syst.	17 Surface
07 Effluent	18 Artesian well
08 Storm sewer	19 Swimming pool
09 Irrigation	14 Other
10 River	

719 Sample Source

WATER USE TABLE

1. Culinary
2. Agriculture
3. Industrial
4. Other

708 Current
709 Proposed

COUNTY CODE TABLE

01 Beaver	16 Piute
02 Box Elder	17 Rich
03 Cache	18 Salt Lake
04 Carbon	19 San Juan
05 Daggett	20 Sanpete
06 Davis	21 Sevier
07 Duchesne	22 Summit
08 Emery	23 Tooele
09 Garfield	24 Uintah
10 Grand	25 Utah
11 Iron	26 Wasatch
12 Juab	27 Washington
13 Kane	28 Wayne
14 Millard	29 Weber
15 Morgan	

611 County

CHEMICAL ANALYSIS

me/l	CATIONS	mg/l	ug/l	
	Ammonia as N			722
	Arsenic		0.0	723
	Barium			724
	Boron			725
	Cadmium		0.0	727
	Calcium			728
	Chromium			729
	Chromium, Hex. as Cr			730
	Copper			732
	Iron			733
	Lead		0.0	734
	Magnesium			737
	Manganese			738
	Mercury, Total			739
	Nickel			740
	Potassium			742
	Selenium		0.0	743
	Silver			744
	Sodium			745
	Zinc			749
	TOTAL CATIONS	RE Issue 1/mft		

me/l	ANIONS	mg/l	
	Bicarbonate		758
	Carbon Dioxide		759
	Carbonate		760
	Chloride		763
	CO_3 Solids		
	Fluoride		765
	Hydroxide		767
	Nitrate as N		605
	Nitrite as N		606
	Phosphorus, Ortho as P		607
	Silica, dissolved as SiO_2		750
	Sulphate		772
	TOTAL ANIONS		
	GRAND TOTAL		

pH		782
TDS @ 180° C		786
Phosphorus, Tot.		785
Sufactant as MBAS		773
Total Alk. as $CaCO_3$		752
Total Hardness as $CaCO_3$		754
Iron, Total		755

Turbidity, as JTU		757
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Heptachlor	614
Heptachlor Epoxide	615
Lindane	616
Methoxychlor	617
Toxaphene	618
Other _____	644
2,4-D	619
2,4,5-T	645
2,4,5-TP (Silvex)	646

RADIOLOGICS

	pc/l		Sp. Act.	
Alpha, gross		621		622
Beta, gross		623		624
Tritium, ^{3}H		625		626
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^{228}Radium		629		630
^{90}Sr		631		632
^{89}Sr		633		634
^{131}I		635		636
^{134}Cs		637		638
^{137}Cs		639		640

G. PLANTS

1. Objective. To survey vegetation in the Orr Springs area, and to evaluate the possible involvement of toxic plants in the death of the horses.

2. Experimental and Results. A general survey was made by CPT L. W. Law, a range management biologist, on 6 July 1976 in the Orr Springs area for poisonous plants. As shown in the attached report (inclosure G-1) there was no indication that any poisonous plants had been grazed by horses or other herbivores. Ephedra nevadensis, Mormon tea, which had been grazed, contains minute amounts of ephedrine or pseudoephedrine, both vasoconstrictors. It is a locally common plant and not poisonous to any type of livestock or humans. Photographs were made of a representative variety of plants in the area. Some illustrations are seen in Figures G-1 through G-11.

On 8 July 1976, indigenous plant samples were collected in the Orr Springs locality, identified by CPT Law and placed in cold storage in Baker Laboratory (inclosure G-2). Of these samples, Tetradymia spinosa (spiny horsebrush), produces liver damage and photosensitivity in light-skinned sheep. The toxic effects give rise to a disease called "bighead." It is less toxic to cattle. Available references do not mention such a problem with horses. Tetradymia was not observed to be grazed. There was no indication of a disease resembling bighead in the horses, and dark-skinned horses were affected in this incident no less than the few light-skinned animals in the herd.

Poisonous plants observed include princess plume, locoweed and halogeton. Princess plume tends to concentrate selenium under favorable conditions, but no selenium was found in soil or water. No indication existed pointing toward fatal consumption of halogeton, which would be indicated by the presence of sufficient oxalate crystals in kidneys to damage the tissues and interfere with renal function. This conclusion is based in part on verbal reports given by several veterinarians and on autopsies performed by them. Moreover, serum calcium levels were not depleted (see Diagnostic Survey).

Samples of stomach, small intestine and colon contents obtained from two dead horses and three fecal specimens were transported on 9 July 1976 by courier aboard U.S. Army aircraft to Colorado State University (CSU), Fort Collins, Colorado, for detailed microscopic examination and identification in the Natural Resources Laboratory. On 12 and 16 July 1976, Dr. Richard Hansen, the investigator, gave preliminary reports by telephone. He stated that the samples showed the horses had consumed a typical normal horse diet, mostly forbs and brush-like material. Of poisonous plants growing or likely to be present in the area, there is an insignificant amount in the samples. A written final report,

submitted since then, and attach as inclosure G-4, confirmed preliminary conclusions, and obviated the need for feeding and chemical studies on plants gathered in the Orr Springs area.

It may be noted that ample forage was available to the horses in the Orr Springs area. Therefore, the animals were not forced into consumption of toxic and unpalatable plants exemplified by Tetradymia.

3. Conclusions. Involvement of plants in the etiology of the horse deaths can be ruled out with confidence in that animals instinctively prefer non-toxic forage when, as in this instance, sufficient quantities are available. There is direct evidence that horses did not consume significant amounts of toxic plants, by observation of plants in situ and by examination of gastrointestinal contents. Furthermore, there were no remarkable accumulations of oxalate in renal tissues and no depression of blood calcium indicative of ingestion of halogeton. In addition, there were no elevated concentrations of selenium in soil or water which might have led to concern for potential accumulation of selenium in princess plume.

Figure G-1. Range Condition in Vicinity of Orr Springs

Figure G-2. Mormon Tea (Non-Poisonous)

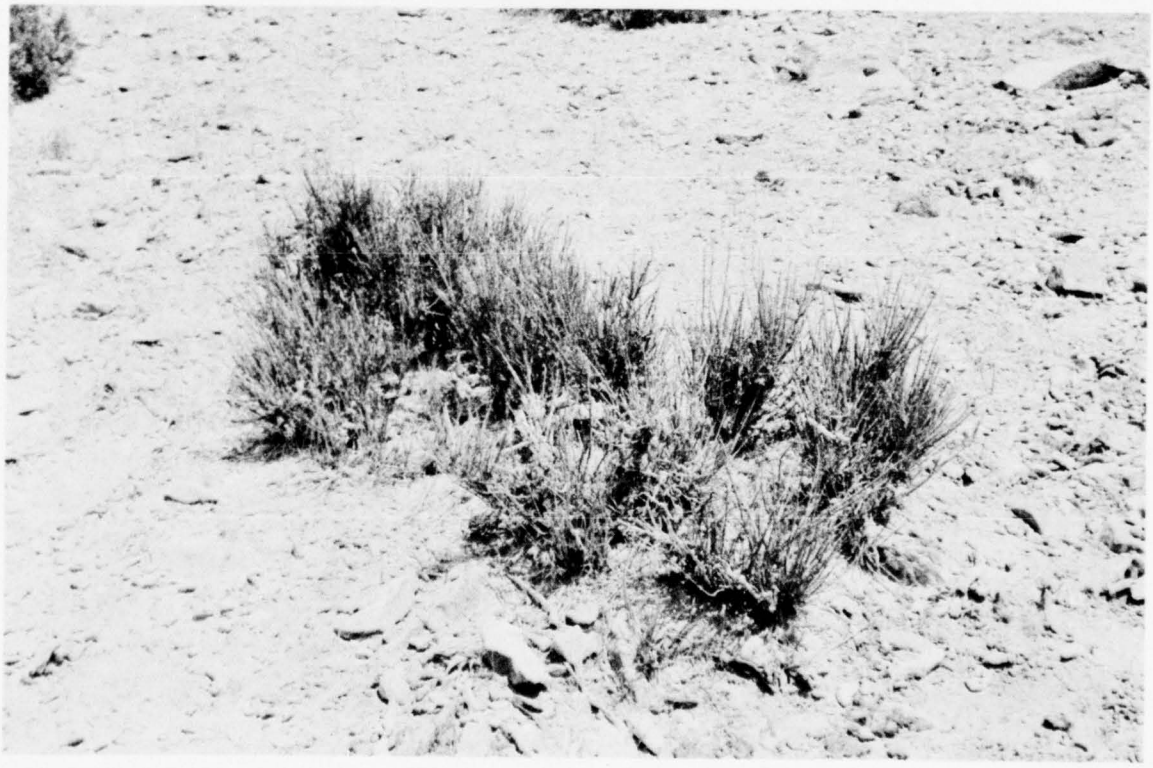

Figure G-3. Spiney Horsebrush (Poisonous)

Figure G-4. Princess Plume (Potentially Poisonous)

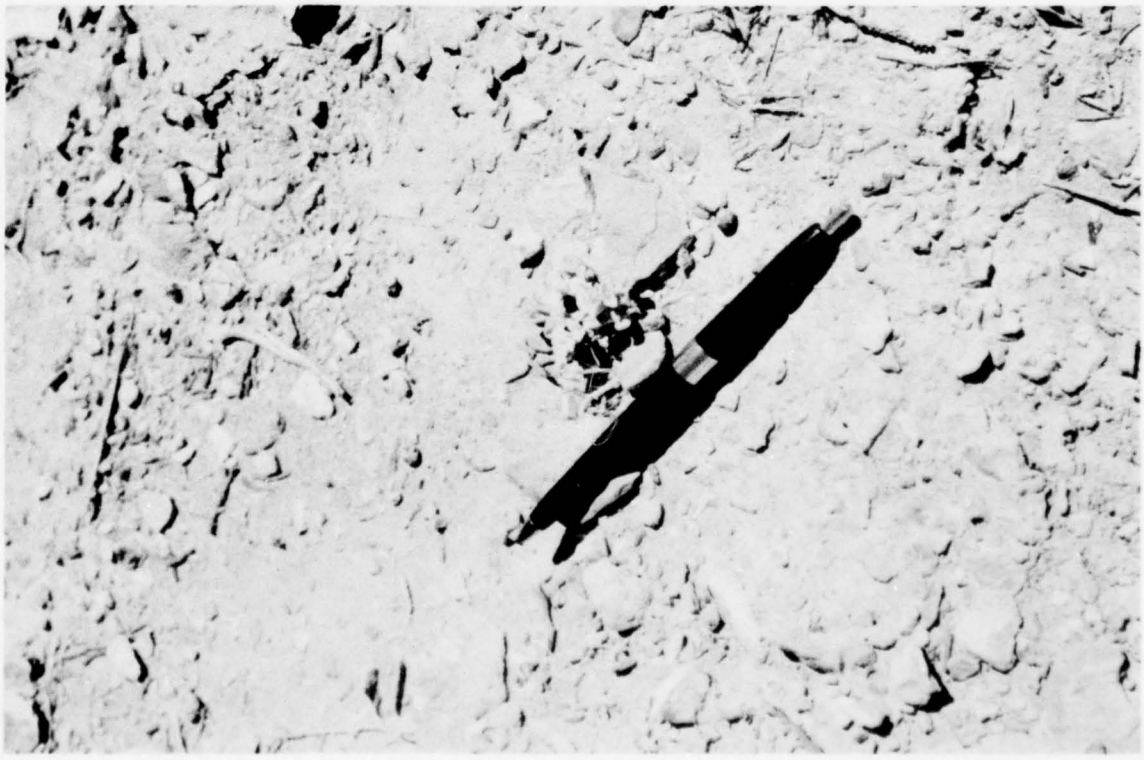

Figure G-5. Locoweed (Poisonous)

Figure G-6. Halogeton (Poisonous)

Figure G-7. Squaw Bush (Non-Poisonous)

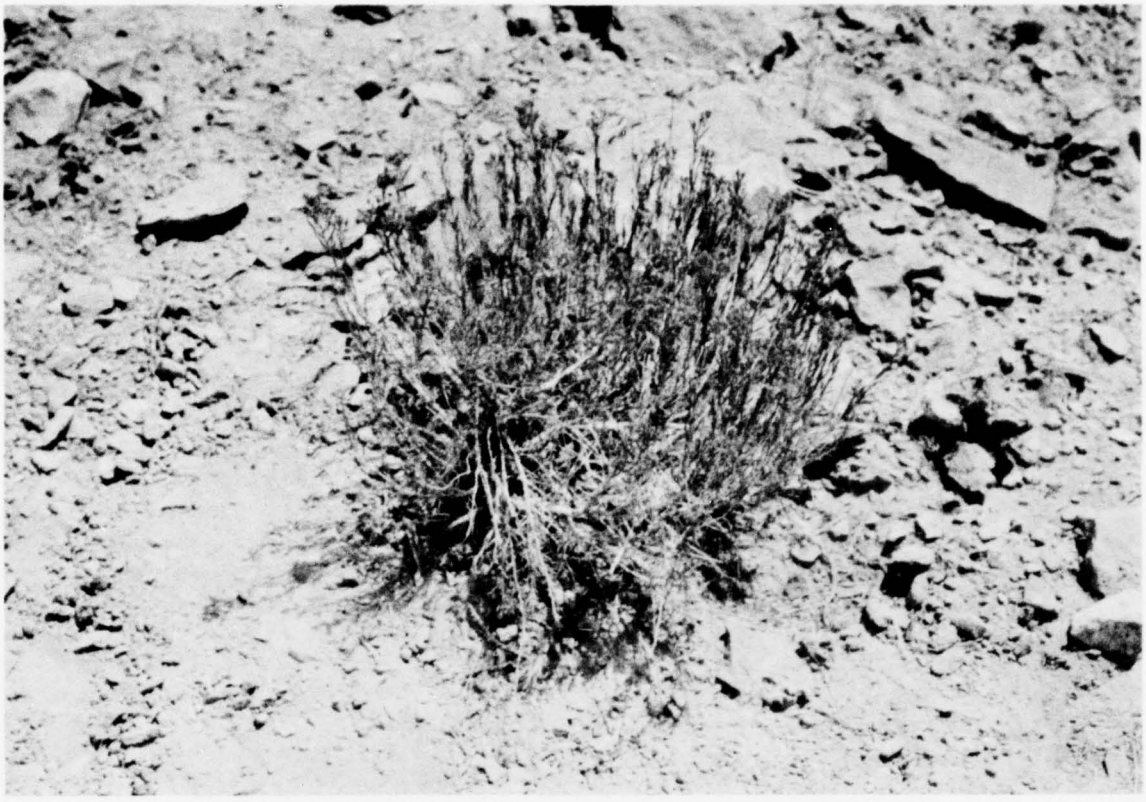

Figure G-8. Rabbit Brush (Non-Poisonous)

Figure G-9. Black Sage (Non-Poisonous)

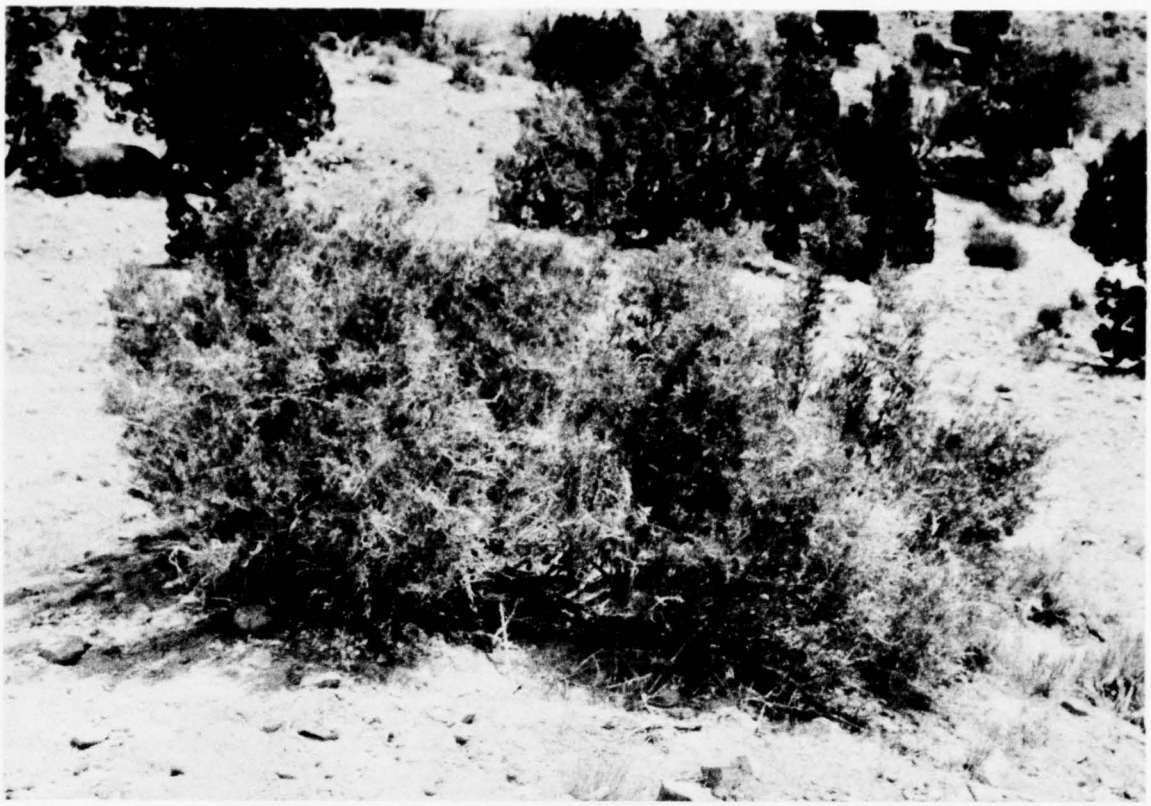

Figure G-10. Greasewood (Non-Poisonous)

Figure G-11. Vetch (Non-Poisonous)

STEDP-MH

Poison Plant Survey

// THRU: Deputy Commander
Dugway Proving Ground
Dugway, Utah 84022

Commander, MMC
Dugway Proving Ground
Dugway, Utah 84022

7 July 1976

TO: Dr. Rothenberg
Dugway Proving Ground
Dugway, Utah 84022

1. Reference: Detail of Commander, MMC to survey poison plant situation in vicinity of Orr Springs.

2. The above survey was conducted on 6 Jul 76. The following poison plants were found growing in the vicinity:

a.	Princess Plume	Stanleya Pinnata
b.	Halogeton	Halogeton Glomerata
c.	Spiney Horse Bush	Tetradymia Spinosa
d.	Loco Weed	Astragalus Utahensis

3. Species a,b, and c above were growing in relative abundance throughout the entire area. Species d was only found in very widely scattered areas and in very small amounts. None of the four species appeared to be grazed.

4. The only plant in the area that appeared to be utilized to any extent was the Mormon Tea, Ephedra Nevadensis. Although this plant contains a stimulant (Ephedrin) to my knowledge it would have no detrimental effect on horses.

LAMONT W. LAW
CPT, CM
Commander

Inclosure G-1

Plants from horse death area near Orr Springs collected 8 July identified by CPT L. W. Law, CM.

Utah juniper	Juniperus osteosperma
Rabbit brush	Chrysothamnus vicidiflorus
Russian thistle	Salsola kali
Globe mallow	Sphaeralcea sp. (Coccinia)
Spiney horsebrush	Tetradymia spinosa
Seepweed (inkweed)	Suadea torreyana
Winter fat (white sage)	Eurotia lanata
Cheat grass	Bromus tectorum
Indian ricegrass	Oryzopsis hymenoides
Galleta grass	Hilaria jamesii

Colorado State University
Fort Collins, Colorado
80523

Composition Analysis Laboratory
225 Natural Resources
303/491-5577

July 19, 1976

A. T. Hereim, Chief
Environmental Ecology Branch
Dugway, Utah 84022

Dear Sir:

Enclosed are 2 copies of a table showing the Composition Analysis Lab's estimates for the relative abundance of plants occurring in the eight samples which were delivered to me by Dr. Harold Stark. The plants found are those which I believe horses feed upon. Unfortunately there are no scientific publications which describe what wild or domestic horses eat on North American rangelands.

An invoice will be sent under separate cover.

Sincerely,

Dick Hansen

R. M. Hansen, Director
Composition Analysis Laboratory

RMH:md
enclosure

Relative percent density of discerned fragments from wild horse digestive tract and fecal samples from Dugway Utah. July 16, 1976.

	I	III	IV	V	VI	VII	VIII
Agropyron (wheatgrass)	43.63	2.96		2.22	.53	.69	
Bromus (Brome)	9.39	5.36	12.13	4.51	11.72	10.24	89.22
Elymus (wildrye)	6.09	.65			1.60	1.37	.39
Hilaria (hilaria)	6.73	69.32	16.65	34.26	65.05	16.00	1.18
Koeleria (junegrass)					.53	.69	
Oryzopsis (ricegrass)		4.66		5.30	2.70	.69	1.18
Sporobolus (dropseed)	10.08			.74	3.82	16.00	3.23
Stipa (needlegrass)	5.71	1.30			3.82	4.20	
Atriplex (saltbush)	4.20	10.44		1.47		3.48	
Boraginaceae						.53	.69
Chrysothamnus (rabbitbrush)				.74			
Delphinium (larkspur)	.58						
Eriogonum (wildbuckwheat)							1.99
Eurotia lanata (common winterfat)	1.17	4.66	44.60	36.03	9.17	25.18	2.81
Juniperus (juniper)			26.62	3.74			
Melilotus (sweetclover)					.53	2.07	
Pinus (pine)	.58						
Salsola (russianthistle)	10.08	.65					
Unidentified composite	1.76						
Unidentified forb				10.99	18.70		

R M Hansen
Composition Analysis Laboratory, 225 Natural Resources, Colorado State University

These samples were checked against reference material of the following potentially poisonus plants: Asclepias (milkweed), Astragalus, Oxytropis (vetches), Centaurea (starthistle), Cicuta (waterhemlock), Delphinium (larkspur), Gutierrezia (snakeweed), Halogeton (halogeton), Haplopappus (goldenweed), Helenium (sneezeweed), Hymenoxys (actinea), Lupinus (lupine), Mentzelia (mentzelia), Sarcobatus (greasewood), Stanleya (princesplume), Senecio (groundsel), Tetradymia (horsebrush), Xanthium (cocklebur), and Zigadenus (deathcamus).

I = H-6-G-10 stomach contents 6 July 76
II = H-6-G-10 small intestine (no plants, a few hairs) 6 July 76
III = H-6-G-10 colon contents 6 July 76
IV = H-6-G-2 stomach contents (very little plant material) 4 July 76
V=H-6-G-2 colon contents 4 July 76
VI = Feces "A" 5 July 76
VII = Feces "B" 5 July 76
VIII = Feces "C" 5 July 76

H. HUMAN ACTIVITIES IN THE ORR SPRINGS AREA

1. Objective. To determine the extent and nature of human activities, including military operations, in the Orr Springs area so as to establish whether the wild horses may have been accidentally or deliberately harassed.

2. Findings. The topic was covered in considerable detail during the presentation of the chronology of the horse incident to the Evaluation Panel convened by the Utah State Veterinarian, Dr. F. James Schoenfeld, on 27 July 1976. Details can be found in the report of that meeting.

In brief, it was determined that no significant or unusual military activity occurred at or near Orr Springs during the period preceding the horse incident. The National Guard had been implicated by rumor, but it had ceased operations well before the critical period and, in any case, did not conduct formal maneuvers in the area. (See inclosures H-1 through H-4.)

Trips by Bureau of Land Management personnel to the Orr Springs area preceding the horse deaths were frequent, during which extensive modifications of the water source were made. The log at Dugway Proving Ground lists visits on 24, 29 and 30 June and again on 1 July 1976. Mr. Ron Hall, Bureau of Land Management, at the meeting mentioned above, stated that a visit was also made on 23 June 1976, during which stakes and flags were reportedly emplaced around the water trough. (There is no official record of a visit on that date.) Modifications at the water source reportedly began in May. Creosoted poles were said to have been brought in and stacked near the water trough, one pile on 29 June 1976, the other on 1 July 1976.

It appears, therefore, that the only intensive activity was that by the Bureau of Land Management. The fact that these visits occurred is of interest in another respect. Had any ill or dead horses been sighted, or had any harassment of the horses been observed on these occasions, it is reasonable to assume that proper alarms would have ensued.

The role of Dugway Proving Ground in "improvements" at Orr Springs is described in inclosure H-5. The only known unofficial trip into the Orr Springs area was made by CPT Kirk, a physician stationed at Dugway Proving Ground, who picnicked there with his family on 3 July 1976.

It should be noted that the nature of the terrain is such that pursuit of wild horses to the point of exhaustion is not likely to be successful, at least by ground-based interference, unless there had been a concerted effort by a number of people on horseback.

Not surprisingly, human activity in the Orr Springs area attained an exceptionally high level following the discovery of the dead horses. This persisted for approximately two weeks, then tapered off. After the third week, on or about 23 July 1976, visits by interested individuals from private organization constituted the main disturbance.

3. Conclusion. No persistent or significant human activity at the Orr Springs area has been demonstrated except visits by personnel of the Bureau of Land Management and work performed by them in that area. Since untoward events would, presumably, have been reported by them, it may be concluded the horses did not suffer any problems until after the last visit, on 1 July 1976. That is the date on which the second stack of creosoted poles was brought in, shortly after the stakes and flags were emplaced. The lapse of time between occurrence of these actions, the first sightings of possibly affected horses (on 3 July), and the first sightings of confirmed dead horses (on 4 July), is approximately the time required to cause fatal dehydration at the prevailing temperatures, if the horses did not consume any water.

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

REFERENCE OR OFFICE SYMBOL	SUBJECT
	Use of Wig Mountain Training Area

TO	FROM	DATE	CMT 1
Cdr, Dugway Proving Ground ATTN: Mr. Tanner	Cdr, XI Corps Arty	8 Jul 76	

1. Inclosed is a DF from the 396th Avn Co, UTARNG, showing their use of the Wig Mtn Tng Area on period indicated.

2. As for the artillery operating at Dugway during the period 6-20 June 76, no firing was carried on in other than the White Sage Flats area.

3. It is possible that in a few cases some activity north of Stark Road could be possible, however no formal activity was carried on in that area.

4. It is hoped the problem with the horse deaths can be resolved and that we in the National Guard can still enjoy the use of Dugway as we have in the past.

FOR THE COMMANDER:

KEN G KNIGHT
LTC, FA, UTARNG
O&TS

Inclosure H-1

DA FORM 1 FEB 62 2496 REPLACES DD FORM 96, EXISTING SUPPLIES OF WHICH WILL BE ISSUED AND USED UNTIL 1 FEB 63 UNLESS SOONER EXHAUSTED.

GPO : 1966 O - 323-400

UT-AVN

Use of Cedar Mountains Area by 396th Avn Co

XI Corps Arty
ATTN: LTC Osborne

396th Avn Co

8 July 1976

1. The 396th Aviation Company conducted Nap of the Earth flight training in the Cedar Mountain range from 7 to 18 June 1976. An average of two flights per day were flown, usually between 0600 hours and 1000 hours to take advantage of cooler temperatures at altitudes from five feet to one hundred feet AGL. NOE Route Three passes directly through the Orr Springs area. NOE Route Four passes five to 600 meters South of Cane Springs.

2. Ground training was conducted in grid 3961 by Flight Platoons engaged in an overnight bivouac on the nights of 10 June and 15 June. No other ground operations of any type were conducted in the Cedar Mountains area.

3. My personal experience as an NOE Instructor Pilot flying these courses was that the animals were grazing out toward Wig Mountain during the cooler hours of the day and were rarely encountered in the hills near the springs during our flights.

ROBERT D. MABEY
MAJ, IN, UTARNG
Commanding

STEDP-MT-RC

U.S. Air Force Flight Activities Over
Dugway Proving Ground, 3 through 5 July 1976

XX THRU: Dir, MT

Ch, MT-RC

14 Jul 76
Mr. Tanner/ts/5100

TO: Scientific Director

1. During the 3 through 5 July 1976 holiday week-end, there were no flight activities scheduled or conducted by Air Force units over Dugway Proving Ground, nor over the adjacent Hill/Wendover Air Force ranges. Range activities at DPG and Hill AFB were shut down from 3 through 5 July to allow time off for military and civilian personnel during the holiday week-end. The air space over DPG and the Hill/Wendover ranges, being unused for military activities during this period, was returned to the FAA for the monitoring and control of other potential users. When DPG's restricted air space is under FAA control, flight activities by civil or commercial aircraft are prohibited under 14,000 feet above mean sea level (approx. 10,000 feet above ground level).

2. The 299th Air National Guard Unit (CLOVER CONTROL), which provides air traffic control services to DPG Range Control, is preparing a formal letter to verify the above statements and will forward it immediately to DPG. Preparation of the letter has been coordinated with Hill AFB Range Management.

MT

WILLIAM S. TANNER
Chief, Range Control Office

Inclosure H-3

DEPARTMENT OF THE AIR FORCE
299TH COMMUNICATIONS SQUADRON (ANG) (AFCS)
UTAH ANG BASE, 765 NORTH 2200 WEST
SALT LAKE CITY, UTAH 84116

REPLY TO ATTN OF: CC

14 JUL 1976

SUBJECT: Range Activity 3, 4 and 5 July 1976

TO: Commander, Dugway Proving Ground
Attention: STEDP-MT-RC (Mr Tanner)

1. This is to confirm that no flight activity was scheduled or conducted over the Dugway/Hill/Wendover Ranges (R6404 A & B, R6406, R6402, R6407 and R6405) during the period 3, 4 and 5 July 1976.

2. Airspace associated with subject ranges was released entirely to Federal Aviation Administration control for civil air traffic usage.

3. Telecom with Major George Mannes, OO-ALC/TR also confirms the above.

MAX L COMBE, Major, Utah ANG
Commander

STEDP-LD

MEMORANDUM FOR RECORD 2 August 1976

TO: COL Toepel

The following information is provided per your verbal request of 29 July 1976:

a. The Memorandum of Understanding between the Bureau of Land Management and Dugway Proving Ground provides for a joint management plan to be developed by BLM and DPG.

b. In 1974 as a result of a meeting at DPG, the subject of the status of the plan was raised with the understanding that BLM would develop the plan and provide a copy to DPG in Jan 75.

c. In Feb 75, the undersigned contacted BLM requesting the status of the plan. At that time, Mr. Hillier's office agreed to develop the plan and forward to DPG a plan for the overall control and development by 20 Feb 75. Such a plan was not received. However, in a letter in Feb 75 signed by Mr. Hillier, he stated that they had not yet had time to develop a study proposal for the horses but would pursue this in the near future.

d. In a meeting in Nov 75, it was again requested that the management plan be developed and emphasized that due to the rapid increase in the population of the horses at DPG it was imperative that a jointly developed management plan be produced as rapidly as possible. BLM again expressed its responsibility and desire to develop a plan but stated that it simply had not had time to complete the plan as agreed to.

e. On or about the first part of Mar 76, I was contacted by Mr. Hall, BLM, requesting clearance for some BLM people to visit Orr Springs area for the purpose of developing the water resources at that location. During the conversation, Mr. Hall also amplified that they intended to establish a catch corral around the water hole which would give them the capability to control the animals in the future. The undersigned concurred in their requirement and pointed out that DPG still had not received a draft of the implementation plan as called for in the Memorandum of Understanding. Mr. Hall's response was that this was the purpose of the visit--to develop the furtherment of such a plan.

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f. On or about the first week in April, the undersigned received a call from Mr. Hall requesting authority for contractor personnel to visit the Orr Springs area. Mr. Hall stated that it was BLM's intent to contract for the improvement of the water resources at the Orr Springs area. I made arrangements with Security and Range Control for BLM personnel and contractor personnel to visit the Orr Springs site.

g. During the latter part of Apr 76, I received a call from Mr. Hall requesting assistance of equipment in development of water resources at Orr Springs. I explained to Mr. Hall that the only resources that would be available to BLM during the time frame requested (the first two weeks in May) would be a D7 or D8 cat without operator. Mr. Hall said this was acceptable since they were going to bring their own equipment. The equipment was loaned to BLM during the period 3 May through 12 May 76. I have no personal knowledge as to what additional equipment or supplies were delivered to the Orr Springs area. However, I have been informed that they brought the creosote poles and other supplies for the construction of the catch corral during the latter part of Jun 76.

WILLIAM R. WOODS
Director of Logistics

I. ANIMAL ECOLOGY

1. Objective. To evaluate conditions in the Orr Springs area which may be pertinent to the condition of the horses and to observe range conditions; to observe places where horses died; to observe habits and behavior of living horses in the area; to confer with veterinarians visiting the site to establish possible cause of death from gross pathology; to collect blood and tissue specimens, especially spleen, liver, kidney and brain of horses; to collect rodent and other wildlife specimens in the area to determine if other species are being affected by some unknown malady, and to evaluate modifications of the environment recently introduced by the Bureau of Land Management.

2. Experimental. Photographs of horses in death and of modifications to capped springs, cisterns and watering trough were made. Dying and freshly dead horses were autopsied. Blood and tissue specimens were placed in containers (plastic bags, heparinized and non-heparinized Vacutainer tubes, respectively). All specimens except as shown in Table D-1 were provided to other investigators. One hundred and twenty traps (1-liter cans attached to Museum Special snap traps) were set in four lines of 30 traps each in Ravine No. 1 (see map, Figure D-1) of Orr Springs along the mesas on each side. Traps were first placed, 6 July 1976, on each side of Ravine 1. On 11 July 1976, three of the four lines in Ravine 1 were moved to Ravine 3 since decreasing trapping success indicated over-trapping of the area. Nine mosquito light traps with solid CO_2 (dry ice) as an attractant were set along ravines and in tamarisks below horse trough (see report on Mosquitoes and Ticks for subsequent placement and exact location). Observations were made on living horses and on attitudes of dead and living horses. On-site conferences were held with State and Federal officials visiting the site, e.g., State Veterinarian and Bureau of Land Management personnel.

3. Results. On 4 July 1976 approximately 19 dead horses were observed near Orr Springs in Ravine No. 1 ("Dead Horse Draw"). The dead horses appeared to have been seeking water in the seeps which occurred along the gulch. A water sample was collected from the principal seep (which contained about a teacup of water). Each seep and spot of wet soil had a horse with its face in the seep or very near it in death. Samples of tissue and blood were taken from a dying colt in the area. The following day samples were taken from horses as they continued to die. On the way to the site one dead horse was seen on the mud flat just north of Baker Laboratory, another at a rain pond (or playa, now dry) about halfway toward Wig Mountain and four live horses standing at the dry pond. On the way from Wig Mountain to Orr Springs a band of horses was seen just north of the Navy gun mount (2 colts, 1 yearling, 4 older horses). All appeared to be in good condition. At Ravine Nos. 1 and 2 there was evidence that the horses had been pawing at mud in the wash trying to get water. Some dead horses were piled up two and three deep.

Although the horses had apparently kicked off the lids of the cisterns to get at the water, this maneuver was unsuccessful because the water level was too low. There was no evidence (no footprints) that they had been drinking at the trough which was full to overflowing. However, there were what appeared to be old footprints around an overflow pond below the trough. To provide another water source, the cistern in Ravine No. 2 was opened and a pond created.

Five emaciated horses (2 adults, 3 colts) were nudged to this pond and there they drank for approximately 10 minutes. All were roped and bled. They were allowed to drink briefly then rushed away for brief periods to prevent bloating. On 6 July, four more horses were led to the same pond. One mare was roped and bled. About 10 minutes after she was released, she went to the water and fell and died within 3 to 5 minutes. The horses which were watered the previous day were observed feeding on nearby hillsides.

Dr. Schoenfeld, Utah State Veterinarian, took samples from freshly dead horses on 5 July and 7 July, and took a live colt. Also blood samples were taken from horses in the Dugway corral for control samples.

Two colts which had been given care and water eventually lay down and died. These were autopsied for samples. Without their mothers, there was no chance for survival in any event. Further sightings of horses are described in inclosure to the Minutes of the Meeting of the Evaluation Panel on the Horse Incident.

As of 19 July 1976, 104 rodents were collected by live trapping, at which time trapping was terminated. Blood samples were taken for serology and toxicology as would be required later, but subsequently deemed to be unnecessary. Tissue specimens were inoculated into test animals for recovery of pathogens. Sixty-one of the rodents were held alive for observation until 4 August. Of the trapped animals, 15 (all Perognathus formosus) died. These were examined by the installation veterinarian and no pathological evidence was observed. This particular species does not tolerate well the transition from the wild to the captive state and the mortality is not unexpected. All surviving rodents were released close to the area where they were trapped.

The cistern was found with the plug back in place. It was removed again to ensure availability of water for the surviving horses. This process was repeated a number of times. Troughs were buried in the soil some distance below Orr Springs in a clump of tamarisks at a place called Bitter Spring. Fresh water was placed in these troughs by Dugway personnel. There was no evidence of horses drinking from these buried troughs. A pool was formed above the troughs from an existing seep. There were some hoofprints around this pool, indicating use by horses.

On 29 August 1976, an installation quite similar to that at Orr Springs was seen approximately 5 miles north by northwest of White Rock

Springs at Cochran Springs. It, too, consisted of a green trough surrounded by stakes carrying blue ribbons (most of which had come off the stakes). There were no creosoted poles. Rather than an overflow pond, there was what appeared to be an overflow trough. Despite the absence of flags and poles, there was no evidence of recent use of the water by horses, as seen by the lack of fresh hoofprints. This belief is based on the reasonable assumption that, since footsteps left easily visible impressions in the dirt, horses would have left recognizable hoofprints. On the other hand, the White Rock pond, which has been left in its natural state, evidently is extensively used by horses and other wildlife. Figure 5 shows the large number of hoofprints surrounding the pond. Other aspects, including locations, are seen in Figures 2-4 and A-1.

It is interesting that the White Rock area is a favorite place for outings and readily reached by automobile. Human activities of this nature evidently do not deter the animals from drinking at that site.

A record of field samples collected is shown as inclosure D-1.

4. Conclusions. The horses were obviously attempting to find water in the familiar ravines where the two main springs had been covered by the Bureau of Land Management and were draining through cisterns and pipes into a trough. It is also obvious they ignored, or were frightened by, the water trough located some 300 meters distant. Alongside were two piles of creosoted poles and stakes with blue flags tied to them. Findings from Orr Springs, together with evidence obtained at a similar installation on the eastern side of the Cedar Range indicate that wild horses avoid unnatural water sources. This response is probably independent of flags or creosoted poles, though it may be reinforced by their presence.

The nearly simultaneous deaths were not suggestive of an infectious disease. There was no evidence of "blind staggers" or of thrashing prior to death. Many living horses were so weakened that they could be roped on foot. When water was available in their familiar surroundings, they willingly drank. The action and attitudes of sick, dying and dead horses suggested lack of water. It is possible that dominant horses preempted the water and thus managed to survive, leaving others to die. This may account for horses in the vicinity which were in good condition.

One hundred eight rodents from 1,560 trap nights is 6.9% capture success, which is the expected rodent population density indicator for a foothill area of mixed brush vegetation. This suggests that there was nothing contributing to a general die-off of all vertebrates. With the number of trapped animals all free of disease symptoms, a conservative estimate can be made with 95% confidence that the rodent population was 95% free of overt disease.

Forage was adequate for horses and was not closely cropped except for favorite plants. Under these circumstances, it may be anticipated

that the herds will continue to grow, as they have in the past unless they are periodically thinned out. Limited supplies of water in this arid region will continue to pose a hazard to the animals. Therefore, whether or not the herds are thinned out, but particularly if they are not and thus face increased competition for water, a repetition of the current incident under equally unfavorable conditions at some time in the future can be confidently predicted.

J. DIAGNOSTIC INVESTIGATIONS

1. Objective. To examine blood for hematocrits, serum protein, serum electrolytes and toxic metals, and for acetylcholinesterase in red cells; to conduct studies to determine if the horses suffered a debilitating disease, or were poisoned by Compound 1080.

2. Hematocrit and Serum Proteins

a. Experimental. Heparinized blood samples were drawn into standard hematocrit tubes and centrifuged 10 minutes in an International Hematocrit Centrifuge. Serum was prepared from non-heparinized blood samples taken from wild horses on 5-7 July 1976 and from domestic horses on 9 July 1976. The serum samples were diluted with 0.9% sodium chloride and then assayed for protein by 280 nm and 260 nm light absorption using a Beckman DU-2 spectrophotometer.

b. Results. Table J-1

(1) HEMATOCRIT DATA

Wild Horse No.	Hematocrit (% Packed Cells)	Domestic Horse No.	Hematocrit (% Packed Cells)
EC-7	65	1	38
		2	34
EC-8	69	3	42
		4	32
EC-11	58	5	41
		6	34
		7	38
Mean	64		37

(2) TOTAL SERUM PROTEIN LEVELS

Wild Horse No.	Serum Protein (g %)	Domestic Horse No.	Serum Protein (g %)
EC-1	12.4	1	8.8
EC-3	10.4	2	7.2
EC-4	14.8	3	7.6
EC-5	14.4	4	7.6
EC-6	18.8	5	7.2
EC-7	16.0	6	8.8
EC-8	18.0	7	7.6
		8	7.6
		9	6.8
		10	7.2
Mean	15.0		7.6

EC-6-2 (mother)	10.4	partially recovered animals
EC-11 (colt)	6.8	

Specimens of sera EC-1 through 8, EC-6-2 and EC-11 were sent to the University of Utah School of Medicine Clinical Pathology Laboratory on 14 July 1976 for determination of such blood constituents as the small volume would allow, with emphasis on total serum protein. A preliminary verbal report on 17 July showed that total serum protein values were lower for both normal and affected horses than those measured at DPG. However, the finding of markedly increased serum protein levels in affected horses was confirmed. The final report, inclosure J-1, also bore this out. A comparison of analytical results is shown in Table J-2, including data on electrolytes to be discussed later in this section. Absolute values differed more than desirable, presumably because of differences in methods and, possibly, standards used. However, differences between affected (A) and control (C) horses expressed as percentages, were relatively small. Repeat analyses of specimens from wild horses were precluded by lack of sufficient material. Similarly, hematocrit determinations on these specimens could not be performed by an independent laboratory because of lack of material, except in the case of EC-11, where the Intermountain Laboratories obtained a value of 60%, in good agreement with that from Dugway Proving Ground.

c. Conclusions. The markedly increased hematocrit and serum protein levels in the wild horses are attributable to severe hemoconcentration caused by dehydration. This is the only medically acceptable explanation. The levels were high enough to be responsible for drastic distress without the intervention of other factors, although serum electrolyte imbalance, resulting from advanced hemoconcentration, complicated the condition. This will be further discussed in a subsequent section.

3. Acetylcholinesterase Activity of Erythrocytes.

a. Experimental. Heparinized blood samples were collected from the affected wild horses on 5 to 7 July 1976 and from domestic horses at the Dugway Proving Ground corral on 8 July 1976. Red blood cells were prepared from the samples by centrifugation and washing with 0.9% sodium chloride. Acetylcholinesterase values of the red cells were determined by Warburg manometry on 9 July and again on the 13th. An experimental problem was encountered on 13 July in that insufficient CO_2-N_2 remained to complete gasing of samples.

Table J-2

COMPARISON OF ANALYTICAL DATA FROM TWO LABORATORIES

University of Utah School of Medicine

	Na	K	Cl	Total Serum Proteins (g %)	Albumin (g %)	Bilirubin (mg %)		
						Direct	Indirect	Total
Controls (10)	131	4.1	96	7.0	2.9	0.2	0.6	0.8
Affected (7)	153	14.9	107(6)	10.7(6)	4.6(6)	4.7	2.3	7.0
Change (A/C) %	+17	+263	+11	+53	+59	+2250	+283	+775
6-2	124	5.5	95	8.4	2.5	1.5	2.5	4.0
6-2	123	5.6	95	8.6	2.5	1.5	2.8	4.2
11(7)	135	10.3	101	6.7	3.2	1.6	4.0	5.6
11(7)	136	9.5	100	6.6	3.1	1.5	4.2	5.7

Dugway Proving Ground

	Na	K	Mg	Ca	Total Serum Proteins (g %)	Hematocrit (%)
Controls (10)	119	2.3	1.6	6.9	7.6	37
Affected (7)	125	8.4	4.2	9.1	15.0	67(2)*
Change (A/C) %	+5	+265	+163	+32	+97	+81
6-2	110	5.4	2.0	7.6	10.4	--
11(7)	115	9.7	2.0	6.4	6.8	58

*If erythrocyte volume remained unchanged, indicates 47% decrease in plasma volume.

Inorganic ion concentrations in meq/l.

b. Results.

Table J-3

ACETYLCHOLINESTERASE ACTIVITY OF ERYTHROCYTES

Wild Horse No.	Acetylcholinesterase (μmoles/ml erythrocytes/hr) First Assay	Second Assay	Domestic Horse No.	Acetylcholinesterase (μmoles/ml erythrocytes/hr) First Assay	Second Assay
EC-1	64	57	1	79	63
EC-3	60	49	2	66	58
EC-4	69	55	3	80	77
EC-7	--	44	4	57	54
EC-8	--	65	5	73	71
EC-6	49	46	7	81	69
			8	76	71
			9	58	48
Mean	60.5	52.7		71.3	63.9

c. Conclusions. The difference between wild and control animals was 15% and 18%, respectively, for the two assays. These values are within the variation normally found between various herds of livestock (of the same species) and between populations of given species of wildlife in different locations. A difference between test and control animals of less than an average of 50% has no physiological significance. A difference of 20% or less has no toxicological significance. Therefore, the small variation in the above data has neither physiological nor toxicological significance. The data on blood substantiate findings cited elsewhere in this report, which show that no acetylcholinesterase inhibitors were present in waters or soils of the Orr Springs area and that, therefore, the horses were not exposed to inhibitors of acetylcholinesterase, e.g., nerve agents and/or organophosphorus insecticides.

4. Bacteriology of Horse Tissue Collected at Autopsy.

a. Objective. To isolate and identify possible bacterial pathogens present in horse blood and tissues collected at autopsy.

b. Experimental. The tissues listed below in "Results" were homogenized as 10 percent tissue in tryptose broth and injected (approximately 5 ml) intraperitoneally into each of two guinea pigs on 9 July. Brain tissue from Horse No. 6 was processed similarly and injected on 14 July.

c. Results.

Table J-4

SPECIMENS INOCULATED INTRAPERITONEALLY TO GUINEA PIGS

Horse NO.*	Tissue	Mortality Ratio**	Staining & Morpholoy of Microorganism Isolated	Hemo-lysis	Growth at 25°C	Identity
2	Spleen	2/2	Gram neg. short rods	none	+	Arizona Gr 2
			Gram neg. diplococci	β	+	*Enterobacter* or *Klebsiella*
2	Blood clot	0/2				
1	Blood clot	0/2				
3	Spleen	2/2	Gram neg. med. rods	γ	+	*Enterobacter* or *Klebsiella*
			Gram neg. short rods	none	+	*Escherichia coli*
4	Blood clot	0/2				
5	Blood clot	0/2				
6	Blood clot	0/2				
6	Brain	0/2				
7	Brain	1/2	Gram neg. rods/diplococci	β	+	*Enterobacter* or *Klebsiella*
8	Blood clot	0/2				
10	Spleen	1/2	Gram pos. rods/diplococci¢	β	-	Gr.A Streptococci
			Gram neg. short rods	β	+	(*Enterobacter*
10	Brain	1/2	Gram neg. rods/diplococci	β	+	(or *Klebsiella* (or *Serratia*

* See Inventory of Horse Tissues for date and details of collection, Table D-1.
**Mortality ratio: Numerator equals no. of deaths in guinea pigs; denominator, the number of animals inoculated. Readings were recorded for 21 days, after which survivors were removed from testing.
¢ Typing performed courtesy Bureau of Laboratories, Utah State Div. of Health.

It appears noteworthy that spleen and brain tissues produced deaths in guinea pigs, but that the blood clots from the same animals (taken by sterile vacuum containers) did not produce death.

None of the organisms isolated are suspected of having been the cause of death in horses. Also, it is indeed possible that several of the isolations originated from guinea pigs per se, since intestinal bacteria invade the tissues shortly after the animals succumb. This is particularly true of the isolation of one Group 2 Arizona enteric microorganism; the species was also found in water (see Section E-4 on Water). One isolate that failed to grow on nutrient agar at room temperature was forwarded to the Utah State Division of Health for assistance in identification and was found to be B hemolytic streptococci Group A (see inclosure J-2).

4. Conclusions. No pathogen capable of producing lethality in horses was isolated. In fact, the absence of any deaths in guinea pigs inoculated with homogenized blood clots, which were subject to far less risk of contamination than organ tissues when collected, suggests that no bacterial pathogens were involved in the incidence of horse deaths. In contrast, the deaths produced in guinea pigs from organs removed from dead horses at autopsy suggests that contamination from lack of sterile procedures during processing and handling probably resulted in the deaths of inoculated guinea pigs. It should be noted that tissues were obtained during autopsy in the field with no attempt at sterile procedures (see Figure J-1).

5. Serum Electrolytes.

a. Experimental.

(1) Preparation of Samples. Blood serum samples were analyzed at DPG for arsenic, selenium, calcium, lead, magnesium, potassium and sodium. In order to minimize the effect of organic materials in the blood the samples were diluted with distilled water before analysis by atomic absorption. When calcium, magnesium, sodium, and potassium were analyzed, 100 microliters of serum was diluted to 10 ml (100-fold dilution); the sample used in the analysis of arsenic, lead, and selenium was prepared by diluting 100 microliters of serum to one ml with distilled water (10-fold dilution).

(2) Analyses. The metal content of the serum was determined using atomic absorption spectrophotometry. The instrumental setting and operational conditions for Ca, K, Mg, Na, and Pb levels described in the Water Section were used. A few changes were made in the settings and operational conditions for As and Se. Instead of injecting 100 µl of sample into the graphite furnace of the atomic absorption equipment only 50 µl was used. However, an additional 50 µl of N HNO_3 was added to assist with the charring of the sample. Without the acid the signals obtained during the succeeding atomization step were very noisy.

Some minor changes were also made to the temperature control unit of the graphite furnace. Fifty µl of diluted serum and 50 µl of N HNO_3 were treated as follows:

As

Dried for 60 seconds at 150°C
Charred for 90 seconds at 240°C
Atomized for 10 seconds at 2000°C

Figure J-1. Autopsy in the Field

Se

Dried for 60 seconds at 105°C
Charred for 90 seconds at 350°C
Atomized for 10 seconds at 2300°C

(3) Results. Results obtained from analysis of sera samples are shown below and in inclosure J-1. Table J-5 lists the results obtained from samples taken from the affected horses. Table J-6 lists the results obtained from samples taken from control horses.

Serum samples are normally wet ashed with strong oxidizing agents prior to analyses. However, due to the press of time and number of samples, samples of diluted blood serum to be analyzed for Ca, K, Mg and Na were aspirated directly into the atomic absorption burner. The accuracy of this method was investigated using the method of addition. In this technique, the samples were first analyzed for each metal. Then 1000 µg/ml of each metal was added ("spiked") to each sample and reanalyzed (two serum samples were used). The concentration of each metal in the serum samples was subtracted from results obtained from the "spiked" samples and the recovery of each metal calculated. The results are shown in Table J-7.

It will be seen that acceptable results were obtained from the direct aspiration of diluted blood serum into the burner. This method was investigated only as applied to Ca, K, Mg and Na.

(4) Conclusions. No As, Be, or Pb were found in any of the serum samples (affected horses or control horses). The Ca, K, and Mg levels in most of the affected horse serum samples were significantly higher than the levels found in the control samples, especially the K and Mg levels. Also, the range of Na concentrations was higher in the affected horse samples than in the control serum samples. Elevated Na levels may be expected when renal failure occurs consequential to hemoconcentration leading to circulatory collapse. Elevated K levels may, in part, be caused by failure to maintain correct balance between Na and K while kidneys eliminate electrolytes (chiefly Na) in an effort to maintain proper osmolarity and compensate for water loss. It may also be elevated, in part, by lysis of erythrocytes. The major reason for elevated quantities of K and Mg in serum is probably attributable to tissue damage incident to circulatory collapse, resulting in breakdown of mechanisms controlling the maintenance of concentration gradients of ions. Elevated concentrations of K in extracellular fluid result in characteristic electrocardiographic disturbances. The changes become drastic at twice normal serum K levels and, beyond that may cause the heart to stop in diastole. This involves sudden death, without a struggle, exactly as seen in the wild horses, and correlates well with the grossly elevated levels of K found in the sera. Data from the University of Utah (Table J-2 and inclosure J-1) are supportive of these conclusions.

Table J-4

METAL CONTENT OF SERUM FROM AFFECTED HORSES

Concentration (mM/l)*

Sample No.	Date Rec'd	As	Se	Pb	Na	K	Mg	Ca
EC-1	7/9/76	<0.002	<0.002	<0.005	117	8.0	2.3	4.3
EC-2**	"	"	"	"	112	1.2	1.0	1.8
EC-3	"	"	"	"	129	4.4	2.4	4.1
EC-4	"	"	"	"	113	12	1.7	4.2
EC-5	"	"	"	"	96	10	2.0	4.5
EC-6	"	"	"	"	113	11	2.1	4.4
EC-7	"	"	"	"	147	6.7	2.1	4.5
EC-8	"	"	"	"	157	6.4	2.2	5.8
6-2	7/12/76	"	"	"	110	5.4	1.0	3.8
7-2	"	"	"	"	115	9.7	1.0	3.2
H-10***	7/9/76	"	"	"	85	26	3.7	2.6

*Where appropriate, multiply by valence to convert to milliequivalents/liter.

**Questionable sample; post-mortem from lungs (possibly exudate, interstitial fluid).

***Badly hemolyzed; this serum originates from post-mortem blood taken from the heart, and is not a representative specimen.

Table J-6

METAL CONTENT OF SERUM FROM CONTROL HORSES

Concentration (mM/L)*

Sample No.	Date Rec'd	As	Se	Pb	Na	K	Mg	Ca
1	7/9/76	<0.002	<0.002	<0.005	136	2.6	0.9	3.6
2	"	"	"	"	117	2.2	0.8	3.6
3	"	"	"	"	110	2.7	0.9	3.6
4	"	"	"	"	113	1.9	0.8	3.2
5	"	"	"	"	109	2.2	0.8	3.4
6	"	"	"	"	108	2.6	0.8	3.4
7	"	"	"	"	115	2.0	0.8	3.3
8	"	"	"	"	116	2.4	0.8	3.5
9	"	"	"	"	146	2.2	0.8	3.5
10	"	"	"	"	115	2.3	0.8	3.5

*Where appropriate, multiply by valence to convert to milliequivalents/liter.

Table J-7

PERCENT RECOVERY OF Ca, K, Mg, AND Na FROM SPIKED BLOOD SERUM SAMPLES

Blood Sample	Element			
	Ca	K	Mg	Na
EC-5	100	96	101	105
EC-8	98	98	100	106

6. Stomach Contents.

a. Experimental.

(1) Preparation of Samples. No preparation of these aqueous filtrate samples was required.

(2) Analysis. The samples from wild horses nos. 2 and 10 were analyzed for As, Pb, and Se using the atomic absorption methods described in the water section.

(3) Results and Conclusions. No traces of the three toxic metals were found in the stomach content samples.

7. Horse Tissues Assay for Virus

a. Experimental. Tissues from dead horses were collected in the vicinity of Orr Springs during 4-9 July 1976. From seven of these tissues, suspensions were prepared in a solution consisting of 10 percent normal rabbit serum and Sorensen's phosphate buffer with 200 units of penicillin and 50 micrograms of streptomycin per ml. Each suspension was injected intracerebrally into six suckling mice at a dosage of 0.02 ml per mouse.

b. Results. The mice were held for observation and no signs of viral infection became manifest (see inclosure J-3).

Five tissues and 6 blood clots were submitted to the Center for Disease Control (CDC), Fort Collins, Colorado for arbovirus assay; no evidence for arbovirus has been observed (see inclosures J-4 and J-5).

The Utah State Division of Health tested two horse blood samples for encephalitis antibodies. No evidence of complement-fixing antibody was found for Venezuelan, Western, St. Louis or California encephalitis. See inclosure J-6. Furthermore, extensive tests on blood, brain and spleen specimens by Dr. A. Bailey failed to yield viral isolates (see inclosure J-7).

c. Conclusion. There is no evidence that the horses suffered from a viral disease, or that they had suffered from a prior infection with the listed encephalitides.

8. Compound 1080 (Sodium Fluoroacetate). During the course of this investigation, an allegation was made that Compound 1080 was responsible for the deaths of the horses. This toxic substance has been employed in the past as a rodenticide and to kill coyotes. It has an LD_{50} of 1.0 mg per kg for domestic horses, which means that the poison would have had to be present in rather large quantities (although not necessarily high concentrations) to cause such widespread lethal effects among the horses.

Efforts to detect Compound 1080 in horse specimens failed because available analytical methods require relatively large quantities of tissues, of the order of 100 g. Such quantities were not available nor, at this late stage, any longer obtainable. The analysis for Compound 1080 was also not pressed further because there was no evidence of a die-off among rodents. To this may be added the fact that the symptomatology of poisoning with Compound 1080 (Robinson, W.H., J. Wildlife Management 34, 647 (1970)) is quite unlike that exhibited by the affected horses.

The symptomology of poisoning by Compound 1080 is described as being extremely consistent. Except for a possible slight lethargy in a few animals, all animals would appear normal until just before death. "Some animals were observed eating and drinking up to 10 minutes before symptoms appeared. Terminal symptoms lasted from 3-20 minutes and appeared in the following sequence: urination, staggering, falling down, slight spasms followed by 'in-place running' and death." These symptoms were not present in the horses at Orr Springs.

A conversation between Mr. Don Hawthorne in the Animal Damage Control Office of the State Agricultural Department and LT (Dr.) T. Prociv revealed the history of Compound 1080 use in the Dugway area. Maps and records of all Compound 1080 plantings by trappers have been retained and are available for inspection. Hatch Ranch and the southern sheep ranges were last planted in 1972, Johnson's Pass and Wildcat Mountain in 1969. No Compound 1080 traps had been placed in the Cedar Range. All the poison not taken by animals (predators) has been recovered and destroyed. There is little or no chance any of it could have persisted to this time.

THE UNIVERSITY OF UTAH

DEPARTMENT OF BIOLOGY

July 21, 1976

Dr. L. Choules
Research Laboratories
U.S. Army Depot
Tooele, Utah

Dear Lew,

Enclosed is a tabulation of the chemical analyses performed in the Clinical Pathology Labs of the U of U. They are divided in three groups here, though they were run as a coded intermingled set in the lab.

The first group of normal horse sera gave very uniform results, close to the values normally found in human sera. The second group of samples, collected from the wild horses on July 5th, are much more variable, values often lying well beyond the normal range. Interpretation of these is very much complicated, as you know, by the varying degrees of hemolysis observed in the samples. On the whole I think they are consistent with some degree of hemoconcentration. Samples EC2 and H10 are excluded from the set as not being good serum samples.

Of course, one of the crucial questions concerns the hemolysis - did it occur post-collection of blood samples due to poor handling or fragile cells, or did it occur in vivo as a result of ingestion of some toxin, natural or otherwise? My original purpose in analyzing for bilirubin was to obtain some idea of how much interference there might have been with your spectrophotometric assay for protein. It now seems possible that we can use it to say something about the in vivo versus in vitro question. On this, though, I should like to defer until Dr. Ash returns and we can discuss some questions of analytical technique. In the meantime I shall hang on to the remains of the sera, in case Dr. Ash suggests further tests which can be done to help answer the question.

The third set comprises samples collected from two horses on July 9th, and analysed by Intermountain Labs for BLM; there is some dispute, it seems, about the numbering of one of the horses. Results on these are internally very consistent and suggest the horses had a normal water balance at this date. Both samples were moderately hemolyzed, and again show high bilirubin values. Dr. Taylor of IML told me that the euthanasia injection sometimes causes hemolysis. I think it would be worthwhile to discuss these with Dr. Ash also.

I am sending copies of this letter and the analytical results to Dr. Taylor at IML, to Ron Hall at BLM, and to Dr. Ash. I am also enclosing copies for Dr. Solomon.

With best regards,

B'll

William R. Cross

Inclosure J-1

Summary of Analyses of Horse Sera.

No.	Code (Grey)	Code (Lab)	Na Meq/l	K Meq/l	Cl Meq/l	Bilirubin Direct mg/100ml	Bilirubin Total mg/100ml	Total Protein gm %	Albumin gm %	
1	290	R120	133	4.4	98	0.2	1.2	7.1	3.2	All samples appeared quite free from hemolysis, though a few contained traces of fibrous clot.
2	296	R111	132	4.2	98	0.2	0.9	6.6	3.1	
3	283	R122	132	5.0	92	0.2	0.7	7.6	2.8	
4	285	R108	127	3.3	95	0.2	0.6	6.7	2.7	
5	289	R106	133	4.0	99	0.2	0.6	6.7	2.7	
6	301	R107	132	4.8	94	0.1	0.6	7.6	2.8	
7	284	R110	136	3.6	99	0.2	0.6	6.9	2.7	
8	291	R109	126	4.1	94	0.2	1.2	7.0	3.1	
9	302	R125	134	3.9	98	0.1	0.5	6.8	2.7	
10	298	R118	125	3.9	92	0.2	0.8	6.5	3.0	
										Hemolysis
C1	282	R123	136	13.8	106	6.5	3.8	9.3	4.4	Severe
C3	292	R121 R13	174	8.6	120	1.0	2.9	7.4	3.9	Slight
C4	288	R117	147	20.6	104	1.7	4.4	9.9	3.8	(Pale Orange Color)
C5	286	R115	142	19.0	N.D.	9.2	11.6	N.D.	N.D.	Severe ; Not enough sample for all
C6	300	R105	112	16.7	84	9.1	11.8	13.6	5.1	Severe
C7	287	R124	173	12.8	109	1.8	3.0	11.0	4.7	(Weak Orange Color)
C8	287	R114	189	12.7	118	3.7	6.8	12.7	5.4	Brown
C2	294	R116	146	2.3	146	1.4	2.1	1.1	0.3	Moderate . Doubtful sample .
H10	295	R112	104	62.4	96	28.7	32.5	23.9	13.1	Post-mortem sample of heart blood .
6-1	303	R119	124	5.5	95	1.5	4.0	8.4	2.5	Moderate . IML # V 31233
6-2	303	R153	123	5.6	95	1.4	4.3	8.6	2.5	Moderate IML # V 31233
(10)	299	R113	135	10.3	101	1.6	5.9	6.87	3.2	Moderate IML # V 31234 } BUN (17) & Amy (11) typo.
(11)	304	R152	136	9.5	100	1.5	5.7	6.6	3.1	Moderate IML # V 31234 } numbering of hors

Copy available to DDC does not permit fully legible reproduction

STATE OF UTAH—DEPARTMENT OF SOCIAL SERVICES

CALVIN L. RAMPTON
Governor

PAUL S. ROSE
Executive Director

DIVISION OF HEALTH
44 MEDICAL DRIVE
SALT LAKE CITY, UTAH 84113
AREA CODE 801

PHONE 328-6131

LYMAN J. OLSEN, M.D., M.P.H.
Director of Health

Board of Health
Air Conservation Committee
Health Facilities Council
Medical Examiner Committee
Nursing Home Advisory Council
Water Pollution Committee

BUREAU OF LABORATORIES

July 28, 1976

Horace B. Rees Jr., Ph.D Microbiologist
Environmental and Life Sciences Division
Material Test Directorate
U.S. Army Dugway Proving Grounds
Dugway, Utah 84022

Dear Dr. Rees,

The cultural isolate from the Horse Brain #10 was identified as a B Hemolytic streptococci Group A. I cannot comment on the significance of the isolation from the horse brain because I do not know the conditions under which it was taken at autopsy or how soon after death of the animal the autops was performed.

If I can be of further help please contact me.

Sincerely,

Merlin A. Smith, Chief
Env. Microbiology

Inclosure J-3

E&E LABORATORY DAILY STATUS REPORT - 2 AUGUST 1976

SOURCE OF SPECIMEN	TYPE OF SPECIMEN	DATE COLLECTED (1976)	METHOD OF PROCESSING	ASSAY SYSTEM	DATE INOCULATED (1976)	DOSE (ml)	ROUTE	CLINICAL OBSERVATIONS AS OF THIS DATE
Orr Springs	Horse #3 Spleen	5 Jul	Virus Isolation	1-day Suckling Mice	9 Jul	0.02	IC	14 days post inoculation. Mice appeared healthy. Were removed from test on 23 July 1976.
Orr Spring	Horse #10 Brain	7 Jul	Virus Isolation	1-day Suckling Mice	9 Jul	0.02	IC	14 days post inoculation. Mice were healthy and were removed from test on 23 July 1976.
Orr Spring	Horse #10 Spleen	7 Jul	Virus Isolation	1-day Suckling Mice	9 Jul	0.02	IC	14 days post inoculation. Mice appeared healthy during 14 day observation and were taken off test on 23 July 1976.
Orr Spring	Horse #10 Spinal Fluid	7 Jul	Virus Isolation	1-day Suckling Mice	9 Jul	0.02	IC	14 days post inoculation. Mice appeared healthy during 14 day observation and were removed from test on 23 July 1976
Orr Spring	Horse #2 Spleen	4 Jul	Virus Isolation	3-day Suckling Mice	12 Jul (repeat of 9Jul)	0.02	IC	14 days post inoculation. Mice were healthy during 14 day observation. Removed from test on 14th day (23 July 1976).
Orr Spring	Horse #2 Spleen	4 Jul	Virus Isolation	3-day Suckling Mice	12 Jul (repeat of 9Jul)	0.02	IC	14 days post inoculation. Mice were healthy during 14 days of observation. Removed from test on 14th day (26 July 1976)
Orr Spring	Horse #7 Brain	6 Jul	Virus Isolation	3-day Suckling Mice	12 Jul (repeat of 9Jul)	60.02	IC	14 days post inoculation. Mice appeared healthy throughout 14 day observation period. Removed from test on 14th day (26 July 1976)

(Con't)

SOURCE OF SPECIMEN	TYPE OF SPECIMEN	DATE COLLECTED (1976)	METHOD OF PROCESSING	ASSAY SYSTEM	DATE INOCULATED (1976)	DOSE (ml)	ROUTE	CLINICAL OBSERVATIONS AS OF THIS DATE
Orr Springs	Horse #11 Heart	9 Jul	Virus Isolation	3-day Suckling Mice	12 Jul	0.02	IC	14 days post inoculation. Mice appeared healthy throughout 14 day observation period. On 14th day removed from test (26 July 1976).
Orr Spring	Horse #6 Brain	9 Jul	Virus Isolation	1-3 day Suckling Mice	19 Jul (repeat of 12Jul)	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 2 Aug 1976
Orr Spring	Horse #2 Blood	4 Jul	Virus Isolation	1-3 day Suckling Mice	19 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 2 Aug 1976
Orr Spring	Horse #3 Blood	5 Jul	Virus Isolation	1-3 day Suckling Mice	19 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 2 Aug 1976
Orr Spring	Horse #4 Blood	5 Jul	Virus Isolation	1-3 day Suckling Mice	19 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 2 Aug 1976
Orr Spring	Horse #5 Blood	5 Jul	Virus Isolation	1-3 day Suckling Mice	19 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 2 Aug 1976
Orr Spring	Horse #6 Blood	5 Jul	Virus Isolation	1-3 day Suckling Mice	19 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 2 Aug 1976
Orr Spring	Horse #7 Blood	6 Jul	Virus Isolation	1-3 day Suckling Mice	19 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 2 Aug 1976

(Con't)

SOURCE OF SPECIMEN	TYPE OF SPECIMEN	DATE COLLECTED (1976)	METHOD OF PROCESSING	ASSAY SYSTEM	DATE INOLCULATED (1976)	DOSE (ml)	ROUTE	CLINICAL OBSERVATIONS AS OF THIS DATE
Orr Spring	Horse #8 Blood	6 Jul	Virus Isolation	1-3 day Suckling Mice	19 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 2 Aug 1976
Orr Spring	Horse #10 Blood	8 Jul	Virus Isolation	1-3 day Suckling Mice	19 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 2 Aug 1976
Orr Spring	Mosquitoes pool of Aedes dorsalis (2 females)	6, 10 July	Virus Isolation	/24 hr Suckling Mice	14 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 28 July 1976
Orr Spring	Mosquitoes pool of Culex tarsalis (10 females)	9 Jul	Virus Isolation	/24 hr Suckling Mice	14 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 28 July 1976
Orr Spring	Mosquitoes pool of Culex tarsalis (8 females)	10 Jul	Virus Isolation	/24 hr Suckling Mice	14 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 28 July 1976
Orr Spring	Mosquitoes pool of Aedes melanimon (1 female)	10 Jul	Virus Isolation	/24 hr Suckling Mice	14 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 28 July 1976

(Con't)

SOURCE OF SPECIMEN	TYPE OF SPECIMEN	DATE COLLECTED (1976)	METHOD OF PROCESSING	ASSAY SYSTEM	DATE INOCULATED (1976)	DOSE	ROUTE	CLINICAL OBSERVATIONS AS OF THIS DATE
Orr Spring	Mosquitoes pool of Culiseta inornata (1 female)	10 Jul	Virus Isolation	/24 hr Suckling Mice	14 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 28 July 1976
Tamaricks near Baker Area	Mosquitoes pool of Aedes dorsalis (3 females)	7 Jul	Virus Isolation	/24 hr Suckling Mice	14 Jul	0.02	IC	Mice appeared healthy through 14 days. Removed from test on 28 July 1976
Orr Spring (Traps 1-6)	Mosquitoes pool of Culex tarsalis (29 females)	14-19 July	Virus Isolation	2-4 day Suckling Mice	21 Jul	0.02	IC	Mice appeared healthy through 12 days. Removed from test on 2 August 1976
Orr Spring	Mosquitoes pool of Aedes dorsalis (2 females)	14-19 July	Virus Isolation	2-4 day Suckling Mice	21 Jul	0.02	IC	Mice appeared healthy through 12 days. Removed from test on 2 2 August 1976
Orr Spring	Mosquitoes pool of Culiseta inornata (3 females)	14-19 July	Virus Isolation	2-4 day Suckling Mice	21 Jul	0.02	IC	Mice appeared healthy through 12 days. Removed from test on 2 August 1976

(Concluded)

Copy for Branch -

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL

BUREAU OF LABORATORIES
VECTOR-BORNE DISEASES DIVISION
POST OFFICE BOX 2087
FORT COLLINS, COLORADO 80522

July 27, 1976

Mr. George T. Crane
Microbiologist
Environmental & Life Science Div.
Department of the Army
Dugway Proving Ground
Dugway, Utah 84022

Dear George:

This is to confirm and extend the results I gave you in our telephone conversation of yesterday.

We tested all 13 equine specimens brought here by inoculating undiluted and 10% (spinal fluids) or 10% and 1% (other tissues) suspensions into 2-4 day old suckling mice (SM) by the i.c. route and into Vero cells. Although we observed some cannibalism and two abnormal mice (one dead day 2, one sick day 7), reinoculation and passage of brains from suspect SM did not give us any evidence of the presence of an arbovirus. No plaques were seen in Vero cells. Thus, we have isolated no virus from any of these specimens.

I had already spoken with Ms. Susan Okie of the Washington Post by the time Dr. Salomon returned my call. I told her merely that we had isolated no virus and that she might better contact Dr. Rothenberg, your Scientific Director, or Mr. Ensley, your Public Relations man for any further details. Dr. Spendlove suggested that I do that when I spoke with him yesterday.

Sincerely,

Charles H. Calisher

Charles H. Calisher, Ph.D.
Chief, Arbovirus Reference Branch

cc:
Dr. Monath

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL

BUREAU OF LABORATORIES
VECTOR-BORNE DISEASES DIVISION
POST OFFICE BOX 2087
FORT COLLINS, COLORADO 80522

July 30, 1976

Mr. George T. Crane
Microbiologist
Environmental & Life Science Div.
Department of the Army
Dugway Proving Ground
Dugway, Utah 84022

Dear Mr. Crane:

We have now completed inoculation and passage of all equine specimens. As preliminarily reported in my letter of July 27, all specimens were negative upon isolation attempts in suckling mice and duck embryo and Vero cell cultures.

Sincerely,

Charles H. Calisher

Charles H. Calisher, Ph.D.
Chief, Arbovirus Reference Branch

Enclosure:
Manuscript

cc:
Dr. Monath

UTAH STATE DIVISION OF HEALTH
LABORATORIES

PATIENT Dying Colt # 3 AGE

ADDRESS

DATE OF ONSET DATE OF SPECIMEN 7/5/76

TYPE OF SPECIMEN	EXAMINATION	
☐ THROAT SWAB	☐ HEMOLYTIC STREPTOCOCCI	☐ CASE
☐ SMEAR	☐ NEISSERIA	☐ CONTACT
☐ SPUTUM	☐ ACID FAST BACILLI	☐ UNDER TREATMENT
☐ GASTRIC LAVAGE	☐ DIPHTHERIA	☐ MYCOLOGY
☐ STOOL	☐ ENTERIC PATHOGENS	☐ VIROLOGY (SPECIFY BELOW)
☐ CULTURE	☐ IDENTIFICATION	☐ PARASITOLOGY

OTHER Blood #1 - Encephalitis

CLINIC Dept. of Agriculture

PHYSICIAN Dr. J. Schoenfeld

STREET ADDRESS State Capitol Bldg.

CITY Salt Lake City, Utah UTAH

S10F2 USE TYPEWRITER OR BALL POINT PEN

7/6/76 DATE RECEIVED
7-9-76 DATE REPORTED
77015835 LAB NO

LABORATORY FINDINGS

☐ MICROSCOPIC	☐ NEGATIVE
☐ CULTURE	☐ POSITIVE
☐ PRELIMINARY REPORT	☐ UNSATISFACTORY

Complement fixation test:

WEE	<1:8
VEE	<1:8
Calif. Enc.	<1:8
SLE	<1:8

A Barley
MICROBIOLOGIST

UTAH STATE DIVISION OF HEALTH
LABORATORIES

PATIENT Colt #7 AGE

ADDRESS Light color # 7

DATE OF ONSET DATE OF SPECIMEN 7/5/76

TYPE OF SPECIMEN	EXAMINATION	
☐ THROAT SWAB	☐ HEMOLYTIC STREPTOCOCCI	☐ CASE
☐ SMEAR	☐ NEISSERIA	☐ CONTACT
☐ SPUTUM	☐ ACID FAST BACILLI	☐ UNDER TREATMENT
☐ GASTRIC LAVAGE	☐ DIPHTHERIA	☐ MYCOLOGY
☐ STOOL	☐ ENTERIC PATHOGENS	☐ VIROLOGY (SPECIFY BELOW)
☐ CULTURE	☐ IDENTIFICATION	☐ PARASITOLOGY

OTHER Blood #1 - Encephalitis

CLINIC Dept. of Agriculture

PHYSICIAN Dr. J. Schoenfeld

STREET ADDRESS State Capitol Bldg.

CITY Salt Lake City, Utah UTAH

S10F2 USE TYPEWRITER OR BALL POINT PEN

7/6/76 DATE RECEIVED
7-9-76 DATE REPORTED
77015834 LAB NO

LABORATORY FINDINGS

☐ MICROSCOPIC	☐ NEGATIVE
☐ CULTURE	☐ POSITIVE
☐ PRELIMINARY REPORT	☐ UNSATISFACTORY

Complement fixation test:

WEE	<1:8
VEE	<1:8
Calif.Enc.	<1:8
SLE	<1:8

A Barley
MICROBIOLOGIST

Inclosure J-6

STATE OF UTAH–DEPARTMENT OF SOCIAL SERVICES

Governor
PAUL S. HOSE
Executive Director

DIVISION OF HEALTH
44 MEDICAL DRIVE
SALT LAKE CITY, UTAH 84113
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Board of Health
Air Conservation Committee
Health Facilities Council
Medical Examiner Committee
Nursing Home Advisory Council
Water Pollution Committee

BUREAU OF LABORATORIES

LYMAN J. OLSEN, M.D., M.P.H.
Director of Health

August 11, 1976

MEMORANDUM

TO: Commander, Dugway Proving Ground
Dugway, Utah

FROM: Althea Bailey, Ph. D., Chief of Microbiology
Utah State Division of Health, Virus Laboratory

SUBJECT: Virology work-up on horses dying at Dugway

Specimens from several horses were received on July 6, 7 and 16, 1976. Examinations were made or are in progress on the following specimens as indicated:

Horse Identification	Date Taken	Date Rec'd	Specimen	Examination	Result
Colt #7	7-5-76	7-6-76	Blood	Complement fixation *	WEE <1:8 VEE <1:8 SLE <1:8 CE <1:8
Dying Colt	7-5-76	7-6-76	Blood	Complement fixation *	WEE <1:8 VEE <1:8 SLE <1:8 CE <1:8
			Brain	Mouse inoculation **	No virus isolated
				Cell Culture ***	Neg to date
Sorrel Mare 2½ y o	7-6-76	7-7-76	Brain	Mouse inoculation	No virus isolated
				Cell culture	Neg to date
HGG 2 - Colt	7-4-76	7-16-76	Spleen	Mouse inoculation	In progress
				Cell culture	"
HGG 3 - Colt	7-5-76	7-16-76	Spleen	Mouse inoculation	In progress
				Cell Culture	"
HGG 7 - Mare	7-5-76	7-16-76	Brain	Mouse inoculation	Neg to date
				Cell Culture	Neg to date
HGG 10 - Mare colt	7-5-76	7-16-76	Brain	Mouse inoculation	Neg to date
				Cell culture	Neg to date
			Spleen	Mouse inoculation	In progress
				Cell culture	"

* Complement fixation test - LBCF 50% method used

** Mouse inoculation - Less than 24 hour old mice, 8 mice/specimen, inoculated 3 routes (ic-ip-sc), observed daily for 3 weeks. Viruses which can be found by this method are the arboviruses, Herpes simplex, B virus, and the Coxsackie viruses.

*** Cell Culture - Types used (in 18 x 125 mm tubes) = primary Cynomolgus monkey kidney, Vero, LLC-MK2, HeLa, Hep-2, and WI-38. Human viruses which

grow in these cell lines include Enteroviruses (ECHO, Coxsackie and polio), Adenoviruses, Herpes, Vaccinia, Myxovirus, Paramyxovirus and Reovirus.

All tissue specimens were stored at -70° C.

Mice were inoculated with approximately 0.03 ml of a 10% (w/v) suspension of tissue prepared in 0.75% bovalbumin, fraction V, with penicillin and streptomycin. They were observed daily for 21 days.

Cell cultures were inoculated with 0.25 ml of the 10% suspension (see above), incubated at 35° C, observed daily for CPE. A blind passage to the same types of cell cultures was made after 1 week of observation. The second passage cultures were observed for CPE for seven days. First and second passages were checked for hemadsorbing and hemagglutinating viruses.

Arthur Bailey, Ph.D.
Chief, Microbiology Section

August 30, 1976

As of this date, all work has been completed; no viral isolations have resulted.

Arthur L. Bailey, Ph.D.

K. MOSQUITOES AND TICKS

1. Objective. To determine if mosquitoes and/or ticks might be implicated in the horse incident by serving as vectors of lethal infections, particularly the encephalitides, which are frequently fatal in horses.

2. Mosquito Surveillance for Arboviruses.

a. Experimental. Mosquitoes for arbovirus assay were collected at Dugway Proving Ground during the period 6 July 1976 to 19 July 1976. The collection and assay procedures were similar to those described by Crane, et al., 1970 (American Journal of Tropical Medicine and Hygiene 19:540-543). On 6-7 July 1976 CDC miniature light traps with dry ice attractant were set at Black's Lake, Baker Sewer Lagoon, Cane Spring and at Orr Springs. Beginning 9 July and continuing to 19 July, six sites at Orr Springs were trapped nightly. From 39 trap nights (6-13 July) 25 female mosquitoes were collected and identified by Dr. Bettina Rosay, Entomologist for the Utah Mosquito Abatement Association, Midvale, Utah. Six pools were prepared from the four species of Aedes dorsalis, Aedes melanimon, Culex tarsalis, and Culiseta inornata. These were prepared as suspensions and injected intracerebrally into suckling mice for arbovirus assay on 14 July 1976. From 36 subsequent trap nights (14-19 July), 34 female mosquitoes were collected and identified by Dr. Robert E. Elbel, Biology Department, University of Utah. Three pools were prepared consisting of Culex tarsalis, Aedes dorsalis and Culiseta inornata, respectively. Suckling mice were injected intracerebrally with suspensions of these pools on 21 July 1976 (see inclosure J-3).

b. Results. No signs of illness were observed in the suckling mice during the 14-day observation period. No further studies were conducted because mice remained healthy.

c. Conclusion. There is no evidence that mosquitoes could have served as vectors in the transmission of one of the encephalitides. In any event, because of the low population density, mosquitoes were virtually eliminated as potential disease vectors.

3. Observation for Ticks. Sick and dead horses were observed for the presence of ticks. The ears, particularly were examined, but no ticks were found. No ticks were observed on vegetation or personnel working in the area. The low population of ticks, expected for this time of year, virtually eliminates ticks as potential disease vectors in this incident.

L. SUMMARY

In early July of 1976, a considerable number of wild horses died at Dugway Proving Ground, most of them at the Orr Springs area on the western slope of the Cedar Range, near the northeastern border. The incident was discovered on 4 July during a routine surveillance overflight. Initial autopsies and collection of specimens was conducted on 5 July (an off-duty day); investigative work commenced on 6 July; by 9 July those tests which ultimately proved to be diagnostically most pertinent and useful had been completed at the Dugway laboratories.

It was found that the daily temperatures at Dugway were consistently above the 20-year mean during April, May and June, and during the period 27 June to 4 July, daily maxima averaged 4 degrees above the mean. Relative humidities were below average. There was no measurable precipitation since 21 May. Precipitation from 1 January to 4 July was below average, although above average in April and May. Overall, this had two consequences: 1) it diminished the water supplies available to the horses - some sources had dried up entirely or had been converted to mud earlier than they would have normally; 2) it placed an added heat stress on the animals. In practical terms, there ensued an increased water requirement since the evaporation of water by one mechanism or another provides the means for thermoregulation. Because of decrease in supply of water and an increased demand the horses must always be in a precarious state during the summer, but probably earlier in the summer this year than usually.

The subject of human activities in the Orr Springs area or within some distance thereof is also relevant. Official records show that no military activities occurred in the area near the date the horses started dying. The National Guard had ceased operations well before then. Bureau of Land Management personnel are known to have visited the area on 24, 29 and 30 June, and again on 1 July. They also state to have been there on 23 June. It is presumed that, had they seen ill horses and/or harassment of the horses, they would have responded appropriately.

It should be mentioned that the nature of the nature of the terrain is such that pursuit of wild horses to the point of exhaustion is not likely to be successful, at least by ground-based interference, unless there was a concerted effort by a number of people.

In designing the various studies to be outlined next, a comprehensive approach was chosen. Dugway Proving Ground and collaborating laboratories investigated water, soil, plants, the animal ecology and potential disease vectors in the Orr Springs area. In addition, studies were performed on horse tissues and blood. No restraints were placed on any collaborating laboratory; all were free to use the data at their own discretion. Although the majority of these studies gave negative results and, in most cases, predictably so, they were considered necessary to a complete and exhaustive investigation.

During investigation of various waters from the Orr Springs area, it was found that:

a. They were not toxic to rats by the oral route over a period of 21 days.

b. The waters did not produce depression of acetylcholinesterase in erythrocytes of rats *in vivo*;

c. Algae, in the only water source containing a significant amount (trough installed by the Bureau of Land Management) were identified as an innocuous species (*Ulothrix tenerrima*).

d. Bacterial isolations yielded Group 2 Arizona organisms, which have been identified as the etiologic agent in a type of infant diarrhea, but not as the cause of disease in horses. Nor were other significant findings made.

e. Chemical analyses showed absence of detectable organophosphorus agents or their decomposition products methylphosphonate, isopropyl-methylphosphonate, diisopropylmethylphosphonate and ethylmethylphosphonate; they showed the absence of detectable pesticides; and the absence of substances inhibiting acetylcholinesterase *in vitro*. Nitrates and nitrites were below the levels of Salt Lake City culinary water. The pH was between 7.4 and 8.0, normal for this area.

f. No significant concentrations of potentially toxic metals were detectable.

g. The water may be classified as hard, but certainly in no way hazardous to life or well-being.

Investigations of soil paralled those of water. The bacterial flora included Group 2 Arizona, which was mentioned above, but no pathogens. No acetylcholinesterase inhibitors were found. Neither were nerve agents or their decomposition products. This, of course, is not surprising because no open-air tests with nerve agents had been conducted since 1969 and none of significant scope since 1968. There also was no evidence for the existence of toxic metal ions. Interest in these items stems from the possibility that they could have leached into water or been taken up by plants, e.g., selenium could have been accumulated by plants.

Plant investigations took two approaches:

a. Determination of the plant species in the Orr Springs area, especially toxic species, and those that showed evidence of having been grazed, and

b. Analysis of gastrointestinal contents and feces to determine plant species which had been ingested.

Toxic plants were found, namely princess plume, a selenium miner under appropriate circumstances, spiny horsebrush and locoweed. However, there was an adequate supply of grasses and non-toxic plants, which are preferred by horses. It is, therefore, reasonable that the on-site survey and the analysis at Colorado State University showed no indication of significant consumption of toxic plants.

Extensive bacteriologic and viral studies were made. As a matter of interest, blood clots from the horses were sterile, while tissues were bacteriologically not. Very possibly, the bacterial flora was acquired during the process of autopsy in the field. In any event, there was no evidence that any of the isolates could be implicated in the deaths of the horses. No viral isolates were obtained.

Acetylcholinesterase activity of erythrocytes was within 15 to 18% of the activity found in horses of the Dugway corral. This confirms that the horses were not exposed to significant amounts of organophosphorus substances (nerve agents and organophosphorus insecticides), in complete agreement with findings for soil and water.

Under the general heading of animal ecology, one objective was the assessment of the density of the rodent population. The purpose was to determine if the density, as indicated by trapping success, reflected a normal population state, or indicated some catastrophic event analogous to the horse deaths.

The trapping success was 6.9% for 1,560 trap nights, which is normal for the type of environment represented by the Orr Springs area.

Trapping operations in the Orr Springs area yielded 59 female mosquitoes in 75 trap nights with CO_2-baited CDC light traps. Evidently, the population of mosquitoes was very low, and thus the potential for transmission of diseases was equally low. Mosquitoes were pooled by species and extracts injected intracerebrally into suckling mice. There was no evidence of infection.

Sick horses and carcasses were examined for the presence of ticks. Since none were found, ticks were eliminated as vectors for some unspecified disease.

The low trapping success for ticks and mosquitoes is as expected for this season of the year.

Dugway personnel at the Orr Springs site also made observations regarding general conditions that might help explain the horse incident.

Some cogent observations were as follows:

a. The Bureau of Land Management had recently capped the natural water supply and ducted the water into a small trough; overflow from the trough was collected in a small waterhole or "pond". The trough was surrounded by stakes carrying blue ribbons. The purpose of the ribbons is not known. There also were two stacks of creosoted poles nearby, which were intended for use in construction of a trap for horses.

Horses were frequently found dead and bunched in spots that previously furnished water. They had pawed at and dug out moist ground in an attempt to get at water, and had apparently kicked off the lids of the cisterns in futile attempts to reach water. Some horses had mud in their mouths, possibly attempting to get moisture from the mud.

There was no evidence that any horses had used the water trough. The overflow pond had been used, as judged by tracks coming from the south only. The tracks were reported as "old", but how old is a moot question. If Bureau of Land Management operations at the site deterred the horses from drinking there, the tracks would only have had to be a few days old, since the agency's personnel were in the area at the end of June, and the creosoted logs were placed there reportedly during the latter part of June and the first of July. Stakes and flags were said to have been emplaced on 23 June. (However, there is no record of Bureau of Land Management personnel having been cleared to go to the area on 23 June.)

Consistent with the findings that horses tended to avoid the area is the fact that when the ground was raked or brushed, no tracks appeared next to the trough, and only a few at the overflow pond. Further consistent is the observation that horses also avoided a similarly constructed water source on the eastern slope of the Cedar Range. No dead horses were reported in that area (the area was not visited by Army personnel until 29 August), possibly because a natural pond exists several miles away which is obviously being used extensively by horses. It is also of interest that Dugway personnel installed water tanks, recessed and level with the ground. The tanks remained unused. By contrast, more natural ponds provided to the horses were used. So, also, was water escaping from cisterns when plugs were removed.

At this point, it has been established that neither infectious diseases nor poisons of any kind were responsible for the deaths of the horses. One must, therefore, give serious thought to the hypothesis that the horses suffered from nothing more than water deficiency, which would be consistent with the foregoing observations. It remains to be determined whether the only diagnostic analytical findings, i.e., those demonstrating changes in hematocrits and composition of serum, are also consistent with this hypothesis.

When an animal suffers from inadequate intake of water, the loss of extracellular water nevertheless continues. In consequence, the osmotic pressure of the extracellular fluid would increase were it not for the compensating urinary excretion of ions, chiefly sodium and chloride. Thus,

there is a loss of water and diffusible electrolytes from extracellular fluid, an increase in concentration of non-diffusible substances, that is, plasma proteins and formed elements, and a decrease in blood volume. Ultimately, if uncorrected, the viscosity of blood exceeds the ability of the heart to pump the fluid effectively. At that stage, the animal suffers progressive vascular congestion and circulatory collapse, and renal insufficiency ensues. The tonicity of extracellular fluid is no longer controllable, and the concentration of diffusible electrolytes will now rise, as well as that of other substances normally disposed of by the kidney, such as urea. Both hyper- and hypotonicity have severe effects on the CNS, but in the case under consideration, the CNS experiences a dual insult - hypertonicity and diminished oxygen supply. The results have been widely described in the literature: Depression and areflexia to the extent that it can interfere with the normal drinking of water, stupor and death without convulsions, i.e., shock. Impaired oxygen supply to the tissues, cyanosis, also causes injury to capillaries and affects the ability to maintain a normal electrolyte gradient between cells and extracelluar fluids.

One may not be suprised to discern some signs of this situation on examination of the heart, the vascular system, the brain, and blood. The former three are discussed in veterinary reports. They, in general, as well as the laboratory findings on blood are in consonance with the sequence of events just outlined.

Hematocrits were found to be grossly elevated, indicating drastic hemoconcentration. This fact, plus the concomitant increase in albumin and total serum proteins, shows that the plasma volume was diminished. That degree of diminution found indicates the existence of a terminal condition. Electrolyte concentrations were increased, indicating renal insufficiency. Intracellular cations were found in serum in increased levels, indicating tissue impairment, i.e., failure of electrolyte pumping mechanisms. It has been noted that the animals died without a struggle, and this is reflected in several photographs.

The opinion has been advanced that the horses died from excessive intake of water without electrolytes, following a period of dehydration. In such an event hypotonicity would be expected which, if sufficiently severe, reportedly eventuates in death with convulsions. Moreover, analytical findings are inconsistent with this sequence. Although some horses were found to have water in the gastrointestinal tract upon autopsy, perhaps as a result of forced or spontaneous intake of water just before death, the water obviously was not absorbed into the system and of no further consequence.

In conclusion, findings of Dugway Proving Ground and those of cooperating, but totally independent, laboratories failed to implicate any toxic or infectious materials or exceptional environmental factors, nor was there evidence for deliberate or accidental harassment of the horses.

There are reliable observations that the animals did not use available water at Orr Springs, and there is direct analytical evidence that the animals were extremely dehydrated. Dehydration occurred closely in time following activities conducted by the Bureau of Land Management at Orr Springs. These activities were probably the immediate precipitating factors although, had the weather been more propitious and horses less numerous, the problem may not have occurred. Moreover, the animals may have been weakend by dehydration upon arrival at the Orr Springs site and unable to seek out other more distant water supplies.

APPENDIX A

1-A INTRODUCTION

Compilation of statements, Letters, Disposition Forms and Memos for Record.

The statements have been gathered from personnel who had made observation prior to, during and after the horse incident. They were collected to help establish the facts that may have a bearing on the case. In some cases the statements do not agree with each other as to the exact numbers of horses, times or places but they are made according to the best observations and recollection of the individual making the statement. The material presented here is submitted for the purpose of supplementing the report and for those readers who wish more detail. The chronology, Section 2-A, was prepared by Dr. A. Paul Adams and was presented to Horse Incident Panel convened at Dugway Proving Grounds on 27 July 1976 under the auspices of Dr. James Schoenfeld, Utah State Veterinarian. The chronology was prepared from statements, interviews and personal visits to the sites where the horses had died.

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14A Statement of George Musgrave E&LS Div DPG - 27 July 1976

15A Statement of Lt C George B. Reddin Consultant to Surgeon General - July 1976

16A Letter from Robert C McCandless Counsel American Horse Protection Assoc to Paul L. Howard BLM (undated)

17A Letter from Paul L. Howard BLM to Robert C McCandless Counsel - American Horse Protection Assoc. - 15 July 1976

18A Letter from District Manager of BLM to William Woods DPG - 11 May 1976.

19A D.F. from Plans Office, DPG to Materiel Test Directorate and response from MT to PO dated 22 June and 23 June respectively

20A Letter from Mr. Lonnie Johnson Humane Society of Utah, to Col A.E. Toepel DPG - 15 July 1976

21A Letter from Col A.E. Toepel DPG to Mr. Lonnie Johnson Utah Humane Society - 22 July 1976

22A D.F. from Dr. Harold Stark E&LS Div DPG - 26 July 1976

23A Memo from Dr. M.A. Rothenberg DPG to Dr. James Schoenfeld Chairman Incident Evaluation Panel - 27 July 1976

24A Memorandum from Mr. William Woods Director of Logistics to Col A.E. Toepel - 2 Aug 1976

25A Letter to Horse Incident Evaluation Panel Members from Dr. James Schoenfeld Utah State Veterinarian - 19 July 1976

26A Letter to Mr. Paul L. Howard BLM from Dr James Schoenfeld Utah State Veterinarian - 19 July 1976

27A Letter to Mr. Lonnie Johnson Evee Director the Humane Society of Utah from Dr. James Schoenfeld Utah State Veterinarian - 19 July 1976

CHRONOLOGY OF HORSE INCIDENT

About 250 to 260 wild horses normally range on Dugway Proving Ground. These horses are managed by a joint agreement between Dugway Proving Ground and the Bureau of Land Management. The latter group actually has responsibility for the horses. It is questionable how many of these horses are true mustangs since there are undoubtedly many feral horses in the herd and cross-breeding is inevitable.

Fifty to sixty of the wild horses inhabit the area around Granite Mountain but the large majority range up in the general vicinity of Wig Mountain. In the winter time the horses have a tendency to range north of Wig Mountain up around the sand dunes and obtain their water from snow and melting puddles of water. After the snow melts in the Spring the animals tend to move down on the bench and plains to the south and east of Wig Mountain. There is a large catchment basin or excavation south of Wig Mountain which is periodically replenished with runoff water from Spring storms. Most of the herd traditionally water at this mudhole until it drys up, at which time the horses move up to the springs located to the northeast in the foothills. The most predominant of these springs is Orr Springs, which actually consists of two springs. Other springs in the area are Bitter Springs, Cane Springs and a small unnamed spring located northeast of Orr Springs. The spring north and east of Orr Springs has a very limited flow filling a basin holding no more than a pint or two. Cane Springs, located higher up in the foothills, has a larger flow and a horse trough was installed there about a year ago; however, water is available above the trough and at an overflow basin below the trough from which some horses drink, but they do not drink from the trough. Bitter Springs had a very small basin holding a few pints, but after the death of the horses DPG scooped out a basin with a caterpillar tractor which now is large enough to water several head of horses.

The Bureau of Land Management, beginning on 3 May 1976, started a project to improve and control the water supply at Orr Springs. The Springs were capped and a water line carried the output of the two springs down to a metal water trough located 239 yards distance down the wash from the lower spring. The BLM also planned to build a water trap corral at the water trough to aid them in catching surplus horses for transfer to other areas. A large pile of freshly creosoted posts were hauled in and stacked near the trough. On or about 1 July 1976 a second load of creosote posts were hauled in and stacked near the first pile. These posts had a very strong odor in the hot sun and could be smelled for some distance. Undoubtedly they were a factor in repelling the horses. Lath stakes with blue ribbons were emplaced in the positions where the posts for the planned corral were to be planted. Installation of the trough was completed by the BLM on 13 May, however, construction of the corral was delayed and no further construction has been initiated up to this date.

As the weather warmed up with the coming of summer the catchment basin near Wig Mountain began to dry up. No rain of measurable quantity had fallen in the vicinity since 21 May. On 25 June Mr. George Musgrave of Baker Laboratory had occasion to pass by the Wig Mountain catchment basin and noted about 40-50 horses standing a short distance away. Mr. Musgrave noted that the mudhole was practically dry on that date. On Monday, 28 June, Mr. Musgrave again drove past the catchment basin and noted that all free standing water was gone and the same group of horses was still there. Later that day Mr. Ken Rigby and Leroy Gourley were in the area filming Have Bee flights and noticed about 125 horses standing around. They looked gaunt so they tried to gently herd them towards Orr Springs but only about 20 went towards that direction. On 29 June Mr. Jim Wright was in the area at 1100 - 1400 hours and saw the same number of horses. At 1400 - 1530 hours Mr. Rigby was in the area and attempted to gently herd horses again towards Orr Springs, but with no luck. He found only slightly moist mud in the mud hole.

On June 29, 1976, Mr. Glade Anderson and Mr. Cal McCluskey of the BLM brought a load of creosote poles and hauled them up to Orr Springs. On 30 June these same men also visited DPG. On 1 July Mr. Glade Anderson, Mr. Richard Dekker and a Mr. Cal McCluskey brought out a second load of creosoted poles and hauled them to Orr Springs. They made no observation of sick or dying horses.

On 3 July, Saturday, Dr. H. Kirk, a physician at the DPG Health Clinic, was in the Orr Springs area with his family on a picnic. He did not see any dead horses although he was in an area where 4 or 5 dead horses were found on July 4th. He stated that the 20 dead horses found on 4 July would not have been visible to him when he was there on 3 July. Dr. Kirk spotted several herds of horses comprising a total of about 40-50 in the Orr Springs vicinity, none of which appeared to be ill. He fed his dog water out of a paper cup -- water which had been obtained from the covered spring head. The dog was again watered at the same spot at about 1600 hours after the family had returned to the Orr Springs area. The dog demonstrated no ill effect up to 14 July, when Dr. Kirk's statement was taken.

On 3 July at 0730 hours, a DPG military helicopter was on a routine security overflight and flew over Orr Springs not looking for horses and none were seen. At 1930 on 3 July, the helicopter again overflew the Orr Springs area and this time looking for horses they saw three lying on their side in north gully and assumed they were resting. On 4 July at 0550 hours the helicopter again on routine security check overflew Orr Springs and noted 3-5 horses lying on side in north gully, but again assumed nothing unusual. On evening of 4 July at 1940 hours another overflight was made past Orr Springs and this time 12 horses were noted lying down and one had his feet in the air. The flight crew immediately called Security, who in turn called CPT

Lewter and also COL Templeton, the Acting Commander. The flight came back to pick up CPT Lewter and CPT Lee, post veterinarian. Dr. Stark and Dr. Pinkham of Life Sciences Division were also alerted and called to duty. Horses were found dead in the gulch where they had tried to paw the seep above Orr Springs for water.

SUMMARY: The horses stayed at Wig Mountain catchment basin until it dried up then went to the alternate watering site at Orr Springs only to find the spring capped. The horses apparently did not go to the BLM trough because it was further down the canyon and was strange; the area smelled strongly of creosote and ribbons on stakes were flying. They evidently tried vainly to paw for water in the gulch about 173 yeads above the capped spring which was their traditional water hole but they were too weak and died at that location. Other horses in smaller groups (2 or 3) were found in other areas also apparently looking for another source of water.

Our investigations indicate that human activity in the area was very limited and not more than usual. There was no evidence on any of the horses, living or dead, that they had been excessively running, i.e., no dried salt or sweaty foam. CPT Kirk verified in his statement that he saw no human activity in the area on 3 July.

July 5, 1976 - Picked up equipment at Baker Lab. and started for Orr Springs, by way of Wig Mountain road. Observed one dead horse on mud flat approxmentaly 11/2 miles north of lab. Horse tracks came from sand hills on the east, across the mud to the dead horse and on to the west towards Granite Mountain. Two other horses were found the next day along stark road, that were in same general line of travel if horses were trying to get to Granite for water. At the pond by Wig, one dead horse and 4 live horses were in the center of the pond. It being completely dry. When the truck stopped, the horses started off toward the ease. All were very gaunt and appeared to be quite weak. The band of horses north east of navy gun mount; 2 colts, I yearling, 4 older horses, all appeared to be in good condition. Observed other horses before arriving at springs, but they were all to far away to get a good look at. Bled horse #1 that had just went down.

22 head of colts and older horses dead in wash just above lower spring, was evident that they had been pawing mud and eating mud in an attempt to get moisture. They had been pawing at the cistern, both had the lids knocked off and profusion of horse tracks, especially the upper one, in their attempt to get at the water. ,

Most of the dead horses are adjacent to the original watering holes. Some are piled up two and three deep. Checked at water trough.and pond put in by B.L.M., a few horses are watering at the pond below trough. Appearance of trails suggests that the only horses coming up the wash from the south are drinking at pond. No sign of anything coming from above and no tracks at all around trough.

The fact that the week before two piles of creosote posts were stacked by the trough and 3 feet high stakes with blue ribbon tied to the top were set in along the outline of a proposed corral. Either one would have been enough to keep horses out of the area. Besides the trough its self and the location neither would indicate presence of water to a wild horse.

8 adult horses and 4 colts were observed standing in the shade of a cedar tree about 50 yards above the east cistern . All were very gaunt and weak, appearing to be in a stupor, they showed no reaction to human presence at 25 yards. At this time I opened the drain in the east cistern and let the water out into the wash, which had been damned off to form a pond. Glade Anderson (BLM) myself, and several others tried to drive the horses to the water but they crossed the wash too high above the water. As the horses went up the other side of the wash, Anderson ropped one colt (Horse #3 on data sheets). Had to dig mud out of its mouth, after which the colt drank readily.The band of horses had traveled in a circle and were just west of first encounter. We were able to drive 2 adults, and 2 colts to the water. After they had drank a small amount I drove them away from the water. They would only go as far away as they were forced to and would go back to the water as soon as I moved away. They were allowed to drink several times during the afternoon, but only small amounts at a time. All of these animals were caught and bled during the afternoon. Colts #3 that was roped and #5 that we drove to water died later that afternoon. Colt #3 was autopsyed by Dr. Lee, colt #5 was kept in the shade for the State Vet. who arrived just as I was leaving.

July 6, 1976 - This morning there were 4 horses above Orr east spring, they were driven down the wash and into the pond below the east cistern. After they had drank for a short time, a black mare was roped and bled. Approximately 10 minutes after she was let up, she went back to the water, fell and died. Indicating that being so weak from no water that she could not take the stress of being handled.

The horses that were watered yesterday were observed just around the hill feeding. Dr. Spendlove, myself, Max Green and others tried to drive the three remaining horses back to water again. They were joined by the two older horses that we watered yesterday and all took off at a run down the hill. Before they were watered they could be driven around on foot, even having to push them out of the water so they would not drink too much. Now they are feeding, running and are difficult to approach. Later in the afternoon all the horses that had watered at the east pond were seen at the pond drinking.

Myself, Dr. Spendlove and Captain Law went to Bittersprings. There were approxmently 50 head of horses trying to water and find shade. There were 4 dead, about 10 to 15 gaunt and weak, the rest seemed to be alright. At the spring there was about a pint of water in a depression 6 inches across and 3 inches deep.

July 7 - Met Dr. Lee at the riding club corrals and bled 9 horses for a normal red blood cell sample. I took Dr. Spendlove and Dr. Schoenfeld to Bitterspring, where the last horse death was reported. Autopsyed a colt about 6 months old. No sample of urin was taken as there was no liquid in the bladder. None of the horses that were autopsyed when I was there had any liquid in the bladder or intestines.

July 8 - Went to Orr Springs to pick up more water samples. The field crews were hauling water to Bitterspring where they had put in 3 troughs last night. They had also dug out the spring making a pondpond about 2 feet across and containing a couple of gallon water. The horses had watered at the spring, but none had drank from the troughs. The horses are out on the flats feeding today, first time since I got here on the 5th.

I talked to a dozer operator who was burying dead horses and got him to go to Bittersprings and push the spring out with the cat. When we left there was a good stream of water running into a new pond. Also got him to push out a pond at east cistern where I opened the drain monday. Picked vegatation samples below Orr Spring in the afternoon and all of the horses that we could see were still feeding on the flats.

July 9 - Spncer and Sanders brought in rodents trapped at Orr Springs. They reported that there was around 200 gallon of water in the pond at Bitter Springs and the horses are watering there, but no horses watered at the troughs that were put in. There still have been no horse water at B.L.M. troughs. The ground around it is being brushed and checked for tracks every day. Stated for Orr Spring with bleeding equipment, B.L.M. was to tranquilize two horses. On the way we were stopped by Vowlea and Mel Bushnell, who said they had just seen a mare fall down the hill. They gave directions and we found where she went down, but she had gotten up and was gone. Maxwell called on the radio and told us that Ron Hall had shot 2 horses with a tranquilizer gun and both were dead. They were palomino colt and bay stud that we had watered and bled monday. We were told that Hall shot one other horse later disposition or object unknown.

July 13 - Captain Maxwell called in from Orr Springs and said there were 3 sick horses at East Spring. The plug had been put back in the cistern and the water was gone. The three horses were the ones we had watered on tuesday morning. Took the plug out and let water back in the pond, horses were stronger than before and we could not drive them. Ended up with them going in at Bitter Springs and we sat and watched them drink there. They have been seen watering at Bitter Springs several times since then. Captain Lee was brought out in the chpper and he agreed that the horses were only dry again. B.L.M. shut off cistern drain again.

July 15 - At the request of Col. Templeton, we brushed around BLM trough and pond to see what was watering at each. No sign at all around the trough, a few by the pond, but old.

July 16 - Met Col. Topel, Capt. Maxwell and Mr. Thompson at Orr Springs. Showed them the springs, cisterns and drove were the horses were dead and the BLM trough and pond. His comment was that it was rediculous to expect a wild horse to drink at a place like that and worse yet if the corral had been built there would be no reason for a horse to even look for water there.He appears to be knowledgeable about wild horses and did not think much of what BLM had done at the springs.

July 19- Met Col. Topel, Ron Hall, Mr. Howard and DPG information officer at Orr springs. Was the first trip out for Howard but he had his mind already made up and was not interested in anything anyone had to say or show him. Stayed for about 20 min. and asked questions only of Ron Hall. Mr. Hall made the statement that if a

Questions Only by Ryn Hall. Mr Hall made the statement that if a horse was thirsty he would drink any place that there was water, refering to the horse trough.

Richard Davis

STATEMENT OF MAX GREEN, EQE Branch, Envir & Life Sci Div

July 6 1976. As I approached Orrs Spring I observed 4 head of horses in a very weak condition. We opened the upper cistern and made a pond and drove the 4 horses into water. They drank for several minutes, then we tried to rope one, they moved away for a few minutes then came back to water, they drank again for several minutes, then we roped one black mare and bled her. She laid for several minutes then got up and approached the water hole and then fell over and died, (in about 2 to 3 minutes).

Looked at water trough that had been installed by BLM. Trough is situated on top of a knoll, there is two stacks of creasote poles, 1 stack approx. 15 yds. from trough the other approx. 30 yds. from trough, there were stakes approx. 3 ft. tall with blue ribbons tied on top of stakes, the stakes were situated in a circle around the trough, where they were going to build a corral. There was no evidence of horses watering at the trough at any time.

There were approx. 22 dead horses in a wash just north of spring #1 horses, they showed no evidence of struggle. There were no sweat or salt marks on them. Some had mud in their mouths and they had pawed at the mud bank to try and get moisture. The 22 dead horses were approx. ¼ of a mile from the trough. Observed small water hole at Bitterspring that had been dug by field crew.

4A

July 7 1976. Went to Bitterspring and observed Dr. Schoenfield autopsy young colt, one observation that was made was that the bladder was dry and Dr. Schoenfeld made the statement that the other horses he had autopsied were the same. It was impossible to get a urine sample. There was a small amount of liquid in stomach. Observed about 30 head of horses approx. 1 mile below Bitterspring grazing and seemed well. Observed 3 other dead horses at Bitterspring.

July 8 1976. Saw one colt at spring #2 standing in shade, looked in poor condition, opened cistern and let her drink, then she went up on hill and started grazing, same colt was later killed by BLM and Humane Society. Observed bulldozer digging out Bitterspring, developed very good amount of water. Observed 30 to 35 head of horses grazing below Bitterspring.

July 9 1976. Bled horses at Fox area riding club for normal serum. Was headed for Orrs Spring and was stopped along road by Vowels and Bushnell and told that they had seen a horse fall down hillside, was given directions where she fell, went to location, but could not find her. Capt. Maxwell called on radio and said BLM had shot two horses with tranquilizer and that both had died. Observed 4 head of horses on west side of Cedar Mtn. and about 20 head east of Wig Mtn. As of this date have seen no tracks at trough. Have seen tracks of about 4 or 5 head at the overflow pond below trough.

July 13 1976. Capt. Maxwell called on radio and said there appeared to be sick horses at Orrs Spring #2. Proceeded to Orrs Spring and met Capt. Lee to look at horses. Horses were hunting water. Was told not to open cistern at spring, so we drove horses to Bitterspring and they went right to water and then seemed OK.

July 15 1976. Went to Orrs Spring and brushed all markings from around trough and overflow pond. Observed approx. 40 head of horses grazing below Bitterspring. Observed the 3 head that we drove from Orrs spring to Bitter spring earlier, watering atitterspring.

July 16 1976. Went to Orrs Spring to drive Col. Topel and Mr. Thompson around the area. Looked over area very closely observed all trials comming into Orrs Spring the trails did not seem to come to the area of the trough. There were still no tracks at trough and seems it is the same bunch of 4 or 5 head watering at the overflow pond. Saw about 20 head grazing on bench below Bitterspring. All looked good. Saw the same 3 head that we drove to Bitterspring earlier they appeared to have improved very much.

July 19 1976. Went to Orrs Spring to drive Paul Howard, Ron Hall and Col. Topel around the area. Paul Howard and Ron Hall had their minds made up before they ever got there, it was a total waste of time, they spent approx. 30 minutes at site, were not interested in anyones comments. This is the first time Howard has been to the site, yet he knew all the answers to everything. Had no respect for anyone, was very rude.

Howard claims we were keeping horses off of water by checking our rodent traps once a day, yet there has been no horses watering at trough and 4 or 5 at pond below trough. All horses are watering at Bitterspring and a few at Cane spring 1.5 miles east of Orrs Spring. We discontinued trapping.

July 21 1976. Took two ladies from the predator and animal protection agency to Orrs spring, they were checking on the statement made by Mr. Johnson of the Humane society about 1080 poison being in the area. They looked over the area very well and made the statement that there was no 1080 at Orrs spring. Still no tracks at trough and same few at over-flow pond. Saw approximately 20 head of horses between Orrs spring and Cane spring canyon. They looked very good.

MAX GREEN

Max Green

0800

MEMORANDUM FOR RECORD

14 July 1976

Beginning of statement***On the morning of 3 July 1976, I called the PMO desk seargent (ph. 2933) and obtained permission to utilize the dirt roads north of Stark Road, in the vicinities of the sand dunes, Cane Springs, and Orr springs, for riding with my family in my four-wheel-drive vehicle. We and other families frequently do this on weekends. We left English Village about mid-morning, and arrived at the Cane Springs area just before Noon. There were, besides myself, my wife, three children, and one small mixed-breed dog. Enroute we stopped several times to look at rock formations, etc. Upon approaching Cane Springs, we spotted a small herd of horses on the hillsides, East of the entrance to Cane Springs, of about ten to fifteen animals. They appeared in good health, and moving about freely. They were perhaps 100 to 150 yards from the road. We did not enter Cane Springs canyon, but continued on to Orr springs. Between Cane and Orr springs we spotted another small herd of horses (of about the same size), South of the road, probably greater than 200 yards away. They likewise appeared lively, and were moving off to the South. We pikniked under a tree at Orr Springs, perhaps 100 yards North of the "green trough", and about 50 feet from the so-called "upper Orr Springs well head", in the West arm of the ravine. While my wife walked with one of our children up the East arm of the ravine (to look at some old horse skeletons we had seen on an earlier trip), my two other children walked down to the area of the "green trough". I crossed the West arm of the Ravine (to the West side), and walked up the ravine about 50 yards. I saw no dead horses from that vantage point. I did see approximately three or four live horses farther up the ravine (perhaps 75 yards), under a tree. I did not approach them, as I did not want to "spook them". During our meal, we gave our dog water from the round, silver-colored "well-head", by dipping water with a paper cup into a paper bowl. My children called my attention to "flags" near the green trough, and I noted that it appeared to be staked off, with small stakes with colored flags attached (blue, I think). I remember thinking that it seemed a strange place to stake off, and that the horses might be frightendd by the flags. Following lunch, about 1300 hours, we left Orr springs, and drove around some more. Another herd of horses, somewhat bigger that before was spotted, perhaps about 20 animals in all, just to the southwest of Orr springs. I do not believe it is the same herd seen in that area earlier, since a very attractive stallion which was quite apparent earlier was not seen with this herd, and also it was larger. We returned to Orr springs about 1600 hrs, before starting home, specifically to obtain another drink of water for our dog. Again, no dead horses were seen in the area. On 5 July 1976, I accompanied CPT Lewter, of the Security Office, back to the Orr Springs area. Upon re-tracing my steps of two days earlier, I was able to clearly see some three or four dead horses, which, had they been there on 3 July, I definitely would have seen. We also toured the general area, and I saw approximately twenty other horse carcasses, which I do not believe I would have seen if they were there on 3 July. Otherwise, the area looked unchanged. On our trip 3 July 1976, we saw no other humans in the entire area, and saw no evidence of any (ie. vehicle tracks). My dog has remained in good health continuously.****End of Statement****

Harry L. Kirk, M.D., MAJ, MC
438-64-0705

5A

Statement of Mr. Gourley, TechnicaI Support Division, Photographic Branch

July 15 1976

On the 28th of June Ken Rigby and myself were replacing a generator at Photo PAD # 24 on wig mountain. As we approached the waterhole on the right side of the road going toward wig mountain we noticed horses standing on both sides of the road and some in the waterhole. As we neared the water hole the horses moved out and I tried to count them as we went by. I counted approximately 77 horses on the west side of the road and 25 just east of the waterhole and about 20 to the northeast, so altogether Ken and myself figured there were between a 100 and 125 horses in this area. As we went by the waterhole, we noticed it was dryed up, but we did not stop and check. This was about 1100 in the morning and it was quite warm so we figured they were in need of water.

We came back about a half hour later after dropping off the generator and the horses were still standing just off from the waterhole.

LeRoy L. Gourley

LeRoy L. Gourley

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Statement of Mr. Ken Rigby, Technical Support Division, Photo Branch
15 July 1976

On June 24th LeRoy Gourley and myself had to go to North Mig to change a generator on Pad 24 for a "Haybee" test. We had the generator on behind my truck and were headed for North Mig Mountain. Upon approaching the waterhole along the road by North Mig, we noticed a few horses in on water. When we got closer we noticed there was a big herd around the waterhole. As we drove through them, they broke into three different bunches. One bunch went towards North Mig Mountain. LeRoy Gourley counted 77 in that bunch. Another bunch went straight west. We figured that there were about 20 to 25 head in that bunch. The third bunch went east into the sanddunes, and we figured there were about 20 head there. As we drove past the waterhole, we noticed it was dry. We did not stop or go over to it. This was about 11:00 a.

We went up to change the generator and came back about 30 minutes later. The horses had just moved off a little ways and were still standing around the waterhole.

We went back to Ditto Area and had dinner. About 14:00 I had a little time so I drove back to North Mig Waterhole. Upon arriving, I stopped about a quarter of a mile down the road. I sat and watched the horses for about 5 to 10 minutes. While watching, I thought that maybe if I could catch a bunch of them on the east side of the road, I might be able to start driving them towards Orr Spring. I waited a few minutes longer. There was quite a bunch in on the waterhole. I drove in quite fast and got them started to the east. They ran into the sanddunes and around the sanddunes heading east. I walked over to one fairsized sanddune, climbed up on it and hollared a few times trying to get the horses to run out of the sanddunes, so that I could follow them towards Orr Spring. I think I had about 30 or 40 head when we came out of the sanddunes. I followed behind them

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quite a distance and tried to keep them going towards Orrs. I had the old buckskin stallion and his band, but soon after I left the sanddunes, he ran back along them where he and his mares usually run. I followed the other bunch losing quite a few until I had them up to the C.B.R. Buildings. When I left them, they were on a trot towards Orr Spring.

The next day, 29 June 1976:

Having shot a "Hayhee" test, when I returned to Ditto area I asked James Wright if he had seen any horses at the North Wig waterhole. He had to travel that way to Pad 24. He said that he had seen a big herd around the waterhole. After putting my equipment away, I again got into my truck and headed toward the North Wig waterhole. I tried to do the same thing as I had done the day before; but I didn't have as much time as I had had the day before; so I just got a few horses out through the sanddunes and started them towards Orr's Spring, when, because of time I had to leave them. The horses were real gaunt this day, much more than they were the day before. I left them thinking that "there weren't as many horses there today as there were yesterday". So I thought maybe I had moved some of them to Orr Spring. As I went back past the waterhole I stopped and walked over to it. I could see where the horses were sticking their noses down into the mud and licking and sucking moisture out of the mud. I figured the horses right soon would leave there and go elsewhere hunting water. I returned to Ditto and was not able to get back out the rest of the week.

Ken D Rigby

Ken D. Rigby

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
STEDP-MT-L	Observation of Live Horses

TO THRU Chief, E&E Branch
Chief, Envir & Life Sci Div
Director, Materiel Test

FROM Envir & Life Sci Div DATE 19 July 1976 CMT 1

TO Scientific Director

On any given day over the past 10 days (10-19 July), I have observed from 6 to 8 separate herds of horses, totaling approximately 35-50 head. These animals have been distributed from the Naval Gun Mount on east to Wig Mountain on the west. This area being adjacent to Orr Springs, however nearly all horses in area now water at Bitter Springs, because Bitter Springs was dug out after the horse deaths and now is providing adequate water.

Richard Davis
RICHARD DAVIS
E&E Branch
Envir & Life Sci Div

8A 1.

DA FORM 2406 REPLACES DD FORM 96, WHICH IS OBSOLETE. * U.S. G.P.O. 1976-665697/1018

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
STEDP-MT-L	Observation of Live Horses

TO THRU Chief, E&E Branch
Chief, Envir & Life Sci Div
~~Director, Materiel Test~~

FROM Envir & Life Sci Div DATE 19 July 1976 CMT 1

TO Scientific Director

1. The undersigned has observed 5 head of horses watering at Orr Springs at upper cistern, since 6 July 1976.

2. The undersigned has observed many horses on any given day grazing in an area from below and a little bit east of Cane Springs to Wig Mountain on the west and down to the rough Hall Road on the south. approximately 30-50 head. All of these horses seem to be watering at Bitter Spring and a few at Cane Springs.

Max Green

MAX GREEN
E&E Branch
Envir & Life Sci Div

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DA FORM 1 FEB 67 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE.

☆ U.S. G.P.O. 1976-665697/1018

DAVE MAXWELL

19 July - 1030 hours: Received message to meet COL Toepel, Mr. Howard and Ron Hall at Orr Springs (Maxwell, Green & Davis)

Observed 15 horses N.W. of Navy Gun enroute to Orr Springs

Met Mr. Howard, my first impression was he had been brain-washed by Mr. Hall and was totally blind as to the obvious. He and Mr. Hall had 2 private conversations out in the field. When Mr. Howard did speak, it was totally out of context or he balked at fact (example: much moisture in dead horse gultch from rain last night - he (Mr. Howard) doubted the rain put that much moisture in the gultch - when in fact, I had been there Sunday morning and it was still dry).

I mentioned to Mr. Howard that I'd chased the same 4 horses out of N.W. Orr each morning for past 8 or 9 mornings. He ask "why did I chase them" - I explained that "chase" was a bad choice of words - when I drove over the hill, the horses leave N.W. Orr Springs.

It was blatantly obvious Mr. Howard had his mind made up and was not going to listen to anyone.

I thought it strange that he (Mr. Howard) now decides to come to the horse site 15 days after the first death and then only spends 15 minutes (the area has changed its appearance because of the rain and low temp).

He made no comment about the location of the horse trough.

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D. Maxwell - Con't

Mr. Hall told us the reason for putting the horse trough on top of the hill was because the horses trailed through and over that hill. Sounds to me like a CYA statement, because one doesn't have to be much smarter than one of those horses to determine that the horses didn't and would not walk over that hill.

The horse trails are obviously located and it can be determined from which direction they "came and went"

I felt the meeting at Orr Springs with Mr. Howard was a total waste of time. I feel someone higher up than Mr. Howard, district or region director of BLM should be called - only if he is capable of an unbiased opinion.

STATEMENT

20 July 1976

1. On Sunday, 4 July 1976, at approximately 1945 hours, I received a telephone call from the Security Control Desk Sergeant (telephone 5725), Mr. Theobald. The substance of the telephone message was to inform me that during a scheduled routine helicopter overflight the pilot and 3 armed military police guards had observed and reported to the Security Control Desk approximately a dozen wild horses lying dead in a gulch in the vicinity of Orr Springs. Two wild horses which appeared sick were observed in the vicinity of Baker Laboratory.

2. I directed Mr. Theobald to contact Mr. Ron Hall or any other local BLM representative and inform them of the incident. Mr. Theobald was unable to establish telephone contact with any BLM representative at that time. (I personally contacted Mr. Ron Hall the following day, 5 July 1976, at 0830 hours and informed him of the dead wild horses. He indicated he would immediately depart Salt Lake City by private vehicle. He arrived at DPG at approximately 1100 hours.)

3. I immediately notified COL Templeton, Acting Installation Commander, of the reported incident. I then coordinated by telephone with CPT Lee, Post Veterinarian, who had been notified by COL Templeton to accompany me to Michael Air Field where a helicopter was awaiting our arrival. A military police sedan was dispatched to my on-post quarters, transporting myself and CPT Lee to the Provost Marshal Office, where I obtained a military sedan and proceeded to the Veterinary Clinic in order to obtain additional veterinary supplies before proceeding to Michael Air Field.

4. Upon arrival at Michael Air Field, CPT Lee and I boarded a helicopter piloted by CWO-3 Keen and accompanied by Mr. Faux (Security Guard Supervisor) and PFCs McDaniel and Daniel, military police guards. Upon arrival at Orr Springs I directed Mr. Faux to conduct a count of all dead and live horses in the immediate area. Mr. Faux reported to me that 22 horses were dead and 16 observed leaving the area as we arrived. A double check was made to verify the count before I made a radio report to the Security Control Desk to be relayed to COL Templeton. I then directed the helicopter pilot to return to MAF and transport Dr. Stark, Dr. Pinkham and Jerry Oyler who had been contacted and were enroute to MAF from the English Village Area.

5. While awaiting arrival of the above party, I directed the military police guards to halt a young colt before it departed the area. Without much effort the colt was restrained and remained alive until after the arrival of Dr. Stark, Dr. Pinkham, and Mr.Oyler. Blood samples were drawn from the colt before it expired.

6. On the return trip to MAF all personnel observed 5 live wild horses covered with dry mud running in the vicinity of Baker Laboratory. A meeting was held at COL Templeton's quarters at approximately 2400 hours, 4 July 1976, in order to determine the next days activities. In attendance were COL Templeton, Dr. Ries, Dr. Stark, Dr. Pinkham and myself.

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7. At approximately 1300 hours on 5 July I returned to the Orr Springs area with Dr. Kirk and established which area Dr. Kirk and family had visited on 3 July 1976. Dr. Kirk then related to me that he would certainly have been able to physically see three possibly four dead horses on the 3rd of July, had they been there at that time.

8. I also observed a number of stakes with flags placed around the watering trough when we inspected to determine the amount of horse tracks and traffic at that area. Very few hoof prints could be observed at the watering trough area, although Dr. Kirk's foot prints from the 3rd of July were plainly and clearly visible. End of statement.

Allan A. Lewter

ALAN A. LEWTER
CPT, MPC
521-48-7849
Chief, Security Office

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
STEDP-MT-L	Observation of Live Horses

TO // THRU Chief, E&E Branch
Chief, Envir & Life Sci Div
for Director, Materiel Test

FROM E&E Branch

DATE 20 July 1976

CMT 1

TO Scientific Director

1. I have observed numerous horses in some 30 trips (2 weeks) to Orr Springs. Attached is a detailed listing which specified numbers of animals observed. In many cases I've observed as many as 60 to 75 horses in small groups while traveling to and from Orr Springs.

2. I have seen many of the same horses in the same location each day depending on the time of day.

3. In the mornings and late evenings the horses are in the bench area, spring area and in the Cedar Mountains. The middle of the day shows the horses are grazing down in the flat area toward east wig grid.

1 Incl
as

DAVID A. MAXWELL
CPT, CM
E&E Branch, Envir & Life
Sci Division

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DA FORM 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE.

☆ U.S. G.P.O. 1976-665697/1018

HORSE OBSERVATION

6 July - 0945	1 mare, 1 stud, 2 colts, alive but emaciated (mare died in afternoon)
7 July - 0530	30 horses at Bitter Springs
8 July - 0530	24 horses at Bitter Springs
9 July - 1000	10 to 15 horses at East Wig Grid and north of East Wig Grid, 2 at Orr Springs (killed by BLM)
10 July -	Horses in the flat and horses at Cane Springs
11 July -	Horses in the flat, 4 horses (stud, blue mare, yearling and colt) came out of N.W. Orr)
12 July - 1800	Horses on side hill near Cane Springs (4 horses at N.W. Orr)
13 July - 0900	3 horses at Orr Springs (same group as 6th), 4 horses at N.W. Orr
1030	Herd of 25 to 30 horses, 500 meters east of old CBR gun emplacement
15 July - 0530	Observed same 4 horses at N.W. Orr as past 4 mornings.
15 July - 1700	Spotted groups of 8, 7, 10 and 3 horses north and west of Navy Gun
16 July - 0530	Same 4 horses came out of N.W. Orr, 10 horses and group of 3 at Navy Gun
1030	3 horses at Bitter Springs (overflight - number of horses in flat)
2000	Groups of 3, 10, 7 and 8 North and Northwest of Navy Gun
17 July - 0630	6 horses south of Navy Gun 6 horses at Cane Springs Road Same 4 horses at N.W. Orr 7 north of East Wig Grid 18 east of East Wig Grid

12A - Incl 1

AD-A032 445 ARMY DUGWAY PROVING GROUND UTAH F/G 6/3
INVESTIGATION OF DEATHS OF HORSES AT ORR SPRINGS.(U)
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3 OF 4
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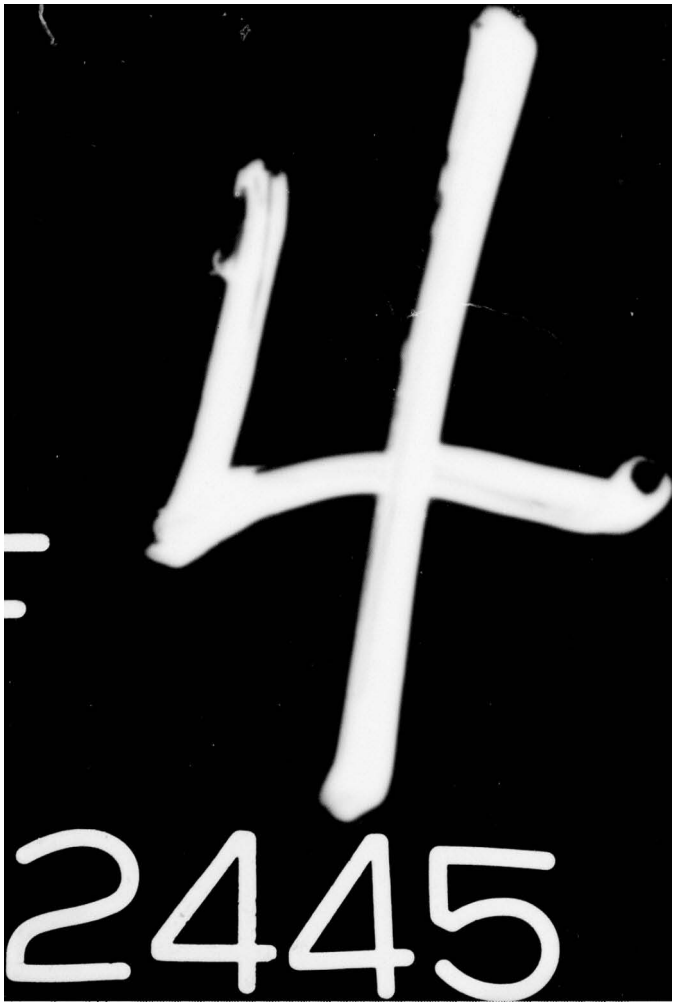
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2445

18 July - 0700	Herds of 3, 10, 6 and 6 towards the flat west of Navy Gun
0900	15 horses East Wig Grid

12 A Incl. 1

DA XWELL

21 ... y 1976 - 1030 hours: Received a call from Dr. Salomon to es...rt BLM personnel to Orr Springs (Maxwell, Green).

Upon arrival at Orr Springs, discovered the personnel were Mr. Glade Anderson, BLM, and Ms. Noinda Burbidge and Ms. Sanda Josie of Predator Animal Protective Agency. The two gals were looking for evidence of 1080 poison.

We escorted the two gals over the entire area, and Ms. Burbidge concluded (to us) that there was no evidence of 1080 poisoning and that "Mr. Johnson of the State Humane Society was full of S... !"

Ms. Burbidge also ask me about what Mr. Johnson (Humane Soceity) told her, that we (Dugway) were going to capture a wild horse and cut it up, then sew it up. I told her that didn't make much sense and that I knew of no plans like that - she again made a comment about the Humane Society and D.S. (Mr. Johnson).

Ms. Burbidge looked at recent coyote tracks found by Mr. Green. I feel this was the thing that proved there had been no 1080 in the area.

I did observe maggots and flies in an area where horse #7 was posted. It seems to me, if 1080 had been used these grubs and insects would not be present.

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27 July 1976

MEMO FOR RECORD 27 July 1976

On or about 25 June 1976, David Gauthier and the undersigned traveled along the road from Baker Laboratory to the North Wig Grid. It was observed that four or five horses were in or near the clump of tamerack bushes along the road. There was a small amount of very dark water in the depression inside the clump of bushes. There was evidence of considerable activity in the area by horses, such as well traveled trails leading into the area. About twenty-five horses were grazing on the flats north and east of the water hole. About ten other horses were grazing in the old artillery impact area west of the road near the top of the pass.

The writer made the same trip the following week, probably on 29 June. At this time, it was observed that an estimated 25 to 30 horses were milling around the clump of bushes and that there was no water in the hole.

George Musgrave
GEORGE MUSGRAVE

14A

WILD HORSE INVESTIGATION

DUGWAY, UTAH

JULY 1976

STATEMENT

Extensive biological and chemical laboratory investigation by the various agencies have eliminated heavy metal and pesticide toxicities, common bacterial and viral etiologies and other toxic agents as the cause of death of fifty wild horses at Dugway.

Pathologists are in agreement that vascular congestion, cerebral edema and other circulatory abnormalities compatible with a shock syndrome are the only significant changes. Elevated hematocrit and serum proteins are indicative of dehydration.

Of the many forms of serious stress that produce a shock syndrome, all have been eliminated by investigation with the possible exceptions of dehydration or intoxication (water).

On site examination of the area and observation of the animals (alive and dead) and their migratory patterns leads to the following conclusions.

The horses were severely stressed by a combination of environmental factors primarily heat, and insufficient water. The horses had reached a critical point of dehydration and debilitation before they abandoned their customary watering site at Wig Mountain. They then followed their normal migratory trails to the secondary watering sites at Orr Springs, which had been capped and diverted 1200 feet down hill to the west. Unable to locate water at the springs and unable to smell water from the man-made sources because of the creosote piles, the horses followed their instinctive desert survival technique of pawing at moist seepage points to create small water holes. These efforts were either unsuccessful or insufficient and added to the animals exhaustion.

The premature drying up of the herds customary watering hole, unremitting heat, natural migratory patterns, instinctive survival mechanisms (fear of movements and water location technique) and the alteration of the normal environment resulted in death due to shock produced by insufficient fluid intake and heat exhaustion.

George B. Reddin Jr.

GEORGE B. REDDIN, JR.
LTC VC
Consultant to Surgeon General

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Recvd 0930 16 July

American Horse Protection Association
1707 "H" Street, N.W. (Suite 1005)
Washington, D.C. 20006

Mr. Paul Howard
State Director
Bureau of Land Management
University Club Building
Salt Lake City, Utah 84112

Dear Mr. Howard:

We respectfully request your assistance in obtaining the following documents relating to, or samples taken from, the dead wild horses found on the public lands of the Dugway Proving Grounds on, or about, July 4, 1976:

1. Copies of any choline esterase tests run by B.L.M., U.S. Army, State or other veterinarians or lab technicians;

2. Copies of any white blood count differential tests;

3. Copies of any and all virolosy tests, included but not limited to tests of injecting day old mice with serum from the horses (and their results);

4. Samples of tissue, feces, blood, and results of tests run on any organs of the horses;

5. Copies of the autopsy reports;

6. Copies of the 40 to 50 8" X 10" color pictures taken by the U.S. Army of the horses --- dead, alive, or after autopsy;

7. Any and all reports of new deaths or new test results as they are found or completed.

Please forward this material to A. H. P. A.'s Consultant, Dr. James Naviaux, 450 Boyd Road, Pleasant Hill, California 94523.

Sincerely,

Robert C. McCandless

Robert C. McCandless
Councel

16 A

RCM/jb

IN REPLY REFER TO

4700
(U-910)

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

Utah State Office
University Club Building
136 East South Temple
Salt Lake City, Utah 84111

JUL 15 1976

Mr. Robert C. McCandless
Counsel
American Horse Protection Association
1707 "H" Street, N.W. (Suite 1005)
Washington, D. C. 20006

Dear Mr. McCandless:

This is in response to your undated and hand-delivered letter to me concerning the death of wild horses on Dugway Proving Grounds on and after July 4 weekend. Inasmuch as you asked for specific information to be sent to Dr. James Naviaux, we are sending him a copy of this letter. The following are responses to the seven specific requests you made:

1. No cholinesterase level tests were run by the BLM consulting veterinarians. We have no knowledge that either the Army or State ran these tests. It was the impression of the consulting veterinarians that cholinesterase inhibitors were not the cause of death due to clinical signs and the lack of other deaths in sylvatic wildlife.

2. No white blood count differentials were completed. Complete blood count excluding white blood count differential was done. No field slides were made and making EDTA slides in the laboratory may have produced erroneous results.

3. Encephalitis complement fixation tests were completed for WEE, VEE, Calif. Eng., and SLE by Utah State Division of Health Laboratories. According to the Army, the Communicable Disease Center Unit in Fort Collins, Colorado, is running serological viral and tissue samples.

4. The BLM consulting laboratory has limited tissue, feces, and blood samples. Results of the BLM-run test will be provided by the consulting laboratory in the next few days.

5. Copies of autopsy and histopathology results will be provided by the consulting laboratory also within the next few days.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

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6. For copies of the 8 x 10 color photographs taken by the U. S. Army, you should direct your request to Commanding Officer, Col. A. E. Toepel, Jr., Dugway Proving Grounds, Dugway, Utah 84022. Photographs taken by BLM personnel have not been processed yet. They will be available to you and the public at cost. Please advise us as to any limitation of costs you are willing to pay.

7. If there are any new results or reports they will be available to you.

When reports mentioned above are received, copies will be sent to Dr. Naviaux.

Sincerely yours,

Paul L. Hauptman

State Director

United States Department of the Interior

4700
(U-020)

BUREAU OF LAND MANAGEMENT
Salt Lake District Office
2370 South 2300 West
Salt Lake City, Utah 84119

May 11, 1976

Mr. William Woods
Logistics Directorate
Dugway Proving Grounds
Dugway, Utah 84022

Dear Bill:

Following our meeting here in Salt Lake, in which you and the Utah National Guard laid out plans for artillery placements in the Wig Mountain area, I have had the District's Wild Horse Biologist make a review and analysis of the impact. I apologize for being over long in getting comments back to you.

We have generally concluded that the proposed artillery placement will probably have a detrimental impact on wild horse populations in the area. This conclusion is based strictly on our knowledge and expectations of wild horse biology and behavior. The proposed gun emplacements are located close to critical water sources and within the center of present wild horse summering areas.

We certainly appreciate the Army contacting and consulting with us. We recognize you have a mission to carry out and our agreements, both formal and informal, provide largely for communication. We, of course, can exercise no jurisdiction within the military withdrawal and would not attempt to do so.

Despite possible adverse impacts, we assume you will proceed to authorize the Utah National Guard to proceed with at least limited use of the area during the coming summer. With your permission and cooperation, we would appreciate analyzing the actual response of the animals to the proposed activity. In this way, we can then assess the actual impact and we can also make a determination as to whether the impact is temporary or permanent.

Thank you for allowing us to comment.

Sincerely yours,

[signature]
District Manager

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

18A

For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

REFERENCE OR OFFICE SYMBOL	SUBJECT
STEDP-PO	Wild Horses MT-L

TO MT FROM PO DATE 22 Jun 76 CMT 1
MAJ McAlpin/jp/3531

1. Reference letter, U.S. Dept. of Interior, 11 May 76, subject as above (Incl 1).

2. The attached was recently received and is forwarded for information.

1 Incl
as

JAMES J. HELBLING
LTC, FA
Chief, Plans & Operations

STEDP-MT (22 Jun 76)

TO: PO FROM: MT DATE: 23 June 1976 CMT 2

As indicated in our original comment of the National Guard firing north of Stark Road, the artillery firing will have an adverse impact on many of the wild animals of Dugway Proving Ground and not just wild horses. This fact should be considered when evaluating National Guard firing and maneuvering in this area.

1 Incl
nc

CLAIR B. OLSEN
Act Dir, MTD

19A

DA FORM 1 FEB 62 2496 REPLACES DD FORM 96, EXISTING SUPPLIES OF WHICH WILL BE ISSUED AND USED UNTIL 1 FEB 63 UNLESS SOONER EXHAUSTED.

THE HUMANE SOCIETY OF UTAH

DEDICATED TO THE ELIMINATION OF FEAR, PAIN AND SUFFERING OF ALL ANIMALS

July 15, 1976

Col. A.E. Toepel, Jr.
Commanding Officer
Department of the Army
Dugway Proving Grounds
Dugway, Utah 84022

Dear Col. Toepel:

Remarks made by Steve Horan, the acting Dugway Proving Grounds public affairs officer, indicate the Department of the Army "would be very happy to cooperate" concerning results of laboratory tests in regards to the death of 50 wild horses at your Facility.

Please accept this correspondence as a formal request for information. We would appreciate obtaining copies of all written test results and autopsy reports, to include the animals' designated number, plus written evaluation of these tests performed by Department of Army Staff and its civilian employees.

In addition, we would appreciate your approval to duplicate any or all of the photographs taken by the Department of the Army Staff relating to this incident.

The access to examine, or obtain samples of tissue, blood or blood serum from these horses, specifically those relating to hapatic toxicology, ie: liver, is also requested.

As I am sure you have surmised, our Society would be most interested in being notified of all reports of new deaths, new tests or investigation results as they are found or completed.

With kind regards,

Lonnie L. Johnson
Executive Director

LLJ/jb

20A

STEDP-CO 22 July 1976

Mr. Lonnie L. Johnson
Executive Director
The Humane Society of Utah
P.O. Box 19222
Salt Lake City, Utah 84119

Dear Mr. Johnson:

Your request, dated July 15, 1976, for copies of written results and reports of laboratory investigations related to the wild horse deaths in the Orr Springs area of Dugway Proving Ground has been received.

My professional staff currently is in the process of completing comprehensive laboratory and field studies. I estimate that this concerted effort will require two additional weeks of work, at a minimum. Reports of findings from external federal, state, university and independent laboratories and from other eminent scientists contributing to specific aspects of the investigation are anticipated within the next few weeks, as well. When these reports are received and consolidated with our own, we would be pleased to make a copy available to you.

Your request for duplication of Department of Army photographs related to the incident must await identification of those photos presently in your possession. The photographs will be reviewed on a case-by-case basis prior to release with the additional proviso that the Department of Army source must be identified on each occasion when such photos are to be used. Please address your requests to the Public Affairs Officer, Dugway Proving Ground.

The tissue samples which you requested should be obtained from Dr. J. F. Schoenfeld, State Veterinarian, Utah State Department of Agriculture. Dr. Schoenfeld and his coworkers were primarily responsible for post mortem autopsy and pathological

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examination of the animals concerned. Samples of blood and serum, unfortunately, are not available because of external interference with efforts to obtain same by nonprofessional observers and because distribution of available samples to other federal, state, university and cooperating laboratories has exhausted the supply.

We share your deep concern and interest in obtaining comprehensive information surrounding the horse deaths. Be assured that a copy of the comprehensive report will be available to you when it is in final form.

Sincerely,

ADALBERT E. TOEPEL, JR.
Colonel, FA
Commanding

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DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
STEDP-MT-L	Memo for Record - Information on Habits of Wild Horses in Desert Situations

TO THRU Chief, E&E Branch FROM Envir & Ecol Branch DATE 26 July 1976 CMT 1

TO Chief, Envir & Life Sci Div

1. A preliminary literature search (e.g., Journal of Wildlife Management, Bulletin of Wildlife Disease Association) indicates there is virtually no published articles on feeding and watering habits of wild horses.

2. The Denver Public Library has established a data retrieval system on wild horses and their habitats together with an annotated bibliography.

3. An informal visit to the Utah State Widlife Resources Division (specifically with Mark Hilliard) has provided the references given below. Conclusions from the brief conversation suggest that habits of wild horses would preclude their searching for water in strange areas until familarity is established. Sudden and mysterious deaths of groups of bighorn sheep have been described near watering sites which are similar to the July 1976 deaths of horses at DPG.

a. Bradley, W.G., 1965, Water Metabolism in Desert Mammals with Special Reference to Desert Bighorn Sheep, 9th Annual Meeting, Desert Bighorn Council Univ., Redlands, California, p. 26-41.

b. Bureau of Land Management 1976, Fact Sheet: Wild Horses (Brochure explaining Policies, Laws and Statistics on Wild Horses and Burros).

c. Johnson, V.B. and M. J. Pontrelli, 1972. Public Pressure and a New Dimension of Quality - Horses and Burros. 34th N.A. Wildlife Conference, p. 240-252.

Harold Stark

HAROLD STARK
E&E Branch

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DA FORM 1 FEB 61 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE. ☆ U.S. G.P.O. 1976-665697/1018

Dr. Adams

STEDP-SC

27 July 1976

MEMO FOR DR. SCHOENFELD, Chairman
Horse Incident Evaluation Panel

Department of Army would like to have these specific items addressed in the final report of the evaluation panel — in addition to the general broad aspects of the horse incident:

1. African Horse Sickness

2. Viral, bacterial and chemical agents

3. 1080

In addition, the Department of Army would prefer to receive a copy of your report which has been unanimously approved by your panel of experts.

M. A. ROTHENBERG, Ph.D.
Scientific Director

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STEDP-LD

MEMORANDUM FOR RECORD 2 August 1976

TO: COL Toepel

The following information is provided per your verbal request of 29 July 1976:

a. The Memorandum of Understanding between the Bureau of Land Management and Dugway Proving Ground provides for a joint management plan to be developed by BLM and DPG.

b. In 1974 as a result of a meeting at DPG, the subject of the status of the plan was raised with the understanding that BLM would develop the plan and provide a copy to DPG in Jan 75.

c. In Feb 75, the undersigned contacted BLM requesting the status of the plan. At that time, Mr. Hillier's office agreed to develop the plan and forward to DPG a plan for the overall control and development by 20 Feb 75. Such a plan was not received. However, in a letter in Feb 75 signed by Mr. Hillier, he stated that they had not yet had time to develop a study proposal for the horses but would pursue this in the near future.

d. In a meeting in Nov 75, it was again requested that the management plan be developed and emphasized that due to the rapid increase in the population of the horses at DPG it was imperative that a jointly developed management plan be produced as rapidly as possible. BLM again expressed its responsibility and desire to develop a plan but stated that it simply had not had time to complete the plan as agreed to.

e. On or about the first part of Mar 76, I was contacted by Mr. Hall, BLM, requesting clearance for some BLM people to visit Orr Springs area for the purpose of developing the water resources at that location. During the conversation, Mr. Hall also amplified that they intended to establish a catch corral around the water hole which would give them the capability to control the animals in the future. The undersigned concurred in their requirement and pointed out that DPG still had not received a draft of the implementation plan as called for in the Memorandum of Understanding. Mr. Hall's response was that this was the purpose of the visit--to develop the furtherment of such a plan.

cys to: SC
PA

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MEMORANDUM FOR RECORD 2 August 1976

f. On or about the first week in April, the undersigned received a call from Mr. Hall requesting authority for contractor personnel to visit the Orr Springs area. Mr. Hall stated that it was BLM's intent to contract for the improvement of the water resources at the Orr Springs area. I made arrangements with Security and Range Control for BLM personnel and contractor personnel to visit the Orr Springs site.

g. During the latter part of Apr 76, I received a call from Mr. Hall requesting assistance of equipment in development of water resources at Orr Springs. I explained to Mr. Hall that the only resources that would be available to BLM during the time frame requested (the first two weeks in May) would be a D7 or D8 cat without operator. Mr. Hall said this was acceptable since they were going to bring their own equipment. The equipment was loaned to BLM during the period 3 May through 12 May 76. I have no personal knowledge as to what additional equipment or supplies were delivered to the Orr Springs area. However, I have been informed that they brought the creosote poles and other supplies for the construction of the catch corral during the latter part of Jun 76.

WILLIAM R. WOODS
Director of Logistics

24A

July 19, 1976

MEMORANDUM TO THE FOLLOWING PEOPLE:

Dr. James L. Shupe
Dr. Ross Smart
Dr. Jack Taylor
Dr. A. C. McChesney, Colorado State Univ.
Dr. George Klover
Dr. J. I. Moulthrop
Dr. Robert Poulson
Commissioner Joseph H. Francis
Dr. Tairi Fukushima
Mr. David Waldron

Dear Doctors:

The Dugway Horse loss evaluation Seminar will be held at 10:00 a. m. on Tuesday, July 27th, 1976, at the Office of Dr. M. Rothenberg at Dugway. A Helicopter will pick up passengers at the National Guard Pad at 8:30 a. m., and will return us back to the same at the completion of the Seminar, hopefully by 4:00 p. m..

We are enclosing all pertinent information for your review prior to the Seminar. Additional material will be presented as it is obtained.

We thank you for accepting this responsibility.

Sincerely yours,

UTAH STATE DEPARTMENT OF AGRICUL

F. James Schoenfeld, D. V. M.
State Veterinarian
Veterinary Services

FJS;cb

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July 19, 1976

Mr. Paul L. Howard, State Director
Bureau of Land Management
Room 1504
University Club Building,
Salt Lake City, Utah 84111

Dear Mr. Howard:

I am trying to put all information available together for my report to the Commissioner of Agriculture and I would like to get information concerning your procedures and policies pertaining to the management of Wild Horses particularly to the programs on the Dugway Proving Grounds.

I thank you for your cooperation in this matter.

Sincerely yours,

UTAH STATE DEPT. OF AGRICULTURE

F. James Schoenfeld, D. V. M.
State Veterinarian
Veterinary Services

FJS:cb

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July 19, 1976

Mr. Lonnie Johnson, Executive Director
The Humane Society of Utah
4613 South 4000 West
P. O. Box 19222,
Salt Lake City, Utah 84119

Dear Mr. Johnson:

I would appreciate a copy of your report and findings as to the Dugway Horse deaths. You had Dr. James L. Naviaux of the Horse Protection Society doing some Investigations, and to complete the file history, it is necessary that your report be included.

Thanking you for your cooperation in this matter.

Sincerely yours,

UTAH STATE DEPARTMENT OF AGRICUL

F. James Schoenfeld, D. V. M.
State Veterinarian
Veterinary Services

FJS:cb

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APPENDIX B

Appendix B consists of (a) a Background Log with supporting documents (b) Technical Survey (c) Administration and Support and (d) Dugway Proving Ground Air Transportation and Support. The latter log only runs through 8 July since the DPG helicopter had to go down for scheduled maintenance and repair on that date. A BLM helicopter flew after that date but no record is available of its activity.

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1B Background Log - 3 pages

1B1 D.F. from L.D. Beard, Chief of Michael Air Field on NOE Training, 13 July 1976

1B2 Log of NOE Flights (1 page)

1B3 D.F. from William Tanner, Chief Range Control on National Guard Activities at DPG, 9 July 1976.

2B Technical Survey (15 pages)

3B Administration and Support Log (46 pages)

3B1 Carcass Burial Record (4 pages)

3B2 Unclassified EFTO on Horse Incident, 7 July 1976 (3 pages)

4B DPG Air Transportation Support (9 pages)

BACKGROUND

Date	Time	Action
May-Jun-Jul		Climate for this period is provided in Incl 1.
3-13 May		BLM caps upper and lower Orr Springs and installs watering trough and overflow basin. Details:
3 May		Arthur Micalicek drives to Orr Springs in the afternoon to check access road and site conditions.
4 May		Ned Penrod of US Forest Service drives his backhoe/loader through Dugway to Orr Springs and begins development of the lower spring. Mr. Micalicek arranges for an Army D-7 Cat to be taken by the Army to an unloading site within 3 miles of Orr Springs. Grant Kimber walks the D-7 Cat up to Orr Springs and begins grading a road for the proposed pipeline.
5 May		Mr. Micalicek, Mr. Penrod, Mr. Kimber, Glade Anderson and Richard Dekker work on spring development of both upper and lower springs. Horse tracks observed at lower spring development site.
6 May		Mr. Micalicek, Mr. Penrod, Mr. Kimber, Mr. Anderson and Mr. Dekker (full crew) continue to work on spring development. A trough is placed 100 feet below the lower spring as temporary facilities for the horses. Horses are still drinking at development site of lower spring.
7 May		A severe rainstorm the previous night has washed out much of the access road and the upper spring development. Mr. Penrod, Mr. Anderson, Mr. Kimber and Mr. Dekker survey damages. Little development is accomplished due to muddy conditions. Crew leaves Orr in early afternoon.
10 May		Mr. Penrod, Mr. Anderson and Mr. Dekker continue on development of springs and pipeline construction. Evidence of horses drinking from development site of lower spring.

11 May		Mr. Micalicek, Mr. Penrod, Mr. Anderson and Mr. Dekker at site. Collection system is near completion. Pipeline construction continues.
12 May		Mr. Micalicek, Mr. Penrod, Mr. Anderson and Mr. Dekker at site. Pipeline construction nears completion.
13 May		Full crew is on hand for completion of pipeline. The water system is completed to the prepared corral area; the trough is moved to corral location and hooked up. A small reservoir (see details below) is dug below the corral site to contain the overflow from the trough. Total water from the system is measured at 2 gal/min. Reservoir: The reservoir is dish-shaped, 20 feet in diameter at the top and 3 feet deep. Total capacity is approximately 5,000 gallons. The reservoir has a gravel bottom, so that it doesn't fill rapidly. Nevertheless, it reached a height of 8" and a capacity of 600 gallons within one week. Three weeks after construction the reservoir was near 1,000 gallons. Evidence of heavy use by the horses has been observed on the reservoir site. Horse Observations: Horses are observed in the flats every day. Horses are observed at the Orr Spring area at least 75% of the time upon the crew's arrival. Horses at the spring site numbered from 5 to 25.
6-20 Jun		Air Force conducts Nape-of-the-Earth flights (Incl 2).
7-18 Jun		Wyoming National Guard briefly surveys its proposed firing positions southwest of Orr Springs (Incl 3).
28 Jun	1100-1500	Mr. Ken Rigby and Mr. Leroy Gourley (MT-T-AV) are in the area filming Have Bee flights over the Salt Flats of mudhole south of Wig Mountain (site F). They count approximately 125 horses at the mudhole which seems to be dry. Some of the horses are definitely those which use Orr Springs. The horses appear somewhat gaunt. Mr. Rigby later attempts to gently herd them to Orr Springs. He meets with questionable success; only 20 or so may have gone to Orr Springs.

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29 Jun	1100-1400	Mr. Jim Wright (MT-T-AV) is in the area of site F on duty; sees approximately the same number of horses as day before.
	1400-1530	Mr. Rigby is in the area; attempts to herd the horses again, this time with no luck. He inspects the mudhole and finds it dry except for several pots approximately 6 inches deep with slightly moist mud in the bottom.
3 Jul	1200-1300	Dr. H. Kirk (Health Clinic Physician) and family picnic at Orr Springs. Dr. Kirk walks in an area from which he would have been able to observe the carcasses on the northern ridge above the gully where approximately three carcasses were found the next day. No dead horses were observed. Dr. Kirk observes four to five horses standing under trees in north ridge. They are too far away to note their position.
	1200-1400	Dr. Kirk observes a herd of approximately 10 horses in three separate localities. He is unable to determine if they are the same or different horses; all herds are in foothills of Cedars--herds 1 and 2 between Orr and Cane Springs. All appear to be running vigorously. Otherwise, he is not close enough to observe their condition.
	1600	Dr. Kirk returns to Orr Springs, gets a cup of water from lower Orr Springs and feeds it to his dog. As of 1500 hours, 6 July, his dog is showing no ill effects.
4 Jul	1940	Dead horses observed at Orr Springs by helicopter crew.

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DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
STEDP-AV	MEMORANDUM FOR RECORD (6-20 June 396th NOE Training)

TO Personnel Concerned FROM Chief, MAAF DATE 13 July 76 CMT 1
CPT GRAY/aec/5166

1. Initial pilot briefing on 6 June 76 at 1400 hours. Items dicussed: Local flying rules and procedures,safety,CAIC procedures, and enviromental impact.

2. On or about 9 Jun 76 a discussion was held with Maj Maybe reference possible incident concerning harassment of horses. It was determined that the incident did not occur and that in fact horses were at least a half mile from helicopter flight route.

LAWRENCE D. BEARD
CPT, IN
Operations Officer

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DA FORM 1 FEB 62 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE. ☆ U.S. G.P.O. 1976-665697/1018

Dec 21 July 1976

HOURS ON NAPE-OF-EARTH COURSE

Date	NOE #1	#2	#3	#4	#5
6 June	0	0	0	0	0
7 June	4 hrs	2 hrs	4 hrs	2 hrs	1 hr 15 min
8 June	2 hrs	4 hrs	2 hrs	0	0
9 June	6+30	4+30	2+00	4+00	+30
10 June	4+00	4+00	5+00	2+00	0
11 June	4+00	6+00	2+00	4+00	0
12 June	2+00	4+00	4+00	0	2+00
13 June	2+00	2+00	2+00	0	0
14 June	4+00	2+00	5+00	4+00	6+00
15 June	2+00	1+30	4+00	4+00	2+00
16 June	0	6+15	2+00	4+00	0
17 June	4+00	4+00	0	6+00	2+00
18 June	6+00	0	0	4+00	4+00
19 June	0	0	4+00	0	0

TOTALS

NOE #1, 40 hrs 30 min
#2, 40 hrs 15 min
#3, 36 hrs
#4, 34 hrs
#5, 17 hrs 45 min

Total hours of chase helicopter:

Chase mission was to insure that aircraft used and stayed on correct NOE course
Chase = 28 hrs 40 min

Dates and hours of chase:

7 June	2+00
8 June	3+30
9 June	2+00
10 June	6+00
11 June	2+00
12 June	2+00
14 June	6+30
16 June	1+40
17 June	3+00

* Detailed Course Maps Available at DPG (Edit Doc)

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

REFERENCE OR OFFICE SYMBOL	SUBJECT
STEDP-MT-DA-HD	National Guard Activities at Dugway Proving Ground, 1976

TO Dir, MT FROM Ch, RC DATE 9 July 1976 CMT 1

1. Army National Guard units conducted training maneuvers and artillery firing at Dugway Proving Ground on 7 through 18 June 1976, and on several successive week-ends in April and May. None of these activities, however, were conducted in the Orr Spring/Wig Mountain area nor in the areas north of Stark Road. A few vehicles transitions and helicopter overflights were made to survey the Wig Mountain area as a potential site for artillery fire, but this was the extent of National Guard activity in the vicinity of Orr Spring.

2. Although the National Guard originally planned to use the Wig Mountain area for artillery fire and training maneuvers, such activity was not conducted because of the Guard's failure to support the preparation of an updated Environmental Impact Assessment and to abide by the restrictions necessary to protect the wildlife, terrain and vegetation of the Wig Mountain area, which includes Orr Spring. The National Guard activities, therefore, were restricted to White Sage Flat, with artillery fire directed southward toward Simpson Buttes. Both the firing and impact areas were at least 20 miles southeast of Orr Spring.

William S. Tanner

William S. Tanner
Chief
Range Control Office

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Fld 3

DA FORM 1 FEB 62 2496 REPLACES DD FORM 96, EXISTING SUPPLIES OF WHICH WILL BE ISSUED AND USED UNTIL 1 FEB 63 UNLESS SOONER EXHAUSTED.

☆ GPO 1970 O - 390 415

TECHNICAL SURVEY[a]

Date	Time	Action
4 Jul	2010	Helicopter arrives at Orr Springs. Most of the wild horses are in the north gully pawing at the seep. Helicopter frightens most of them a short distance down the gully onto the flats below. As they run some are observed to stumble.
	2015	CPT Lewter (Chief, SO) and CPT Lee (Post Veterinarian), Mr. Faux (Security supervisor), E-3 Daniel (SO) arrive at the site and begin investigations.
	2100	CPT Lewter reports to Provost Marshal's Office that 20 dead horses are counted, one colt on last legs. Approximately 16 horses are weakened but alive. Some of the dead are bloated and one colt had its hind quarters eaten by a scavenger. CPT Lewter noted that children's footprints were seen by the watering trough (later determined to belong to the Kirk children). No horse prints observed at or around trough.
	2115	Colt that was too weak to run falls down.
	2120	Colt has recovered and gets back on its feet.
	2140	Colt collapses again.
	2145	Mr. Oyler (SA) and Dr. Stark and Dr. Pinkham (MT-L-E) arrive at site. Verify count of 20 dead horses. No evidence of encephalitis, i.e., no traces indicating circular wandering (or "blind staggers"). No "running" on the side before death. Head is thrown backwards on one horse.
	2150	Colt is steadily weakening. Dr. Lee and Dr. Stark begin examination of colt by flashlight (assigned specimen #2 on 5 July). Findings: Heart rate is gradually slowing, breathing is slow, labored and irregular, content of bladder is lost, oral mucous membranes are ashen gray rather than pink indicating presence of toxin; pupils dilated, distinct lack of evidence of cyanosis; condition is extremely emaciated and, therefore, horse is weakened. Severe dehydration is contraindicated evidenced by a lack

[a]Some notes on sightings of carcasses and live horses are contained in the Air Transportation Support log and the Administration and Support log.

		of sunken eyes and tenting up of the skin. Attempt to draw blood sample from jugular vein. Vein is collapsed, attempt unsuccessful. Dr. Pinkham conducts plant survey by flashlight: finds evidence of grazing on alkali sacaton (Sporabolus sp.). Approximately 50% of the clumps of this species in the area have been grazed. Halogeton abundant, but not being grazed.
	2200	Colt dies; attempt to draw blood sample from lungs; approximately 1-2 cc's of clotted blood is obtained with great difficulty. Attempt to obtain sample of stomach contents with a syringe--no success.
	2215	Dr. Stark and Dr. Lee join Dr. Pinkham in reconnaissance of area. Findings: Rest of horses have been dead too long (probably no more than two days) to tell anything definite. No signs of violent deaths (soil by feet is not dug up). Some carcasses have a bloody froth coming from the nostrils. Note that more feces would be expected around watering hole frequented regularly by so many horses. Observe wet area (diarrhea area?) collect sample. Collect sample of reasonably fresh feces. Collect sample of water from seep on north gully. Seep is contaminated with feces. All carcasses are in north gully except three on ridge north of gully and one on ridge south of gully.
5 Jul	0820	Dr. Lee, E-3 Washington and Mr. Anderson arrive at site. Mr. Anderson reconnoiters site. Dr. Lee begins autopsy of colt that died the night before, assisted by E-3 Washington.
	0850-0900	Dr. Stark, Dr. Pinkham and Mr. Davis arrive at site. They are joined by Mr. Glade Anderson. Observe approximately five horses above and to the north of the springs. They are emaciated. Mr. Davis remarks that fence posts and flags around water trough would keep wild horses away from the trough. Furthermore, they wouldn't drink from trough even without these other foreign objects unless they were very thirsty.
	0900	Dr. Stark, Mr. Anderson and Mr. Davis draw two blood samples (one with and one without anticoagulant) from a colt that was near death (specimen #1). (Each horse is marked with its specimen number on the blaze on its forehead.) Dr. Stark takes a water sample from the overflow basin and the watering trough. Dr. Stark,

2B

5 Jul	Mr. Anderson and Mr. Davis proceed up the north gully where Dr. Stark obtains a water sample from the seep (nicknamed "Dead Horse Draw Seep" by Dr. Stark and so entered in his records). Dr. Stark, Mr. Anderson and Mr. Davis cross over to the location of upper Orr Springs, Mr. Davis removes the cover to the head box and releases the plug so that water flows into area below head box where horses could drink it. Dr. Stark takes a water sample from the head box--flow is vigorous.
0900-0915	Dr. Pinkham examines trough for macroscopic animals; none is observed. Filamentous algae are present; walks down banks to overflow basin. The soil has been pulverized by horses. They are obviously using this as a watering hole. Only trails leading to it come up the gully. Filamentous algae are noted, but no attempt is made to look for macroscopic animals. Dr. Pinkham continues investigation of plant species begun the day earlier. Notes recent grazing on cheat grass (Bromus tectorum) and less recent grazing on Mormon tea (Ephedra sp.). Also identifies one stalk of Sisymbrium altissimum that had been grazed. Identifies abundant princess plume (Stanleya sp.) indicating the presence of selenium in the soil. It is not grazed, although many of the plants are dried up and most of the leaves and pedicels (flower stalks) are fallen off, giving the impression of grazing until close examination.
0915	Pinkham meets Stark, Davis and Anderson at upper springs. Note presence of water in overflow basin and small seep on north gully plus knowledge that Cochran and Cane Springs and Black's Lake are watering holes used regularly by horses. All are puzzled by dehydrated appearance of the horses when water is available and apparently being used.
0915-0935	Team attempts to drive a herd of three colts and six adult horses (one has ID collar) to water at upper Orr Springs just recently released from head box. They run right by the water. A colt in the herd is lassoed and it is assigned specimen #3: two blood samples are drawn and then it is lead to the water where it at first seems incapable of drinking. After splashing water into its mouth, it starts to drink.
0935-1100	COL Templeton, Mr. Oyler and Mr. Stephens arrive. COL Templeton obtains update from team present at site. Mr. Oyler takes Mr. Stephens around site where the latter photographs each of the 21 carcasses. CPT Lee joins group at

5 Jul

Upper Orr Springs. He has completed autopsy (he obtained stomach contents (a gray fluid), lung, liver, spleen and kidney tissue, none of which appears macroscopically abnormal). Central nervous system (CNS) not dissected. All the samples taken during the day are placed on ice. Dr. Pinkham constructs an earthen dam at upper Orr Springs to provide a water hole. Dr. Stark, Mr. Davis, Mr. Anderson and CPT Lee attempt to capture/drive the remaining eight horses back to the water. A mare, a stud and two colts are driven to water. The mare is lassoed, two blood samples are taken (mare is specimen #4). Stud has watery stools. Observe a healthy jackrabbit (Lepus californicus) on side of gully near upper Orr Springs. Also note two to three whiptail lizards (Cynemidophorus tigris). Team desires saddle horses to herd other wild horses to Orr Springs. COL Templeton requests two saddle horses.

1100 Colt (#3) shows signs of weakening, falls on its side. (Brought into shade where it slowly weakens like colt (#2) the night before.) Colt (#1) brought back to site by Mr. Stephens and Mr. Oyler; it has improved markedly; able to stand now. (Mr. Oyler had been hand-feeding it water from the trough) The colt (#1) is led to the water where it drinks. All horses are prevented from drinking too much water at one. Team decides to get dextrose for horses. Health Clinic has none available.

1115 Colt and stud are lassoed and blood samples taken from each. (#5 is a colt and #6 is the stud.)

1135 Team agrees that requirement for saddle horses is unwise in light of uncertainty over cause of death.

1210 Colt (#3) expires; shows no signs of kicking at its belly (death by water shock). Colt (#3) dies in similar manner as colt (#2) the night before. In addition, it lost control of its bladder. Colt (#5) shows signs of weakening, after perking up from water it drank. Dr. Lee performs autopsy on colt (#3). Findings: Same as with colt (#2) autopsied earlier, also compacted feces in colon, probably has not passed feces in past 3 days. Stomach is empty. No organs look peculiar. CNS not dissected. Colon contents sampled.

1230 Stud at upper Orr Springs is lassoed; two blood samples are drawn (specimen #6).

2 B

5 Jul	1315	Mr. Deuel, Mr. Hall and Dr. Watkins arrive on site.
	1340	Colt (#5) dies. Dr. Watkins decides to await arrival of Dr. Schoenfeld before performing autopsy on #5. Mr. Deuel and Mr. Hall survey the site.
	1440	CPT Lewter and Dr. Kirk arrive at Orr Springs. Dr. Kirk verifies that he should have been able to see some of the carcasses on 3 July. Dr. Schoenfeld and Mr. Nichols arrive on site.
	1445	Drs. Schoenfeld and Watkins and Mr. Nichols perform autopsy on colt (#5) (autopsy file number 27327, see Incl 5). Findings: Ashen gray mucous oral and conjunctival membranes. Spleen is edematous (excessive fluid in tissue spaces) stomach contents consist of gray fluid also seen in #3. Caecum is packed with approximately 75% mud. Diffuse hemorrhages in stomach and petachial (pinpoint) hemorrhages on spleen and some diffused hemorrahagic lesions on the caecum and small intestine. Lining of the wall of small intestine appears thinner than normal. Two fractured ribs which appear incidental. White froth at bifurcation of trachea; perhaps due to aspiration when drinking.
	1500	CPT Lewter and Dr. Kirk depart Orr Springs.
	1510	Stop autopsy, survey other carcasses.
	1525	Return to colt (#5) and perform autopsy on CNS. Findings: Approximately 30 cc's of bloody fluid in brain cavity. Brain has appearance expected 12-24 hours after death (Muddy texture); very high number of petechial hemorrhages on brain; Formalin specimens of standard tissue were taken. Dr. Schoenfeld also took blood samples from three clinically ill but alive horses (#1, #4, and #6). Schoenfeld will have tests run on Western and Eastern Equine Encephalitis and Equine infectious anemia.
	1545	Complete autopsy.
		A colt recently found wandering above the spring is put to sleep by Mr. Deuel because it is 2-3 weeks old and its mother is apparently dry, therefore, it has no chance

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5 Jul		of living. It is taken by Schoenfeld who will have state pathologist perform necropsy (file autopsy # 27326). Blood sampletaken from Palomino colt, marked #7 by Mr. Deuel. This is not the #7 marked by the MT-L-E team the following day.
	1600	Team leaves site.

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6 July	0745-1000	Executive briefing (see Administrative and Support Log) Experimental Approach (Incl 1) in development.
	0900	CPT Maxwell and Sp Saunders (MT-L-E) arrive on site in Baker Vehicle.
	0900-0930	CPT Maxwell and Sp Saunders survey the situation and verify the count of carcasses, except they find another colt at upper Orr Springs. It turns out to be #1 from the day before. They identify the location to set traps and assist in setting out traps and collecting samples.
	0930	Max Green and Dick Davis arrive on site in Baker vehicle.
	1020	Dr. Spendlove, Ogden Kraut (DPG Photographer), Mr. Anderson, Mr. McRae (BLM), Dr. Watkins and CPT Law (DPG plant expert) arrive on site in helicopter.
	1020-1040	Crew observes one mare in north gully on its last legs, surrounded by four other live horses. Also observe two colts and two mares just above upper Orr Springs. One of the mares appears to be the same mare (with mud caked on rump) as watered yesterday. They appear stronger than most horses seen around Orr Springs yesterday.
	1020-1600	CPT Law conducts plant survey (Incl 2).
	1040	BLM crew leaves on aerial survey in helicopter.
	1045	Mare in north gully dies in same manner as other horses were observed to die. Blood is sampled (#7) by Mr. Davis.
	1045-1500	It is then decided to gently move the four remaining horses that are standing docile up to the right hand draw and try to water them. They are emaciated and appear almost beyond caring. The crew forms a semi-circle and move them over to the water. When they are about 20 feet from the hole, they become aware of the water and immediately move in and begin to drink heavily. The team lets them drink for 10 minutes and attempts to rope one to

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6 July		obtain blood. The first attempt fails and the horses move up the hillside. The team moves back and the animals immediately return to the water and begin drinking again. After 10 more minutes the team attempt to rope another horse and this time succeed. The team brings down a large black mare. After bleeding, (specimen #8) cannot rise so we helped her. Once up, she very shakily returned to the water and started drinking. The stress of roping is apparently too much for her, because within five minutes she falls down and expires. It is now obvious that water is a major problem. So a decision is made to cease taking blood samples, clean up the area, move out the dead horses from around the spring and leave, so the remaining horses could water in peace. Once this is done we try to move the remaining three horses back, but they have joined the horses that had watered the day previously. These horses, which were near death on the 5th of July now appear like any healthy mustang. As the team approaches, they run at full gallop. The team moves out of the area and within an hour all five horses move back for water.
6 July	1300	Dr. Spendlove and Mr. Davis drive back to Baker.
	1345	Mr. Davis returns in Baker Vehicle
	1345-1500	Mr. Vowles and Mr. Skelton (MT-T-O) Grid Operations, dig out catch basin below upper Orr Springs. Mr. Vowles and Mr. Skelton do the same at Bitter Springs and place four watering troughs flush with the ground. Horses do not use them but they are using watering holes at Bitter Springs. (Subsequent entrees of this nature are contained in Administration and Support log.)
	1400	Dr. Stark arrives on site.
	1400-1930	Dr. Stark and various people from MT-L-E set out 120 can traps (liter oil can attached to Museum Special snap-trap) on Orr Springs. Thirty traps are set in each line as follows: 1. Along north gully 2. On ridge between north and south gully 3. Below watering trough 4. In old corral with squaw bush, A-3. (Some rodent sign in Line 4). Nine mosquito light traps with CO_2 ice are set along ravine and in Tamaracks below horse trough.

6 July		Soil samples are collected (objective: Anthrax) at 13 sites in the north and south gullies. These are in places where the soil has been disturbed such as road cuts and fills around the two springs. Also soils are taken around seeps, dry creek bottoms and in some places on the ridge above the ravines, e.g., a moist spot supporting Distichilis stricta, which had been closely cropped by the horses and in a site in which soil had been trampeled into powder by horse activity. Algae samples are collected from overflow basin.
	1400	Helicopter with Dr. Taylor and Dr. Spendlove arrives on site. Dr. Taylor performs autopsy on mare that died this morning (File # 27325 - Report arrives DPG 8 July).
	1500	Dr. Spendlove and Mr. Kraut leave in helicopter. Dr. Taylor performs autopsy on mare.
	1600	Mr. Green, Mr. Davis and CPT Law depart site in Baker vehicle.
	1600-2130	Burial crew retrogrades 17 carcasses from Orr Springs to Site 2. They are *not* buried. (Further retrograde operations are recorded in Administration and Support Log.)
	1930	CPT Maxwell, SP Saunders and Dr. Stark depart site in Baker vehicle.
7 July	0600	CPT Maxwell, SP Saunders arrive at site. They run trap lines; three mosquitoes are collected by light traps. It is reasoned that future light traps will be placed where mosquitoes and horses are found together. (Additional results are prescribed in Incl 5.)
	0800	Dr. Salomon receives results from Baker Lab (Incl 5) as well as the weather data (see Background Log) and the information on the genus Ephedra (Incl) requested at 1200 on 8 July (see Administrative and Support Log).
	0900	CPT Maxwell and SP Saunders leave site after running trap lines.
		Dr. Stark identifies 5 mosquitoes caught from Orr Springs. Mr. Crane has records of light traps and identification of

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7 July

species from 7 and 8 July. Dr. Stark prepares sensitized sheep cells for tularemia serology. These await time to run.

0930

Mr. Green and Dr. Rees collect soil samples from mud hole south of Wig Mountain (Site F) and another from Bitter Springs (Site B). They also collected two five gallon water samples from each of the upper Orr Springs, lower Orr Springs, watering trough and overflow basin. A smaller sample (approximately 1 liter) was taken from the seep in the north gully. All water samples are for analysis in the Chemical Laboratory (results presented in Inclosure 4).

0930-1600

MT-L-E personnel perform the following tasks:

Captured rodents are bled and some are kept alive (numbers in field records).

Mr. Bob Weaver of CDC in Atlanta can confirm bacteriology of anthrax - Job Sealey can confirm serology of Anthrax (303-482-0213).

Dr. Thomas J. Quan is contacted at Plague Branch, Vector-Borne Disease Laboratory, CDC, Ft. Collins. It is decided that specimens for bacterial study (anthrax, plague, tularemia, enterocolitis) should not be sent.

It was decided to send specimens for arboviral isolation to CDC for confirmation. Arrangements were made between Dr. Salomon and Mr. Crane at DPG and Mr. Thomas Monath, Director of Vector-Borne Disease Lab and Charles Calisher, virologist.

Colon contents, stomach contents and fresh feces samples were separated for Dr. Richard M. Hansen, Natural Resources, Colorado State University, Ft. Collins. Ten samples in all were sent from several horses (Incl). AchE, hematocrit and other tests are continuing.

1030

CPT Maxwell leaves Baker for Orr Springs. He is informed over the radio (George 2 is the call sign used) of the location of a mare that just fell. The location is in the vicinity of Orr Springs road and Relay Station road. With assistance from National Guard helicopter, a thorough search is made and no

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7 July		mare can be found. It is assumed that the mare recovered and left the area.
	1100	Dr. Rees and Mr. Green leave the site.
	1135-1300	Helicopter transports newsmen to and from site (see PAO log). Also included are Dr. Schoenfeld, Dr. Klover (Veterinary Services, USDA), Dr. Rothenberg, Dr. Watkins, COL Templeton, Mr. Hall and Mr. McRae.
	1200	CPT Maxwell and SP Saunders arrive at 1200 to set trap lines and continue survey.
	1400	National Guard helicopter brings Mr. Hall and Mr. Lonnie Johnson (Humane Society, State of Utah) to site.
	1430	Dr. Lee, Dr. Schoenfeld, Dr. Klover, Dr. Spendlove, CPT Maxwell, Mr. Davis, Mr. Max Green (MT-L-E) arrive on site in vehicle to perform autopsy on a foal (specimen #10); take blood and tissue from brain, spinal cord, heart, trachea, mesenteries, lymph node, kidney, colon (and contents), stomach (and contents), small intestine (and contents), caecum (and contents), liver and spleen.
	1445	National Guard helicopter takes veterinarians to site (see below).
	1500	CPT Maxwell observes Mr. Hall and Mr. Johnson tranquilize and kill two wild horses (#5 and #6). The horses had been bled previously on 5 July. Prior to being put down, the horses appear healthy and greatly improved.
	1530	CPT Maxwell observes autopsy of horse #7 by Dr. Schoenfeld, Dr. R. A. Smart, Dr. Taylor, CPT Lee, LTC Reddin, Dr. J.L. Shupe and Dr. R.L. Poulson (Assistant State Veterinarian for Utah). (Dr. Smart and Dr. Shupe are from Veterinary Sciences Department, University of Utah.) CPT Maxwell receives blood samples and tissue samples (brain, liver, heart, colon and kidneys).
		CPT Maxwell, Dr. Stark and Mr. Crane arrive at site to set mammal and mosquito light traps: Four light traps in Orr Springs east ravine, one in Orr Springs west ravine and

2B

7 July		one at horse trough. (Still no sign of horse hoof prints at trough.) Set 120 can traps for rodents on each side of south gully at Orr Springs.
	1545	Dr. Rees innoculates guinea pigs for bacterial analysis.
	1600	Dr. Watkins briefs COL Templeton and others on results to date of pathological investigation (see Administration and Support Log) results are at Incl 3.
	1615	Analyses of water samples is completed (Incl 4).
	1630	Team of veterinarians leave site. Mr. Hall and Mr. Johnson stay.
	1700	Dr. Osguthorpe arrives at site. Mr. Hall and Mr. Johnson tranquilize another horse (horse #49 in Incl 2, Administration and Support Log).
	1800	Dr. Osguthorpe and Mr. Hall and Mr. Johnson leave site.
		MT-L-E is feeding water samples to rats to determine toxicity.
	1900	CPT Maxwell, SP Saunders, Mr. Crane and Dr. Stark leave site.
8 July	0600	CPT Maxwell, SP Spencer (MT-L-E) and SP Saunders arrive at site to check trap lines (results in Incl 5) and reset spring traps.
	0900	Above team leaves the site; mosquito traps are not reset, but rodent traps are reset.
	1000-1230	Specimens (Incl 5) were selected and separated for CDC Laboratory, US Public Health Service, Natural Resources Laboratory, Colorado State University, both at Ft. Collins, Colorado. Portions of all samples sent were kept in the isolation refrigerator at Baker Lab.
	1109	Mr. Rigby (MT-T-AV) observes seven head at Granite Mountain, that were previously part of Orr herd (all are less skittish than the other horses are).

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8 July	1230	Dr. Stark leaves on M-8 fixed wing plane for CDC. Upon arrival at Ft. Collins, specimens for arbovirus testing were delivered to John Lazvick and Charles Calisher at the CDC Laboratory and to Dr. Richard M. Hansen at the Natural Resources Lab, Colorado State University.
	2100	Dr. Stark returns from CDC.
10 July	0600	Dr. Stark, SP Sanders and CPT Maxwell arrive at Orr Springs to check rodent and mosquito traps. Results: Line #1 - 1 Peromyscus moniculaties (PM) and 1 Perognathus Plavus (PF) Line #2 - None Line #3 - 1 PF Line #4 - 1 Ammospermophilis Leucurus (AL) Total of four animals, all are kept alive for observation. Of the six mosquito traps the team finds numerous trash insects and a total of 10 mosquitoes (more details are in Incls 7 and).
	0900-1900	Team returns to Baker via Old Orr Springs road. They observe standing water in the watering hole south of Wig Mountain. Dr. Stark charges up batteries for mosquito traps and separates and identifies mosquotoes (Incl). Dr. Stark places specimens in freezer of rodents trapped this morning; 2 are bled for samples, 2 are kept in lab for observation. Dr. Stark posts guinea pigs for Dr. Rees. Spleens from horses #2 and #3 killed guinea pigs. Dr. Stark takes liver, spleen, heart and lung tissue and streaks it on blood agar plates which are incubated (Incl). Specimens are placed in freezer in June McAllister's animal room. The team discover blood samples which were taken from horses #6 and #7 last night are missing. Dr. Salomon is informed. He apparently locates the samples in SLC with Dr. Taylor. Mr. Hereim will pick them up.

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10 July 1900 CPT Maxwell and Dr. Stark proceed to Orr Springs, bait and set five mosquito traps (1 trap is not working -- brushes burned out).

The plug was removed from cistern at Orr Springs West in order to protect DPG from further loss of horses. There is no evidence of horses taking water from established BLM trough or from temporary troughs established by decon near burial site. There is some evidence of horse hood prints in pond above these troughs. It is obvious that all the remaining horses in the area are getting most or all of their water from Site D at this time. It is also obvious the horses are avoiding Orr Springs area (Sites A-1, A-2 and A-3) perhaps because of excessive human activity there.

2200 Team returns to English Village.

11 July 0600 CPT Maxwell, SP Sanders and Dr. Stark arrive at Orr Springs. Team checks mammal traps:

Line #1 - 2 Pm
Line #2 - 1 Al
Line #3 - 2 Pf
Line #4 - None
Total of 5 animals (one Pm escaped in lab)

Lines 1, 2 and 3 were moved to Site D approximately 1/4 mile from the upper gully at Orr Springs. These lines will now be referred to as 5, 6 and 7. Also checked the 5 mosquito traps (see below).

0900 The team observes that the water hole at Bitter Springs has been enlarged by bulldozer. Hole is now approximately 10 feet wide and 12 inches deep. The troughs placed there last week still have not been touched by the horses.

Dr. Stark identifies 11 mosquitoes from 5 functional traps (1 Nedes melchomon, 1 Culista inomata, 9 Culex tarsalis) (Incl).

Dr. Stark posts 3 guinea pigs which died from horse brain #10 and #7 and horse spleen #10. Dr. Rees has record. Slides are made for staining.

Dr. Stark checks Crane's suckling mice -- none died.

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11 July	0945	Returned to Baker. There is a disagreement and/or misunderstanding on the system of record keeping for the live animals.
	1900	Dr. Stark and CPT Maxwell return to site to set traps (transported there by decon personnel earlier in the week).
	2100	Team returns.

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ADMINISTRATION AND SUPPORT

Date	Time	Action
4 July	1945	CPT Lewter is notified of dead horses at Orr Springs. CPT Lewter calls COL Templeton. COL Templeton instructs CPT Lewter to notify Dr. Pinkham (MT-L-E) and then COL Templeton goes next door to get Dr. Lee (post Veterinarian).
	1950	CPT Lewter contacted Mr. J. Oyler (SA) who also lives in Terra because Dr. Pinkham did not answer his phone.
	2015	Mr. Oyler locates Dr. Pinkham. Mr. Oyler leaves for DPG.
	2045	Dr. Pinkham and Mr. Oyler convene at Provost Marshal's Office (PMO). Dr. Pinkham recommends that Dr. H. Stark (MT-L-E) also be contacted.
	2140	Dr's. Stark and Pinkham and Mr. Oyler leave Ditto for Orr Springs.
	2140	PMO attempts to contact Mr. Ron Hall (Bureau of Land Management). This and following attempts are unsuccessful. (Mr. Hall was away from his residence between 2100, 4 July and 0100, 5 July.)
	2145	COL Templeton contacts Dr. J.C. Spendlove (Chief, MT-L). Dr. Spendlove contacts Dr. Rees (MT-L). Dr. Rees suggests contacting Dr. Schoenfeld (Utah State Veterinarian) and Dr. Fukushima (Chief of Bureau of Epidemiology, Utah State Division of Health). Dr. Spendlove attempts to contact Dr. M. A. Rothenberg (Scientific Director, DPG), Dr's. Schoenfeld and Fukushima -- unsuccessful.
	2155	Dr. Spendlove calls COL Templeton; suggests Dr. Rees call Dr. Schoenfeld and relays that he was unable to get Dr's. Fukushima and Rothenberg.
	2300	Team at Orr Springs returns to MAAF.
	2300	Samples taken at Orr Springs are placed in the refrigerator at the Health Clinic.

4 July	2330	Dr's. Rees, Stark and Pinkham (all MT-L) convened at COL Templeton's house. It is agreed to meet at 0730, 5 July at the PMO. Mr. R. Davis (MT-L-E) is called and requested to be present at 0730, 5 July. He is asked to contact Mr. R. Hall (BLM). He notifies those present that Glade Anderson has replaced Mr. Hall as the field representative for BLM. Mr. Davis will attempt to contact Mr. Anderson and request his presence. Dr. Rees agrees to contact Dr. Schoenfeld (Utah State Veterinarian) and Dr. Fukushima first thing in the morning.
	2355	Mr. Davis contacts Mr. Anderson's mother and leaves message to meet him in the morning.
	2400	Meeting breaks up. Dr's. Pinkham and Stark leave.
5 July	0030	COL Templeton and CPT Lewter advise TECOM Staff Duty Officer that approximately 25 horses have died on DPG. The State and BLM will be involved later this morning and a team of DPG and BLM personnel is scheduled to leave for the site at 0730. There is no known reason for the deaths. The duty officer is asked to relay the message to Chief of Staff and Public Affairs Officer at TECOM.
	0730	COL Templeton, Dr's. Stark and Pinkham, CPT's Lee and Lewter, Mr. Davis and Mr. Anderson convene at PMO.
	0735	Dr. Pinkham notifies Mr. K. Deuel (Installation Pest Control Officer). Mr. Deuel agrees to come to DPG ASAP.
	0745	Above teams leave Health Clinic pad for MAAF.
	0755	Arrive MAAF. Dr. Stark and Mr. Davis leave to pick up key to Baker and 4-wheel drive vehicle.
	0800	Leave for Baker.
	0805	Arrive Baker; Dr. Pinkham leaves. Dr. Stark and Mr. Davis arrive at Baker.
	0810	Mr. Oyler arrives at PMO.

5 July	0810-0820	Three men at Baker gather gear consisting of ice chest, syringes, blood sampling tubes (some with anticoagulants) and other gear to support the sampling program.
	0810-0820	Mr. Oyler obtains update from CPT Lewter and learns that a photographer is needed. Mr. Oyler suggests Mr. R. Stephens (DPG photographer).
	0815	Dr. Rees recalls that Dr. Fukushima is in San Francisco; decides to call Mr. Nichols (a subordinate of Dr. Fukushima) who, in turn, calls Dr. Schoenfeld. They agree to meet the helicopter at the National Guard heliport in Salt Lake City and Ogden between 1200 and 1300. Above three-man team leaves Baker for Orr Springs. Travels over paved road to Wig Mountain, then up dirt road, past naval gun mount to Orr Springs. Mr. Stephens and Mr. Oyler arrive at PMO.
	0822	Three-man team observes one dead horse approximately two miles north of Baker on west of road.
	0825	Three-man team reconnoiters dried mud hole south of Wig Mountain. Observes same dead horses seen in helicopter overflight the previous night and four emaciated horses which are reluctant to leave mud hole. Approach within 40 feet of these horses before they leave. One stumbles as it moves up bank.
	0830	CPT Lewter calls Mr. Ron Hall, BLM representative for this area (phone 363-2874). Mr. Hall will be in area approximately 1030 hours for recon. Mr. Hall attempts to contact other BLM officials: Rulon McRae (Acting District Manager, Salt Lake District), Al Logosz (Range Specialist, Utah State Office), Bill Levall (Associate State Director), Paul Howard (State Director) -- all unsuccessful. Mr. Hall contacts Dr. R. Watkins at home; he agrees to come to DPG with Mr. Hall.
	0830-0840	Dr. Rees and Mr. Stephens arrive at PMO. Dr. Rees informs PMO that he has promised a helicopter pickup in Salt Lake City (agreed upon at COL Templeton's the night before). CPT Lewter decides to inform COL Templeton of decision and reaffirm permission to arrange helicopter flight.

5 July	0840	Three-man team observes a herd of 5 head, one yearling and 2 colts on first major ridge to the south of Orr Springs. All appear very healthy; vigorous and slick coats.
	0845	Three-man team observes approximately 5 horses on outwash plain at foot of gully containing Orr Springs (Bitter Springs). Horses too far away to observe condition. They were standing in the shade of juniper trees.
	0845	LTC Schultz calls Mr. Endsley, Mrs. Riddle (DPG PAO) to coordinate PA news release. No answer.
	0850	Three-man team arrives at Orr Springs.
	0900	Mr. Stephens and Mr. Oyler leave for Ditto by car.
	0910	Security Office attempts to notify COL Templeton that Dr. Schoenfeld and Mr. Nichols are available and interested. Call garbled, only "SLC" comes through.
	0915	COL Templeton arrives at MAAF; he immediately calls Security Office to determine nature of call at 0910; grants SO's request to arrange a helicopter pick-up in SLC and Ogden. COL Templeton calls LTC Schultz to give him an update: All herds checked. Only those at Wig Mountain, Orr Springs area are in trouble. Of a herd of 50, approximately 25 dead are at Orr Springs, one between Wig Mountain and Baker Lab causeway; three are emaciated and apparently not getting enough fluids. Helicopter to pick up Mr. Nichols at SLC 1230 hours; Dr. Schoenfeld Ogden 1300 hours. Drs. Pinkham, Stark and Lee still in field.
	0920	Mr. Stephens and Mr. Oyler arrive Ditto; Mr. Stephens goes to photography lab to obtain film and equipment.
	0925	Mr. Stephens and Mr. Oyler check in at Ditto Security, meet COL Templeton who offers to take them to site in helicopter.
	0930	COL Templeton, Mr. Stephens and Mr. Oyler depart for Orr Springs. Mr. Deuel arrives at PMO. He is told that BLM crew is due in shortly and that he should wait for them.

5 July	0936	TECOM SO is called -- busy.
	1045	CPT Lewter calls FBI Special Agent Johnson. Mr. Johnson says he is available.
	1050	Security called by COL Templeton. Desire two saddle horses at Orr Springs.
	1055	Security notifies Mr. Deuel that the horses are needed.
	1105	Mr. Deuel leaves for Terra to pick up his horse.
	1135	CPT Lewter receives call from COL Templeton, told to cancel order for horses.
	1140	Mr. Hall and Dr. Watkins, veterinarian in private practice, acting as a BLM consultant, arrive at PMO.
	1145	Mr. Hall and Dr. Watkins leave for bowling alley.
	1150	Mr. Deuel returns to PMO; learns BLM crew at bowling alley and that requirement for horses has been cancelled; picks up lunches at PMO and goes to bowling alley.
	1155	Mr. Deuel arrives bowling alley; notifies BLM crew to meet him at Fries Park.
	1200	Mr. Deuel arrives at Fries Park and off-loads horse.
	1205	BLM crew arrives at Fries Park.
	1215	BLM crew and Mr. Deuel depart Fries Park for Orr Springs in BLM vehicle.
		Dr. Spendlove contacts Dr. Rothenberg.
	1315	BLM crew arrives at Orr Springs.
	1600	Personnel remaining at site depart and return to their respective home bases. COL Templeton, Dr. Schoenfeld, Mr. Nichols, Mr. Oyler and Mr. Stephens in the helicopter; Mr. Hall and Dr. Watkins in the BLM vehicle and Mr. Deuel in the Baker Lab truck.

5 July	1800	Mr. Hall contacts Mr. Howard.
	1900	Dr. Spendlove notifies Dr. Salomon (Deputy Dir, MT) of situation. Dr. Salomon attempts to call C.B.Olsen, Dir., MT; unsuccessful.
	2145	Dr. Salomon contacts Mr. Olsen.
	2300	Mr. Hall contacts Mr. McRae. Mr. McRae agrees to come to DPG next morning (6 July) for executive briefing and planning meeting.
6 July	0745-1000	Hold executive briefing and planning meeting in Dr. Rothenberg's office. In attendance: COL Templeton, Dr. Rothenberg, Mr. Olsen (Dir, MT), Dr. Salomon (Dep Dir, MT), Dr. Spendlove, Dr. Pinkham, Mr. Woods (Dir, Logistics), Mr. Deuel, LTC Schultz and CPT Lewter, all from DPG; Mr. McRae, Mr. Hall, Mr. Anderson and Dr. Watkins, BLM. Dr. Pinkham agrees to take notes and maintain an accurate log on the investigation. The history of the incident is discussed (see logs for details), and an experimental approach to the investigation is developed (see Appendix A, Technical Survey, for details). It is decided to prepare news release (see PAO log) and to request that Dr. Jack Taylor (State Pathologist) visit site. Dr. Salomon suggests that electrolyte imbalance may be a factor.
	1020	Helicopter lifts off with BLM and DPG people; Emergency Operations Center continues to monitor.
	1200	COL Templeton briefs LTC Herndon (DARCOM) Chief of Environmental Quality, Office of the Surgeon, on incident.
	1215	Helicopter enroute to SLC airport (National Guard heliport) to pick up Dr. Taylor, Intermountain Lab pathologist.
	1250	COL Templeton briefs COL Jones, Project Manager's Office, Demil Office, Edgewood Arsenal, on incident.
	1355	Mr. Hall and Mr. Anderson suggest hauling animals out of the drainage area this afternoon to another point before carcasses decompose so badly they cannot be moved. They and Dr. Rothenberg decide to haul the animals even though hauling might spread a pathogen (if one is involved) because burying

6 July

them in situ (in the gully) would spread pathogens even farther with next flash flood. Burial will be in pits six feet deep and the carcasses will be covered with quicklime.

1430 Mr. Woods receives guidance from Dr. Rothenberg to establish a time to go ahead and start pulling dead animals out of the canyons to a centralized location for burial; however, burial would not be accomplished until further notification. Mr. Woods calls Facilities; tells them to dig hole.

Helicopter returns from SLC with Dr. Taylor; proceeds to site.

1435 Mr. Woods calls Boyd Coombs (LD-S) and requests that he get a wrecker, dump trucks, a team of people, and contact Mel Bushnell (Chief, MT-T) to provide operator for crane in the event the wrecker does not have the capability to lift the animals into the dump truck. Mr. Woods emphasizes the need for detailed log and that overtime is authorized up to darkness.

1445 Mr. Woods calls Mr. Olsen and explains to him the requirements of burial; requests that change house be notified and alerted that gas masks, rubber gloves and protective aprons will be required; also, that Mr. Coombs is working with Mr. Bushnell to find an operator of the crane. Mr. Olsen states Mr. Bushnell will provide operator.

LT Cable and MSG Dean (LD-S-E) receive a call from Mr. Coombs stating that a commitment has been made to help dispose of 25 dead horses.

Mr. Coombs requests two dump trucks, one 4x4 with winch, the wrecker, slings, and eight personnel. Mr. Coombs asks if Equipment Pool could be ready to go in 30 minutes.

LT Cable tells Mr. Coombs the wrecker is not capable of lifting (high enough) to place an object in a dump truck, and that a 4x4 pickup with winch does not exist at Dugway, at least as part of the Equipment Pool. Equipment Pool states a crane or Equipment Operations Branch (MT) boom truck will be needed. The Equipment Pool does not have a qualified operator for this equipment.

6 July	1455	LD-S-E dispatcher calls Facilities for two dump trucks. SSG Brown (LD-S-E) gathers a crew of eight people.
	1500	Mr. Earl Retford (LD-F) calls MSG Dean (LD-S-E) and asks what is going on. The former states that Facilities has the work order to dig a hole to bury the horses. He asks what LD-S-E is going to do with them since his people have not lined up a dozer for that area. MSG Dean answers, "We don't know. We are just following instructions." Mr. Woods receives a call from Ray Russell (MT) who provides XO and Job Order number for collection account for costs associated with horse incident (XO: 1137713101 JO: 7751). Mr. Woods notifies Mr. Coombs who in turn notifies LT Cable.
	1505	LT Cable coordinates with Mr. Kenneth Antry (LD-S-M Maintenance Branch) to have some steel cable slings made to lift the horses. Mr. Coombs calls LD-S-E; tells them to use Equipment Operations boom truck #585, but that LD-S-E would have to supply the operator and that there are some tricks in operating this vehicle. At this time MSG Dean coordinates with Maintenance to have Lynn Anderson (LD-S-M) proceed to Equipment Operations to show SGT Williams (LD-S-E) how to operate vehicle. Two dump trucks arrive. SGT Roche (LD-S-E) and SGT Williams are the drivers. Two dead animals are found near intersection of Stark and Tango - one is north of Stark; one is south of Stark. Both are 1/4 mile off Stark Road.
	1510	SSG Brown contacts SO for clearance. He is instructed that LD-S would type up a DF of names and SSN's and SO would authorize it. At this time SSG Brown gives names and SSN's for the people who are going. The people are: MSG Dean, SSG Brown, SSG Roche, SP4 Morrow, SGT Williams, SP5 Larson, SP5 Hong, SGT Miller, SP4 Hadley (all LD-S-E).

6 July	1510	The wrecker is pulled off from another commitment. Wrecker and two dump trucks are fueled and redispatched -- standing ready to go.
		The Post Taxi picks up Mr. Hall (BLM) at Logistics and brings him to the Equipment Pool.
		LT Cable talks to LT Robar at Headquarters Company and asks for water, food, salt tablets and whatever else they could get immediately. SP5 Larson is sent to pick up Kool-Aid and salt pills.
	1515	SGT Williams and SP5 Hong depart for Equipment Operations to pick up the boom truck. Lynn Anderson is to follow shortly.
		SP4 Hadley is driving an IRF vehicle 4x4; only one is available. He departs with Mr. Hall for the change house and on to the site. It is determined that SP5 Larson knows the area and would lead the rest of the crew.
		LT Cable contacts CPT Lewter to ask if any radio contact was available in the area -- patrol -- security escort? His answer is NO. He doesn't know they are going out there. Problem is straightened out.
		Another group (wrecker, dump truck) leaves for the change house. Morrow picks up the signed security clearance from LD-S.
	1520	LT Cable cannot reach Ray Russell (all lines busy) for a radio equipped vehicle.
		SGT Williams calls to say Equipment Operations is supplying an operator for #585. He also says the vehicle has a test net radio.
	1525	SGT Brown and SGT Roche leave for change house with a dump truck and slings from Maintenance Shop.
	1530	Mr. Coombs directs a log of events be kept.
	1540	LT Cable calls 1st SGT at Headquarters and Headquarters Company (HHC) to ask if box lunches can be supplied to be carried by MSG Dean who will go to the area at 1640 hours.

6 July	1540	He calls back to inform LD-S-E that lunches (materials) are not available.
		LT Cable calls Ditto Security to inform them of the people and trucks proceeding to the area, and that vehicle #585 has a test net radio.
		MT-L personnel go to site of two dead horses on Stark Road; report puncture wound at base of neck down by shoulder; proceeding to other animal. (Puncture wound turns out to be a hole formed in deteriorated tissue caused by the release of internal decomposition gases.)
	1600	COL Templeton requests an EOC roster be established.
	1615	Mr. Woods calls to ask for call sign of the radio-equipped vehicle. A call to Equipment Operations and back to Mr. Woods in the Commander's Office reveals call sign to be 'TERMITE 5". He also states that the same crew should be ready to go back at 0730 the following day (7 July).
	1620	Mr. Woods receives a call from Dr. Salomon requesting emergency procurement of animals in support of horse incident. Requirements are as follows:
		a. 200 rats, 200-250 grams, male or female -- however, all must be the same sex.
		b. 110 guinea pigs, 275-350 grams, all male.
		c. 35 pregnant mice, to litter within 72 hours after receipt.
	1625	Mr. Woods calls Don Boothe (Procurement) and Bob Hunt (LD-S-S); requests purchase request numbers from Bob Hunt, which are provided (6189-001 thru 003). Provides Mr. Boothe with the above information; requests he take expeditious action to procure.
	1630	Cookies and cold soda are purchased and taken by MSG Dean to the area.
	2030	MSG Dean returns from the site.

6 July	2100	COL Templeton meets with Mr. Hall; learns 17 horses removed to burial site (#2) but not buried since trench is not dug yet.
	2130	ECO receives call from Dr. Spendlove to hold off removal of remaining horses until after press has departed DPG. First SGT Sullivan (HHC) will contact MSG Dean to hold work party until after press has left. MSG Dean is contacted and he will hold personnel in normal duty status until notified otherwise.

The crew (all eight people) returns from site. The following trucks were sent to the area:

IRF - Skunk, 4x4 ton	#481
Dump truck	#395
Dump truck	#396
Wrecker	#416
Boom	#585

7 July	0620	MAJ Click (Deputy Chief of Staff, Research & Development) and COL Phillips call EOC (LTC Helbling); get run down.
	0730	SSGT Brown tells MSG Dean that Mr. Hall said they were not going back to the site this morning to bury the horses because of the news media.
		CPT Lee briefs COL Shay (Chief Veterinary Activities (Fitzsimons Army Medical Center), 8-227-2145) and COL Clark (Surgeon General's Office, 8-227-2145) on situation.
	0730	Mr. Woods is notified by Dr. Rothenberg that two additional horses have been identified along Stark Road where Tango intersects. Mr. Woods receives direction to go ahead and bury those two horses at the site of death. Dr. Rothenberg decides to bury these horses since the news crew will not go near the area. Mr. Woods also receives guidance after burial of horses on Stark Road to proceed to Cain Springs and dig a trench to bury the horses that were being collected at that point but not to bury animals until further notification.
	0740	Mr. Coombs' calls Mr. Woods to determine requirements for today on burying detail. The former is told decision would be made about 1000 and to have people stand by.

7 July	0750	Mr. Woods calls LTC Wuerz and requested that the latter proceed to Stark Road to bury animals there. The former amplifies that at the Orr Springs area he will not bury the animals until such time as authority is received from Dr. Rothenberg. Mr. Woods provides him with the JO and XO; requests detailed log be maintained.
	0750	Mr. Coombs calls MSG Dean, Equipment Pool Branch, to have his people stand by.
	0755	LTC Wuerz visits Mr. Bill Webster (Chief, Roads and Grounds), and requests a burial detail. Mr. Webster dispatches two equipment operators (Mr. Dymock and Mr. Newton) with bull-dozer to the Stark Road and Tango area.
	0800	Mr. Hall calls Motor Pool and says to standby for burial detail. He will call back after the press leaves.
	0830	MSG Dean receives a call from Bill Webster. He requests a 10-ton tractor and lowboy to transport dozer to site to bury the horses. The tractor/trailer will stay with bulldozer to move from point to point. COL Templeton calls COL Shay and asks for additional help in the form of a veterinarian with experience in horse care and a specialist in water-electrolytes imbalance. Dr. Sharp and CPT Trotter of COL Shay's office indicates he does not have that type of talent in horses. He will try to get a specialist from Colorado State University (CSU).
	0835	Mr. Woods calls Boyd Coombs and tells him to continue his exercise on pulling the animals in and to coordinate with Mr. Bushnell (Chief, MT-T) on spraying of lime and to hold his operation in abeyance until after at least 1000 hours as there is a press conference being held at that time and the go-ahead would come from Dr. Rothenberg. Mr. Olsen directs MT-T-D (Decon) to haul more water to water-ing holes established by Life Sciences personnel 6 July 1976.
	0846	Dr. Schoenfeld, accompanied by Dr. Klover (BLM, Denver Office) is at Salt Lake City ready to depart for DPG via Army helicopter.

7 July 0900-0915 Mr. McRae tells EOC that CPT Lee, Dr. Schoenfeld and Dr. Klover will be urged to perform another autopsy to obtain frozen samples that will allow a more complete analysis than a formalin-packed specimen. Dr. Watkins predicts the analysis will be 50-60% completed by 8 July in the afternoon. At that time BLM scientists will be ready to talk to our scientists to try to come up with a preliminary diagnosis. BLM is doing pathology through Dr. Watkins and Dr. Taylor, plus Intermountain Lab will be conducting laboratory studies on the specimens.

0915 Dr. Schoenfeld, Dr. Klover arrive.

0920 Mr. McRae and LTC Schultz are joined by Mr. Hall. Glade Anderson is in the field today.

0930 Mr. Dymock and Mr. Newton finally find the two horses. One is about 0.4 miles west from Papa and Stark Road intersection and 0.5 miles south in the sagebrush (later called burial Site 1). The other is about 0.1 miles north of Stark Road and about 0.3 miles east of Romeo (later called burial Site 3). Each site has one horse buried (this fact was confirmed on 0800 hours, 9 July by Wuerz to Dymock since confusion existed on 8 July as to whether both horses were buried in a common grave or separate graves) (Incl 2).

0935 Executive Meeting -- at the meeting are:

Dr. Schoenfeld	COL Templeton
Dr. Klover	Mr. Olsen
Dr. Rothenberg	LTC Schultz
Dr. Spendlove	Dr. Taylor
Dr. Salomon	

Dr. Taylor states that most of the pathology he found is indicative of dehydration.

Dr. Schoenfeld agrees to performing another autopsy today with the assistance of Dr. (CPT) Lee. Dr. Rothenberg, Dr. Schoenfeld and Mr. McRae agree to conduct a review of each agency's plans for conducting further tests, etc. Dr. Schoenfeld asks status of certain formalin samples taken yesterday and their location. This will be covered in the meeting this afternoon.

7 July	0935	Dr. Salomon brings up theories of dehydration and water-electrolyte imbalance. Dr. Schoenfeld indicates Dr. Maxine Benjamin, faculty member at CSU, Ft. Collins, Colorado is a recognized expert in the field and should be available; he will call today.
	1000	Mr. Vowles and Mr. Skelton (MT-T-D) haul 1000 gallons of fresh water to Bitter Springs.
	1030	Mr. Deuel arrives at the site and prepares to move carcasses but waits for word to begin.
	1100	CPT Lewter tells LTC Schultz that the Serious Incident Report (SIR) is ready to be transmitted. It is being staffed with COL Templeton (Incl 3). Mr. Woods receives a call from Dr. Salomon expressing a need for a service contract with Dr. Hansen (Colorado State University) for analysis of the animals. Dr. Salomon says he will get the details and call back later. Mr. Woods receives a call from Joe Roybal (Procurement) that the mice and rats will be delivered on United Flight 946, SL Airport, 1604 hours, 7 July.
	1115	Mr. Woods notifies Dr. Salomon of arrival of mice and rats and amplifies that there has been no delivery date established for the guinea pigs. Dr. Salomon requests that all mice and rats be delivered to DPG; Mr. Woods explains that delivery will be approximately 1900 hours; needs a contact; Dr. Salomon says the contact will be June McAllister, home phone 3160, who will escort mice to Baker Lab.
	1120	Mr. Woods receives information from Dr. Rothenberg to proceed with burial. Mr. Woods calls Mr. Retford and explains the need for the requirement as LTC Wuerz is not available; tells him to proceed to Orr Springs area and that he now has authority to bury the animals. Mr. Retford explains that he does not expect to be in a position to bury until late in the afternoon, approximately 1430-1500 hours. Mr. Woods tells Mr. Retford that overtime is authorized up until approximately 2100 hours or darkness and that if he needs transportation or quarters for any people to notify Mr. Woods by 1600.

7 July	1220	Mr. Woods calls Dr. Salomon who provides information that the contract would be with a Dr. Richard Hansen, Colorado State University, for six samples of stomach, intestine and fetus to determine plants content. However, he cannot give the final details at this point but will call back later.
	1230	Mr. Woods calls Mr. Coombs and makes arrangements for burial detail and for the pick up of mice and rats at SLC; provides contact point information and also XO.
	1320	Mr. Woods calls LTC Schultz, states that Equipment Operations, Facilities Engineering and Motor Pool burial teams will be on the way in a few minutes.
	1330	A number of DPG trucks with apparent sightseers are in the area and are observed by Mr. Deuel.
	1335	Mr. Coombs instructs MSG Dean to deploy burial party to West area.
	1340	Mr. Coombs MT-T-E to request Mr. Gardner and truck crane to go to West area. Is told the hydraulic system on the crane leaks and the equipment is in the maintenance shop.
	1343	Mr. Coombs goes to the maintenance shop to check on the truck crane. Talks with Mr. Gardner and comes to get the equipment out of the shop.
	1345	Mr. Retford calls MSG Dean to inform him that they have four people and Mr. Deuel on site. Between MSG Dean and Mr. Retford, judging from the amount of equipment on site and the number of operators needed, they decide all eight Equipment Pool Branch people are not needed. MSG Dean calls Mr. Coombs to inform him of the situation and Mr. Coombs agrees.
	1400	Mr. Retford receives a telephone call from Mr. Woods. Message is to bury all horses at vicinity of Orr Springs after identifying sex, age and color. Mr. Retford goes to Orr Springs area to find Mr. Kenneth Deuel and passes on message.
	1400	SGT Miller, SP4 Hadley, SP5 Larson, PFC Smidt and PFC Smith take two dump trucks, slings and one 4x4 pickup with radio to change house and proceed to the site. Mr. Gardner leaves for West area with the truck crane.

7 July	1430	Burial personnel start moving 17 and 10 dead horses from the Orr Springs area to the burial site (Site 2). Identification of those buried by Mr. Hall is given in Incl 2.
	1430	Dr. Lee, Dr. Schoenfeld, Dr. Klover, Dr. Spendlove, CPT Maxwell, Mr. Davis, Mr. Max Green arrive on site in vehicle to perform autopsy on another foal. (See Technical Survey Log.)
	1530	Autopsy team (Dr. Lee, etc.) leave site.
	1530	Tractor/trailer and driver are released. Bulldozer is left at site.
	1535	LTC Reddin (Fitzsimons) calls EOC. He will be on way tomorrow at approximately 1750 hours; requests meeting with Dr. Salomon.
	1545	Mr. Woods receives notification from Mr. Roybal that guinea pigs will arrive in SLC, 8 July 1220 hours, United Flight 375.
	1550	Calls Dr. Salomon and confirms the information for service contract with Dr. Hansen; provides him with information on delivery of guinea pigs.
	1555	Mr. Woods calls Don Boothe (Procurement) gives him information on the service contract with Dr. Hansen for analysis.
	1600	Autopsy team arrives at Ditto.
		Burial personnel find and move four more dead horses from the Bitter Springs area to the burial site (Site #2). Identification is contained in Incl 2.
	1610	Mr. Woods calls Mr. Retford; reemphasizes to Mr. Retford the need for maintaining log and accurate and detailed information on numbers and location of burial sites.
	1615	Dr. Schoenfeld, Dr. Klover return to SLC via US aircraft.
	1615	Preliminary analyses of water samples is completed by Chem Labs (see Technical Survey Log).

7 July	1720	Mr. Ken Rigby, Photo Branch (5701) wants Mr. Hall to call him. He says he feels the horses were dying for lack of water. He has observed the horses last Monday or Tuesday and wants to pass this information to the BLM representative.
	1730	COL Templeton calls Dr. Salomon to find out about water (Technical Survey Log). In summary, GB and VX and their breakdown products not detected. Hematocrit indicates severe dehydration: 67% volume of blood packed red blood cells in unit is detected vs 40% (normal).
	1900	Mr. Deuel departs Site 2 for Site 1 near Stark Road but cannot find it.
	2030-2130	Mr. Deuel arrives at English Village and departs for home. Other personnel on burial detail complete burial of the 31 horses found around Orr and Bitter Springs and arrive at English Village. Heavy equipment is left at Site 2.
	2130	Security guard at desk calls EOC. He got the following information from Mr. Gardner, Equipment Operations Branch: 33 horses buried (31 at Orr (Site 2) east of Granite Mountain (Sites 1 and 3)). All but 10 adults were studs. 10-20 more still out there requiring burial. There were still horses in the area acting sick, no count.
	2135	ECO (LTC Schultz) calls COL Templeton, is instructed to debrief crew in the morning and get more detailed information.
8 July	0730	LTC Wuerz holds planning meeting with LTC Schultz and Mr. Deuel.
	0730	Dr. Lee attempts to call COL Robert Cutting (284-9023) (DARCOM surgeon) and LTC Herndon. No success.
	0745	Dr. Lee calls Dr. Rothenberg for update. Informed by Dr. Rothenberg that a horse expert is coming this afternoon. He is LTC George Reddin, U.S. Army MEDDAC, Ft. Leonard Wood, Missouri, Deputy for Veterinary Activity, and a consultant to the Surgeon General in equine medicine.

8 July	0750	LTC Schultz debriefed Mr. Gardner, who worked yesterday on the burial detail. He states that he was unsure of the number of carcasses buried. Mr. Hall has this pertinent information.
	0800	LTC Schultz calls Boyd Coombs; the burial detail will continue to operate today. He is directed to get his crews out to site and coordinate with Equipment Operations Branch, MTD.
	0800	COL Templeton calls GEN Powers (CO, TECOM); provides an update.
	0800-0830	Dr. Lee attempts to phone LTC Cutting, but he and COL Herndon are both busy. CPT Lee leaves message and phone number. CPT Lee receives call from MAJ McLaurin, Entomologist from FAMC (943-8090) concerning the possibility of any insect or rodent control being done in that area. Dr. Lee relays to him that trapping for mosquitoes has begun.
	0900-0930	Dr. Pinkham receives call from Mr. Thomas R. Sherrod, SLC, 467-8005 (retired Federal employee -- Atomic Energy Commission). He suspects heavy metals.
	0900	Dr. Rothenberg is called by LTC Chapman (Action Officer Chemical Nuclear Office of the Director of Operations of the Deputy Chief of Staff for Operations and Plans of DA), phone 8-227-3535. Latter requests update.
	0915	Bill Woods picks up copy of the press conference tape to try to filter out the machine noise on the tape. CPT Bush indicates that the reworked tapes should be available to the Commander's Office by early afternoon.
	0930	LTC Schultz talks to Mr. Hall, Mr. Anderson and Mr. Deuel. Latest data is: 41 confirmed dead; 33 buried; 27 are ill.
		Mr. Woods receives a call from Dr. Rees requesting an additional 100 pregnant mice be procured; delivery 50 each on 12 July and 50 each on 15 July.
	0955	Dr. Schoenfeld tells Dr. Rothenberg that the former has been called by LTC Shay about forthcoming visit of LTC Reddin, and Dr. Schoenfelt suggests that he join LTC Reddin at DPG. Dr. Schoenfeld will come with two or three people on Friday morning

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to work with LTC Reddin in getting additional horse tissue and blood samples, and perform autopsies, etc. Mr. Hall and CPT Lee are so informed. Aircraft support is arranged for Dr. Schoenfeld.

0935 Dr. Rothenberg talks with Mr. Hall. They discuss capability of Intermountain Labs to run total blood chemistry on horse blood samples and choninesterase analyses. Mr. Hall states such has been run previously by a BLM contractor in Montana and therefore baseline data should be available. It is suggested that the same contractor Mr. Hall asked to run repeat analyses on blood samples remain available for doublecheck.

Mr. Hall states 75% of the adult deaths are among male animals (later found to be incorrect). Mr. Hall indicates that he will control the putting to death of any animals that require it. He will attempt to estimate number of down or sick horses and check the other herds.

0945 CPT Lee receives call from BG Murnane, Chief, Veterinary Corps (227-2108 or 2145). Former gives latter summary of situation and latter briefs former on the importance of the situation and the role Dr. Lee should play.

0945 Dr. Pinkham talks with Mr. Hall. The former receives commitment to get the latter's log NLT Tuesday, 13 July. Mr. Hall also relates that a trough was installed at Cochran Springs at the same time as the one at Orr Springs. The horses are drinking out of the trough at Cochran, but there was a trough there before anyway.

0945 Dr. Watkins informs Dr. Rothenberg that approximately 50% of pathological analysis is completed. He will have the typed version by 1500 hours this day.

Mr. Woods calls Don Boothe and places the order for 100 mice and provides delivery instructions and purchase request number.

0950 LTC Schultz talks with Mr. Hall and Mr. Anderson. Anderson will provide DPG a listing, chronologically arranged, of all actions taken to develop Orr Springs (requested earlier in the day by Dr. Rothenberg).

8 July	1000-1130	Mr. Deuel and LTC Schultz travel from English Village to Site 2 (Orr Springs area).
	1000	LTC Wuerz and Mr. Retford with wooden stakes, paint, stencils, etc., depart English Village for Stark Road and Tango area to meet DPG photographer on site. Can only find one burial site south of Stark Road and stake it as Site 1. Marker is 4" x 4" wooden post, about 3 feet above ground, with 3 inch white painted top. Blue numbers on all four sides of marker show "7-76" and a 1 (designating Site 1).
	1030	COL Templeton requires from Dr. Pinkham a Technical and Operational Summary by COB 9 July for briefing in Washington. (COL Templeton will depart Saturday a.m., 10 July.)
		Mr. Woods receives a call from Dr. Salomon conveying information that the driver has been given information on the pick up and delivery of the guinea pigs, information is being provided directly to the driver.
	1045	CPT Lee calls COL Shay, talks with CPT Trotter. Briefs the latter.
	1200	Dr. Salomon requests Meteorology Division to provide a summary of the weather at Ditto for the past several months. He requests Dr. Volney Wallace (MT-C, Chem Division) to investigate the effect of ingesting large amounts of Mormon tea (Ephedra Sp.).
	1200	LTC Wuerz, Mr. Retford and photographer go to Orr Springs burial site and mark it Site 2 with stake, coloring, etc., as described for Site 1.
	1215	LTC Wuerz is informed by Mr. Deuel at Site 2 that another horse was placed in the burial trench a little while before. It was a four-year old black stud (Incl 2). This brings the total buried at Site 2 from 31 to 32 horses. Equipment operator is Mr. Ferrin Olson.
	1230	U-8 with Dr. Stark leaves for CDC (see entry at 1300 this day).
		Mr. Woods calls National Guard and requests support of helicopters. Information is received that we should contact BG Hixon direct. Convey information to COL Templeton.

8 July	1240	COL Templeton calls GEN Hixon (Asst. Adj. Gen., Utah National Guard) 533-5474, and COL Nielson (Chief of Staff, Utah National Guard). COL Templeton requests helicopter support until DPG gets its own back into operation. They agree to try to arrange it and call back.
	1245	COL Cutting calls Dr. Rothenberg to volunteer medical-veterinary support. The former is aware of LTC Reddin's forthcoming visit and asks about investigative detail related to the horse incident. Dr. Rothenberg provides him with a complete rundown in technical detail as outlined in Incl 1, Technical Survey Log. COL Cutting states that any desired assistance would be supported by his office and that U.S.A. Surgeon General is anxious to help in any way possible.
	1300	Dr. Rothenberg prepares daily status report (incl 4). Heavy metals, GB, VX, pH, ACh E enzyme inhibition, blood ACh E activity, all negative. Only five mosquitoes trapped (3 on 6th and 2 on 7th) and rodent population appears normal.
	1315	Mr. Woods calls Mr. Johnson (96th ARCOM), 582-1313, requesting aircraft support. Mr. Johnson states that he does not believe that they have any aircraft available within the state. However, a call to Mr. Mike McCafferty (Acting Facility Supervisor, 96th ARCOM Flight Activity, SLC) 524-4084 was made; if they had anything available we could have the support.
	1345	COL Nielson calls Dr. Rothenberg. The former says DPG can have one helicopter.
	1400	LTC Bremer (Utah National Guard) calls (524-4073) Dr. Rothenberg. They coordinate use of helicopter and arrange to pick up Dr. Schoenfeld, Dr. Shupe and Dr. Poulson, Assistant State Veterinarian, Utah Dept. of Agriculture, at SLC helipad.
	1400	Mr. Woods receives another call from Mr. McCafferty who states he possibly could support DPG's requirement on Monday 12 July. The former says that if there is a requirement, DPG will call back on the morning of the 12th.
	1430	Mr. Vic Pratt (Environmental Coordinator, DPG) is notified by Mr. St. Onge (Agent, Military Intelligence (MI)) that sick horses have been reported at Tooele Army Depot (TAD). LTC Schultz tells Mr. Pratt to get report to Dr. Rothenberg ASAP. Mr. Pratt passes word on to COL Templeton and Dr. Rothenberg.

8 July 1435 Dr. J. Schoenfeld, Utah State Veterinarian, is contacted by Dr. Rothenberg with regard to the MI report of sick horses at TAD. Dr. Rothenberg queries Dr. Schoenfeld with regard to availability of his veterinary associate in Tooele to investigate the report. He informs me that he would contact Dr. Mike Marshall.

1435 COL Templeton calls Mr. St. Onge; learns that on 3-4 July horses at TAD came down with high temperature, disorientation, coughing and runny noses. Dr. Schoenfeld returns. Calls Dr. Rothenberg and reports that Mr. Lyman Wahr (home phone Tooele 882-2618) is in charge of the horses at Tooele Army Depot which were reported sick. Dr. Marshall is aware of the illness which has been diagnosed as flu (para influenza). The horses are being treated with antibiotics. It is also stated that this is known locally as "24th of July disease," is common at this time of year and is associated with rodeo activities in various Utah towns and cities.

1445 CPT Lee calls Dr. Pinkham. The former explains that on the 6th he was on an inspection tour of a cheese factory which has a contract with the military for cheese.

1450 GEN Powers calls COL Templeton, the former requests an update. COL Templeton requests helicopter support.

1500 White Sands Missile Range is alerted for helicopter support as per GEN Power's direction. CPT Covell, LTC Brown 867-4260/6869 are contacted.

Dr. Rothenberg calls LTC Schultz. Tooele sickness was diagnosed as 24th of July disease and flu. The illness has been reported to the Utah State Department of Agriculture. There is apparently no connection between the two situations -- Tooele and DPG.

1545 LTC Wuerz returns to English Village. Information noted at 1215 is given to Mr. Woods who passes it to Dr. Rothenberg. Some miscount (2 horses) was detected from other data available. However, the above count is the count verified by LTC Wuerz with Mr. Deuel and Mr. Hall at 0745 on 9 July.

Mr. Woods receives a call from A.T. Hereim requesting one tank of compressed gas, 5% carbon dioxide, 95% nitrogen, FSN 6739 00X00 0666.

8 July 1600 Dr. Watkins briefs COL Templeton, Dr. Rothenberg, Mr. McRae, Mr. Deuel, Mr. Hall and Mr. Anderson on the results so far from the pathological investigation (Technical Survey Log). Summary follows:

> "The most significant change observed in all of the tissue examined was vascular congestion primarily of the small peripheral capillaries. This of course, is a consistent feature of shock, induced by a number of different factors. A few areas of inflammation were noted within the intestines and occasionally within the kidneys. However, these changes were judged not to be significant enough to result in the death of the animal. At this time there appears to be no good evidence for an infectious disease to be the cause of death. Within the kidneys of the Sorrel mare that was necropsied on Tuesday the 6th of July, there was some evidence of oxalate crystal accumulation suggesting that ingestion of oxalate containing plants had occurred. However, the changes within the organ were not compatible with severe renal toxicosis as the result of toxic plant ingestion. During the necropsy of the Sorrel mare, fibrin like tags were noted on the body surfaces and organs. When these structures were examined microscopically, it was determined that they were well organized and thus probably of long duration. This suggests that this finding may not be directly related to the current death loss. Additional necropsies are needed to determine if this is a consistent finding."

1600 LTC Schultz releases the motor pool drivers for the evening. All burial activities at the Orr Springs area are terminated for the day. BLM representative, Mr. Anderson, concurs.

1630 LTC Schultz directs Mr. Pratt to call Mr. St. Onge and inform him that there is no connection between the Tooele and Dugway horse problem.

1638 ECO (LTC Helbling) is briefed by COL Templeton; the former is updated on situation. LTC Reddin will arrive and when he does, Dr. Salomon and Dr. Lee are to be contacted. BLM will conduct an overflight before dark.

8 July	1640	Mr. Gardner reports in the log of the equipment operation that he had spent all day picking up dead horses. Only one was buried. Mr. Buzionis had spent all day hauling Ditto water to the troughs installed at Bitter Springs. Mr. Buzianis reports no horse tracks around sunken troughs, but fresh tracks around Bitter Springs (Bitter Springs were dug out yesterday so that they flowed more vigorously).
	1645-1730	Mr. Deuel and Mr. Anderson travel from English Village to MAAF.
	1745-1945	The helicopter only has space for Mr. Anderson and Mr. Hall to fly over the area of the dead horses.
	1900	LTC Reddin arrives at HQ Building. Dr. Salomon and CPT Lee are called to brief him this evening prior to the morning conferences. COL Templeton approves transient quarters for BLM contract helicopter pilots. Quarters keys will be picked up by Mr. Hall when they return from the Orr Springs area.
	2000-2030	Mr. Deuel, Mr. Anderson and Mr. Hall travel to English Village from MAAF.
	2015	SDO receives call from Dr. Gawlikowski (Environmental Toxicology Group, Cook College, Rutgers University) saying she is just learning of the horse deaths and thinks she can help solve the problem. She will speak to Dr. Salomon and he will make a memo of the conversation.
	2020	COL Templeton stops in and asks that Mr. Hall come to his home after the overflight.
	2030-2045	Mr. Ron Hall, Mr. Deuel and Mr. Anderson return from overflight. They debrief the ECO: Three more dead horses spotted approximately one mile north of Orr Springs. Pilots are sent back to SLC by Mr. Hall. Mr. Hall is informed of COL Templeton's request.
	2045-2115	The above persons visit COL Templeton and report the facts known to date concerning the buried and other located dead horses.
	Various	Total horses buried 7 and 8 July: Stark Road area, two; and Orr Springs area, 32. Total 34 (Incl 2).

9 July	0730	EOC (MAJ Bills) reports no activity from midnight to 0730.
		GEN Powers calls COL Templeton. The latter provides a briefing.
	0730-0815	Meeting among LTC Wuerz, Mr. Deuel and Mr. Hall in empty room in Mr. Woods' office area. Count of buried horses at end of meeting is agreed to as 2 near Stark Road and 32 at Site 2. Thirteen others have been sighted by either Deuel or Hall and plotted on map for retrieval (if possible) and burial on 9 July.
	0800	Dr. Salomon is called by Dr. Gawlikowski. She suspects plants; suggests DPG contact Dr. Anthony Verlangieri of Rutgers (201-932-9442) or Texas A & M where there is similar capability. Dr. Salomon reassures her that plants are being considered.
	0800	Mr. Woods calls LD-S-E to say there are 13 dead horses still out in the area and to stand by with the crew until further notice.
		Dr. Salomon receives results from Baker and Chem Labs (see Technical Survey Log).
	0815	LTC Wuerz telephones Mr. Oyler to verify that he (Oyler) had seen 20 dead horses north of Wig Mountain near the DPG boundary fence. This report is erroneous; Mr. Oyler had seen 17 dead horses at Orr Springs on 7 July and no others north of Wig Mountain.
	0817	A.T. Hereim (MT-L-E) calls and states he has obtained a government-owned cylinder for the compressed gas and would deliver it to Supply this a.m. so they could determine the type of valve required.
	0830	LTC Wuerz contacts Mr. Dymock, equipment operator, and ascertains that 2 graves were made at Stark Road and not one on 7 July. Site 1 is south of Stark Road. Mr. Retford goes to the area north of Stark Road, finds the site and marks it Site 3.
	0830	Mr. Deuel meets with soldiers on burial team and discusses day's activities.

9 July	0835	Mr. Woods calls Mr. Hunt; notifies him of the expected delivery of the government-owned cylinder for the compressed gas. Mr. Woods calls Becky (PR) and tells her LD will have a government-owned cylinder.
	0900	Mr. Woods calls Motor Pool; makes arrangements for pick up of compressed gas. Mr. Woods tells them to hold until firm delivery and pick up information becomes available.
	0900	Mr. Deuel visits QA Office and asks for the burial team to be dispatched to the Orr Springs area. Equipment needed: cat with operator, boom truck with operator, two 4-wheel drive vehicles and a dump truck. SFC Dean, Earl Retford's office and Equipment Operations is notified to get team on the way. Mr. Deuel indicates 13 carcasses have been sighted, 10 of which may be accessible.
	0920	Mr. Deuel, LTC Wuerz and Mr. Retford meet to discuss past and future events.
	0930	Contact is made with Mr. Woods, who informs LTC Schultz that Dr. Rothenberg does not want to resume burial. LTC Schultz contacts Dr. Rothenberg to tell him Mr. Anderson indicated he wanted the project continued this morning. Dr. Rothenberg gives OK to continue the operation. LTC Schultz talks to Mr. Woods and tells him to continue with the burial. Dr. Rothenberg states that the question of what to do with the carcasses that are inaccessible is not settled.
	0930	Dr. Rothenberg briefs LTC Schultz. Plans for today include field trip by Dr. Schoenfeld and LTC Reddin to get additional samples from dead, ill and healthy horses.
	0930	Mr. McRae talks with COL Templeton. The former requests a log of National Guard activity in the area.
	1000	Mr. Dymock departs English Village with the diesel tanker to refill the bulldozer and continue to bury the horses brought to Site 2 grave, or bury the horses where they died (if accessible). Dead horses not accessible for burial maylater be allowed to be left in place and coated with quicklime, but that decision has not been made.

9 July	1000	Mr. Woods calls Mr. Coombs and directs that Mr. Deuel and SGT Miller report to him immediately.
	1000	LTC Carruth (LTC Chapman's Office, DA) calls for an update LTC Schultz takes the call. DA is told that preliminary lab results give DPG an idea of what is not our problem but have yet to identify what is the problem. We have tentatively ruled out heavy metal and chemical-agent poisoning, and viral or bacterial organisms. The blood samples have indicated that dehydration could have been a contributing cause. No conclusion as to the cause of death has been reached yet.
	1100	Mr. Woods receives a telephone call from Procurement that the cylinder of gas is ready for pick up from U.S. Welding, 999 South Redwood Road.
	1110	Mr. Woods calls MGS Dean and passes information for pick up of compressed gas.
	1215	LTC Schultz takes a call from LTC Humphreys (227-1059), DA-MA-PPM-T. The latter says that one of the staff had heard reports from NBC or CBS that bubonic plague had caused the horse deaths at DPG. Is there any truth to the report? LTC Schultz relays the same information that he gave LTC Carruth at 1000. LTC Humphreys asks he be sent info copies of anything sent to Carruth. (Nothing was sent to Carruth).
	1230	Mr. Deuel arrives at Site 2 and departs to search for horses.
	1315	Mr. Hereim calls to have a package of samples at Baker Lab picked up and delivered to State Health Department Laboratory.
	1325	Pick up man departs motor pool at 1325 hours for Baker Lab.
	1330	Mr. Deuel finds 1 bay stud, 16 years old. It died sometime last spring and was dehydrated. This horse will be buried 10 July.
	1330	COL Templeton grants permission for Dr. Osguthorpe (private veterinarian hired by BLM) to land private plane at MAAF. Dr. Osguthorpe will require a room tonight.
	1345	Call from GEN Powers 301-272-6874 (home). COL Templeton provides update.

9 July	1400	Mr. Deuel locates five horses at Site D, approximately one mile northeast of Site 2 (these will be buried later in the day at Site 2). Horses were sighted night before by BLM helicopter crew. They are at a spring heretofore unknown to anyone (capacity approximately 20 gallons). Horses found are: 1 Bay Mare, 10 years old 1 Buckskin Mare, 4 years old 1 Sorrel Striped-face, Mare, 2 years old 1 Red Roan Mare, 4 years old 1 Bay Stud, 3 years old
	1400	Mr. Woods receives a call from LT Cable that the gas will be delivered to Bldg. 6002 by approximately 1445.
	1403	Mr. Woods calls Mr. Hereim and notifies him that gas will be delivered to Bldg. 6002 at approximately 1445.
	1405	Mr. Coombs taks to Mr. Woods concerning where to deliver special nitrogen bottle. The latter says to Shipping & Receiving. Dr. Rees will be contacted by Mr. Woods that the nitrogen will be arriving between 1430 and 1445 hours.
	1445	Mr. Woods receives information from Dr. Rothenberg that DPG will be working this weekend on continuing burial and location of animals.
	1447	Mr. Woods notifies LTC Wuerz to plan to continue working this weekend on location and burial of animals.
	1449	Mr. Woods calls Mr. Coombs and notifies him that DPG will be working this weekend and that he should notify his crew.
	1500	Bulldozer roughs out a road for truck use to get to 5 horses. Horses are moved to burial Site 2 (these are the 5 horses which were found at 1400 hours). Decontamination crew is notified by radio to come to Site 2.
	1515	Mr. Deuel meets with Dr. Schoenfeld and discusses condition of living horses.

9 July	1530	Mr. Hall tranquilizes 1 palamino mare colt, which was identified as #7 on head (was marked at 1545, 5 July), and 1 bay stud, 3 years old, which was identified as #6. Seven veterinarians autopsy these two horses, after which the carcasses are then taken to Site 2 and buried.
	1540	LTC Wuerz completes summary diary of actions and map of actions pertinent through 9 July. Two copies of diary and one map are delivered to Mr. Woods at 1600 hours. Map and one copy of diary summary are given to Dr. Rothenberg by Mr. Woods. (Information in map and diary is incorporated into log.)
	1545	Mr. Deuel locates two more horses (first sited by helicopter at 1150 hours on the 7th) and leaves them where found to be buried on 10 July. Horses are: 1 Bay Mare, 4 years old with blue neck band 1 Bay Mare, 8 years old
	1545	Dr. Rothenberg prepares "daily status report" (Incl 5).
	1600	Mr. Woods receives a call from LT Cable requesting information as to whether his crew will be working this weekend. The former answers in the affirmative and also elaborates on the fact that the Motor Pool, both Ditto and English, will be open and to contact LTC Schultz on Saturday moring to determine whether the Motor Pool will be required to be manned during the balance of the day. Mr. Woods also requests LT Cable have the NCO in charge report to LTC Schultz at Headquarters Building at 0730 Saturday, 10 July.
	1600	Decontamination crew arrives at Site 2 and sprays horses in burial pit.
	1615	Mr. Woods meets with LTC Wuerz; has general discussion as to accuracy of records being maintained and emphasizes that detailed records be kept, and requests that he notify Mr. Deuel to report to LTC Schultz at HQ Building, 10 July. Mr. Woods also states that inaccessible carcasses could be sprayed on site and left to decompose.
	1630	LT Cable calls Security and MP's to have SGT Miller call SSG Roche when they arrive at the Gate (to relay message about Saturday).

9 July	1640	Dr. Pinkham prepares "Operational and Technical Summary for COL Templeton (Appendix F).
	1700	COL Toepel arrives.
	1700	COL Toepel is briefed by COL Templeton, Dr. Rothenberg, LTC Reddin, CPT Lee and LTC Schultz. Arrangements are made to overfly the area the next morning, 10 July 1976.
	1710	Mr. Hall flies out to area to gather additional samples.
	1730	Site 2 horses in burial pit are covered with soil. Mr. Hall tranquilizes another horse (at Site 1) for Dr. Osguthorpe to examine.
	1800	LTC Reddin makes telephonic report to Chief Vet, US Army. Report basically says that the situation is well in hand and progressing well. Enough outside agencies are involved to preclude any charge that the Army is "covering up."
	2000	Mr. Deuel meets with BLM personnel at Post Headquarters Building to discuss today's events and tomorrows plans.
	2030	Mr. Deuel and LTC Wuerz discuss day's activity.
	2030	All operations terminate. All parties, COL Toepel, Mr. Hall, LTC Reddin, CPT Lee, Mr. Deuel will meet at HQ Building at 0830 to coordinate tomorrow's activities.
	2100	Mr. Deuel has meeting with LTC Schultz and discusses day's activity.
	2400	As of midnight horses buried to date are:

Site 1 - 1 horse
Site 2 - 39 horses
Site 3 - 1 horse

TOTAL 41 horses

2400 EOC is closed.

10 July	0800	Meeting with LTC Schultz, Mr. Deuel, LTC Reddin, CPT Lee, COL Toepel and Mr. Hall. 1. Chopper 1 will make recon of area starting from hospital pad until approximately 1000 hours. 2. National Guard chopper will arrive from SLC approximately 0930 with Mr. Frei, BLM. 3. BLM contract chopper will arrive approximately 1000 hours. 4. All commo on 460. Deuel -- Digger Hall -- Red Dog EOC -- Timber Operator
	0800	SP4 Hadley and SGT Miller go to HQ's for meeting and instructions. The rest of the crew remain at the Motor Pool.
	0830	Chopper recon is made of the area. On board are COL Toepel, LTC Reddin, CPT Lee, Mr. Hall and Mr. Anderson. Mr. Tex Hansen (MTD) volunteers to work with Mr. Deuel.
	0845	All vehicles and personnel depart Motor Pool for the site. The same crew and vehicles were used Friday (9 July).
	0900	Mr. Deuel talks with Field Protective Branch and makes appointment for Mr. Frank McAtee (Engineer Equipment Operator) to meet Mr. Deuel at Site 2 at 1330 to bury horses.
	0905	Mr. Deuel meets with burial detail and instructs them to go to North Wig Mountain to pick up 2 horses.
	0910	Mrs. Thompson, BLM secretary, arrives to support Mr. Hall. Given secretarial equipment (typewriter, etc.) by LTC Schultz. Two copies of all photos (color prints) are obtained from CSM McLaughlin for LTC Reddin and Mr. Hall.
	1000	Mr. Peterson is contacted. LTC Reddin needs two rolls of color slide film.

10 July	1030	Dr. Pinkham arrives in EOC.
	1000-1150	Mr. Deuel finds 2 horses about one mile southeast of Orr Springs. He radios for personnel to bury the horses on location at new site, called Site 4. Horses are marked with standard wooden post. Horses buried are: 1 Bay mare, 4 years old 1 Bay mare, 8 years old
	1130	Dr. Salomon calls. He cannot find the blood samples drawn on 9 July at 1530. LTC Schultz contacts CPT Lee for information. The blood samples were given to Dr. Taylor, Intermountain Lab. Dr. Salomon will call Dr. Taylor to see if the sample can be split. LTC Schultz picks up lunch for the HHC personnel in field with burial party. Helicopter reports another carcass is sited near the mud hole south of Wig Mountain and another approximately 1 mile north of Baker Lab (originally sited at 0822 on 5 July).
	1200	Helicopter back from the field. COL Toepel, LTC Reddin, CPT Lee finish day's activities.
	1300	National Guard helicopter takes lunch to the burial crew (Digger). It is then released by Mr. Hall and returns to SLC. Meeting of all BLM personnel in Conference Room B. Horses picked up at North Wig area (see 0905 and 1130 entries above) arrive at Site 2. Mr. Tex Hansen and Mr. Deuel identify the horses going into burial Site 2 (Incl 2).
	1305	EOC receives a call from Mr. Hereim requesting dry ice for samples (the normal supply at Baker will not make it to Wednesday when the next delivery is scheduled). EOC makes the necessary contacts for a Monday morning delivery at DPG.
	1330	Mr. Deuel went to look for horses 3 miles north of Site 2.

10 July 1400 Mr. Deuel finds one bay stud, 16 years old. He is buried on site which is marked with standard marker as Site 5.

1400 CPT Rauber returns home; he had replaced LTC Schultz between 1130 and 1330. Will return during the evening and breaks.

1430 Mr. Dekker (BLM) asks for any information available concerning when the following BLM and USFS personnel were issued badges during 30 April - 8 June:

Glade Anderson	Ned Penrod (USFS)
Richard Dekker	Art Micalacek
Grant Kimber	

Called Security. Information will be ready by 1200 hours, 11 July 76. Information to be used to construct history of Orr Springs area development.

Mr. Deuel and Mr. Hansen depart for Site 2 area. While enroute, BLM notifies them on the radio that a horse was found above Orr Springs.

1445 BLM personnel (Ron Hall, Mr. Anderson, Mr. Dekker, etc.) take off from hospital helipad on overflight of DPG.

1500 Mr. Horan reports to LTC Schultz that Mr. Olsen will call Range personnel in to get information concerning Guard activities during December 1975 and January 1976. LTC Schultz asked that they also get any information available on the National Guard Aerial Weapon Delivery Company that was training here during Dugway Days (6 June - 19 June 1976) per COL Toepel.

Mrs. Thompson, BLM Secretary, leaves DPG.

1530 Mr. Deuel finds the horse (1430 entry, Site 1) and takes her to Site 2 for burial (Incl 2).

1545 LTC Schultz is called by Mr. Tanner (Chief, Range Control). Relates following information: 1. 396th Aviation Co (UT NG) flew Nape-of-the-Earth missions 6-19 June 1976. MAAF has all the flight plans. CPT Gray told Mr. Tanner the company flew missions at least 10 miles from Orr Springs (later determined to be incorrect -- see Background Log).

10 July

2. Hill Range Management, USNG, Clover Control: No fixed wing missions were scheduled during the 3-5 July 1976 timeframe. If no flights (DoD) are scheduled the airspace is turned over to FAA, whose radar does not cover low level flights in Wig Mountain area.

3. Starting 2 July 1976, security overflights were conducted over DPG by MAAF personnel.

4. If information regarding National Guard activities during December 1975 - January 1976 is required we should contact Mr. Jim Deal.

1600 LTC Schultz calls SGT Elkins, MAAF Operations, to relay the following message:

1. Do not destroy any flight logs of National Guard missions, and keep all we have on hand (regardless of unit) until told otherwise. (These are normally destroyed in 30 days.)

2. Have CPT's Gray and Beard call LTC Schultz regarding any aircraft they may have sited during their security flight and any information they might have concerning National Guard training flights.

1600 Sent Road Runner 1 and 2 into flat area south of burial Site 2 to look for horses. Mr. Deuel radios Timber Operator and informs him that no horses could be found in the flats.

1615 SGT Elkins calls: One other National Guard unit used DPG air space for training during period of 7-15 June 1976 -- Aviation Sec. HQ 115 FA GP (Wyoming NG). He has flight plans for these units. LTC Schultz instructed SGT Elkins to insure that these are not destroyed.

1620 Call U.S. Army Aviation, SLC, to get phone numbers of 115th FA GP and 396th Helicopter Company. They will call back. SGT Elkins provides name and telephone number of CO, 396th Company, MAJ Maybe, 533-5014. Flight plans on file at MAAF only show airspeed, aircraft number, and MAAF local training flight; no locations or altitudes (later on locations are obtained--see Background Log).

10 July 1700 Burial crew reports in from the field; 8 horses were buried, one of which was an older carcass (#35, Incl 2).

1705 Mr. Hall and Mr. Anderson all briefed on support arrangements for refueling BLM helicopter. They are told to call SGT Elkins (3127) or SGT Crouse (2278) and they will provide necessary service at MAAF.

1745 Mr. Hall gave latest count of dead animals at 50, plus three sacrificed for samples and one which died before incident.

1800 Mr. Deuel visits Security Office at Ditto to return the radio. While there, the guard said that there was a stench near Granite Mountain. Mr. Bud Cox reported to Security on 8 July that he could smell something dead near where Victor and Tango roads meet, but could not find anything. This will be checked out by Mr. Deuel on 12 July.

1810 LTC Schultz talks to CPT Beard and CPT Gray reference over-flights of 396th Aviation Co. and 115th FA GP:

1. They have overlays of Nape-of-the-Earth flights taken by 396th and flight plans.

2. CPT Beard will make an MFR on a conversation he had with the CO, 396th, MAJ Maybe and one of his pilots concerning one occasion where they did overfly five horses who happened to be in their path.

3. 115th FA GP flights were in the White Sage Flats area.

4. No other aircraft were spotted operating in the area during overflights conducted 2 thru 6 July.

5. During these overflights horses normally seen in the Wig Mountain area could not be spotted.

6. CPT Beard will call MAJ Maybe and advise him to review his records for completeness.

7. All flight records at MAAF will be kept until further notice.

10 July	1815	LTC Schultz calls COL Toepel and briefs him on 1810 and 1545 entries.
	1830	LTC Schultz is called by Mr. Dekker. The information he wanted (see 1430 entry) will be available at 1300 hours on 11 July 1976. He will call LTC Schultz at home.
	1900	LTC Schultz calls Mr. Tanner to give him update. He asks that EOC call Mr. C.B. Olsen. EOC calls C.B. Olsen -- no answer.
	1900	EOC ceases operations.
	1915	Mr. Deuel and Mr. Hansen compiled notes for the daily log. (While working on the notes, Military Police gave Mr. Deuel and Mr. Hansen parking tickets for being parked in graveled area west of the I&R Building, and east of the movie theatre.)

ADMINISTRATIVE AND SUPPORT LOG

Date	Time	Action
11 July	1100	Ron Hall calls. He needs the name and telephone number of aviation contact for refueling. He is given SGT Elkins telephone number by LTC Schultz.
(approx)	1400	Ron Hall needs a 3" pipe cap. Someone has been removing parts of their Orr Springs plumbing setup and it is countering their plans for developing water resources in the area. LTC Schultz calls LTC Wuerz. He contacts Geronimo Construction Co. (contractor for housing maintenance) and Equipment Operations Branch. LTC Wuerz comes up with a plugged elbow joint which is taken down to a BLM man at the airport.
	1600	COL Toepel calls and leaves telephone number if needed this evening. LTC Schultz gives update.
	1700	Mr. Decker, BLM calls. LTC Schultz passes on information that the following BLM men visited DPG on these dates: Andersen 20 May, 1, 7, 8 June Dekker 7, 8 June Kimber 20 May I think this information is incomplete but it is all our security records show.
	1745	Dr. Pinkham leaves for day.*
	1800	LTC Schultz leaves for day.
12 July	0800	Mr. Deuel has been having difficulty locating horses identified by helicopter. He comes up with the idea for the helicopter crewchief to drop helium filled balloons with a weight. LTC Wuerz says that Mr. Neel (Fire Chief), has a bottle of helium and Fire Prevention Week balloons, plus the pipe shop has scraps of pipe for use as weights. Mr. Deuel will pursue this idea further with LTC Schultz.

12 July	0800	Meeting with Dr. Rothenberg, COL Toepel, Ron Hall, Dr. Pinkham, LTC Reddin and LTC Schultz. BLM is provided a copy of the proposed news release drafted by Dr. Rothenberg. After some discussion Dr. Rothenberg calls Dr. Schoenfeld and reads release over phone. Everyone agrees to meet at 1400 hours today to coordinate release.
	0815	MAJ McAlpin passes message to LTC Schultz that TECOM is opening their EOC in response to "horse affair".
	0830	Mr. Woods talks with Dr. Rothenberg about the continuance of locating and burying of animals; former receives information to discontinue until after meeting later today.
	0835	Mr. Woods calls Mr. Coombs and tells him that no further action is required at this time on locating and burying animals until later today; that Mr. Woods will call him if there are any other requirements.
	0840	Mr. Woods contacts LTC Wuerz and tells him that no other action will be taken for locating or burying animals until after meeting later today.
	0847	Mr. Woods receives a telephone call from Ed Coucher saying that he received a call from Dr. Pinkham on Saturday, 10 July, requesting that they buy dry ice; that he purchased 600 pounds (50 lb. blocks) of dry ice from Carbo Chemical Company, 1246 East 21st South, SLC; contacted a Mr. D. Mulks, delivery order M-2060.
	0850	Mr. Woods asks Dr. Pinkham about the dry ice; he requests that Mr. Woods call Mr. Hereim to get details.
	0855	Mr. Woods calls Mr. Hereim; tells him that the dry ice is in SLC to be picked up; LD needs dry ice containers for the dry ice if they have them.
	0857	Mr. Hereim calls Mr. Woods and says he has located some styrofoam containers for shipment of the dry ice. Mr. Woods requests he ship them to the Motor Pool (MSG Dean).
	0859	Mr. Woods calls MSG Dean and gives him information on pick up of dry ice; tells him if the containers are inadequate to use blankets.

12 July	0900	Ron Stauffer, Office of the Counsel General calls and asks for progress report. He is told of scheduled coordination meeting this afternoon. He wants to have information concerning BLM-DPG relationship.
	0915	CPT Bush, JAG, Mr. Woods, LTC Schultz, call Mr. Stauffer (8-227-4348) and provide him with a summary of the BLM-DPG-Hill AFB agreement on Wild Horse Herd Management. He seems satisfied that management is a BLM responsibility.
	0930	Mr. Woods calls LTC Wuerz for a plastic relief map of Orr Springs area for the Surgeon General. LTC Wuerz says these maps have been on order for about 6 months and are not expected for another 2 to 3 months. LTC Wuerz volunteers the last one which is hanging in the Plant Engineering Branch Office. The map is delivered to Mr. Woods' office at 1145 on 12 July.
	1000	LTC Reddin needs maps. Sonny Duel and Mr. Retford (Facilities Engineering Division) will furnish these.
		MAAF calls LTC Schultz; MAAF confirms 1245 Salt Lake City pickup for Dr. Schoenfeld and party.
	1100	Copies of the color prints are given to LTC Reddin.
	1130	Mr. Deuel is instructed by LTC Schultz and Mr. Woods that no action will be taken to bury a dead horse that is not accessible.
	1150	LTC Wuerz delivers a handwritten copy of the diaries to Dr. Pinkham at Headquarters Building. Dr. Pinkham will present "requirements" still hanging fire to Dr. Rothenberg later today to determine which ones should be completed after today. Further actions may be indefinitely suspended.
	1300	LTC Schultz passes instructions to Photo Branch. Dr. Rothenberg wants 3 copies (slides) of entire color slides. To be charged to horse collection account.
	1315	Mr. Tanner has messages from LTC Knight and MAJ Maybe regarding their use of training areas in June 76. A copy of these documents will be sent to the QA office.

12 July 1330 CPT Law identified plants in the color photo packages provided to LTC Reddin (see attached sheet).

1345 LTC Wuerz contacts Fire Chief Neel and verifies that dark colored balloons and helium are available, if needed, for the helicopter identification marker for dead horses.

1400 Meeting with COL Toepel, Dr. Rothenberg, Ron Hall, Dr. Schoenfeld, Dr. Watkins, Dr. Spendlove, Mr. McColgan, LTC Schultz, Mr. Howard, Mr. Horan, Mr. Frei, LTC Reddin, Mr. Jack Reed (BLM PIO), Mr. McRae, Mr. Glade Anderson, Mr. Don Hardcastle, Mr. Lonnie Johnson, Mr. Fox, (Humane Society of Utah) and Dr. Osguthorpe.

Mr. Hall and Dr. Spendlove have disagreement concerning choice of watering hole by wild horses, upper or lower seeps. Dr. Spendlove insists that the BLM water distribution system is not consistent with the natural inclination of the horses. Mr. Hall stated that with the intense activity in the area horses have adjusted to the situation and are now watering at Cain Spring. Fifty-seven horses were counted at Granite. Mr. Hall says that BLM data does not show dehydration to be a factor and Dr. Spendlove states that DPG lab data does show this to be a major problem. Mr. Hall doesn't believe that any more deaths will be reported.

On 28-29 June Mr. Rigby observed a large number of horses (in gant condition and apparently choking) in dried up area. On 1 July Glade Anderson observed 35-40 horses at Orr Springs. Hypothesis: Horses stood around dried up hole, finally decided to move, were stressed, watered at Orr, died. Deaths were due to stress.

In the morning interview, Mr. Howard and Mr. McRae gave history of the spring development program (1230 hours on 12 July). No comments were made concerning cause of deaths. BLM had not adversely affected water supply; lack of water was not cause of death, summary of discussion with Channel 2. It appears to be a difference of opinion, which are examined as follows:

> "Dr. Schoenfeld -- Were horses seen by Mr. Rigby the same ones as those seen by Anderson on the 1st?

12 July

Dr. Spendlove -- They were filled with mud, indicating they had eaten dirt trying to get moisture. Horses watered -- some survived and some died of shock. Horses, after being watered the previous day showed a remarkable recovery. Hematocrits -- very high. Blood protein -- very high. Mares -- have no milk in udders. Forty-eight hours after first drawings hematocrits went from abnormal to normal or near normal.

Mr. Hall -- The horses Dr. Spendlove saw recovered were still lethargic; disagrees with Spendlove's conclusions.

Dr. Spendlove -- Ask toxicologist at University of Utah to re-run DPG samples for independent appraisal of our laboratory results. Wildlife survey vectors, soil, water, vegetation, tissues; no other leads other than dehydration.

Mr. Howard -- Do we have reports on dehydration data?

Dr. Spendlove -- Yes, we have enough samples to split one more time. Hematocrit taken 5, 6, 7 and 9 July.

Dr. Watkins -- Sudden deaths from dehydration; improbable, should have been more lingering. Studs should have been last to die, not first as did. Physiological problem not chemical, etc. Intermountain Laboratory's report indicated massive congestion in all vital organs, diagnosis shock!! What shock? Heat -- limited water supply (but adequate) -- exertion. BLM activity in area should not have kept horses out of area, but perhaps limited hours of accessibility. In June there was increased activity in the northeast area -- what was the effect of combined BLM and Army activity -- additional movement or exertion; high environmental temperatures; limited watering; just before they died they panicked for 2-4 hours. Horses that died 5 July died within 24 hours. Bloody foam seen on most is caused by rapid breathing. Deaths that followed were different in nature; died of circulatory collapse. Stress theory vs. dehydration theory. Same blood sample, same horse, different data.

Dr. Taylor -- No evidence of dehydration.

12 July

BLM theorizes that deaths were due to limited water, exertion, water intoxication.

Mr. Howard -- Was the National Guard authorized to be in the area?

COL Toepel -- No. No National Guard activity was going on up there.

Mr. Howard -- The only activity in the area was BLM (National Guard had potential to be in the area).

Dr. Schoenfeld -- High temperatures, wanting to get back to normal waterholes, stressed by heat/moving, death rapid, came into lounging areas and died, not running; used to limited amounts of noise; choppers, trucks, are part of normal activity they are used to. Animals watering at night. Hot weather, movement, project disturbed them -- extensive dehydration based on chemistry Spendlove has done, hematocrits, tissue changes, paired samples taken by DPG, Intermountain Laboratory, University of Utah per 9 July autopsy. Dr. Ramsey, Ramona, horse from Ephraim mountains exhibited same characteristics, same death; domestic horse. Others are dying in that same area.

LTC Reddin -- Dehydration; stress."

1545 Briefing for MG Griffity -- asked for lab reports and PAO releases.

1600 Stress aggravated by lack of water, human activity, weather, and some other cause.

Received following from joint conference in SLC -- COL Toepel and Mr. Howard healing their wounds and settling differences. COL Toepel, LTC Reddin, Mr. Howard and Dr. Schoenfeld present at meeting.

1615 Draft press release passed out to conferees. Latest count on horses dead -- 50, of which 3 were sacrificed.

1700 BLM needs third set of color prints. Dr. Schoenfeld needs one copy of prints.

12 July 1730 Meeting adjourned.

1800 LTC Schultz calls MAJ Brisker to provide information for briefing (13 July) for MG Griffith and LTG Sammett. Briefing covered PAO, status of herds, lab work update and discussion of BLM-DPG-Hill AFB wild horse agreement. Dr. Rothenberg and COL Toepel have notes LTC Schultz worked from.

13 July Dr. Salomon turns in report to Dr. Rothenberg. Hematocrit data should be there showing electrolyte values not converted to mg/l for horses associated with Orr Springs area.

14 July 1100 LTC Schultz returns MAJ Briskers phone call (TECOM EOC). Following information is passed on:

1. Watering area completed by BLM 13 May 76.

2. Logs and stakes shown in one photo were preparations for BLM's proposed water trap to be built in the area.

3. Artillery and impact area bounded by following coordinates: 414436
456398
403346
456346

4. Artillery firing points used in National Guard training:

Point	Coordinates	Point	Coordinates
514R	493503	522	468519
514	492500	521	461519
513	488501	501	467504
512	485501	701	447486
511	482503	702	452482
523	475519	703	460477
503	476508		
502	472506		

1100 LTC Schultz tries to return Mr. McRae's telephone call -- gets wrong number.

14 July	1115	CPT Bush contacted by LTC Schultz. He will facsimile a copy of the 1973 BLM-DPG-Hill AFB horse management agreement to MAJ Brisker, TECOM.
	1120	LTC Schultz calls Mr. McRae at 524-4348. No answer.
16 July	0930	Statements from Rigby and Gourley arrive.
	0950-1010	Mr. Clarence Thompson (Special Investigator with BLM) interviews Dr. Pinkham and Dr. Adams.
	1100	LTC George Reddin briefed Drs. Pinkham and Adams on his findings before departing for Ft. Leonard Wood, Missouri.
19 July	1000	Mr. Glade Anderson, BLM, reports to Dr. Adams that he would like to take saddle horse into vicinity of Orr Springs to look for more dead horses. He was told to inform Security and Range Control of his intentions.
	1100	Mr. Paul Howard (State Director of BLM) accompanied by Mr. Ron Hall, arrives at COL Toepel's office for helicopter overflight of Orr Springs area. Personnel on flight are COL Toepel, Mr. Howard, Mr. Hall, Mr. Mark Endsley (PIO) and Dr. A.P. Adams. Overflight visits made to White Rock Spring, Cochran Spring, Orr Springs (where setdown occurs), Cane Spring, (spring northeast of Orr Springs), Wig Mountain mud hole, Black's Lake and return to English Village. While at Orr Springs it is evident that weekend rains had greatly increased seepage at several points in the area. Water was running from water trough overflow to basin below at Orr Springs. Evidence by tracks of two horses drinking at overflow of Orr Springs basin. No tracks near BLM water trough. Runoff had replenished water supply at Wig Mountain mud hole. Evidence of horses in the area. Weather was cooler and pleasant. Horses observed on plain below Bitter Springs and also in the vicinity of Cane Springs. Mr. Anderson arrived with horse and truck at Orr Springs at about 1200 hours. Mr. Howard said very little, mainly indoctrinated by Mr. Hall. Mr. R. Davis, Mr. Green and CPT Maxwell come up from Baker Lab by 4-wheel drive truck to meet the party and provide any information required. CPT Maxwell said mosquito and

19 July		animal traps were set each evening and collected early each morning. Mr. Howard suggests that trapping vicinity in the area be curtailed to once a week from here on out. COL Toepel replies he would take suggestion under advisement and confer with scientists working on problem to see if such a course were advisable.
20 July	1000	Mr. Louis C. Stover from U.S.Army DARCOM Installations & Services Activity, Rock Island, Illinois, arrives in company with Mr. Sonny Deuel to investigate possible involvement of encephalitis in mosquitoes and horse deaths. Mr. Stover spends rest of day and 21 July with Mr. Deuel on non-horse related matters and makes appointment with Dr. Adams, Mr. Crane and Dr. Stark for 22 July, 1030 hours, at Baker Lab.
	1120	Supposedly a member of the Utah Mustang Association, Mr. Kent Gregersen of 2260 West and 4805 South, reports in the July 20 issue of the Salt Lake Tribune that he had been to Orr Springs Sunday (18 July 1976) and that flags on the stakes near Orr Springs would keep wild horses away. A check with Security reveals that Mr. Gregersen was not cleared to Orr Springs on 18 July. (Mr. Gregersen was there also without knowledge of BLM, but Mr. Glade Anderson of BLM did note Monday, 19 July, shod horse tracks coming over the pass from the direction of Cochran Springs.) COL Toepel asked that Security call Mr. Gregersen and advise him of proper procedures to gain base access. CPT Lewter calls Mr. Gregersen and queries him about his access to Orr Springs and advises him of the procedures to gain proper access.
	1500	Dr. Donald Bode', University of Utah and former Commander of Dugway Proving Ground, calls Dr. Rothenberg and states that an article in "American West", July issue, states that Rattleweed (locoweed) when eaten by horses makes them so they will not drink and will die of thirst. Request Dr. Bode' to send a reprint of the article since it is not available from the University of Utah Library.
21 July	0900	Mr. Glade Anderson of BLM shows up at main gate with two women representing Predatory Animal Protection Agency. They give names of Ms. Norinda Burbidge and Ms. Sandra Joe Josie. They state they have come out to check Humane

21 July

Society claims that Compound 10-80 may have poisoned the horses. Accompanied to site by CPT Maxwell to Orr Springs. They conclude that Compound 10-80 was in no way involved in the horse incident. They also note fresh coyote tracks in vicinity of Orr Springs and maggots and flies near water; and blood remains of one of dead horses, which is strong evidence of no Compound 10-80 in horse tissues. Depart area approximately 1300 hours.

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APPENDIX D. CARCASS BURIAL RECORD

Number	Description	Sex[a]	Age[b]	Found Dead			Buried		
				Location	Date	Time	Location	Date	Time
1	Sorrel	M	2 y	1[c]	6/7	1505	1	7/7	0930
2	Bay	F	2 y	3[c]	6/7	1505	3	7/7	0930
3	Sorrel, Diamond Forehead	M	12 y	A-1	4/7	2100	2	7/7	1430-1600
4	Brown	F	3 y	A-1	4/7	2100	2	7/7	1430-1600
5	Colt	F	2 m	A-1	4/7	2100	2	7/7	1430-1600
6	Bay	M	11 y	A-1	4/7	2100	2	7/7	1430-1600
7	Brown (#3)	--	Colt[d]	A-2	5/7	1210	2	7/7	1430-1600
8	Brown (#5)	--	Colt[d]	A-2	5/7	1340	2	7/7	1430-1600
9	Brown	--	Colt	A-2	6/7	1045	2	7/7	1430-1600
10	Sorrel	M	2 y	A-1	4/7	2100	2	7/7	1430-1600
11	Sorrel	--	1 m	A-1	4/7	2100	2	7/7	1430-1600

[a] M = Male
F = Female

[b] y = Years
m = Marks

[c] Uncertain which horse was found and buried at site

[d] Autopsied. Number in parentheses equals number in DPG records

[e] = Hind quarters eaten away. Determination of sex impossible.

Number	Description	Sex[a]	Age[b]	Found Dead			Buried		
				Location	Date	Time	Location	Date	Time
12	Brown	M	4 y	A-1	4/7	2100	2	7/7	1430-1600
13	Black	M	12 y	A-1	4/7	2100	2	7/7	1430-1600
14	Black	M	14 y	A-1	4/7	2100	2	7/7	1430-1600
15	Sorrel	F	6 y	A-1	4/7	2100	2	7/7	1430-1600
16	(#2)	--	Colt[d]	A-1	4/7	2100	2	7/7	1430-1600
17		--	Colt[e]	A-1	4/7	2100	2	7/7	1430-1600
18		--	Colt	A-1	4/7	2100	2	7/7	1430-1600
19	Black, Blaze	M	5 y Coming	A-1	4/7	2100	2	7/7	1430-1600
20	Brown	M	6 y	A-1	4/7	2100	2	7/7	1500-1700
21	Buckskin	M	12 y	A-3	6/7	1025	2	7/7	1500-1700
22	Black	F	10 y	A-2	6/7	1215	2	7/7	1500-1700
23	Black	M	5 y	A-1	4/7	2100	2	7/7	1500-1700
24	Brown	F	Mature	A-1	4/7	2100	2	7/7	1500-1700
25	Brown	F	Mature	A-1	4/7	2100	2	7/7	1500-1700

[f] Uncertain which of these four was found on the 6th and which on the 7th

[g] Died last spring

[h] Billed for autopsy. Death from tranquilizer

Number	Description	Sex[a]	Age[b]	Found Dead			Buried		
				Location	Date	Time	Location	Date	Time
26		F	Mature	A-1	4/7	2100	2	7/7	1500-1700
27	Brown	M	3 y	A-1	4/7	2100	2	7/7	1500-1700
28		M	6 y	A-1	4/7	2100	2	7/7	1500-1700
29		F[d]	4 y	A-1	6/7	1045	2	7/7	1500-1700
30	Palomino	M	5-6 m	B	6/7	1040[f]	2	7/7	1600-1900
31	Black	F	4 y	B	6/7	1040[f]	2	7/7	1600-1900
32	Blue[d](#10)	--	Colt	B	7/7	1430[f]	2	7/7	1600-1900
33	Brown	M	2 y	B	7/7	1430[f]	2	7/7	1600-1900
34	Black	M	4 y	C			2	8/7	1200
35[g]	Bay	M	16 y	5	9/7	1330	5	10/7	1400
36	Bay	F	10 y	D	8/7	1700	2	9/7	1730
37	Buckskin	F	4 y	D	8/7	1700	2	9/7	1730
38	Sorrel	F	2 y	D	8/7	1700	2	9/7	1730
39	Stripe-face Red Roan	F	4 y	D	8/7	1700	2	9/7	1730
40	Bay	M	3 y	D	8/7	1700	2	9/7	1730

Number	Description	Sex[a]	Age[b]	Found Dead			Buried		
				Location	Date	Time	Location	Date	Time
41	Palomino[d,h]	F	Colt	E	9/7	1530	2	7/7	1500-1700
42	Bay[d,h]	M	3 y	E	9/7	1530	2	7/7	1500-1700
43	Bay with Blue Collar	F	4 y	4	7/7	1100	4	10/7	1200
44	Bay	F	8 y	4	7/7	1100	4	10/7	1200
45	Bay	F	7 y	F	4/7	2257	2	10/7	1530
46	Sorrel with Bald Face	M	12 y	F	6/7	1115	2	10/7	1530
47	Black	M	4 y	G	10/7	1130	2	10/7	1530
48	Black, Bald Face	M	4 y	H	5/7	0822	2	10/7	1530
49	Bay[d]	F	3 y	I	9/7	1730	2	10/7	1530
50	Sorrel[d]	--	2 m	A-2	5/7	1545	Moved to Salt Lake City		
51		--		J	8/7	1715	Left in situ		
52				K	8/7	1715	Left in situ		
53				L	8/7	1730	Left in situ		
54				L	9/7		Left in situ		

JOINT MESSAGEFORM

SECURITY CLASSIFICATION: UNCLAS EFTO ~~FOUO~~

PAGE	DATE-TIME GROUP	PRECEDENCE ACT	PRECEDENCE INFO	EMP	CLASS	CIC	FOR MESSAGE CENTER/COMMUNICATIONS CENTER ONLY DATE - TIME	MONTH	YR
1 OF 2		PP	PP		UUUU				

BOOK NO.

MESSAGE HANDLING INSTRUCTIONS

FROM: CDRDPG DUGWAY UT//STEDP-SO//

TO: HQDA WASH DC//DAPE-HRE//

INFO: CDRTECOM APG MD//DRSTE-SE//

INFO: CDRDARCOM ALEX VA//DRCSS-M//

UNCLAS EFTO ~~F O U O~~

SUBJECT: SIR NUMBER 760004

1. CATEGORY 2

2. TYPE OF INCIDENT: WILD HORSE DEATH (9Z)

3. DATE/TIME OF INCIDENT: 041941 JUL 76

4. LOCATION: ON DPG INSTALLATION IN THE VICINITY OF ORR SPRINGS, 17 MILES NW OF HEADQUARTERS AREA.

5. RACIAL: NO

6. PERSONNEL: NO IDENTIFIED SUBJECTS OR VICTIMS

7. SUMMARY OF INCIDENT:

A. ON SUNDAY EVENING, 4 JULY 1976, A ROUTINE SECURITY FLIGHT WAS MADE BY HELICOPTER OVER THE WESTERN SLOPE OF THE CEDAR MOUNTAIN RANGE OF DUGWAY PROVING GROUND, DUGWAY, UTAH.

B. DURING THIS OVERFLIGHT THE PILOT AND OBSERVER REPORTED SEEING DEAD WILD HORSES IN THE AREA OF THE ORR SPRINGS WATERING HOLE, WHICH

INFO:

CO, DC, SO, CCNC-TDG

DRAFTER TYPED NAME, TITLE, OFFICE SYMBOL, PHONE & DATE
ALAN A. LEWTER, CPT, MPC
Chief, Security Office
SO/3561/7 Jul 76

SPECIAL INSTRUCTIONS

RELEASER TYPED NAME, TITLE, OFFICE SYMBOL AND PHONE
ALAN A. LEWTER, CPT, C,SO 3561

SECURITY CLASSIFICATION: UNCLAS EFTO ~~F O U O~~

DATE TIME GROUP

DD FORM 1 DEC 76 173 REPLACES DD FORM 173, 1 JUL 68, WHICH WILL BE USED. S/N 0102-014-6601

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1.

JOINT MESSAGEFORM

SECURITY CLASSIFICATION: UNCLAS EFTO ~~E F T O~~

PAGE	MASTER OR RELEASER TYPE	PRECEDENCE ACT	PRECEDENCE INFO	LMF	CLASS	CIC	FOR MESSAGE CENTER/COMMUNICATIONS CENTER ONLY: DATE – TIME	MONTH	YR
2 of 3									

BOOK | MESSAGE HANDLING INSTRUCTIONS

FROM:

TO:

IS 17 AIR MILES NORTHWEST OF THE HEADQUARTERS AREA. DUGWAY LIFE SCIENTISTS AND THE INSTALLATION VETERINARIAN WERE IMMEDIATELY DISPATCHED TO THE INCIDENT SITE AND OBSERVED APPROXIMATELY 20 DEAD WILD HORSES IN THE VICINITY OF THE SPRING. THE CAUSE OF DEATH HAS NOT YET BEEN DETERMINED. DUGWAY HAS NOT CONDUCTED OPEN-AIR TESTS WITH TOXIC AGENTS OR NOXIOUS MATERIALS SINCE 1969. RECENT ACTIVITY IN THE AREA HAS INVOLVED THE DEVELOPMENT OF THE WATER SOURCES FOR WILD HORSES.

C. ON MONDAY, 5 JULY 1976, BUREAU OF LAND MANAGEMENT AND STATE PROFESSIONAL CONSULTANTS JOINED THE DUGWAY SCIENTISTS IN AN ATTEMPT TO DETERMINE THE CAUSE OF DEATH IN THE WILD HORSE HERD. ON-SITE INSPECTION REVEALED 26 DEATHS AND APPROXIMATELY 16 SICK ANIMALS IN THE HERD OF 90-100 ANIMALS. FRESH WATER WILL BE HAULED TO THE AREA UNTIL ANALYSIS OF THE SPRING IS MADE. ARMY LIFE SCIENTISTS, BUREAU OF LAND MANAGEMENT AND UTAH STATE DEPARTMENT OF AGRICULTURE PERSONNEL HAVE COLLECTED SAMPLES REQUIRED TO CONDUCT LABORATORY ANALYSES TO DETERMINE THE CAUSE OF DEATH.

D. DUGWAY IS INHABITED BY APPROXIMATELY 250 WILD HORSES AND THESE ANIMALS ARE BEING MANAGED UNDER A COOPERATIVE AGREEMENT BETWEEN

DISTR:

RELEASER'S NAME, TITLE, OFFICE SYMBOL, PHONE & DATE | SPECIAL INSTRUCTIONS

TYPED NAME, TITLE, OFFICE SYMBOL AND PHONE

SIGNATURE | SECURITY CLASSIFICATION | DATE TIME GROUP

DD FORM 173 REPLACES DD FORM 173, 1 JUL 68, WHICH WILL BE USED.

JOINT MESSAGEFORM

SECURITY CLASSIFICATION: UNCLAS EFTO ~~F O U O~~

PAGE	DATE-TIME RELEASER FILE	PRECEDENCE ACT	PRECEDENCE INFO	LMF	CLASS	CIC	FOR MESSAGE CENTER/COMMUNICATIONS CENTER ONLY DATE - TIME	MONTH	YR
OF									

MESSAGE HANDLING INSTRUCTIONS

FROM:

TO:

THE U.S. ARMY AND BUREAU OF LAND MANAGEMENT. THE WILD HORSE HERDS WHICH NORMALLY INHABIT THE GRANITE MOUNTAIN AREA, NORTH WIG AND RYDALCH CANYON AREA APPEAR TO BE HEALTHY.

E. UTAH STATE DEPARTMENT OF AGRICULTURE, BLM AND DUGWAY SCIENTISTS ARE CONTINUING THEIR EFFORTS TO DETERMINE THE CAUSE OF DEATH AND MONITOR THE CONDITION OF THE OTHER HERDS ON THE DUGWAY RANGES.

. REMARKS: SUMMARY OF INCIDENT AS OUTLINED IN PARAGRAPH 7 WAS ELEASED TO THE NEWS MEDIA BY COMMANDER, DPG, 071000 JUL 76.

. PUBLICITY: CONSIDERABLE LOCAL AND NATIONAL NEWS COVERAGE IS NTICIPATED. AN ADVERSE EFFECT ON COMMUNITY RELATIONS AND ARMY RESTIGE IS EXPECTED TO OCCUR.

. COMMANDER REPORTING: JAMES L. TEMPLETON, JR., COLONEL, CM, CTING COMMANDER.

. FOUO MARKING MAY BE REMOVED 7 JULY 1979.

OTR:

TYPED NAME, TITLE, OFFICE SYMBOL, PHONE & DATE	SPECIAL INSTRUCTIONS
TYPED NAME, TITLE, OFFICE SYMBOL AND PHONE	
SIGNATURE	SECURITY CLASSIFICATION / DATE TIME GROUP

DD FORM 1 DEC 68 173 3 REPLACES DD FORM 173, 1 JUL 64, WHICH [illegible]

DPG AIR TRANSPORTATION SUPPORT

Date	Time	Action
30 Jun	1500	CPT Beard, SGT Crouse and Mr. Raymond Morales (Medic) make routine (weekly) fenceline overflight. Crew is not looking for horses. None is seen.
2 Jul	1930	CPT Gray and SGT Crouse leave Michael Army Air Field (MAAF) for first overflight of weekend.
	1940	Arrive at Health Clinic pad to pick up two Military Police (MP's).
	1950	Complete flight of Cedar Mountain fenceline and head for Granite Mountain. Flight path is approximately two miles to the southeast of Orr Springs. Crew is not looking for horses. None is seen.
	2030	Arrive MAAF; terminate overflight.
3 Jul	0730	CW3 Keen and SP5 Taylor leave MAAF for second overflight of weekend. Follow same flight pattern as above, except fly over Orr Springs. Crew is not looking for horses. None is seen.
	0830	Arrive MAAF; terminate overflight.
	1930	CW3 Keen and SP5 Taylor leave MAAF for third overflight. Follow same flight pattern as second overflight. Crew is looking for horses.
	1950	Two to three horses are observed lying down in the north gully at Orr Springs (assumed to be resting, as is common with horses). No motion is detected. Approximately another 20 horses are standing nearby. They would not have been able to detect the carcasses found later under the trees.
	2045	Arrive MAAF; terminate overflight.
4 Jul	0530	CW3 Keen and SP5 Taylor leave MAAF for fourth overflight of weekend. Follow same flight pattern as second overflight.

AD-A032 445 ARMY DUGWAY PROVING GROUND UTAH F/G 6/3
INVESTIGATION OF DEATHS OF HORSES AT ORR SPRINGS.(U)
SEP 76 L L SALOMON

UNCLASSIFIED NL

4 OF 4
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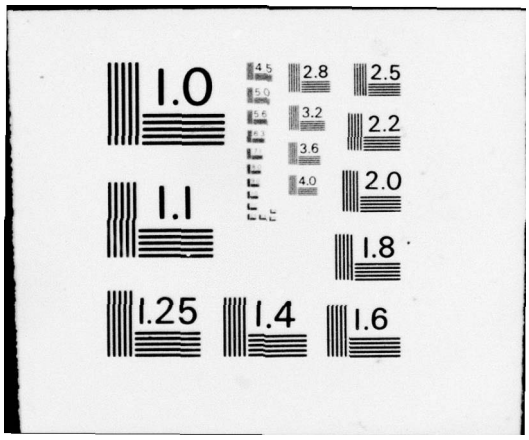
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DPG AIR TRANSPORTATION SUPPORT

Date	Time	Action
4 Jul	0550	Notice three to five horses on their sides in the north gully at Orr Springs. Again, this is not deemed unusual.
	0630	Arrive MAAF; terminate overflight.
	1920	CW3 Keen and SP5 Taylor leave MAAF for fifth overflight of weekend. Follow same flight pattern as on second overflight to the point of Orr Springs.
	1930	Arrive at Health Clinic pad. Pick up E4 Daniel and E3 McDonald (MP's).
	1940	Upon arrival at Orr Springs, one horse is observed with its feet sticking up in the air. Approxi-
	1941	mately 12 other horses are down. Immediately notify Security who notify Military Police.
	1945	MP's call CPT Lewter (SO). CPT Lewter calls
	1950	COL Templeton (Acting Commander).
	1955	Terminate overflight. Go to hospital pad to pick up CPT Lewter, CPT Lee (Post Veterinarian) and Mr. D. Faux (Security Supervisor).
	2015	Return to Orr Springs, drop off CPT Lee and CPT Lewter, E4 Daniels and Mr. Faux.
	2115	Leave site for MAAF to pick up Mr. Oyler (SA), Dr. Stark and Dr. Pinkham (MT-L-E).
	2140	Leave MAAF for site.
	2145	Arrive at site. Observe approximately 15 horses frightened by helicopter upon take off. All appear to be running vigorously.
	2255	Leave site.
	2257	Observe one dead horse and five live horses (emaciated) at mud hole (now dried up) north of Baker and just south of Wig Mountain.
	2300	Arrive MAAF; terminate flight.

NOTE: No evidence of human activity was detected on overflights; gates were closed and no vehicle tracks observed. No other way to get over cedars short of on foot or horseback or through DPG.

DPG AIR TRANSPORTATION SUPPORT

Date	Time	Action
5 Jul	0730	CW3 Keen and SP5 Taylor leave MAAF for health clinic pad.
	0740	Arrive at health clinic pad. COL Templeton, Dr. Stark and Dr. Pinkham, Mr. R. Davis (MT-L-E), E5 Underhill (MP), Mr. Glade Anderson (BLM), CPT Lee, E3 Washington (MP) on board.
	0745	Leave health clinic pad.
	0755	Arrive MAAF. Dr. Stark and Mr. Davis leave to pick up key to Baker and obtain four-wheel drive vehicle to get into Baker.
	0800	Leave MAAF for Baker.
	0805	Arrive Baker. Dr. Pinkham leaves.
	0806	Leave Baker, travel to Granite Mountain. Observe canyons on northeast side of Granite Mountain. An average of seven to ten horses per herd. All horses appear healthy. No other horses seen elsewhere on Granite, which was completely circled.
	0815	Leave Granite Mountain and follow road from Baker to Orr Springs. Observe the same dead horse at the mud hole north of Baker. No live horses seen. Observe coyote running in gully approximately one mile south of Orr Springs.
	0820	Arrive at Orr Springs. Dr. Lee, E3 Washington and Mr. Anderson depart.
	0825	Leave Orr Springs with CW3 Keen, SP5 Taylor, COL Templeton and E3 Underhill for surveillance of other known horse localities.
	0840	Over North Wig area. Observe a single herd with approximately five horses in foothills. All appear healthy.
	0850	Fly to West Rydalch Canyon; observe approximately ten horses. All appear healthy.

DPG AIR TRANSPORTATION SUPPORT

Date	Time	Action
5 Jul	0900	Fly to eastern side of Cedars; observe another herd with approximately seven head. All appear healthy.
	0910	Fly to Cain Springs. Observe no horses.
	0915	Arrive MAAF for refueling and contact with LTC Schultz and CPT Lewter.
	0930	Pick up Mr. Oyler and Mr. Stephens (DPG photographer); leave MAAF for Orr Springs.
	0935	Arrive Orr Springs, drop off COL Templeton. Pick up E5 Underhill.
	1140	Leave Orr Springs for health clinic pad. Take two MP's.
	1145	Arrive at health clinic pad. Drop off MP's.
	1150	Leave hospital pad for Salt Lake City (SLC).
	1230	Arrive helicopter pad at SLC National Guard. Pick up Mr. Nicholes.
	1300	Arrive helicopter pad at Ogden National Guard. Pick up Dr. Schoenfeld.
	1400	Arrive at MAAF; refuel. CPT Beard and SP Ring take over flight. SP5 Taylor departs; Mr. Keen remains.
	1435	Leave MAAF.
	1440	Arrive at Orr Springs. Dr. James Schoenfeld, Utah State Veterinarian and Mr. Craig Nicholes (State Division of Health, Bureau of Disease Prevention) are off loaded.
	1445	Leave Orr Springs. Observe two herds of horses. One not far from Orr Springs is not frightened by helicopter, stays under junipers; other herd farther south (probably same herd spotted at 0840 by three-man crew (background, administrative and supporting).

DPG AIR TRANSPORTATION SUPPORT

Date	Time	Action
5 Jul	1450	Arrive MAAF, Mr. Keen departs.
	1455	CPT Beard and SP Ring leave MAAF.
	1500	Arrive Orr Springs.
	1600	Depart area; COL Templeton, Mr. J. Oyler, Mr. R. Stephens, Mr. Nichols and Dr. Schoenfeld.
	1605	Arrive MAAF; drop off Mr. Oyler and Mr. Stephens.
	1610	Leave MAAF for health clinic pad.
	1625	Arrive health clinic pad; COL Templeton departs.
	1630 to 1830	Return Dr. Schoenfeld and Mr. Nichols to home station.
	1830	Return to MAAF; terminate flight.
6 Jul	1000	CPT Gray, CPT Beard and SGT Crouse (pilots and crew) pick up Dr. Watkins, Mr. McRae, Mr. Anderson and CPT Law (DPG plant expert) at health clinic pad; fly to MAAF and pick up Dr. Spendlove and Ogden Kraut (DPG photographer).
	1020	Fly to site and drop off passengers.
	1025 to 1205	Dr. Spendlove, Mr. Kraut and CPT Law remain behind; rest of passengers go on overflight. Upon takeoff, observe one dead horse (buckskin stud) just to northwest of Orr Springs. Then observe approximately 25 head at Bitter Springs and two carcasses. Some of the live horses appear to be in good condition; others in poor condition. Those in good condition do not run when helicopter approaches. East of Orr Springs there is one carcass in wash, and two to three others in the area. One with collar (seen the day before) is very weak. Fly to Wig Mountain which is circled with no sightings, alive or dead. Pass over mud hole just south of Wig Mountain; two carcasses there now. Two healthy horses on flats south of Wig. Fly to Cain, Cochran and White Rock Springs; no horses, alive or dead. Pilot receives call to pick up Dr. Taylor in SLC; head for MAAF.

DPG AIR TRANSPORTATION SUPPORT

Date	Time	Action
6 Jul	1210	Return to MAAF. Drop off passengers.
	1215	Fly to SLC airport, National Guard helipad, to pick up Jack Taylor (State Pathologist).
	1350	Helicopter returns from SLC with Dr. Taylor; stops at Baker to pick up Dr. Spendlove and proceeds to site.
	1400	Return to site.
	1500	Fly to Stark Road and Tango; passengers: Dr. Taylor, Dr. Spendlove, Mr. Kraut, to observe horse reported to have puncture wound. While enroute, observe 35-40 horses in tamarack trees below Orr Springs); appear okay, but too far for certain observation. They all react toward helicopter in normal manner. Two dead horses also at Bitter Springs.
	1530	Mr. Kraut remains at Stark Road; fly back to site to drop off Dr. Taylor; overflight on rest of installation and Skull Valley; no carcasses seen. Herd of six to eight horses not seen on White Sage Flat today.
	1630	Dr. Spendlove is dropped off at health clinic pad.
	1945	Dr. Taylor is dropped off at SLC International Airport National Guard pad.
	1905	Return to MAAF empty.

DPG AIR TRANSPORTATION SUPPORT

Date	Time	Action
7 Jul	0730	CPT Beard and SGT Crouse fly to SLC National Guard helipad, pick up Dr. Schoenfeld and Dr. Klover, Veterinary Services, APHIS, US Dept. of Agriculture.
	0900	Return to English Village; drop off passengers at health clinic pad.
	0940	Return to MAAF for refueling.
	0955	CPT Beard, CPT Gray and SGT Crouse return to health clinic pad.
	1130	Fly first group of reporters to site.
	1138	Drop off group at site: Dr. Schoenfeld Mr. McRae Dr. Klover Mr. Frank Bourgholtzer, NBC, Los Angeles Mr. Richard K. Smith, NBC, Los Angeles Mr. Phil Muellar, KSL TV, SLC Mr. Roger Andrews, NBC, Los Angeles
	1150	Fly back to MAAF empty. Observe two carcasses in base of gully approximately 800 yards southeast of upper Orr Springs, one with a collar (probably same as one spotted in the first group of horses driven by the upper springs on 5 Jul). Observe six to seven herds of live horses of four to five head each at Bitter Springs. They appear healthy but are too far away for accurate observation. These herds observed during remaining flights.
	1215	Pick up second group at MAAF.

DPG AIR TRANSPORTATION SUPPORT

Date	Time	Action
7 Jul	1220	Drop off second group at site: Dr. M. A. Rothenberg Mr. David Andrews, KTVX, SLC Mr. Jack Allison, KUTV, SLC Mr. Garry S. Moes, Associated Press, Los Angeles Mr. Robert S. Halliday, Salt Lake Tribune Mr. Steve Horan (PAO, DPG)
	1230	Leave site empty.
	1235	Return to MAAF.
	1240	Pick up third group at MAAF.
	1245	Drop off third group at site: COL Templeton Ms. Barbara Grossman, KUTV, SLC Mr. Randy Kiplinger, KUTV, SLC Mr. Duane Cardall, KSL TV, SLC Mr. Ron Eisenbardt, KSL TV, SLC Mr. Ron Hall, BLM
	1300	Make three trips back to MAAF to return reporters. SGT Crouse remains at site on last trip back.
	1330	Reporters are met by bus at MAAF. Remain in field; SGT Crouse, COL Templeton, Dr. Rothenberg and Mr. Horan.
	1400	The helicopter goes down for maintenance on fourth trip out (to pick up COL Templeton's party). LT Graham (DPG Adjutant) is brought out to site.
	1405	EOC dispatches vehicle to back haul personnel from site and requests Hawthorne Aviation people to repair aircraft.
	1445	MP vehicle pulls up - Amber 20. Takes back Dr. Rothenberg and Mr. Horan.

DPG AIR TRANSPORTATION SUPPORT

Date	Time	Action
7 Jul	1515	Ron Hall comes out with BLM vehicle. COL Templeton and LT Graham ride back with Mr. Hall.
	1520	Maintenance truck comes out; checks out aircraft.
	1540	Helicopter departs area to MAAF.
	1545	Returns to MAAF. Rest of party rides back in maintenance vehicle.
	1600	Arrives at MAFF.
	1615	CPT Beard flies U-8 fixed wing aircraft to SLC National Guard helipad. Drops off Drs. Schoenfeld and Klover.
	1900	Return to MAAF. Terminate operations.
8 Jul	1230	CPT Beard and CPT Gray depart MAAF for Ft. Collins, Colorado with Dr. Stark and Specimens for Communicable Disease Center.
	2100	Return to MAAF.