Attachment 2.8-1 WGFD Wildlife Observations System Data

obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
3607900000406	LRO	36079	4/2/1992	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	261604	4669009	NAD-83	ADMIN	ADMIN	4/2/1992	
2618900000106	LRO	26189	3/26/1988	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	1				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	262288	4669653	NAD-83	ADMIN	ADMIN	3/26/1988	
2618900000406	LRO	26189	3/26/1988	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	1				Courtship	OIL AND GAS SITES	NONE	Ground Trend Counts	9	0	13	262404	4668204	NAD-83	ADMIN	ADMIN	3/26/1988	
2473900000506	LRO	24739	3/30/1987	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	1				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	267199	4668044	NAD-83	ADMIN	ADMIN	3/30/1987	
2473900000406	LRO	24739	3/30/1987	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	1				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	266800	4668502	NAD-83	ADMIN	ADMIN	3/30/1987	
3417000000806	LRO	34170	4/19/1986	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	1				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261578	4668232	NAD-83	ADMIN	ADMIN	4/19/1986	
3109800000606	LRO	31098	12/1/1982	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	2				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261976	4667774	NAD-83	ADMIN	ADMIN	12/1/1982	
3109600000606	LRO	31096	11/30/1982	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	2				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261232	4670244	NAD-83	ADMIN	ADMIN	11/30/1982	
3109600000806	LRO	31096	11/30/1982	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	1	0	0				Disturbed	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261067	4665358	NAD-83	ADMIN	ADMIN	11/30/1982	
3077700000306	LRO	30777	9/3/1982	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261976	4667774	NAD-83	ADMIN	ADMIN	9/3/1982	
3397500000806	LRO	33975	10/30/1975	EAGLE, GOLDEN	*AQUILA CHRYSAETOS*	0	0	0	0				0	0	0	0				0	0	0	2				Feeding	UNKNOWN	NONE	Casual observation	0	18	13	261405	4668015	NAD-83	ADMIN	ADMIN	10/30/1975	1
3397500000706	LRO	33975	10/30/1975	FALCON, PRAIRIE	*FALCO MEXICANUS*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Casual observation	0	18	13	266679	4664837	NAD-83	ADMIN	ADMIN	10/30/1975	
4858600000306	LRO	48586	7/30/2003	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				1	0	5	0				0	0	0	0				Unknown	UNKNOWN	NONE	Unknow/ Undetermined	0	0	13	264803	4665716	NAD-83	BROWN	ffaulk	7/30/2003	

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obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
4846700000506	LRO	48467	3/22/2003	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	0				Territorial Behavior	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	267114	4669153	NAD-83	HIATT, GREG	emeyer	3/22/2003	
4766800000606	LRO	47668	4/6/2002	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	1	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	267689	4668303	NAD-83	HIATT, GREG	emeyer	4/6/2002	
4766800000706	LRO	47668	4/6/2002	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	0				Territorial Behavior	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	267114	4669153	NAD-83	HIATT, GREG	emeyer	4/6/2002	
4625100000406	LRO	46251	3/23/2000	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	0				Territorial Behavior	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	9	0	13	266412	4669293	NAD-83	HIATT, GREG	emeyer	3/23/2000	
4625100000806	LRO	46251	3/23/2000	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	0				Sign: tracks, scat, etc.	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	HIATT, GREG	emeyer	3/23/2000	
4372400001606	LRO	43724	4/6/1998	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	0				Territorial Behavior	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	4/6/1998	
3736600000206	LRO	37366	4/5/1993	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	5	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	Cause Undetermined	Unknow/ Undetermined	9	0	13	265999	4669307	NAD-83	ADMIN	ADMIN	4/5/1993	
3608000000406	LRO	36080	4/2/1992	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	6	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	4/2/1992	
3604400000706	LRO	36044	3/21/1992	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	1	0	0	0				0	0	0	0				0	0	0	0				Disturbed	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	3/21/1992	
2978500000506	LRO	29785	3/9/1991	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	6	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	3/9/1991	
2854600000506	LRO	28546	3/20/1990	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	13	0	0	0				0	0	0	0				0	0	0	0				Unknown	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	3/20/1990	
2746300000506	LRO	27463	4/13/1989	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	25	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	4/13/1989	
2618700000706	LRO	26187	3/26/1988	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	10	0	0	0				2	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	3/26/1988	
2618900000206	LRO	26189	3/26/1988	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	SAGEBRUSH-GRASSLAND	Predation	Unknown/ Undetermined	9	0	13	262032	4669439	NAD-83	ADMIN	ADMIN	3/26/1988	

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obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
2618900000304	LRO	26189	3/26/1988	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	SAGEBRUSH-GRASSLAND	Predation	Unknown/ Undetermined	9	0	13	260049	4669506	NAD-83	ADMIN	ADMIN	3/26/1988	
2473900000306	LRO	24739	3/30/1987	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	17	0	0	0				4	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	3/30/1987	
3417100000206	LRO	34171	4/19/1986	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	30	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Ground Trend Counts	9	0	13	266412	4669293	NAD-83	ADMIN	ADMIN	4/19/1986	1
3417100000106	LRO	34171	4/19/1986	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				1	0	0	0				0	0	0	0				Escape: direct flight	SAGEBRUSH-GRASSLAND	NONE	Casual observation	9	0	13	263975	4668151	NAD-83	ADMIN	ADMIN	4/19/1986	1
3397600000206	LRO	33976	10/30/1975	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	30				Unknown	UNKNOWN	NONE	Casual observation	9	0	13	261965	4667440	NAD-83	ADMIN	ADMIN	10/30/1975	
3397600000106	LRO	33976	10/30/1975	GROUSE, GREATER SAGE	*CENTROCERCUS UROPHASIANUS*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	Golden Eagle	Casual observation	9	0	13	261405	4668015	NAD-83	ADMIN	ADMIN	10/30/1975	
3417100000406	LRO	34171	4/19/1986	HARRIER, NORTHERN	*CIRCUS CYANEUS*	1	0	0	0				0	0	0	0				0	0	0	0				Courtship	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	265108	4664889	NAD-83	ADMIN	ADMIN	4/19/1986	
3416600000706	LRO	34166	4/18/1986	HARRIER, NORTHERN	*CIRCUS CYANEUS*	1	0	0	0				0	0	0	0				0	0	0	0				Flying	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261923	4666219	NAD-83	ADMIN	ADMIN	4/18/1986	
4846700000406	LRO	48467	3/22/2003	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Reproduction	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	266459	4668383	NAD-83	HIATT, GREG	emeyer	3/22/2003	
4625400000806	LRO	46254	3/25/2000	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				2	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	262032	4669439	NAD-83	HIATT, GREG	emeyer	3/25/2000	
3736500000406	LRO	37365	4/5/1993	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	0	18	13	262472	4670203	NAD-83	ADMIN	ADMIN	4/5/1993	
3417000000106	LRO	34170	4/19/1986	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	262296	4664983	NAD-83	ADMIN	ADMIN	4/19/1986	
3417000000206	LRO	34170	4/19/1986	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Live Trapping Operation - Animal	0	18	13	261923	4666219	NAD-83	ADMIN	ADMIN	4/19/1986	

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obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
3417000000406	LRO	34170	4/19/1986	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261232	4670244	NAD-83	ADMIN	ADMIN	4/19/1986	
3416600000806	LRO	34166	4/18/1986	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261067	4665358	NAD-83	ADMIN	ADMIN	4/18/1986	
3416700000106	LRO	34167	4/18/1986	HAWK, FERRUGINOUS	*BUTEO REGALIS*	0	0	0	0				0	0	0	0				1	0	0	0				Loafing, Roosting, Resting, etc.	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261867	4664553	NAD-83	ADMIN	ADMIN	4/18/1986	
2854700000206	LRO	28547	3/20/1990	HAWK, ROUGH-LEGGED	*BUTEO LAGOPUS*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	SAGEBRUSH-GRASSLAND	NONE	Unknown/Undetermined	0	18	13	261179	4668690	NAD-83	ADMIN	ADMIN	3/20/1990	
4766700001206	LRO	47667	5/19/1993	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				4	0	0	0				Unknown	UNKNOWN	NONE	Unknown/Undetermined	0	18	13	267801	4666246	NAD-83	ADMIN	ADMIN	5/19/1993	
3766700000206	LRO	37667	5/19/1993	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				4	0	0	0				Unknown	UNKNOWN	NONE	Unknown/Undetermined	0	18	13	267801	4666246	NAD-83	ADMIN	ADMIN	5/19/1993	
3774000000506	LRO	37740	5/11/1993	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				7	0	0	0				Unknown	UNKNOWN	NONE	Unknown/Undetermined	0	18	13	262923	4666408	NAD-83	ADMIN	ADMIN	5/11/1993	
3736600000106	LRO	37366	4/5/1993	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				0	0	0	6				Feeding	SAGEBRUSH-GRASSLAND	NONE	Unknown/Undetermined	0	18	13	266427	4669737	NAD-83	ADMIN	ADMIN	4/5/1993	
3604400000806	LRO	36044	3/21/1992	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	SAGEBRUSH-GRASSLAND	Cause Undetermined	Unknown/Undetermined	0	18	13	266255	4669520	NAD-83	ADMIN	ADMIN	3/21/1992	
2618700000806	LRO	26187	3/26/1988	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				10	0	0	0				Escape: direct flight	SAGEBRUSH-GRASSLAND	NONE	Unknown/Undetermined	0	18	13	267024	4670273	NAD-83	ADMIN	ADMIN	3/26/1988	
3416600000606	LRO	34166	4/18/1986	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				4	0	1	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261923	4666219	NAD-83	ADMIN	ADMIN	4/18/1986	
3416600000406	LRO	34166	4/18/1986	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				2	0	0	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	260206	4669279	NAD-83	ADMIN	ADMIN	4/18/1986	
3415600000806	LRO	34156	4/11/1986	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				3	0	0	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Casual observation	0	18	13	261405	4668015	NAD-83	ADMIN	ADMIN	4/11/1986	
3255400000506	LRO	32554	6/11/1984	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	Aerial Trend Counts	0	0	13	263694	4664714	NAD-83	ADMIN	ADMIN	6/11/1984	
3255400000306	LRO	32554	6/11/1984	HORSE, WILD	*EQUUS CABALLUS*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	General Census	0	0	13	265373	4667882	NAD-83	ADMIN	ADMIN	6/11/1984	
4920400000306	LRO	49204	8/8/2004	PRONGHORN	*ANTILOCAPRA AMERICANA*	2	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	NONE	Unknown/Undetermined	61	0	13	265842	4669659	NAD-83	BROWN	cmeyer	8/8/2004	
88439520000040(	LRO	9E+06	8/10/1998	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	NONE	Classification counts	61	0	13	261751	4666002	NAD-83	ADMIN	ADMIN	8/10/1998	

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obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
884395200000306	LRO	9E+06	8/10/1998	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	NONE	Classification counts	61	0	13	261803	4667557	NAD-83	ADMIN	ADMIN	8/10/1998	
4205700001706	LRO	42057	8/16/1996	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	NONE	Classification counts	61	0	13	265000	4669117	NAD-83	ADMIN	ADMIN	8/16/1996	
4197000000306	LRO	41970	5/20/1996	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				43	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	0	0	13	266653	4669063	NAD-83		ADMIN	4/28/2005	
4196200000406	LRO	41962	5/14/1996	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				9	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	0	0	13	266653	4669063	NAD-83		ADMIN	4/28/2005	
4765700001106	LRO	47657	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	261859	4669223	NAD-83	ADMIN	ADMIN	5/19/1993	
4765700001206	LRO	47657	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	260206	4669279	NAD-83	ADMIN	ADMIN	5/19/1993	
3765700000106	LRO	37657	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	261859	4669223	NAD-83	ADMIN	ADMIN	5/19/1993	
3765700000206	LRO	37657	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	260206	4669279	NAD-83	ADMIN	ADMIN	5/19/1993	
4765600001106	LRO	47656	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	268118	4665790	NAD-83	ADMIN	ADMIN	5/19/1993	
3765600000106	LRO	37656	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	268118	4665790	NAD-83	ADMIN	ADMIN	5/19/1993	
3765600000206	LRO	37656	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	6				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	266547	4665842	NAD-83	ADMIN	ADMIN	5/19/1993	
4765600001206	LRO	47656	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	6				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	266547	4665842	NAD-83	ADMIN	ADMIN	5/19/1993	
3765500000306	LRO	37655	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	266653	4669063	NAD-83	ADMIN	ADMIN	5/19/1993	
4765500001306	LRO	47655	5/19/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	0	13	266653	4669063	NAD-83	ADMIN	ADMIN	5/19/1993	
3774000000406	LRO	37740	5/11/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	Unknown/ Undetermined	61	18	13	260040	4664393	NAD-83	ADMIN	ADMIN	5/11/1993	
3773900000406	LRO	37739	5/11/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	UNKNOWN	NONE	General Census	61	0	13	263322	4665950	NAD-83	ADMIN	ADMIN	5/11/1993	
3773900000306	LRO	37739	5/11/1993	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	3				Unknown	UNKNOWN	NONE	General Census	61	0	13	263374	4667504	NAD-83	ADMIN	ADMIN	5/11/1993	
3513900000506	LRO	35139	8/14/1991	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	1	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	NONE	Classification counts	61	0	13	265000	4669117	NAD-83	ADMIN	ADMIN	8/14/1991	
2566200000406	LRO	25662	9/5/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	Legal Harvest	Field Check Station	61	0	13	266969	4668607	NAD-83	ADMIN	ADMIN	9/5/1987	
2566200000506	LRO	25662	9/5/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	Legal Harvest	Field Check Station	61	0	13	266229	4668743	NAD-83	ADMIN	ADMIN	9/5/1987	

Attachment 2.8-1 WGFD Wildlife Observations System Data

obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
2489500000206	LRO	24895	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				4	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	268118	4665790	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000506	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266602	4667508	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000406	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				3	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	265031	4667560	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000606	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	268172	4667456	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000106	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				5	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	268223	4669011	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000206	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				2	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266653	4669063	NAD-83	ADMIN	ADMIN	5/31/1987	
2489400000306	LRO	24894	5/31/1987	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				2	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	265000	4669117	NAD-83	ADMIN	ADMIN	5/31/1987	
3254700000306	LRO	32547	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266093	4664634	NAD-83	ADMIN	ADMIN	6/11/1984	
3254500000706	LRO	32545	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				3	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266280	4670298	NAD-83	ADMIN	ADMIN	6/11/1984	
3254700000206	LRO	32547	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				8	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	268118	4665790	NAD-83	ADMIN	ADMIN	6/11/1984	
3254900000806	LRO	32549	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	262096	4666435	NAD-83	ADMIN	ADMIN	6/11/1984	
3254600000206	LRO	32546	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	267799	4668691	NAD-83	ADMIN	ADMIN	6/11/1984	
3254600000506	LRO	32546	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				5	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266602	4667508	NAD-83	ADMIN	ADMIN	6/11/1984	
3254600000306	LRO	32546	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	266229	4668743	NAD-83	ADMIN	ADMIN	6/11/1984	
3254600000406	LRO	32546	6/11/1984	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				1	0	0	0				Unknown	UNKNOWN	NONE	Aerial Trend Counts	61	0	13	265402	4668771	NAD-83	ADMIN	ADMIN	6/11/1984	
3165600000206	LRO	31656	9/3/1983	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				0	0	0	0				0	0	0	0				Unknown	UNKNOWN	Legal Harvest	Field Check Station	61	0	13	266653	4669063	NAD-83	ADMIN	ADMIN	9/3/1983	1
3109800000806	LRO	31098	12/1/1982	PRONGHORN	*ANTILOCAPRA AMERICANA*	28	0	0	0				27	0	0	0				0	0	15	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Marked Animal	61	0	13	260777	4669037	NAD-83	ADMIN	ADMIN	12/1/1982	1
3109800000706	LRO	31098	12/1/1982	PRONGHORN	*ANTILOCAPRA AMERICANA*	28	0	0	0				27	0	0	0				0	0	15	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Classification counts	61	0	13	260777	4669037	NAD-83	ADMIN	ADMIN	12/1/1982	1
3077700000206	LRO	30777	9/3/1982	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				1	0	0	0				0	0	0	0				Disturbed	SAGEBRUSH-GRASSLAND	NONE	Classification counts	61	0	13	261123	4667024	NAD-83	ADMIN	ADMIN	9/3/1982	
3077700000106	LRO	30777	9/3/1982	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				3	0	0	0				0	0	2	0				Feeding	SAGEBRUSH-GRASSLAND	NONE	Classification counts	61	0	13	260736	4665370	NAD-83	ADMIN	ADMIN	9/3/1982	

obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
1944800000606	LRO	19448	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	261457	4669570	NAD-83	ADMIN	ADMIN	5/15/1981	
1944800000206	LRO	19448	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	2				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	267103	4670159	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000706	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	4				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	264681	4669462	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000306	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	263002	4666294	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000206	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	265348	4664659	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000106	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	266920	4664607	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000606	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	1				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	263828	4668712	NAD-83	ADMIN	ADMIN	5/15/1981	
1944700000506	LRO	19447	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	4				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	263772	4667046	NAD-83	ADMIN	ADMIN	5/15/1981	

Attachment 2.8-1 WGFD Wildlife Observations System Data

obs_number	district	form_number	obs_date	species_common	species_scientific	male_adult_qty	male_yrlg_qty	male_juv_qty	male_uncl_qty	male_est_count_flag	male_age	male_age_tag	female_adult_qty	female_yrlg_qty	female_juv_qty	female_uncl_qty	female_est_count_flag	female_age	female_age_tag	unk_adult_qty	unk_yrlg_qty	unk_juv_qty	unk_uncl_qty	unk_est_count_flag	unk_age	unk_age_tag	animal_activity	habitat	mortality	observer_activity	hunt_area	degree_block	utm_zone	utm_easting	utm_northing	datum	observer_name	user_id	append_date	other_info
1944800000506	LRO	19448	5/15/1981	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	0	0	0				0	0	0	0				0	0	0	3				Unknown	BASIN-PRAIRIE SHRUB-SHRUB STEPPE	NONE	Aerial Trend Counts	61	0	13	262201	4667099	NAD-83	ADMIN	ADMIN	5/15/1981	
61700001804	GRRO[2]	617	10/4/1977	PRONGHORN	*ANTILOCAPRA AMERICANA*	0	1	0	0				3	0	0	0				0	0	2	0				Unknown	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	60	0	13	260232	4667610	NAD-83	ADMIN	ADMIN	10/4/1977	
61900001804	GRRO	619	10/4/1977	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				5	0	0	0				0	0	4	0				Unknown	SAGEBRUSH-GRASSLAND	NONE	Unknown/ Undetermined	60	0	13	260232	4667610	NAD-83	ADMIN	ADMIN	10/4/1977	
61800001804	GRRO	618	10/4/1977	PRONGHORN	*ANTILOCAPRA AMERICANA*	1	0	0	0				3	0	0	0				0	0	4	0				Unknown	GRASSLANDS	NONE	Unknown/ Undetermined	60	0	13	260232	4667610	NAD-83	ADMIN	ADMIN	10/4/1977	

[1] LRO = Lander Regional Office
[2] GRRO = Green River Regional Office

This report was written on behalf of Ur Energy, USA. NFU and LC ISR, LLC are both 100% owned by UR-Energy, USA.

Wildlife surveys were conducted on the Lost Creek Permit Area and in a buffer area of up to two miles beyond the permit boundary.

Attachment 2.8-2

Biological Studies Work Plan
Lost Creek ISR Uranium Project
Ur-Energy USA Inc.

Prepared By:
AATA International, Inc.
300 East Boardwalk Drive, Suite 4A
Fort Collins, CO 80525

February 2006

Table of Contents

Biological Studies Work Plan
Lost Creek ISR Uranium Project
Ur-Energy USA Inc.

1.0 Introduction

AATA International, Inc. (AATA) is pleased to submit this work plan for Biological Field studies to support permitting efforts for the proposed Ur-Energy USA Inc, Lost Creek property in Fremont and Sweetwater Counties, Wyoming. The project is located on lands administered by the Bureau of Land Management (BLM) Rawlins Field Office. Because the site is located on lands administered by the BLM and will require other federal permits the project will have to be considered under the National Environmental Policy Act (NEPA). The Wyoming Department of Environmental Quality (WDEQ) is responsible for state permitting and review of the project.

The following scope of work summarizes field surveys and data gathering that will be required to support WYDEQ and BLM permitting for the project. Informal agency scoping meetings with the BLM, WYDEQ and Wyoming Game and Fish Department (WGFD) were completed to help define the work scope outlined in this plan (Blomquist 2006, Etzelmiller 2006, Hyatt 2006).

2.0 Biological Studies Work Plan

2.1 Data Collection and Mapping

To expedite field work formal data request will be made to the BLM, WYGF, and Wyoming Natural Heritage Program for the project. Data requests will include GIS mapping of habitat areas for big game, sage grouse, raptors, prairie dog colonies and other habitat features. These data requests will supplement existing data already gathered for the project. The data that is received (sage grouse lek locations, raptor nest locations, and other data) will help focus the spring/summer field work. AATA will develop project GIS maps that show appropriate data. These maps will be used to focus the biological studies for the project.

2.2 Sage Grouse Surveys

2.2.1 Lek Surveys (from BLM 2005)

Lek Survey: A monitoring technique to identify new sage grouse leks and to determine whether known leks are active.

<u>Lek Survey</u> **Methodology:**

1. Searches should be conducted from early April to early May (April 1 – May 7). (Survey season corresponds to peak male attendance as established by the WGFD for documenting population trends.)

2. Surveys for new leks should be conducted three (3) times (with subsequent surveys 7-10 days apart).

3. Surveys for new leks should be conducted throughout suitable habitat. New leks can be located by the discovery of concentrated tracks/droppings/feathers at all times of the day when conducting other field activities. Return visits to such sites during the morning strutting hours must be made to confirm the location as a lek.

4. Surveys to confirm the activity of a lek may require only one visit if grouse are identified on the lek.

    - **<u>NOTE</u>** To designate a known lek as inactive requires either an absence of birds on the lek during multiple <u>ground</u> visits under ideal conditions throughout the strutting season or a ground check of the exact lek site late in the strutting season that fails to find any sign (droppings/feathers) of strutting activity.

5. Surveys can be conducted from the ground or from an aircraft.

    - Lek surveys can be conducted from the **ground** by driving along roads in suspected or known breeding habitat and stopping every ½ mile to listen for sounds of breeding grouse. Ground searches can be conducted from an hour before to an hour after sunrise. In less accessible areas, searches can be made from a mountain bike, trail motorcycle, 4-wheel all terrain vehicle, horseback, or on foot. On a calm morning, breeding sage grouse may be heard at a distance of 1.5 km (about 1 mi). All openings or areas of less dense sagebrush should be searched for breeding birds with binoculars or a spotting scope.

    - Helicopters or fixed-wing airplanes can be used for **aerial** surveys. Suspected breeding habitat should be flown on north - south transects with lines about one km (.6 mi) apart. Aerial searches are biased toward finding larger leks; small leks (<15 birds) are more difficult to detect. Calm, clear mornings are a prerequisite to aerial searches. Winds over 15 mph and more than scattered cloud cover should be sufficient to cancel search flights. Cocks can be observed from the air at distances greater than one km (0.6 mi) in early morning sun, but cloud cover greatly reduces observability. Under conditions of marginal light, transect width should be narrowed. High winds not only make traveling a straight transect difficult, but also affect strutting behavior. Fewer cocks will strut continuously, and flushing distance appears to be greater under windy conditions.

      Transects should be flown at about 100-150 meters (300-450 ft) above ground level. Whenever possible, two observers should be used in addition to the pilot so that one observer is always looking away from the sun regardless of the direction the aircraft is flying. Surveys should begin at the east edge of the survey area and work west to minimize the possibility of the plane flying over leks prior to them being observed. Special attention should be paid to old lakebeds, stock-watering areas, and other relatively open sites largely surrounded by sagebrush with 15 to

25% canopy cover. Lek searches from an aircraft should be conducted from ½ hour before to one hour after sunrise.

6. If a new lek is identified, the location should be accurately determined and recorded in UTMs using NAD83 datum. It is advisable to record/map the perimeters of new leks. Surveyor(s) should **not** disturb grouse to GPS lek locations. If a lek is active, the surveyor(s) should make the best estimate of the lek location and return later to confirm.

2.2.2 Lek Trend Surveys (from BLM 2005)

Lek Count: A census technique that documents the actual number of male sage grouse observed on a particular lek.

- Lek count data are primarily used to develop indices to relative population levels and provide short and long term trend information for both populations and changes in occupied range.

Lek Count Methodology:

1. Counts should be conducted during the month following the peak of mating activity, which is usually in early April in Wyoming (April 1 – May 7). Research has shown that the highest numbers of male sage grouse are observed during this period. The increased number of males is due to young males showing up later in the strutting season even though most of the breeding has already occurred.

2. Counts should be conducted from the ground. Counts from fixed-winged aircraft are not accurate enough to be used for monitoring population trends.

3. Counts should be made as close to sunrise as possible and may extend for one-half hour after sunrise. The phase of the moon may affect use patterns of leks. During a full moon, grouse may display at night and consequently terminate activities earlier in the morning.

4. Counts should be conducted a minimum of three (3) times each year between April 1 – May 7 for each lek (at least one count every 7-10 days.)

5. Optimum weather conditions for counts are clear, calm days. Wind speeds should be less than 20 mph due to the fact that high winds reduce lek activity. Temperature seems to have little effect on lek activity. Weather conditions should be recorded each time lek observations are made.

6. The location of each lek should be accurately determined and recorded in UTMs using NAD83 datum. Observer(s) should not disturb grouse to obtain lek locations. If a lek is active, the observer(s) should make the best estimate of the lek location and return later to confirm.

7. Data should be recorded on the standardized statewide reporting form with the following information:

LOCATION ________ GPS________ UTM________

Date Time Observer Males Females Unk QQ Sec Twn Rng northing easting Grouse Sign Comments

Annual status - Each year a lek will be determined to be in one of the following status categories:

Active. Any lek that has been attended by male sage grouse during the strutting season. Presence can be documented by observation of birds using the site or by signs of strutting activity.

Inactive. Leks where it is known that there was no strutting activity through the course of a strutting season. A single visit, or even several visits, without strutting grouse being seen is not adequate documentation to designate a lek as inactive. This designation requires either an absence of birds on the lek during multiple ground visits under ideal conditions throughout the strutting season or a ground check of the exact lek site late in the strutting season that fails to find any sign (droppings/feathers) of strutting activity.

Unknown. Leks that have not been documented either active or inactive during the course of a strutting season.

2.3 Nesting Raptor Surveys (from BLM 2005)

Recommended protocol based on peer reviewed publications.

1. Surveys (combination of aerial and ground) should be conducted within 0.5 miles of proposed surface disturbance or activity to document nest activity during April 15 to June 15. Surveys outside this period may not accurately depict nesting activity. It is recommended for early nesting species such as eagles and great-horned owls that this survey be conducted early as possible, while late nesting species could be conducted later in the survey window. Surveys for nest sites between Feb. 1 and April 15 shall be avoided to protect this sensitive breeding and nesting period. Surveys conducted at other times of the year, are allowed however a nest occupancy check and/or additional surveys may be required.

2. Surveys should be done in important raptor habitat including: rock outcrops, cliffs, ridges, knolls, stream banks, conifer, and cottonwood trees. Nests should be recorded in UTM cooridinates using NAD83 datum.

3. Optimum weather conditions for surveys are clear, calm days. Nests should be approached cautiously to avoid flushing the female, and their status (ie, number of nestling) will be determined from a distance with binoculars or a spotting scope.

4. Nests will not be visited during adverse weather conditions (e.g. extreme cold, precipitation events, windy periods or during the hottest part of the day). Visits will be as brief as possible.

5. Photograph the nest to help illustrate nest shape, condition, and substrate. See attached nest photographs in appendix 2 for assistance in determining nest condition.

6. Data should be recorded on the standardized form, and summarized for project reports in a table format; data should be provided to the land management agency in a digital format. Field names and codes to use are as follows:

Raptor Nest ID
Previously documented nests should be identified in all documentation (reports, tables, etc.) with the identification number supplied by the land management agency, in order to avoid confusion and duplication.

New nests should be identified in a unique 12 digit, alpha/numeric format. The number in its entirety indicates species and location. The first two characters are alpha and refer to the raptor species (first letter). Next is a three digit alpha/numeric character which indicates the township number and whether the township is north or south of the base line (N or S). This is followed by another three more alpha/numeric characters which indicate the range number and whether the range is east or west of the base line (E or W). The next two characters refer to the section and the final two numeric characters represent a sequential number for all known and inventoried nests for that particular species within that section. Therefore, nest number FH11N54E2102 is a Ferruginous Hawk nest in T.11N., R.54E., Section 21, and this is the 2nd ferruginous hawk nest identified within section 21.

Species

BUOW = Burrowing Owl
COHA = Cooper's Hawk
FEHA = Ferruginous Hawk
GOEA = Golden Eagle
GRHO = Great Horned Owl
NOGO = Northern Goshawk
BAEA = Bald Eagle
AMKE = American Kestrel
LOOW = Long-eared Owl
MERL = Merlin
NOHA = Northern Harrier
OSPR = Osprey
PEFA = Peregrine Falcon
PRFA = Prairie Falcon
RETA = Red-tailed Hawk
SWHA = Swainson's Hawk
SHHA = Sharp-shinned hawk
UNAC = Unknown Accipiter
UNBU = Unknown Buteo
UNOW = Unknown Owl
UNRA = Unknown Raptor

LOCATION
Enter Township Number; for example, **12**; Select/Circle either **N** for North or **S** for South;
Enter Range Number; for example, **57**; Select/Circle either **E** for East or **W** for West;
Enter the **Quarter**, and **Quarter/Quarter** Section.

UTM ZONE

Enter the UTM Zone for the nest location:

GEO. DATUM: Circle NAD 27 or NAD 83 or whatever datum is used. NAD83 preferred.

NORTHING: Enter the northing UTM coordinate (7 characters);

EASTING: Enter the easting UTM coordinate (6 characters);

NEST SITE ELEVATION
Enter the elevation at the nest in feet. (**NOT** nest height, but the elevation of the terrain)

USGS QUAD NAME
Enter the name of the appropriate USGS 7½" Quad.

BLM MAP NAME
Enter the name of the appropriate BLM 1:100,000 Map.

COUNTY
Enter the name of the appropriate County (if desired).

NEST STATUS
Status of the nest when observed (4 Characters)

ACTI: ACTIve nest; A nest in which a breeding attempt was made as indicated by:
1) Eggs in nest, or
2) Young in nest, or
3) Fledged young near nest, or
4) Incubating/brooding adult.

ACTF: ACTive Failed; An active nest that did not fledge young, indicated by:
1) Egg shells in or around nest with no young when, young should be in the nest, or
2) Young present but known not to have fledged, or
3) Eggs in nest but obviously abandoned (past the time when eggs should have normally hatched).

DNLO: Did Not L0cate; Surveyor searched but was unable to locate the nest (does not mean nest is gone or destroyed, merely that the observer was unable to find the nest).

OCCU: OCCUpied; A nest with one or more of the following:
1) Fresh lining material
2) Adult presence at or near the nest
3) Recent and well-used perch site near the nest

OCAL: OCcupied ALternate; A tended nest within the boundaries of a territory housing an ACTIve nest.

INAC: INACtive; A nest with no apparent recent use or adult presence at the time of observation, but in good condition.

INAL: INactive ALternate; An inactive nest within a territory that contains an active nest.

INDI: INactive DIlapidated; An inactive nest in a state of ruin due to weather, natural aging and/or neglect.

INDE: INactive DEstroyed; A nest showing no sign of raptor activity that is destroyed to the point that it is no longer usable without major reconstruction. These nests, for all practical purposes, have disappeared, but there is often still lingering evidence of an historic presence.

GONE: nest was GONE; A nest that was located during a previous survey but has subsequently been found to have been destroyed and no longer exists. No evidence remains.

PRED: PREDated; The nest was active, but there is evidence that it was predated (remains of adults or young, feathers or egg shells scattered, or other physical evidence is present).

NEST CONDITION

GONE: There may or may not be evidence of where the nest was, but it is no longer there.
REMNANTS: Scant material remaining and not usable unless fully rebuilt.
POOR: Nest is dilapidated, in need of major repair to be used.
FAIR: Nest is not dilapidated, but needs significant repair in order to be used.
GOOD: Nest is in need of only minor attention in order for it to be used.
EXCELLENT: Nest is able to be used with little or no attention or maintenance.
UNKNOWN: The nest is obviously present (i.e. a tree cavity, rock cavity), but because of its location, a determination can't be made.

NUMBER OF YOUNG

Record the number of young in the nest.

DATE OBSERVED

Date of observation in Month/Day/Year format (MM/DD/YYYY). This format applies to the date of the first observation and the dates of all future observations.

OBSERVED BY

Record the name of the person making the first observation of this nest.

OWNERSHIP

P: Private Land
S: State Land
FS: Forest Service

BLM: BLM (Public) Land
LU: Bankhead-Jones LU Lands
OTHER: Other - Specify

NEST SUBSTRATE
Substrate upon which nest is built (3 Characters)

ABB = Abandoned Burrow
ACB = Active Burrow
ANS = Artificial Nesting Structure
ASP = Aspen Tree
BLS = Blue Spruce Tree
BLT = Broadleaf Tree
BOX = Boxelder Tree
BTT = Butte
CLF = Cliff
CKB = Creek Bank
CTL = Cottonwood Tree (Live)
CTD = Cottonwood Tree (Dead)
DOF = Douglas Fir
ERC = Erosion Cone
ERR = Erosion Remnant (Badland)
GRE = Green Ash
GHS = Ground/Hillside
JUN = Juniper Tree
LIM = Limber Pine Tree
LOW = Low Ridge/Knoll
LPP = Lodgepole Pine Tree
MMS = Manmade Structures
OSS = Other Shrub Species
PON = Ponderosa Pine Tree
RIM = Rimrock
RIP = Riparian Area
ROC = Rock Cavity
ROK = Rock Outcrop
ROL = Rocky Ledge
ROP = Rock Pillar/Pinnacle
RUS = Russian Olive
SAG = Sagebrush
SER = Serviceberry
UNK = Unknown
WIL = Willow (Live)

HEIGHT OF SUBSTRATE
Record (in feet) the height of the substrate upon/in which the nest is located. Height of the cliff/butte/tree/etc. above the surrounding terrain.

HEIGHT OF NEST ON SUBSTRATE
Record (in feet) the height of the nest on/in the substrate (i.e. height of tree nest above the ground; height of cliff nest on cliff eight of pillar nest above the surrounding terrain).

NEST EXPOSURE
Record the general direction of nest exposure (i.e. N, NE, S, SW, WNW, etc.)

VEGETATION TYPE
Indicates the type of habitat/vegetation found around the nest site; select habitat type from pull down menu of options.

Badland
Bitterbrush Shrubland
Cottonwood/Riparian
Cultivated Cropland
Cultivated/Reseeded
Grassland
Juniper Woodland

Mixed Mountain Shrub
Ponderosa Pine Woodland
Ponderosa Pine/Grassland
Ponderosa/Juniper Woodland
Ponderosa Pine/Skunkbrush
Riparian
Sagebrush/Grassland
Short Grass Prairie

<u>REMARKS</u>
Any unique features, physical relationships to other nests, proximity to human disturbances, or other pertinent observations are to be placed in the remarks section.

RAPTOR NEST LOCATION
Raptor Inventory Data Sheet

Raptor Nest ID*:________________________

Species:________________________

Location: Township _____ N S, Range _____ E W

Section _______, _______ ¼ _______ ¼

UTM Zone:____________________

Geo. Datum (circle one): NAD 27 NAD 83

Northing: ________, Easting:________

Nest Site Elevation: ____________________

USGS Quad Name: ____________________

BLM Map Name: ____________________

County: ____________________

Nest Status*: ____________________

Nest Condition*: ____________________

Number of Eggs: ________ Young: ________

* Use existing data codes ‡ Historic Nest

Date First Observed*:____________________

Observed By:____________________

Ownership: P S FS BLM LU Other___

Nest Substrate*: ____________________

Height of Substrate (ft.):________________

Nest Height On/In Substrate (ft.):____________

Nest Exposure: ____________________

Vegetation Type*:____________________

Remarks/Comments: Physical Relationship to Other Nests, Proximity to Potential Disturbances, Etc.:

____

____

____

____

____

Record Monitoring of Nest Activity on Reverse Side

Map/Photo

NEST HISTORY
Nest Number ____________________

* Date MM/DD/YY	* Nest Status	* Nest Condition	Number Of Young	Observer Name	Remarks

* Use existing data codes.

2.4 Nesting Bird Surveys

Nesting non game bird surveys will be conducted in representative habitat types within the claim areas. Surveys will be completed in areas where mining activities area proposed to occur and in adjacent areas where active mining is non currently proposed.

Surveys will be completed by following techniques recommended by the WYDEQ (WYDEQ 1987). At least 2 transects will be established in each vegetation type of the Lost Creek site. Transects will be 1,000 meters in length (2,000 meters per habitat type) on each site. Transects will be concentrated on areas that are proposed for mining disturbance.

In upland vegetation types belt transects (100 meters) wide will be walked. All birds observed or heard will be recorded. In riparian zones point transects will be used. The observer will walk from point to point (100 meters apart). At each point the observer will stop (for 5 minutes) and listen and observe birds within 50 meters. If possible 1,000 meter transects will be used in riparian habitat.

Surveys will be completed during the peak of the nesting season from June 1 to July 1. Surveys will be completed from 0.5 hours before sunrise to 9:30 am.

2.5 Mountain Plover Surveys

Mountain plover presence and absence surveys will follow USFWS recommended protocol (USFWS 1999, 2002).

MOUNTAIN PLOVER SURVEY GUIDELINES

(From U.S. Fish and Wildlife Service2002)
March 2002

The mountain plover (*Charadrius montanus*) is a small bird (17.5 cm, 7 in.) about the size of a killdeer (*C. vociferus*). It is light brown above with a lighter colored breast, but lacks the contrasting dark breast-belt common to many other plovers. During the breeding season it has a white forehead and a dark line between the beak and eye, which contrasts with the dark crown.

Mountain plover breeding habitat includes short-grass prairie and shrub-steppe landscapes; dryland, cultivated farms; and prairie dog towns. Plovers usually nest on sites where vegetation is sparse or absent, conditions that can be created by herbivores, including domestic livestock and prairie dogs. Vegetation in shortgrass prairie sites is typically less than 4 inches tall. Nest sites within the shrub-steppe landscape are also confined to areas of little to no vegetation, although surrounded by areas visually dominated by shrubs. Commonly, nest sites within shrub-steppe areas are on active prairie dog towns. Nests are commonly located near a manure pile or rock. In addition to disturbance by prairie dogs or livestock, nests have also been found on bare ground created by oil and gas development activities, and on dryland, cultivated agriculture in the southern part of their breeding range. Mountain plovers are rarely found near water. Positive indicators for mountain plovers therefore include level terrain, prairie dogs, bare ground, *Opuntia* pads, cattle, widely spaced plants, and horned larks. It would be unusual to find mountain plovers on sites characterized by irregular or rolling terrain; dense, matted vegetation; grass taller than 4 inches, wet soils, or the presence of killdeer.

These guidelines were developed by Service biologists and Dr. Fritz Knopf, USGS-BRD. Keep in mind these are guidelines - please call the local Fish and Wildlife Service, Ecological Services office, if you have any suggestions.

GENERAL GUIDELINES FOR SURVEYS

On February 16, 1999, the Service proposed the mountain plover for federal listing as threatened. Because listing of this species is proposed, the Service may recommend surveys for mountain plovers to better define nesting areas, and minimize potential negative impacts. The Service may recommend surveys for mountain plovers to better define nesting areas, and minimize potential negative impacts. The Service may recommend surveys for mountain plovers in all suitable habitat, as well as avoidance of nesting areas, to minimize impact to plovers in a site planned for development. While the Service believes that plover surveys, avoidance of nesting and brood rearing areas, and timing restrictions (avoidance of important areas during nesting) will lessen the chance of direct impacts to and mortality of individual mountain plovers in the area, these restrictions do nothing to mitigate indirect effects, including changes in habitat suitability and habitat loss. Surveys are, however, a necessary starting point. The Service has developed the following 3 survey guidelines, depending on whether the intent is to determine the presence or absence of plovers at a site during the nesting season for permanent and short term projects, or to determine the density of nesting plovers at known nesting sites.

Survey Protocol

Surveys for mountain plovers are conducted during the period where the highest numbers of plovers are likely to be tending nests and territories, and therefore are most likely to be detected. Throughout their range, these dates are generally from May 01 through June 15. However, seasonal restrictions for ground disturbing activities in suitable mountain plover nesting habitats are usually longer than the survey dates. The longer seasonal restrictions allow for protection of early nesting birds, and very young chicks which tend to sit still to avoid detection during the first week post-hatch. Since specific nesting dates across the breeding range of the plover vary according to latitude and local weather, the project proponent or the land management agency should contact the local U.S. Fish and Wildlife Service Office to determine what seasonal restrictions apply for specific projects.

Two types of surveys may be conducted: 1) surveys to determine the presence/absence of breeding plovers (i.e., displaying males and foraging adults), or 2) surveys to determine nest density. The survey type chosen for a project and the extent of the survey area (i.e., beyond the edge of the construction or operational ROW) will depend on the type of project activity being analyzed (e.g., construction, operation) and the users intent. One methodology outlines a breeding survey that was used in northeastern Colorado to establish the density of occupied territories, based on displaying male plovers or foraging adults. The other was developed to only determine whether plovers occupy an area.

Techniques Common to Each Survey Method

- Conduct surveys during early courtship and territorial establishment. Throughout the breeding range, this period extends from approximately mid-April through early July. However, the specific breeding period, and therefore peak survey days, depends on latitude, elevation, and weather.

- Conduct surveys between local sunrise and 1000 and from 1730 to sunset (periods of horizontal light to facilitate spotting the white breast of the adult plovers).

- Drive transects within the project area to minimize early flushing. Flushing distances for mountain plovers may be within 3 meters for vehicles, but plovers often flush at 50 to 100 meters when approached by humans on foot.

- Use of a 4-wheel drive vehicle is preferable where allowed. Use of ATVs has proven highly successful in observing and recording displaying males. Always seek guidance from land management agencies regarding use of vehicles on public lands, and always obtain permission of private landowners before entering their lands.

- Stay in or close to the vehicle when scanning. Use binoculars to scan and spotting scopes to confirm sightings. Do not use scopes to scan.

- Do not conduct surveys in poor weather (i.e., high wind, precipitation, etc.).

- Surveys conducted during the courtship period should focus on identifying displaying or calling males, which would signify breeding territories.

- For all breeding birds observed, conduct additional surveys immediately prior to construction activities to search for active nest sites.

- If an active nest is located, an appropriate buffer area should be established to prevent direct loss of the nest or indirect impacts from human-related disturbance. The appropriate buffer distance will vary, depending on topography, type of activity proposed, and duration of disturbance. For disturbances including pedestrian foot traffic and continual equipment operations, a 1/4 mile buffer is recommended.

SURVEY TO DETERMINE PRESENCE/ABSENCE

Large scale/long term projects

Conduct the survey between May 1 and June 15, throughout the breeding range.

1. Visual observation of the area should be made within 1/4 mile of the proposed action to detect the
    i. presence of plovers. All plovers located should be observed long enough to determine if a nest is present. These observations should be made from within a stationary vehicle, as plovers do not appear to be wary of vehicles. Because this survey is to determine presence/absence only, and not calculate statistical confidence, there is no recommended distance interval for stopping the vehicle to scan for birds. Obviously numerous stops will be required to conduct a thorough survey, but number of stops should be determined on a project and site-specific basis.

2. If no visual observations are made from vehicles, the area should be surveyed on ATV's. Extreme care should be exercised in locating plovers due to their highly secretive and quiet nature. Surveys by foot are not recommended because plovers tend to flush at greater distances when approached using this method. Finding nests during foot surveys is more difficult because of the greater flushing distance.

3. A site must be surveyed 3 times during the survey window, with each survey separated by at least 14 days. The need for 3 surveys is to capture the entire nesting period, with the intent of reducing the risk of concluding the site is not nesting habitat by an absence of nesting birds during a single survey.

4. Initiation of the project should occur as near to completion of the survey as possible. For example, seismic exploration should begin within 2 days of survey completion. A 14 day period may be appropriate for other projects.

5. If an active nest is found in the survey area, the planned activity should be delayed 37 days, or seven days post-hatching. If a brood of flightless chicks is observed, activities should be delayed at least seven days.

MOUNTAIN PLOVER GENERAL HABITAT INDICATORS

Positive habitat images

Stock tank (non-leaking, leaking tanks often attract killdeer)
Flat (level or "tilted") terrain
Burned field/prairie/pasture
Bare ground (minimum of 30 percent)
"Spaced" grass plants
Prairie dog colonies
Horned larks
Cattle
Heavily grazed pastures

Opuntia pads visible

Negative habitat images

Killdeer present (indicating less than optimal habitat)
Hillsides or steep slope
Prominent, obvious low ridge
Leaky stock tanks
Vegetation greater than 4 inches in height in short-grass prairie habitat
Increasing presence of tall shrubs
Matted grass (i.e., minimal bare ground)
Lark buntings

2.6 Prairie Dog Colony Mapping (from BLM 2005)

Recommended Protocol

1. Delineate colonies using a GPS receiver in UTM coordinates and NAD83 datum. First, Identify the prairie dog colony with one GPS fix at the approximate center of the town. Then map the colony perimeter by taking points approximately every 10 meters at the outermost burrows around the colony edge. Document segments of the colony by activity level (high, low, or inactive).

2. Use this table to submit data on prairie dog colony locations. If you have GPS files, guidelines and a data dictionary are available at http://nris.state.mt.us/mtnhp (navigate to "animals" and "submit data").

Location: provide as specific location information as possible in UTM coordinates, NAD83 datum. **Township-Range/UTM:** Include township, range, section and ¼ section and UTM's for the approximate center of the colony. **Activity:** defines if the colony is occupied: YES = animals or fresh sign seen, NO = mounds present but neither fresh sign nor animals seen and mounds show various stages of abandonment. UNKNOWN = mounds present but neither fresh sign or animals seen, mounds may or may not show various stages of abandonment OR the survey was not at the time of day and/or season when animals or fresh sign would be expected to be seen. **Size:** If a colony is active, record the acreage of active mounds. Include the acreage of any inactive mounds, if possible. If a colony is inactive or activity is unknown, indicate the acreage of all mounds. If acreage cannot be accurately estimated, place size in one of the following acreage categories; A: 0-5, B: 6-40, C: 41 – 160, D: 161 – 640, E: > 640, or U: unfamiliar with or unable to give acreage estimation. **How size determined:** Indicate how the size was determined, e.g., visual, 7.5-minute map, GPS. **Density:** estimate the number of burrows per acre: Low = less than 5 burrows per acre, Medium = 5 – 10 burrows per acre, High = more than 10 burrows per acre. (An acre is a circle with a diameter of 235 feet, or a square 209 feet to the side.) **Land Ownership:** Indicate ownership, if known. **Comments:** provide any notable information such as shape of colony, landscape features, or adjacent land use. Indicate if any of these associated species are present: Burrowing Owl, Mountain Plover, Ferruginous Hawk, Swift Fox, or Black-footed Ferret.

Prairie Dog Colony Observation Form

Observer ______________________

Address ______________________

____

Tel. ______________________

Email ______________________

Location or Identifier	Township, Range, Section, ¼ and UTM zone, east, north	Date (mo/day/yr)	Activity Y, N, U	Size (acres) all mounds	Size (acres) active mounds	How size determined	Density L, M, H	Land Ownership
Example: 2.5 mi SSE of Miles City	T7N,R47E,12,NW	7/1/00	Y	20	15	Mapped	M	Private
Comments: Example: Colony is semi-circular in shape. Colony is bordered by grain fields on the north. Five acres of inactive burrows adjacent to the west.								
Example: town ref #. muss99012	13T 271988E, 5171617N	7/12/00	Y	D		Visual	M	BLM
Comments : Example: Colony is elongate, approximately ¾ mile long and ½ mile wide. Two burrowing owls near center of colony and one Ferruginous Hawk.								
1.								
Comments:								
2.								
Comments:								
3.								
Comments:								
4.								
Comments:								
5.								
Comments:								

2.7 Black-Footed Ferret Surveys

If active prairie dog colonies are present within the study area that meet criteria as potential black-footed ferret habitat (white-tailed prairie dog towns or complexes greater than 200 acres) the BLM and U.S. Fish and Wildlife Service (USFWS) will be consulted regarding requirements for black-footed ferret surveys. A portion of the study area has been block-cleared for black-footed ferrets.

If ferret surveys are required survey protocol will follow standard USFWS guidelines (USFWS 1989). Nocturnal (spotlight) surveys would be completed during the survey window of July 1 and October 31. Each section (320 acres or smaller) of the colony would be surveyed for 3 consecutive nights. All results would be recorded on standard data forms. Survey reports would follow USFWS guidelines. A biologist who has completed USFWS training in conducting ferret surveys would lead the field effort.

2.8 Other Wildlife Resources

Specific field studies are not proposed for small mammals, reptiles and amphibians, big game animals, predators, wintering sage grouse, waterbirds, wintering and migrating passerine birds, wild horses, or other biological resources. Existing data will be used to describe other wildlife resources in the project area. Past environmental studies, GIS data bases, research reports, and field reconnaissance level surveys will be used to describe these resources.

All sightings or sign of BLM Sensitive Species (that are not included in other studies) that are observed on the site will be recorded on standard field data sheets. BLM Sensitive Species are listed in the following table.

Table 2.8-1 BLM Sensitive Species than may occur in the Great Divide Basin Project Area

Common Name (scientific name)	Habitat
Amphibians	
Northern leopard frog (*Rana pipiens*)	Beaver ponds, permanent water in plains and foothills
Great Basin spadefoot toad (*Scaphiopus intermontanus*)	Sagebrush, semi-desert shrublands, ephemeral pools, streams
Birds	
Baird's sparrow (*Ammodramus bairdii*)	Grasslands, weedy fields
Brewer's sparrow (*Spizella breweri*)	Basin-prairie shrub
Burrowing owl (*Athene cunicularia*)	Grasslands, basin-prairie shrub
Ferruginous hawk (*Buteo regalis*)	Basin-prairie shrub, grasslands, rock outcrops
Greater sage-grouse	Basin-prairie shrub, mountain-foothill shrub

(*Centrocercus urophasianus*)	
Loggerhead shrike (*Lanius ludovicianus*)	Basin-prairie shrub, mountain-foothill shrub
Long-billed curlew (*Numenius americanus*)	Grasslands, plains, foothills, wet meadows
Mountain plover (*Charadrius montanus*)	Sparse shrub and grasslands, prairie dog colonies with vegetation < 4 inches and slopes < 5%
Northern goshawk (*Accipiter gentilis*)	Conifer and deciduous forests
Peregrine falcon (*Falco peregrinus*)	Cliffs, especially over rivers
Sage sparrow (*Amphispiza billi*)	Basin-prairie shrub, mountain-foothill shrub
Sage thrasher (*Oreoscoptes montanus*)	Basin-prairie shrub, mountain-foothill shrub
Trumpeter swan (*Cygnus buccinator*)	Lakes, ponds, rivers
White-faced ibis (*Plegadis chihi*)	Marshes, wet meadows
Yellow-billed cuckoo (*Coccyzus americanus*)	Riparian cottonwood forest with a dense shrub understory.
Fish	
None in the general area	
Mammals	
Fringed myotis (*Myotis thysanodes*)	Conifer forests, woodland chaparral, caves and mines
Long-eared myotis (*Myotis evotis*)	Conifer and deciduous forest, caves and mines
Spotted bat (*Euderma maculatum*)	Cliffs over perennial water, basin-prairie shrub
White-tailed prairie dog (*cynomys leucurus)*	Colonies on grasslands and shrublands
Pygmy rabbit (*Sylvilagus idahoensis*)	Tall sage brush stands, draws.
Swift fox (*Vulpes velox*)	Grasslands
Townsend's big-eared bat (*Corynorhinus townsendii*)	Forests, basin-prairie shrub, caves and mines
Plants	
Starveling milkvetch (*Astragalus jejumus*)	Dry barren ridges and bluffs
Contracted Indian ricegrass (*Oryzopsis contracta)*	Basin and foothill areas, dry sandy soils
Gibben's beardtongue (*Penstemon gibbensii)*	Sparsely vegetated shale, sandy, clay slopes
Devil's Gate twinpod (*Physaria eburniflora)*	Cushion plant communities
Persistent sepal yellowcress (*Rorippa calycina*)	Riverbanks, shorelines, sandy soils
Laramie false sagebrush (*Sphaeromeria simplex*)	Cushion plant communities.

2.9 Aquatic Life Surveys

There is no perennial stream in the Lost Creek Permit Area and there is no aquatic life. Therefore, no survey on aquatic life is needed.

3.0 Summary Report

The results of all field surveys completed during the 2006 field season will be summarized in a Biological Field Survey Report.

The report will describe survey methods and survey results. Resource locations will be shown on 1:24,000 Scale Quadrangle maps. Mapping will include sage grouse leks, raptor nests, mountain plover locations and nests, prairie dog colonies, and locations of all study transects and points. Site photographs, photographs of raptor nests and other features will be included as attachments to the report.

4.0 References

Blomquist, F. 2006. Bureau of Land Management, Wildlife Ecologist, Rawlins Field Office, Rawlins Wyoming. Personal Communication With AATA International, Inc. February 2006

Bureau of Land Management. 2005. Wildlife Survey Protocal for Coal Bed Natural Gas Development Powder River Basin Wildlife Taskforce. Buffalo Field Office, Buffalo Wyoming.

Clark, T.W., T.M. Campbell III, M.H. Schroeder, and L. Richardson. 1994. Handbook and Methods for Locating Black-Footed Ferrets. BLM Technical Wildlife Technical Bulletin No. 1. Cheyenne, Wyoming 55pp.

Etzelmiller, R. 2006. Bureau of Land Management, Wildlife Biologist, Rawlins Field Office, Rawlins Wyoming. Personal Communication With AATA International, Inc. February 2006

Hyatt, G. 2006. Wyoming Game and Fish Department, District Wildlife Biologist, Sinclair, Wyoming. Personal Communication. With AATA International, Inc. February 2006

U.S. Fish and Wildlife Service. 1989. Black-Footed Ferret Survey Guidelines for Compliance With the Endangered Species Act. Denver and Albuquerque Field Offices.

U.S. Fish and Wildlife Service. 1999, 2002. Mountain Plover Survey Guidelines.

Wyoming Department of Environmental Quality. 1987. Guideline No. 5, Wildlife. Land Quality Division.

Wyoming Game and Fish Department. 1982. Handbook of Biological Techniques.

Attachment 2.8-3 BLM and WDEQ Correspondence

Correspondence Wildlife Report
Ur Energy Lost Creek Project
NRC Technical Report
August 2007

List of Letters and Memos:

Memo1 – Meeting Notes BLM and AATA International on Project Overview and Wildlife Study Requirements

Memo2 – Meeting Notes WDEQ and AATA International on Project Team Introductions

Letter 3 – Correspondence between Cecily Mui (AATA Wildlife Specialist) and Rhen Etzelmiller (BLM Wildlife Biologist)

Letter4 – Correspondence between Cecily Mui (AATA Wildlife Specialist) and Rhen Etzelmiller (BLM Wildlife Biologist)

Letter5 – Correspondence between Cecily Mui (AATA Wildlife Specialist) and Melissa Bautz (WDEQ Senior Environmental Analyst)

AATA International, Inc. - Internal Memorandum
Ur-Energy USA Great Divide Basin ISL Project
Meeting Notes – BLM and AATA International
Meeting Date: February 2, 2006

Subject: Project overview and wildlife study requirements

Attendance:
AATA International, Inc.: Ping Wang (Project Manager/Geologist, Scott Kinderwater (Assistant Project Manager/Soil Scientist), Cecily Mui (Wildlife Ecologist), Eric Berg (AATA Associate/Wildlife Consultant)
BLM: Mark Newman (Project Manager/Geologist), Rhen Etzelmiller (Primary Wildlife Biologist for the Project), Frank Blomquist (Wildlife Biologist), Bob Lange (Hydrologist), Debbie Johnson (Assistant Field Manager), Mr. Carmella Miller (Supervisor)

Materials Provided: Regional topo map, aerial photos for Lost Soldier and Lost Creek project sites.

Ping Wang, Scott Kinderwater, Cecily Mui, and Eric Berg met with BLM staff at the Rawlins BLM Field Office to present a quick overview of the project and to discuss wildlife study needs for the Ur-Energy Great Divide Basin ISL Uranium Project - baseline study. Mark Newman of BLM Rawlins was assigned as the project manager for this project. Rhen Etzelmiller was introduced as the primary wildlife biologist who will be working with us. Frank Blomquist will be a secondary wildlife biologist contact for the BLM.

Scott Kinderwater presented an overview of the Ur-Energy ISL mining process. Mark Newman clarified that we will need to submit a Plan of Operation, which is the classification for mining activities with an area greater than five acres. The Plan is described in 43-CFR-3809 Surface Mining Claim Regulations. (The next day, Mr. Mark Moxely, WDEQ – Lander, clarified that the Wyoming Permit to Mine is comparable to BLM's Plan of Operation and that WDEQ will be the lead agency for the permit application process). Mr. Newman mentioned that we can submit a Plan of Operations to include both the Lost Soldier and Lost Creek project sites. The plan will be reviewed by BLM and WDEQ simultaneously. BLM will have 30 days to review the Plan of Operations (permit application) and to make decisions and comments. If they see problems with the plan, i.e. threatened and endangered species concerns, they can request an additional 60-day extension for the review process. Should there be findings of no significant impacts, the Plan of Operation will be accepted as an EA. Otherwise, the plan will move into NEPA review and an EIS process will be required. Debbie Johnson was concerned about the project timetable should NEPA and EIS be involved. Mark Newman mentioned that he does not foresee that need.

The meteorology station will disturb an area less than 5 acres, hence, a Notification of Intent will need to be filed prior to its installation. BLM will have 15 days to review the

Notice. Mark Newman mentioned that Ur-Energy has filed a Notice of Intent for the Lost Soldier and Lost Creek sites for exploratory drilling operations. Ur-Energy will need to amend the Lost Soldier Area Claim Notification of Intent with a letter describing actions for the meteorology station. The reclamation process should follow protocols described in 43-CFR-3809. AATA International will forward an electronic copy of the letter describing the met station amendment to Nancy FitzSimmons at Ur-Energy. Ur-Energy, USA will then send the amendment to Mark Newman on their letterhead.

Projected related questions posed by BLM concerned:

- Processing plant and building construction on the claim site – Ping and Scott clarified that project design and engineering are still under development. Currrent Plan of Operations does not include constuctrion of a mill on-site and uranium extraction from the "resin" will be processed off-site. Possible building structure on the claim sites would be a small-scale construction (less than 5 acres) for the primary pre-processing of extracted solution and preparation of lixivant injection.

- Aquifer depletion, contamination, and post-mining status – Bob Lange of BLM wanted to know what will be the source for water used for re-injection. Ping explained that the water will come from the same aquifer from which dissolved uranium is recovered. He explained that during wellfield reclamation, water will be returned to the aquifer in a background state. There will be numerous monitoring wells surrounding the active ISL wellfield to ensure a successful reclamation. The aquifer to be mined will have a categorical exemption under EPA's underground injection control (UIC) program. WDEQ has a parallel program for underground injection. The aquifer exemption (for human consumption and other uses) will remain in that status after mining – even after water quality action levels are met as a result of reclamation.

  Bob was also interested in the depth of the wells. Ping responded that potential depths will mostly be 100 – 900 feet below ground surface (shallower in the Lost Soldier Claim Area and deeper in the Lost Creek Claim area). BLM will be interested in knowing about ISL in areas of shallow groundwater, since they recharge water in the Lost Soldier Creek area for agricultural, wetlands, and wildlife beneficial uses. Ping pointed out that the recharging are is up-gradient from the claim areas and thus will not be impacted by proposed ISL operations.

  Bob referenced us to a USGS groundwater study that was recently conducted for Sweetwater County and is currently being conducted for Carbon County. Ping recorded the reference for the publication. (AATA has obtained a digital copy of the report.)

The discussion at the point was re-directed to wildlife. Scott presented the background that Gas Hill recently presented an EA for a similar project. It is unknown if the Great Divide Basin ISL Uranium permit application would likely achieve a similar outcome, although the intent is to conduct baseline studies that would meet all data requirements for any potential NEPA requirements.

Rhen wanted us to better clarify the extent of surface disturbance. Ping and Scott described the following probable disturbance: monitoring well, exploration well, injection wells, and production well drilling; adjacent temporary well pad areas and mud pits; one small primary pre-processing building and header works on each claim; some buried pipelines. Well monitoring activities may disturb the surface, but will be minimized by not monitoring when the surface is wet. No new roads are anticipated except for a road at each claim to the header works building. In summary, 40 plus wells will be active before and after operations commence. Minimal noise levels are anticipated - similar to compression stations.

BLM wants the restoration to be to the state of Wyoming engineering standards. Rhen mentioned that the mining activities will need to be sensitive to wildlife activities such as migratory bird nesting seasons especially for species on the BLM species of concern list which is slightly different from the Wyoming state list.

Rhen mentioned the need for a nesting bird survey in representative habitats on the Project sites. Eric will modify his scope of work to include it.

Eric presented the studies that he has planned that the BLM will most likely require. He will be doing a sage grouse lek survey. He wanted input from BLM on their preferred method, either aerial or ground. BLM suggested talking to grouse expert Greg Hyatt of WGFD. They will contact him for additional information on lek surveying and the need for winter surveys. Winter survey requirements are determined on a project-to-project basis and will need Greg's input. These surveys will be conducted with a two mile radius around the Project sites. Cecily asked if we could acquire presently know data for leks and other wildlife. BLM said yes and we could get it from their GIS department.

Eric presented his plan for a mountain plover survey. Frank agreed because he believes that they are nesting in the Lost Creek area.

Eric mentioned that he planned to conduct a raptor nest survey. That will include a one mile radius around the Project sites.

Eric inquired if additional big game data would be need or if existing data would suffice. Rhen and Frank agreed that additional data is not necessary.

Eric asked if this area is black-footed ferret block-cleared, which meant that the area is exempted from further needs to search for black-footed ferrets. Rhen and Frank do not think that it is. Hence if prairie dogs are found on the site, the towns will not only need to be mapped, they will need to be searched for black-footed ferrets. (However, later review of GIS data showed that the Project sites are block-cleared except for two section of Lost Soldier Claim Area.)

Eric mentioned that he is doing pygmy rabbits studies on another site and wanted to know if the Rawlins BLM wanted it for this area. Frank and Rhen mentioned that they recently learned from upper division BLM that they have pygmy rabbits in their management area. They do not know about proper protocols yet. Eric proposed that he could submit surveying protocols for the study if it is needed. Cecily suggested that we should wait for the BLM to determine their regulatory policies and they could then contact us on the monitoring needs. Rhen and Frank agreed.

Cecily asked if BLM were aware of any plant of concern on these sites. BLM said no.

Mark Newman want to know the actual extent of the disturbance area and if it was throughout the whole site. Ping said no. Mark mentioned that a biological study of the whole site might not be necessary. Scott stated that Ur-Energy wanted a baseline for the whole area and not just the active mining areas.

Action Plan:

Eric Berg (wildlife specialist) will present an updated scope of work to AATA International based on the information gathered at the BLM meeting.

Eric Berg will communicate survey plans and methods to BLM. All problem areas will be clarified with further consultation with BLM and WGFD.

Cecily and Eric will get GIS and previous wildlife data from Rhen and Frank.

Eric will touch base with Greg Hyatt from WGFD to review our meeting with BLM.

Rhen and Frank will contact Greg for sage grouse lek surveying methods and winter surveying needs.

If there is a need to conduct sage grouse winter surveys, Eric will see to those needs immediately.

Rhen will follow-up with us on BLM pygmy rabbit policy.

Rhen requested that we provide the BLM with our wildlife findings and maps.

AATA International, Inc. - Internal Memorandum
Ur-Energy USA Great Divide Basin ISL Project
Meeting Notes – WDEQ and AATA International
Meeting Date: February 3, 2006

Subject: AATA International project team introductions

Attendance:
AATA: John Aronson (President), Ping Wang (Project Manager/Geologist, Scott Kinderwater (Assistant Project Manager/Soil Scientist), Cecily Mui (Wildlife Ecologist), Eric Berg (AATA Associate/Wildlife Consultant)
WDEQ-Land Quality Division: Mark Moxley (Project Manager?/District Supervisor) and Amy D. Boyle (Senior Environmental Analyst)

Materials Provided: Regional topo map, aerial photos for Lost Soldier and Lost Creek project sites.

John Aronson, Ping Wang, Scott Kinderwater, Cecily Mui, and Eric Berg met with Mark Moxley and Amy Boyle at the Wyoming DEQ Landers office on February 3, 2006..

John introduced the members of the AATA team to WDEQ and mentioned other members not present, including Warren Keammerer (Botanist) and Kathol (Sociologist). Mark asked about the hydrologist for the project and John mentioned a specialized hydrology firm based in Wyoming will be contracted by Ur-Energy for the work.

Ping was asked by John to summarize the key points of the BLM Rawlins Field Office meeting from the previous day.

Ping mentioned the meteorology station and John presented background information and data that will be collected by the meteorology station. Ping and Scott mentioned their plans to add an amendment to the Notice of Intent for exploratory drilling present by Ur-Energy. This amendment was advised by BLM based on the discussions during the previous day at the Rawlins BLM Field Office. The meteorology station would most likely be installed immediately after the Notice is reviewed by the BLM.

Ping reviewed the ISL mining procedures. John suggested that a visit should be made by the participating government agencies to the Smith Ranch Highlands ISL site so that they can see and understand how the operation works and the level of environmental impact.

Ping reviewed the aquifer discussion at BLM and that ore depth ranged from 100-900 feet (shallower in the Lost Soldier Claim Area and deeper in the Lost Creek Claim area). Mark wanted to know about past drilling exploration activities and the possibility of existing open bore holes. John mentioned that their may be holes that were not covered properly in the past but that it was a very small percentage.

Eric Berg reviewed the BLM wildlife discussion and his scope of work. Mark reaffirmed that he wanted us to follow the WDEQ wildlife guidelines. Ping mentioned that he will be posting protocols to the environmental management website.

Everyone concurred that the baseline studies will have to be done this summer for permitting review to begin in the fall.

Tom Nicholson, his association?, will be the on-site geologist and will be conducting the geohydrology work. Mark wants a meeting with the groundwater team as soon as possible. He would like to review well drilling that was conducted last fall and ground water sampling at each site, especially if the sampling will begin again soon this year. John stated that the sampling protocol will need to be reviewed by WDEQ and that similarly, architects will want to come up to meet with WDEQ. John further assured that Ur-Energy plans to hire a groundwater specialized company with an engineering focus. However, AATA will help review the environmental aspects their groundwater plans.

Mark discussed BLM and the NEPA process. NRC will take the lead on NEPA. Steve Cowen from NRC will be reviewing the environmental aspects. Mark mentioned that there has been poor coordination between NRC and BLM in the past. BLM does not appear to understand the NRC environmental assessment process. John assured that he will have meetings with NRC in Washington, D.C. to review the NEPA and that he will bring the agencies together.

Ping mentioned that the riparian area along Lost Soldier Creek will not be disturbed and that mining activities will be concentrated up-gradient of the stream. Mark reaffirmed a need for riparian delineation.

Ping discussed present road conditions on the site and WDEQ were able to see the numerous existing roads on the aerial photos. Ping reaffirmed that no new roads will be built except for a road to the primary pre-processing building which will be on parcels less than 5 acres on each site. Dirt roads on the site will not be used if the ground surface is wet and off-road driving will not occur.

Mark asked if a monitoring station will be installed for surface hydrology studies. John responded that it will be and there will be sampling during the wet and dry seasons. Eric mentioned that the BLM had said that they supplement flows in Lost Soldier for agricultural and wildlife enhancements. Ping reassured that activities should not impact the riparian area.

Action Plan:
Ur-Energy will need to contact WDEQ with the name of the firm administering to groundwater and to set-up a meeting between the firm and WDEQ.

AATA will contact Ur-Energy to amend the Notice of Intent for Lost Soldier for the meteorology station installation.

Eric Berg will conduct the wildlife studies in a manner that will meet WDEQ wildlife guidelines.

The architectural team will need to meet with WDEQ to review architectural plans.

John Aronson will meet with NRC in Washington, D.C. and will orchestrate a smooth communication between pertinent government agencies.

AATA will confirm proper riparian delineation and surface water monitoring according to WDEQ guidelines.

March 17, 2006

Rhen Etzelmiller
Wildlife Biologist
Bureau of Land Management
Rawlins Field Office
1300 North Third Street
P.O. Box 2407
Rawlins, WY 82301

Dear Rhen,

I would like to give you an update on the progress we are making in the Wildlife section of the baseline study for Ur-Energy at the Lost Soldier and Lost Creek Claim Areas.

First of all, many thanks to you, Frank Blomquist, and Lynn McCarthy for the time, data support, and insights that you have all given to us on the project. Our wildlife team is well-situated for a timely start to the field season. The fieldwork will begin with Sage Grouse Lek Surveys and Counts on the first week of April. Other wildlife surveys planned for the season are:

- Raptor nest survey
- Nesting mountain plover survey
- Breeding bird survey
- Prairie dog colony mapping
- Black-footed ferret survey
- Aquatic survey

I have enclosed a rough timetable of our field schedule.

We have also compiled a set of written field protocols for each of the above surveys to ensure uniform data collection. These protocols are based on your inputs and techniques commonly used by BLM and WGFD. We desire to use techniques that are accepted by the BLM that would result in a data set which may be useful for your database. Any suggestions or comments that you have on our field protocols would be acknowledged and greatly appreciated.

I look forward to hearing from you.

Sincerely,

Cecily H.Y. Mui
Environmental Specialist II

cc: Mark Newman, BLM, Rawlins Field Office

From: Rhen_Etzelmiller@blm.gov
Sent: Thursday, March 23, 2006 10:35 AM
To: Cecily Mui
Subject: Re: Ur-Energy Wildlife Work Plan

Cecily,

First off, I apologize for not getting back to you sooner. I've been out of the office for a few days. I haven't yet had a chance to review the Wildlife Studies Workplan that you sent to me. There are a couple of issues that must be resolved before I can allocate much work time to the review or coordination of the project. I completely understand the desire to get out there and get ahead of the project to gather some important and relevant wildlife baseline info. The primary problem from my end is that there is no Plan of Operations submitted yet for the project, and the Plan of Ops. is the document that is necessary for us (BLM) to officially start work on the project.

Now, with that being said, I can also say that I am trying to figure out what I am allowed to do in regards to this project, and I am fully willing to do whatever I can in order to facilitate the implementation of survey protocols and ensure that the information gathered will be up to standard. In that regard, I will say that whatever wildlife work that is done before a Plan of Operations is submitted is dependent upon what you (AATA) determine to be necessary and are willing to pay for. I can not/will not require/request any surveys until I have reviewed the Plan of Operations and determined exactly what is relevant.

Thanks,

Rhen M. Etzelmiller, Wildlife Biologist
BLM, Rawlins Field Office
1300 N. 3rd, P.O. Box 2407
Rawlins, WY 82301-2407
1 (307) 328-4200
"Rhen_Etzelmiller@blm.gov"

"Cecily Mui" <cecily.mui@aata.com>

03/17/2006 12:18 PM

To <rhen_etzelmiller@blm.gov>
cc <mark_newman@blm.gov>, <frank_blomquist@blm.gov>, "John Aronson" <john.aronson@aata.com>, "Ping Wang" <ping.wang@aata.com>, "Scott Kinderwater" <scott.kinderwater@aata.com>, "Ayman Salloum" <ayman.salloum@aata.com>
Subject Ur-Energy Wildlife Work Plan

Dear Rhen,

I would like to give you an update on the progress we are making in the Wildlife section of the baseline study for Ur-Energy at the Lost Soldier and Lost Creek Claim Areas.

First of all, many thanks to you, Frank Blomquist, and Lynn McCarthy for the time, data support, and insights that you have all given to us on the project. Our wildlife team is well-situated for a timely start to the field season. The fieldwork will begin with Sage Grouse Lek Survey and Counts on the first week of April. Other wildlife surveys planned for the season are:

- Raptor nest survey
- Nesting mountain plover survey
- Breeding bird survey
- Prairie dog colony mapping
- Black-footed ferret survey
- Aquatic survey

I have enclosed a rough timetable of our field schedule.

We have also compiled a set of written field protocols for each of the above surveys to ensure uniform data collection. These protocols are based on your inputs and techniques commonly used by BLM and WGFD. We desire to use techniques that are accepted by the BLM that would result in a data set which may be useful for your database. A hardcopy of the attachments to this email will follow via post. Any suggestions or comments that you have on our field protocols would be acknowledged and greatly appreciated.

I look forward to hearing from you.

Sincerely,
Cecily

CECILY H.Y. MUI
Environmental Specialist II
AATA International, Inc.
300 East Boardwalk Dr, Ste 4A
Fort Collins, CO 80525
Office: 970-223-1333
Fax: 970-223-9115
cecily.mui@aata.com

March 24, 2006

Melissa L. Bautz
Senior Environmental Analyst
State of Wyoming
Department of Environmental Quality
Land Quality Division
Lander, WY 82520

Dear Melissa,

You may have heard from either Mark Moxley or Scott Kinderwater that I am the wildlife task manager at AATA International, Inc. I would like to give you an update on the progress we are making in the Wildlife section of the baseline study for Ur-Energy at the Lost Soldier and Lost Creek Claim Areas.

Our wildlife team is well-situated for a timely start to the field season. The fieldwork will begin with Sage Grouse Lek Surveys and Counts on the first week of April. Other wildlife surveys planned for the season are:

- Raptor nest survey
- Nesting mountain plover survey
- Breeding bird survey
- Prairie dog colony mapping
- Black-footed ferret survey
- Aquatic survey

I have enclosed a tentative schedule for our field work in 2006.

We have also compiled a set of written field protocols for each of the above surveys to ensure uniform data collection. These protocols are based on techniques commonly used by BLM and WGFD. Please let us know if you have comments on our wildlife studies work plan.

Sincerely,

Cecily H.Y. Mui
Environmental Specialist II

cc: Greg Hyatt, Biologist, WGFD

Attachment 2.8-4 MBHFT in Wyoming

Because attachment is comprehensive, it may be used for both coal and non-coal projects (WDEQ Guideline 5).

Migratory Bird of High Federal Interest in Wyoming
COAL MINE LIST

Based on Wyoming Bird Conservation Plan, 1 May 2000 (Cerovski et al. 2000)

May 2, 2002

U.S. Fish and Wildlife Service, Wyoming Field Office,
4000 Airport Parkway, Cheyenne, Wyoming 82001

The Wyoming Field Office of the U.S. Fish and Wildlife Service (Service) has compiled the following list from the ongoing work among State and Federal agencies, non-governmental organizations, and the interested public that produced the Wyoming Bird Conservation Plan. This list will now serve as the Service's list of Migratory Birds of High Federal Interest (also known as the Migratory Bird Species of Management Concern in Wyoming) to be used exclusively for reviews concerning existing or proposed coal mine leased land. The Wyoming Bird Conservation Plan identified "priority species" based on a number of criteria (see below) using the best information available for these generally un-studied species. In many cases, this list reflects identified threats to habitat because no information is available on the species population trends. In some cases it reflects identified population declines though no causal factors have been identified.

Partners in Flight (PIF) is the name given to the coalition of groups that produced the Wyoming Bird Conservation Plan. PIF developed a scoring system to rank species in order of conservation priority. A species' PIF score is the sum of seven sub scores rating the following biological criteria: relative abundance (RA), breeding distribution (BD), non-breeding distribution (ND), threats on breeding grounds (TB), threats on non-breeding grounds (TN), population trends (PT), and area of importance (AI). These criteria are more fully described the end of this document. AI, PT and total PIF scores are listed for each species in Tables 1 and 2. Species with a PIF score of 18 or above, an AI score of 3 or above, and/or PT score of 3 or above were identified as the highest priority species. For more information on the listing process, refer to the Wyoming Bird Conservation Plan, available from the U.S. Fish and Wildlife Service, 4000 Airport Parkway, Cheyenne, Wyoming 82001; or Wyoming Game and Fish Department, Nongame Branch, 260 Buena Vista, Lander, Wyoming 82520.

Table 1. **Level I Species (Conservation Action)**. Species clearly needs conservation action. Includes species of which Wyoming has a high percentage of and responsibility for the breeding population, and the need for additional knowledge through monitoring and research into basic natural history, distribution, etc.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Mountain Plover[d]	28	4	3	Shortgrass Prairie, Shrub-steppe
Sage Grouse	26	5	3	Shrub-steppe
McCown's Longspur	26	3	2	Shortgrass Prairie, Shrub-steppe
Baird's Sparrow	26	2	3	Shortgrass Prairie
Ferruginous Hawk	23	4	3	Shrub-steppe, Shortgrass Prairie
Brewer's Sparrow	23	5	5	Shrub-steppe, Mountain-foothills Shrub
Sage Sparrow	22	5	2	Shrub-steppe, Mountain-foothills Shrub
Swainson's Hawk	21	3	3	Plains/Basin Riparian
Long-billed Curlew	21	2	3	Shortgrass Prairie
Short-eared Owl	20	3	3	Shortgrass Prairie
Peregrine Falcon	19	3	3	Specialized (cliffs)
Burrowing Owl	19	3	4	Shortgrass Prairie
Bald Eagle	18	3	3	Montane Riparian, Plains/Basin Riparian
Upland Sandpiper	18	2	2	Shortgrass Prairie

[a] From the PIF Priority Database (Carter et al. 1997).
[b] AI = Area Importance (from the PIF Priority Database, Carter et al. 1997).
[c] PT = Population Trend (from the PIF Priority Database, Carter et al. 1997).
[d] Species previously appeared on the Service's 1995 list.

Table 2. **Level II Species (Monitoring)**. The action and focus for the species is monitoring. Includes species of which Wyoming has a high percentage of and responsibility for the breeding population, species whose population trend is unknown, species that are peripheral for breeding in the habitat or state, or species for which additional knowledge is needed.

Species	PIF Score[a]	AI[b]	PT[c]	Primary Habitat Type(s)
Cassin's Kingbird	22	3	3	Juniper Woodland, Plains/Basin Riparian
Lark Bunting	22	4	4	Shortgrass Prairie, Shrub-steppe
Dickcissel	21	3	3	Shortgrass Prairie
Chestnut-collared Longspur	21	2	3	Shortgrass Prairie
Black-chinned Hummingbird	20	2	3	Plains/Basin Riparian, Shrub-steppe
Pygmy Nuthatch	20	3	3	Low Elevation Conifer
Marsh Wren	20	3	4	Wetlands
Western Bluebird	19	3	3	Juniper Woodland, Low Elevation Conifer
Sage Thrasher	19	5	2	Shrub-steppe
Grasshopper Sparrow	19	3	5	Shortgrass Prairie, Shrub-steppe
Bobolink	19	2	3	Shortgrass Prairie, Shrub-steppe
Common Loon	18	3	3	Wetlands
Black-billed Cuckoo	18	2	3	Plains/Basin Riparian
Red-headed Woodpecker	18	2	3	Plains/Basin Riparian, Low Elevation Conifer
Yellow-billed Cuckoo	18	3	3	Plains/Basin Riparian
Eastern Screech-Owl	18	3	3	Plains/Basin Riparian
Western Screech-Owl	18	3	3	Plains/Basin Riparian
Western Scrub-Jay [d]	18	3	3	Juniper Woodland
Loggerhead Shrike	18	3	3	Shrub-steppe
Vesper Sparrow	18	5	4	Shrub-steppe
Lark Sparrow	18	3	4	Shrub-steppe
Ash-throated Flycatcher [d]	16	2	3	Juniper Woodland
Bushtit [d]	16	3	3	Juniper Woodland
Merlin	15	3	3	Low Elevation Conifer
Sprague's Pipit	n/a	n/a	n/a	Grassland, Plains/Basin Riparian, Shortgrass Prairie
Barn Owl	n/a	n/a	n/a	Shortgrass Prairie, Urban

[a] From the PIF Priority Database (Carter et al. 1997).
[b] AI = Area Importance (from the PIF Priority Database).
[c] PT = Population Trend (from the PIF Priority Database).
[d] Nicholoff, S. 2002. Wyoming Bird Conservation Plan, Version 1.1. Wyoming Partners In Flight and Wyoming Game and Fish Department, Lander. In press.

Wyoming Partners In Flight Process for Prioritizing Species

Wyoming Partners In Flight participants developed the current list of priority species based on a combination of the seven criteria in the national Partners In Flight Priority Database (Carter et al. 1997). This database serves as a defensible method of prioritizing both species and habitats in need of conservation. The criteria include Wyoming-dependent and Wyoming-independent factors. The Wyoming-independent criteria are constant over a species' range and do not vary for each species. The Wyoming-dependent criteria were the key components used to prioritize species and their conservation action needs. In the absence of any more rigorous statewide surveys, Breeding Bird Survey data dating back to 1968 were used to determine population trends in Wyoming.

Criteria

Within each criterion below, a species was given a rank score ranging from 1 to 5, with 1 being the least critical rank and 5 the most critical. Each ranked species could potentially receive a low score of 7 and a high score of 35. However, setting conservation goals based only on total score could be misleading; therefore, each total score was reviewed in conjunction with its component parts. In Wyoming, species were initially ranked using total score, area importance, and population trend.

1. Relative Abundance (RA) - The abundance of a bird, in appropriate habitat within its entire range, relative to other bird species. This criterion gives an indication of a species' vulnerability to withstand cataclysmic environmental changes. A low score would indicate a higher relative abundance, therefore reducing the risk of complete extirpation from losses in one or more regions. Higher scores indicate a lower relative abundance, thus more vulnerability to drastic losses or population changes.

2. Breeding Distribution (BD) - A relative measure of breeding range size as a proportion of North America [defined as the main body of the continent, excluding Greenland, through Panama and the islands of the Caribbean, comprising an area of 22,059,680 km^2 (National Geographic Society 1993)], and as such it provides an index of a species' vulnerability to random environmental events. High scores indicate localized breeding, thus a higher likelihood of serious decline from drastic environmental changes. Low scores indicate wide breeding distribution, therefore less likelihood of extirpation. Used for breeding birds only.

3. Non-breeding Distribution (ND) - A relative measure of non-breeding, or winter, range size as a proportion of North America, and as such it provides an index of a species' vulnerability to random environmental events. High scores indicate localized distribution on the non-breeding grounds. Low scores indicate wide distribution on the non-breeding grounds, therefore less likelihood of extirpation. Used for wintering birds only.

4. Threats on Breeding Grounds (TB) - The ability of a habitat in an area to support populations of a species in that area. Two factors are considered here: 1) each species' demographic and ecological vulnerability (the potential inability of a species to recover from population loss by normal reproductive effort due to low reproductive rate, high juvenile mortality, or both; and the level of ecological specialization of a species and, hence, its potential inability to withstand environmental change), and 2) habitat loss or disruption (a combination of the amount of habitat or conditions necessary for survival and reproductive success that has been lost since 1945, and the amount that is anticipated to be lost in the future). High scores indicate either a large loss of habitat or a species that is an extreme ecological specialist. Low scores indicate a stable or increasing habitat or a species that is an ecological generalist. Used for both breeding and wintering birds.

5. Threats on Non-breeding Grounds (TN) – Range-wide threats on non-breeding, or winter, grounds. This is scored using the same criteria as threats on breeding grounds but reflects non-breeding issues, including migratory habitat. Used for wintering birds only.

6. Population Trend (PT) - The overall population trend of each species assigned independently for each state, province, or physiographic area. This criterion must meet two thresholds, reliability and magnitude, to warrant either a very high or very low score. When possible, a score was assigned using BBS data, which incorporated a population trend uncertainty score based on the statistical validity of the BBS data (i.e. a species must be detected on a minimum of 14 BBS routes per state for population trends to have statistical significance). This criterion was chosen to alert managers to species with modest, but certain, population declines.

7. Area Importance (AI) - The abundance of a species within a state, province, or physiographic area relative to its abundance throughout its range. This criterion helps direct conservation efforts toward areas that are most important to a species' survival. Area Importance is scored locally; therefore, high scores indicate that a large proportion of the species' breeding or winter range occurs in Wyoming, or a species is using a habitat that is only available in Wyoming. Low scores indicate that a small proportion of the species' range occurs in Wyoming, or the preferred habitat is widespread across its range. Used for both breeding and wintering birds.

Priority Species

Priority bird species in Wyoming were identified from the PIF Priority Database (Carter et al. 1997) and by qualitative, informed decisions. Those species with a total score of 18 or above, Area Importance (AI) of 3 or above, and/or Population Trend (PT) of 3 or above from the database, or with a total score less than 18 but of significant local interest were identified as the highest priority species. However, as more information becomes available, the highest priority species for Wyoming may change, as this is a dynamic database that allows for updated information to be periodically inserted and reviewed. The primary habitat type or types required for breeding were identified for each species to determine the highest priority habitat types for the state.

Literature Cited

Carter, M. F., W. C. Hunter, D. N. Pashley, J. S. Bradley, C. S. Aid, J. Price, and G. S. Butcher. 1997. Setting landbird conservation priorities for states, provinces, and physiographic areas of North America. Partners In Flight Priority Database Final Report, Colorado Bird Observatory, Brighton.

Cerovski, A., M. Gorges, T. Byer, K. Duffy, and D. Felley. 2000. Wyoming Bird Conservation Plan, Version 1.0. Wyoming Partners In Flight, Lander, WY.

Nicholoff, S. 2002. Wyoming Bird Conservation Plan, Version 1.1. Wyoming Partners In Flight and Wyoming Game and Fish Department, Lander. In press.

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2.9 Background Radiological Characteristics

A baseline radiological survey was performed within the Permit Area to establish and document the pre-operation radiological environment. The primary goals were to: detect areas having anomalously high radiological activity, establish preliminary surface background radiological levels in water resources, and provide source data for MILDOS radiation dispersion and dose calculation modeling.

To detect areas of anomalously high radiological activity, sodium iodide (NaI) detectors linked to data loggers and a GPS were used to take hundreds of thousands of gamma measurements throughout the Permit Area. These measurements were correlated with radiation levels in soil samples, and with gamma levels measured by High-Pressure Ionization Chambers (HPICs). Radiological analysis was completed on quarterly groundwater and stormwater samples; and the results are presented in **Section 2.7** of this report. Passive air samplers were used to measure natural gamma and Rn-222 at multiple locations within and outside of the Permit Area; and these results are presented in **Section 2.5.2**of this report.

The Project will not produce particulate emissions because the end-product is yellowcake slurry. Therefore, there will be no radiological impact on vegetation; and baseline characterization of vegetation radiological characteristics was not conducted. Because there is no perennial surface water in the Permit Area, sediment sampling was not conducted.

2.9.1 Background Gamma Radiation Survey and Soils Sampling

Baseline environmental studies in the Permit Area began in January 2006. As part of the overall baseline study, a radiological baseline survey of naturally occurring gamma exposure rates and soil radionuclide concentrations was performed. Radiological baseline surveys in the Permit Area began in late August 2006.

Basic guidance for radiological baseline surveys at uranium recovery sites can be found in Regulatory Guide 4.14 (NRC, 1980). This regulatory guide, intended for conventional uranium mill recovery facilities, includes a pre-operational radial gamma survey design that covers a maximum area of 1,750 acres with up to 80 individual gamma exposure rate measurements. The recommended sampling design calls for a higher density of measurements near the mill location, and more dispersed measurements in a radial pattern at greater distances from the mill location.

Although Regulatory Guide 4.14 does not address special considerations associated with uranium ISR sites, NRC and WDEQ-LQD (WDEQ-LQD, 2007) currently recommend following Regulatory Guide 4.14 for conducting radiological baseline surveys of ISR uranium projects. Consistent with ISR permit application guidelines described in Regulatory Guide 3.46 (NRC, 1982) and NUREG-1569 (NRC, 2003), as well as with decommissioning considerations outlined in MARSSIM, the Multi-Agency Radiation Survey and Site Investigation Manual (NRC, 2000), Tetra Tech proposed using state-of-the-art GPS-based scanning technologies capable of providing uniform, high-density gamma measurements across very large areas. This scanning system can be mounted in various configurations including in backpacks, OHVs, or trucks, and has been used in the US and abroad for remedial support at multiple uranium mill site decommissioning projects as well as for other site characterization applications.

During a site visit at the beginning of gamma survey activities (August 30, 2006), discussions between: Tetra Tech; LC ISR, LLC; AATA International, Inc.; and NRC representative Bob Lukes resulted in a general consensus that using an OHV-mounted version of this scanning system for baseline radiological surveys would meet or exceed minimum guidelines outlined in Regulatory Guide 4.14 and would provide more detailed information on baseline radiological conditions in the Permit Area.

2.9.1.1 Methods

The background radiation survey of the Permit Area consisted of a number of methods including high density gamma scanning with NaI detectors, measurements with a HPIC, and soil sampling as described below.

Gamma Surveys and Mapping

Although various GPS-based scanning system configurations used previously by Tetra Tech were well developed and extensively field tested prior to the Project, unique aspects and challenges of scanning the Permit Area presented the need for different vehicles and mounting systems. Given the rugged terrain, sagebrush vegetation and the large Permit Area, two-seater OHVs with roll-bar cages and conventional driver control systems with steering wheel, and gas and brake pedals were best suited for the Project. The OHV models selected were Yamaha Rhinos. Equipped with extra-wide tires, these Rhino OHVs were well suited to safely negotiate the Permit Area while minimizing environmental impacts.

Roll-bar cages on the Rhino OHVs addressed safety considerations and provided a support system for adjustable outriggers. Three Ludlum 44-10 NaI gamma detectors and paired GPS receivers were mounted on the outriggers of each OHV (**Figure 2.9-1**). The detectors were coupled to Ludlum 2350 rate meters housed in a cooler carried in the OHV cargo bed. Simultaneous GPS and gamma exposure rate data were recorded using an onboard personal computer (PC) with data acquisition software developed by Tetra Tech.

After several days of field testing, site scanning, and mounting system modifications, a final system design was achieved that proved stable, reliable, and practical for the terrain. The final system configuration was about ten-foot spacing between detectors (measured perpendicular to the direction of travel), with each detector positioned 4.5 feet above the ground surface. A three-foot detector height is generally accepted, but not mandated, by NRC. This height was impractical in the Permit Area given the tall brush, ravines, and fence gate crossings. A detector height of 4.5 feet was the lowest practical height for the system under the conditions. Experimental measurements were later performed to statistically quantify any measurement difference between the three-foot and 4.5-foot detector heights.

Based on previous experiments conducted under similar scanning geometries, lateral detector response to significantly elevated planar (non-point) gamma sources at the ground surface is about five feet, giving each detector an estimated "field of view" of about ten feet in diameter at the ground surface. This does not imply that a system detector can pick up readings from a small point source five feet away, but does suggest that scattered photons from larger elevated source areas (e.g., 1,076 square feet or 100 square meters [m^2]) are likely to be detected at that distance. Within this conceptual framework, the scanning track width for each vehicle's scanning system is estimated to be about 30 feet across, perpendicular to the direction of travel. The vehicle speed while scanning ranged between two and eight miles per hour (mph), depending on the roughness of the terrain, with an average speed of four to five mph.

Data were downloaded daily into a Project database and mapped using Gamma Viewer software developed by Tetra Tech (Tetra Tech Inc., 2006). In addition to daily quality control (QC) measurements used to evaluate instrument performance and insure data quality (discussed later), daily scan results were evaluated in terms of general agreement between onboard detectors to help identify any problems that may have occurred during data acquisition throughout the day. Evaluation of updated gamma maps each day also helped in planning the next day's scanning activities.

Initial results indicated that spatial variability in gamma exposure rates across the Permit Area was higher than expected. In areas near orebodies or proposed operational facilities, attempts were made to achieve scanning coverage close to 100 percent. After assessment of initial scanning results for these areas, a distance of 15 to 30 feet between the adjacent detectors in both vehicles was deemed practical and sufficient to resolve smaller-scale variability in the areas targeted for higher-density scanning coverage. This vehicle spacing provided an estimated effective ground scan coverage of 75 to 90 percent. In other portions of the Permit Area, five to ten percent was the initial target coverage, though practical considerations such as safety, terrain, and natural obstructions often dictated actual distances maintained between vehicles. For most areas of the Permit Area, a target distance of 300 feet between vehicles was a conservative goal employed during scanning, as this provides an estimated scan coverage of about 15 percent.

Cross-calibration between NaI Detectors and the HPIC

Gamma exposure rates measured by NaI detectors are only relative measurements, as response characteristics of NaI detectors are energy dependent. True gamma exposure rates are best measured with an energy independent system such as an HPIC. Depending on the radiological characteristics of a given site, NaI detectors can have measurement values significantly higher than corresponding HPIC measurement values. NaI systems are useful for ISR sites; because they can quickly and effectively demonstrate relative differences between pre- and post-ISR gamma exposure rate conditions. Unless the exact same equipment is used for both surveys; however, it is necessary to normalize the data to a common basis of comparison. This is the purpose of performing NaI/HPIC cross-calibration measurements. Cross-calibration insures that the results of future gamma scans, which are likely to use different detectors (and perhaps different detector models or technologies), can be meaningfully compared against the results of the pre-ISR baseline gamma surveys.

To perform NaI/HPIC cross-calibrations, static measurements were taken at various discrete locations covering a range of exposure rates representative of the Permit Area. Many locations were selectively chosen to be at or near earlier soil sampling grids for verification purposes. At each cross-calibration measurement location, ten to 20 individual HPIC readings were recorded and averaged. The center of the HPIC is positioned about three feet above the ground surface. A pin flag was pushed into the ground directly below the center of the HPIC to mark the exact spot for subsequent NaI measurements. The OHVs were then systematically positioned, such that each NaI detector was located directly above the pin flag, when taking measurements. For each NaI detector, 20 individual NaI readings at both three-foot and 4.5-foot detector heights were automatically collected and averaged using a special data acquisition software program. Mean values were recorded.

Soil Sampling and Gamma Correlation Grids

Regulatory Guide 4.14 specifies that baseline soil sampling be conducted in a radial pattern originating at the center of the milling area, with samples collected at 984-foot (300-meter) intervals in eight compass directions. At the time of this portion of baseline survey activities, the exact location and types of ISR processing facilities to be employed were uncertain. This, coupled with the expected high density of gamma survey information, resulted in a decision to initially focus on developing a correlation between soil Ra-226 concentrations and gamma exposure rates. Depending on the statistical strength of any such relationship, the resulting correlation can be used to infer approximate Ra-226 concentrations across the Permit Area based on the gamma survey results.

Other radiological soil sample analyses were also conducted per Regulatory Guide 4.14 recommendations. Those recommendations indicate that, in addition to Ra-226 analysis for all soil samples, ten percent of samples should be analyzed for natural uranium (U-nat), thorium-230 (Th-230), and lead-210 (Pb-210). In this case, all ten correlation grid samples were analyzed for these additional radionuclides, providing a reasonably representative characterization across the Permit Area.

Soil sampling was conducted as composite sampling over 33-by-33 foot (ten-by-ten meter) grids. Within each grid, ten soil sub-samples were collected to a depth of six inches (15 centimeters) then composited into a single sample. GPS coordinates were taken at the center of each sampling grid and recorded. Samples were sent to Energy Laboratories Incorporated (ELI) in Casper, Wyoming, for analysis of Ra-226 and other select radionuclide concentrations, as stated above. Samples were dried, crushed, and thoroughly homogenized prior to analysis to insure a representative average radionuclide concentration over each 1,076-square-foot ($100m^2$) grid. For high-purity germanium (HPGe) gamma spectroscopy analyses (method E901.1), samples were first canned, sealed, and held 21 days prior to counting to allow sufficient ingrowth of radon and short-lived progeny. Separate aliquots of homogenized samples were used for analyses requiring wet radiochemistry methods.

Each 1,076-square-foot ($100m^2$) soil sampling grid was also scanned to determine the average gamma exposure rate over the same area, following methods described in Johnson et al. (2006). A diagram depicting the sampling design for correlation grid measurements is shown in **Figure 2.9-2**.

This Project does not include a yellowcake dryer in the Permit Area. As such, the correlation soil samples and related estimates of Ra-226 concentrations across the Permit Area (discussed later), along with the other recommended radiological parameters at representative correlation grid locations, provide sufficient information on baseline soil radionuclide concentrations for the proposed operations which are described **Section 3.0**.

2.9.1.2 Data Quality Assurance and Quality Control

Sources of gamma measurement uncertainty include instrument variability, spatial variability in gamma exposure rates (differences in readings due to small differences in the measurement location or geometry), and temporal variability in gamma exposure rates (differences over time due to changes in soil moisture, barometric pressure, etc. that can affect ambient radon levels and/or photon attenuation characteristics of the soil profile).

Data quality assurance (QA) and QC issues for the radiological surveys in the Permit Area are addressed in various ways. In general, QA includes qualitative factors that provide confidence in the results, while QC includes quantitative evidence that supports the accuracy and precision of results.

Data QA factors for the Project include the following.

- The investigators have extensive qualifications and over 100 years worth of combined experience for performing radiological measurements and site assessments (curriculum vitaes [CVs] provided in **Attachment 2.9-1**).
- Scanning system methodologies and technology are published in peer-reviewed radiation protection and measurement research publications (Johnson et al., 2006; Meyer et al. 2005a; Meyer et al. 2005b; Whicker et al., 2006).
- All NaI and HPIC gamma detectors were calibrated by the manufacturer within one year prior to use on the Project (calibration certificates are provided in **Attachment 2.9-1**).
- Chain-of-custody protocols were followed for soil sampling and contract laboratory analyses (relevant forms are provided in **Attachment 2.9-1**).
- Soil samples were analyzed by ELI. ELI is certified by EPA as well as by seven different states, including Wyoming. The laboratory follows chain-of-custody protocols, uses certified standards of the National Institute of Standards and Technology (NIST) for instrument calibrations, and performs measurements on EPA or other certified reference material standards with each set of client samples to provide information on measurement accuracy.

A detailed field log book of daily activities was maintained and is provided in **Attachment 2.9-2**.

Quantification of data QC for the Project included the following:

- Daily QC measurements were performed for each NaI detector used in gamma scanning; and results were plotted on system instrument control charts. Background as well as cesium-137 (Cs-137) check-source QC measurements were taken each day. Detectors performed within acceptable limits throughout the Project (instrument control charts are provided in **Attachment 2.9-2**).

- Daily scan results for each vehicle were reviewed for consistency along track paths for all onboard detectors. Obvious inconsistencies prompted further investigation. On the few occasions where this occurred, technical problems were discovered and the affected data were removed from the Project database. Affected scanning systems were not used again until technical problems were resolved.
- NaI detectors were cross-calibrated in the field at each site against an HPIC. Results were consistent with cross-calibrations at other uranium sites as well as with the literature in terms of the energy dependence of NaI detectors (Ludlum, 2006; Schiager, 1972).
- One or more days in the Permit Area were used for re-scans of areas previously scanned. As part of this effort, certain higher activity locations of particular interest were targeted for static or mobile re-scanning measurements. Re-scanning demonstrated that measurements were reproducible, generally showing good agreement with the original scans.
- ELI performs duplicate analyses on ten percent of all samples to provide information on measurement variability. The results of all duplicate sample analyses, blanks, laboratory control samples, and sample matrix spikes were within acceptable QC limits, as reported in the ELI QA/QC Summary Report (provided in **Attachment 2.9-2**).

2.9.1.3 Results

Baseline Gamma Survey

The gamma survey results in the Permit Area are shown in **Figure 2.9-3**. There is an unexpected degree of variability in gamma exposure rates in the Permit Area. Even within regions of five-to-ten-percent scanning coverage, localized trends or "pockets" of higher gamma activity are evident across the Permit Area. The area of higher-density scanning covers an approximate region of primary subsurface ore deposits and is a probable area of future operational facilities. The smaller bordered area to the south of that region was an additional Permit Area added after initial survey activities had commenced.

Some areas with slightly elevated background radiation occurred near the Permit Area boundaries. Commonly, there was no visible evidence of certain landscape features in these areas that might help explain such findings (e.g., exposed bedrock outcrops or unusual soil layers). Subsequent correlation sampling, re-scanning, and HPIC cross-calibration activities were selectively conducted along some of these boundary areas.

Those investigations generally confirmed the original readings (**Figures 2.9-4** and **2.9-5**). The evidence indicates that some portions of the Permit Area boundaries fall on areas where natural terrestrial radioactivity is slightly elevated at the soil surface.

Baseline Soil Sampling

Soil sampling was conducted in a roughly radial pattern with the origin located near a potential general area of operational facilities. Sample locations were generally selected to try and cover the range of gamma values found across the Permit Area rather than to employ a rigidly fixed spatial pattern. Overlays of soil sampling locations and baseline gamma survey results are shown in **Figure 2.9-6**. The soil sampling results represent the mean Ra-226 concentrations of the 1,076-square-foot (100-m^2) sampling grids; and concentric circles have been added to illustrate the approximate radial pattern of the sampling locations.

A general relationship between gamma exposure rates and Ra-226 concentrations at the soil surface is visually apparent in **Figure 2.9-6**. Statistical analysis demonstrated a significant linear relationship (**Figure 2.9-7**) between the mean Ra-226 soil concentration and the mean gamma exposure rate across all of the sampling grids (**Table 2.9-1**). In general, uranium and Ra-226 in these soils do not appear to be in equilibrium (**Figure 2.9-8**). On average, the uranium concentration was less than 45 percent of the Ra-226 concentration, suggesting a considerable degree of uranium mobility in the surface soil environments in the Permit Area.

HPIC / NaI Cross-Calibration

The results of the cross-calibration between the HPIC and NaI detectors positioned at both three-foot and 4.5-foot detector heights are shown in **Figure 2.9-9**. Regression coefficients for both curves are similar to those measured by Tetra Tech at other uranium recovery sites and to other reported values (Ludlum, 2006; Schiager, 1972). Initial OHV scanning in the Permit Area was conducted with the detectors set three feet above the ground surface until problems with the detector clearance necessitated a change to 4.5 feet. All areas scanned at three-foot detector heights are shown in **Figure 2.9-10**.

Numerical differences between the three-foot and 4.5-foot NaI detector height readings are shown in **Table 2.9-2**. The relationship between the two detector heights is shown in **Figure 2.9-11**. For measured gamma values less than 25 microRoentgens per hour (μR/hr), there was no evidence that readings from the two detector heights were different. For areas with measured values greater than 25 μR/hr, the difference is proportional to the magnitude of exposure rate being measured.

Three-Foot HPIC Equivalent Gamma Exposure Rate Mapping

All final gamma survey data presented have been normalized to a three-foot HPIC equivalent to create a uniform final gamma baseline survey dataset of the Permit Area. The appropriate regressions from **Figure 2.9-9** were used for the data conversions.

A final map of results, showing Permit Area boundaries and the three-foot HPIC equivalent gamma exposure rate data, is presented in **Figure 2.9-12**, with an E-sized version included in **Attachment 2.9-3**. Note that the legend scale increments in **Figure 2.9-12** differ from the maps in previous figures because the raw NaI scan data have been normalized to an HPIC equivalent.

A kriging program in ArcGIS was used to develop continuous estimates of three-foot-HPIC-equivalent gamma exposure rates throughout the Permit Area. Kriging is a geostatistical interpolation procedure that fits a mathematical function to a specified number of nearest points within a defined radius to determine an output value for each location. A given "location" is represented by a cell of specified dimensions that may or may not include any measured data points. Values closer to the cell are given more weight than values further away; and distances, directions, and overall variability in the data set are all considered in the predictive semivariogram model. The input parameters used for this application were as follows:

- cell size: ten feet by ten feet;
- maximum search radius: 350 feet;
- semivariogram model: exponential; and
- number of nearest data points: ten.

A map of the estimated three-foot-HPIC-equivalent gamma exposure rates throughout the Permit Area is presented in **Figure 2.9-12**, with a larger version included in **Attachment 2.9-3**. Note that for the central area of the highest-density scan coverage shown in **Figure 2.9-12**, there is an apparent difference in distribution between the scan track data and the corresponding kriged region in **Figure 2.9-13**. This is because the scan data symbol sizes in **Figure 2.9-12** have been somewhat enlarged for illustrative purposes, and higher values prevail where adjacent data symbols overlap. In such cases, the kriged map is believed to provide a more accurate representation of the actual distribution. The larger version of **Figure 2.9-12** (**Attachment 2.9-3**) or the raw electronic dataset (**Attachment 2.9-4**) should be used to identify values at individual locations.

Soil Ra-226 Concentration Mapping

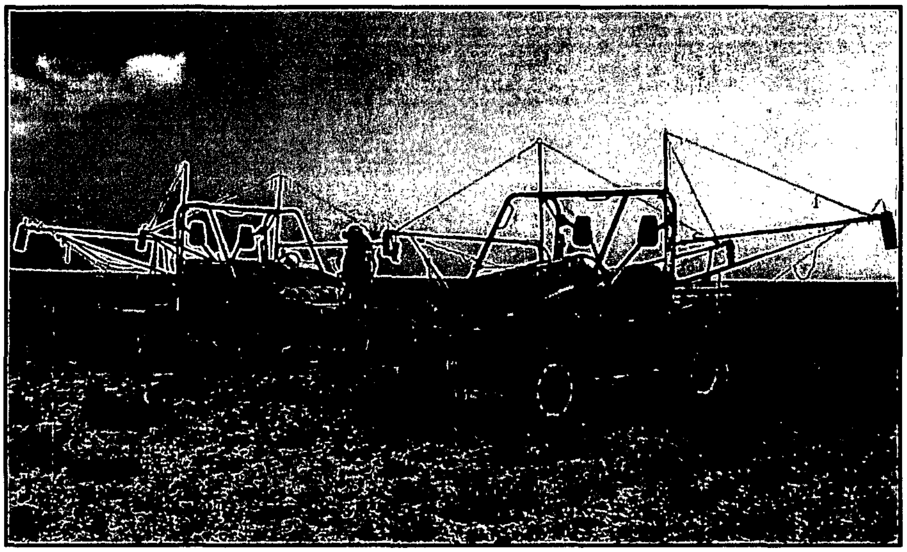
Using the NaI /HPIC cross-calibration results, along with the gamma/Ra-226 correlation data, raw NaI scan data were also converted into estimates of soil Ra-226 concentrations.

The regression associated with the Project data shown in **Figure 2.9-14** was used for this conversion. Also shown in **Figure 2.9-14** is another correlation developed for the nearby Lost Soldier study area that shares similar geophysical and geochemical soil characteristics. One data point for the Lost Creek correlation appears to be a mild outlier that increases the slope of the regression relative to that of the Lost Soldier study area. Without this data point, the two regressions are nearly identical, suggesting that the basic relationship between the gamma reading and the Ra-226 concentration is reasonably consistent in this region of Wyoming.

Using the regression for the Project data shown in **Figure 2.9-14**, kriging was performed to produce continuous estimates of soil Ra-226 concentrations across the Permit Area as shown in **Figure 2.9-15**, with an E-sized version included in **Attachment 2.9-3**.

QC measurements performed each day at the field staging area indicated that instrument variability for background readings was generally on the order of plus or minus one μR/hr (based on the standard deviations of 20 successive readings). OHVs were parked overnight in the same general locations; but the exact location of detectors for daily QC measurements varied by five to ten meters. Day-to-day variability in background QC measurements at the field staging area, thus, provides an indication of respective small-scale spatial variability, as well as temporal variability over successive days. Based on the instrument control charts, these sources of variability approached plus or minus three μR/hr. Thus, the total amount of potential uncertainty in measurements at the staging area approached plus or minus four μR/hr. The staging area had measured background gamma readings in the range of 17 to 27 μR/hr, which is at the lower end of the range of values found in the Permit Area. In areas of higher gamma exposure rates, the degree of uncertainty in measurements may be higher.

Figure 2.9-1 Scanning system equipment and configuration used at the Lost Creek site



(September, 2006)

Figure 2.9-2 Correlation Grid Sampling Design

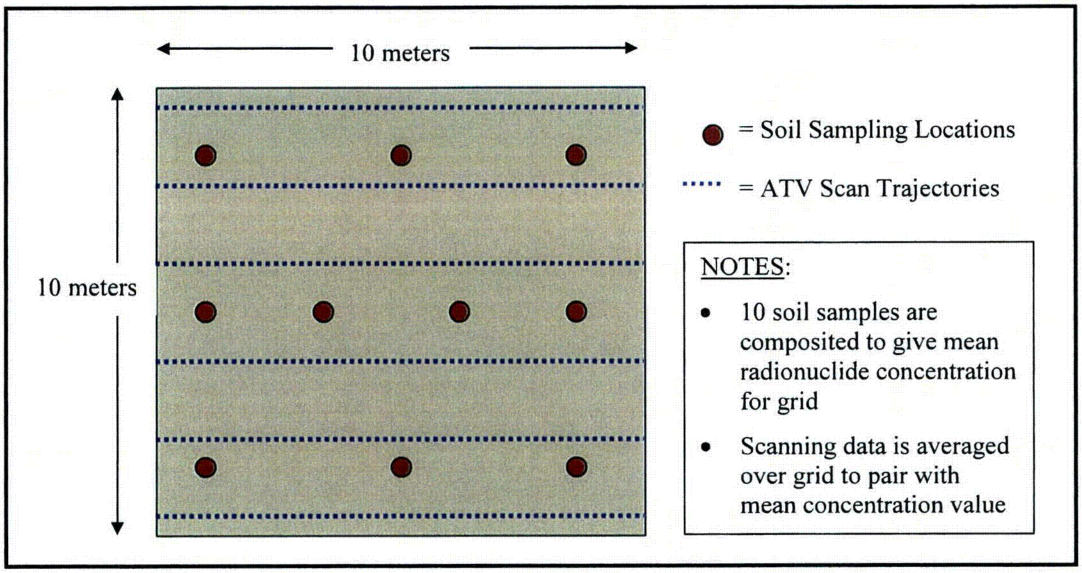


FIGURE 2.9-3
NAI-BASED GAMMA SURVEY RESULTS
Lost Creek Permit Area

Issued For: NRC TR Drawn By: EJS

Issued/Revised: 10.18.07

Drawing No: NRC-TR-2.9-3-10.18.07-EJS

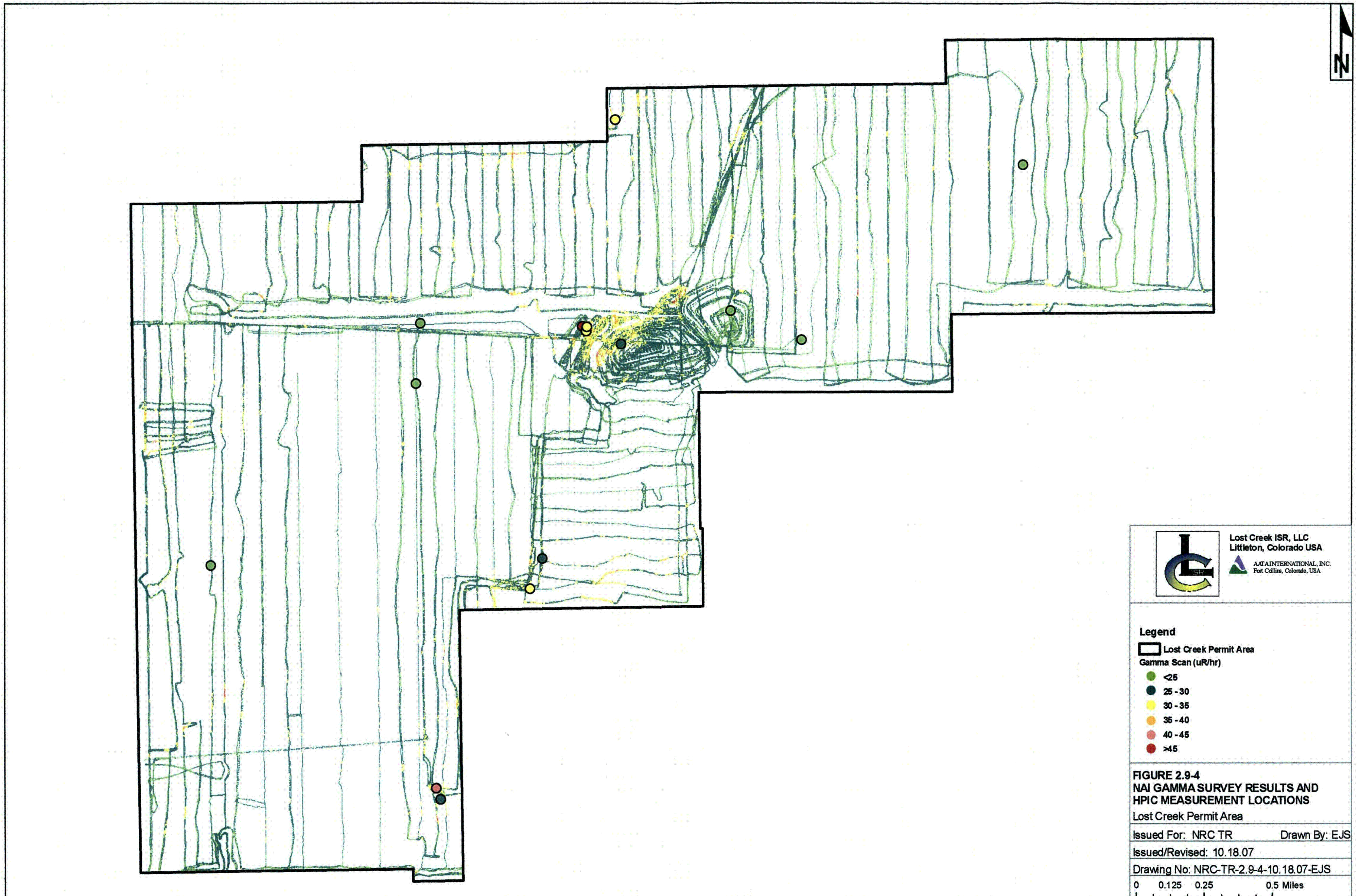


FIGURE 2.9-4
NAI GAMMA SURVEY RESULTS AND HPIC MEASUREMENT LOCATIONS
Lost Creek Permit Area

Issued For: NRC TR Drawn By: EJS
Issued/Revised: 10.18.07
Drawing No: NRC-TR-2.9-4-10.18.07-EJS

FIGURE 2.9-5
OHV RE-SCAN RESULTS

Lost Creek Permit Area

Issued For: NRC TR Drawn By: EJS

Issued/Revised: 10.18.07

Drawing No: NRC-TR-2.9-5-10.18.07-EJS

0 0.125 0.25 0.5 Miles

Lost Creek ISR, LLC
Littleton, Colorado USA

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

FIGURE 2.9-6
SOIL SAMPLING AND GAMMA SURVEY RESULTS

Lost Creek Permit Area

Issued For: NRC TR — Drawn By: EJS

Issued/Revised: 10.18.07

Drawing No: NRC-TR-2.9-6-10.18.07-EJS

Figure 2.9-7: Ra-226 Soil Concentration and Gamma Exposure Rate Correlation

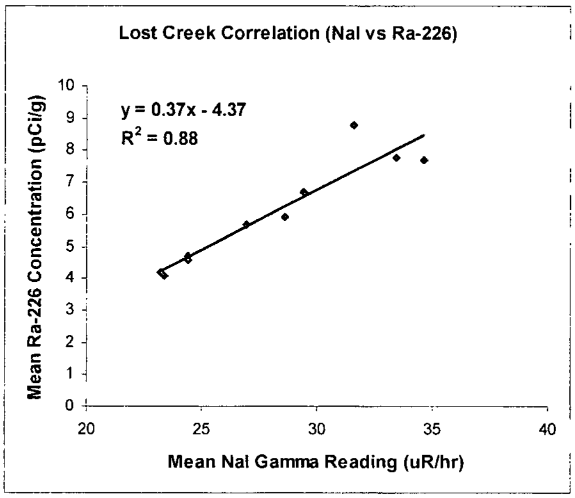


Figure 2.9-8: Ra-226 and Uranium Soil Concentration Correlation

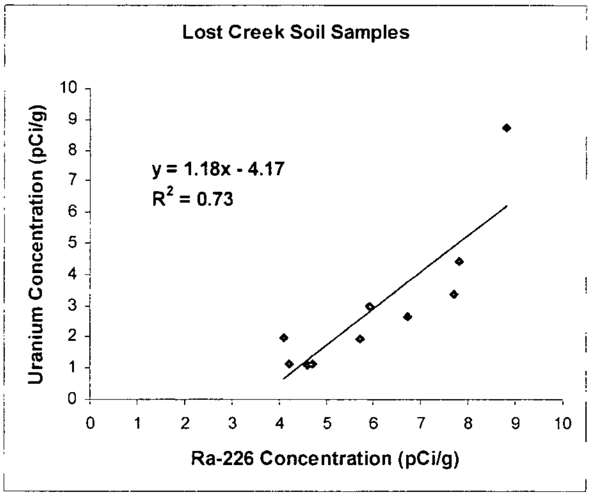
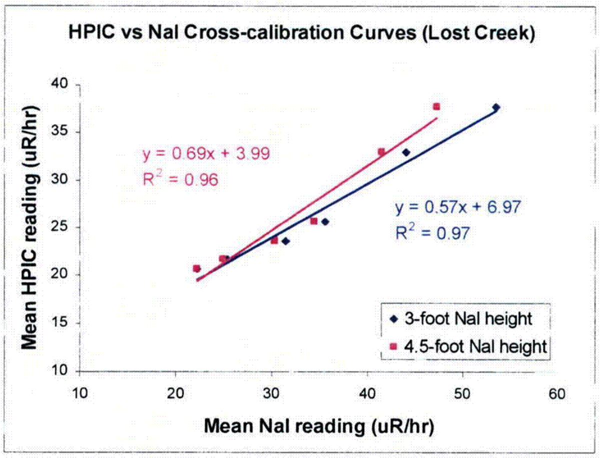


Figure 2.9-9: Calibration Curves for HPIC versus NaI Detectors



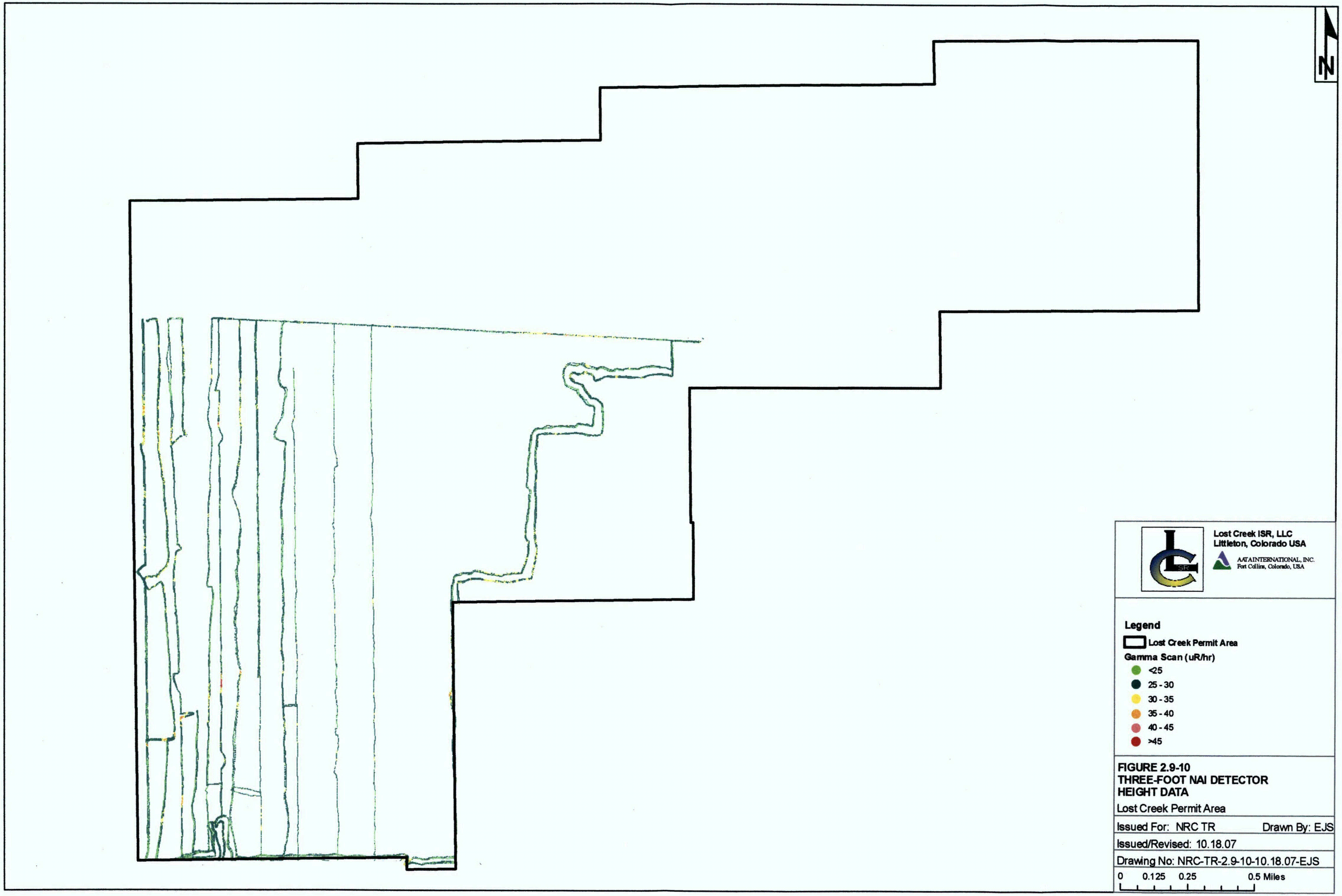
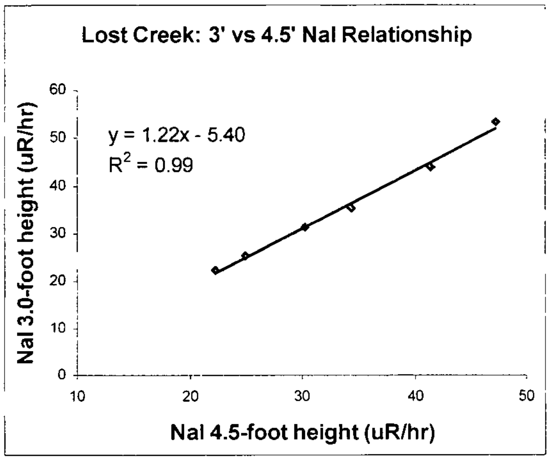
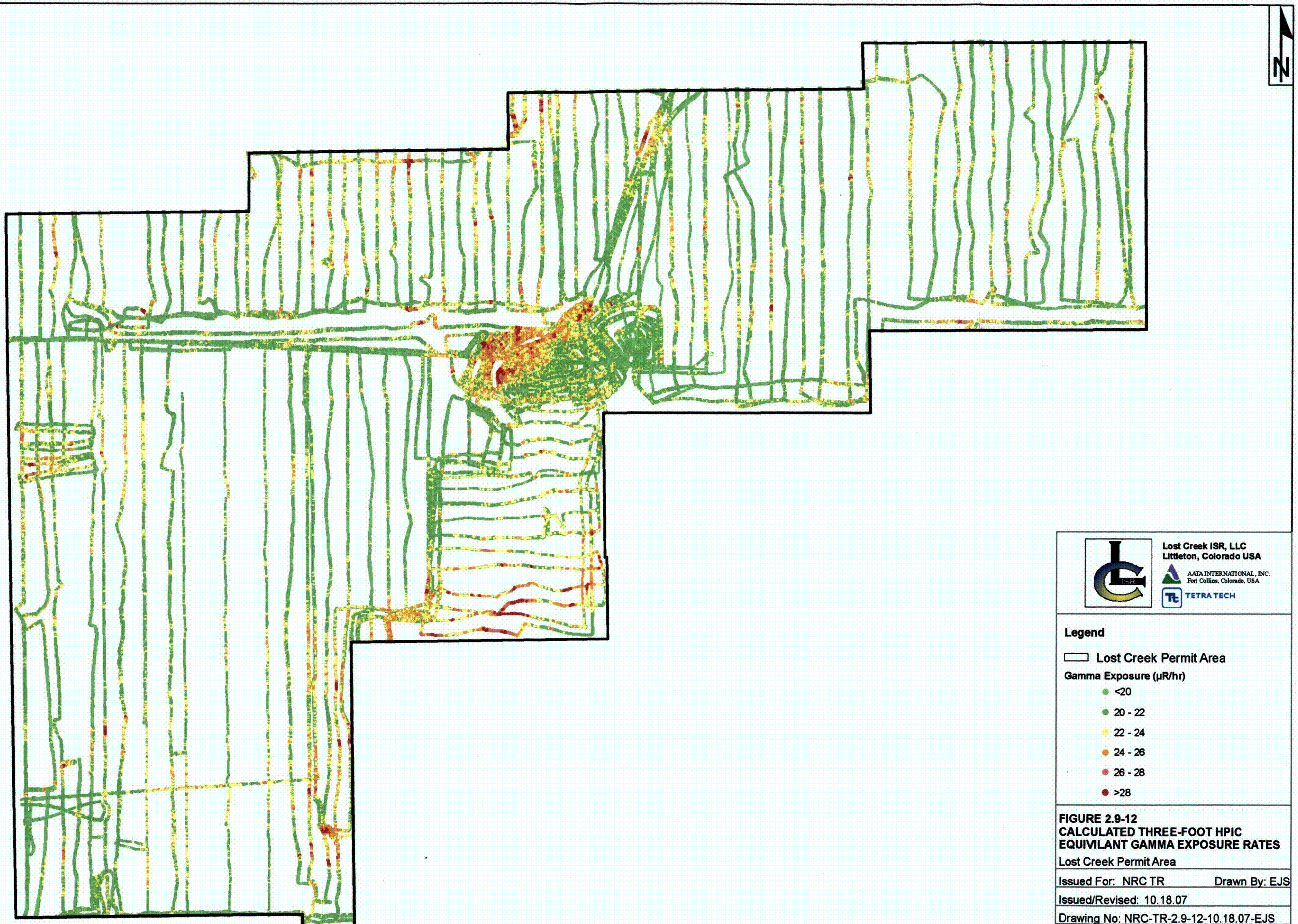


FIGURE 2.9-10
THREE-FOOT NAI DETECTOR HEIGHT DATA
Lost Creek Permit Area

Figure 2.9-11: Three-Foot and 4.5-Foot NaI Detector Height Readings Correlation





Lost Creek ISR, LLC
Littleton, Colorado USA

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

TETRA TECH

Legend

Lost Creek Permit Area

Gamma Exposure (µR/hr)

- <20
- 20 - 22
- 22 - 24
- 24 - 26
- 26 - 28
- >28

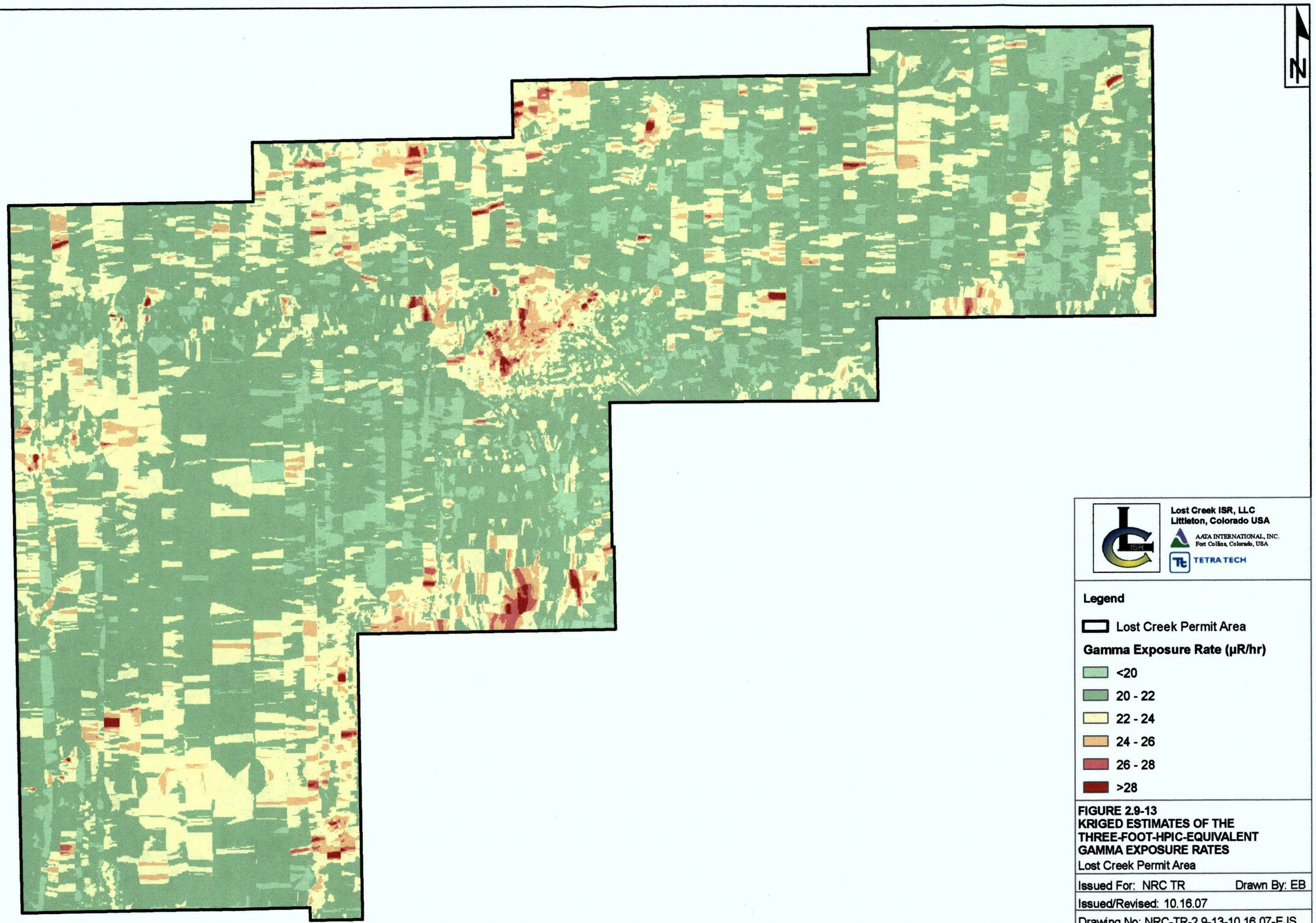
FIGURE 2.9-12
CALCULATED THREE-FOOT HPIC EQUIVILANT GAMMA EXPOSURE RATES
Lost Creek Permit Area

Issued For: NRC TR — Drawn By: EJS

Issued/Revised: 10.18.07

Drawing No: NRC-TR-2.9-12-10.18.07-EJS

0 0.125 0.25 0.5 Miles



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Littleton, Colorado USA
AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA
TETRA TECH

Legend

Lost Creek Permit Area

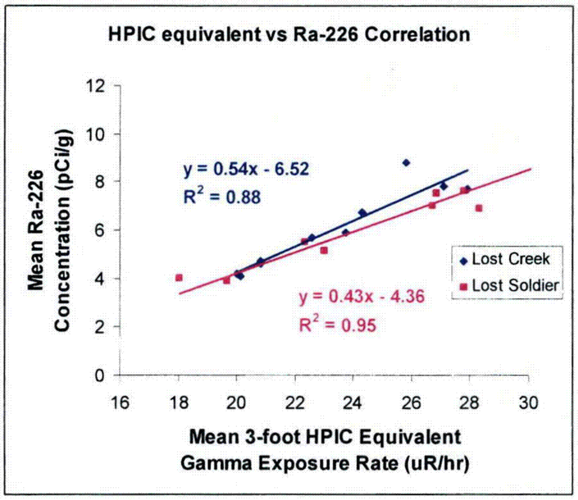
Gamma Exposure Rate (µR/hr)

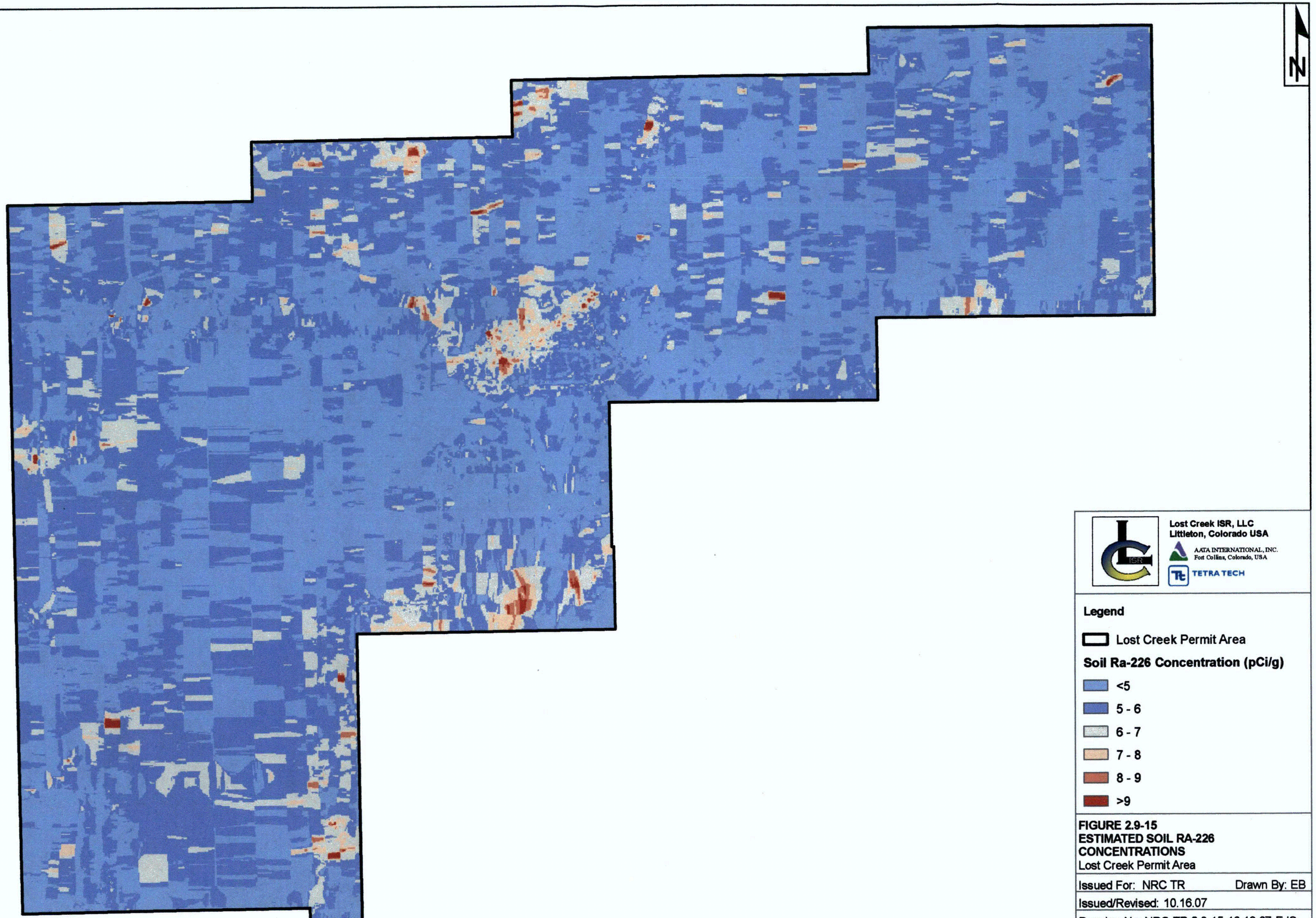
<20
20 - 22
22 - 24
24 - 26
26 - 28
>28

FIGURE 2.9-13
KRIGED ESTIMATES OF THE THREE-FOOT-HPIC-EQUIVALENT GAMMA EXPOSURE RATES
Lost Creek Permit Area

Issued For: NRC TR Drawn By: EB
Issued/Revised: 10.16.07
Drawing No: NRC-TR-2.9-13-10.16.07-EJS
0 0.125 0.25 0.5 Miles

Figure 2.9-14: Regression Used to Predict Soil Ra-226 Concentrations





Lost Creek ISR, LLC
Littleton, Colorado USA

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

TETRA TECH

Legend

Lost Creek Permit Area

Soil Ra-226 Concentration (pCi/g)

- <5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- >9

FIGURE 2.9-15
ESTIMATED SOIL RA-226 CONCENTRATIONS
Lost Creek Permit Area

Issued For: NRC TR Drawn By: EB

Issued/Revised: 10.16.07

Drawing No: NRC-TR-2.9-15-10.16.07-EJS

0 0.1 0.2 0.4 Miles

Table 2.9-1 Soil Sampling and Correlation Grid Results

Sample ID	Latitude dd North	Longitude dd West	Mean Ra-226 (pCi/g)	Ra-226 Precision (±pCi/g)	Uranium (mg/kg)	Uranium (pCi/g)	Mean Th-230 (pCi/g)	Th-230 Precision (±pCi/g)	Mean Pb-210 (pCi/g)	Pb-210 Precision (±pCi/g)	Mean Gamma Exposure Rate (μR/hr)
LC-1	42.14155	107.88055	8.8	1.4	12.9	8.7	2.1	0.6	4.9	0.5	31.6
LC-2	42.11874	107.88639	4.1	1.1	2.9	2.0	1.0	0.4	0.6	0.1	23.4
LC-3	42.10628	107.87012	6.7	1.5	3.9	2.6	1.9	0.6	1.1	0.2	29.4
LC-4	42.11892	107.86263	5.9	1.1	4.4	3.0	0.8	0.4	0.4	0.2	28.6
LC-5	42.13146	107.87123	4.2	1.1	1.7	1.1	0.3	0.3	0	-	23.2
LC-6	42.14215	107.85717	7.7	1.3	5.0	3.4	0.7	0.4	0.4	0.2	34.6
LC-7	42.13118	107.85932	7.8	1.2	6.5	4.4	1.5	0.5	0.4	0.1	33.4
LC-8	42.13024	107.85688	5.7	1.1	2.9	1.9	0.6	0.4	1.0	0.2	26.9
LC-9	42.13038	107.84396	4.6	1.1	1.6	1.1	0.4	0.3	0	-	24.4
LC-10	42.13951	107.82803	4.7	1.1	1.7	1.1	0	-	0	-	24.4
LC-10	*Duplicate Analysis*		4.8	1.1	-	-	-	-	-	-	-

Table 2.9-2 Gamma Exposure Rate Differences of Two NaI Detector Heights

Three-Foot NaI Exposure Rate (μR/hr)	Corresponding Predicted 4.5-Foot NaI Exposure Rate (μR/hr)	Difference Between the Three-Foot and 4.5-Foot NaI Exposure Rates	
		(μR/hr)	(Percent)
25	24.9	0.10	0.4
30	29.0	1.0	3.3
35	33.1	1.9	5.4
40	37.2	2.8	7.0
45	41.3	3.7	8.2
50	45.4	4.6	9.2

Attachment 2.9-1 Data Quality Assurance Documentation

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Education

Ph.D., Radiation Biology, Colorado State University, Fort Collins, Colorado, 1977
M.S., Health Physics, Colorado State University, Fort Collins, Colorado, 1973
Former Line Officer, U.S. Naval Reserve
U.S. Navy Officer Candidate School, Newport, Rhode Island, 1969
B.A., Physics, St. Olaf College, Northfield, Minnesota, 1967

Specialties

Human health risk assessment
Radiation protection and measurement
Public involvement

Professional Experience

MFG Inc.

Senior Scientist and Project Manager, Fort Collins, Colorado (5/2000-present)

Managing the radiation protection and measurements group, including a large set of gamma, alpha and beta monitoring systems. MARSSIM experience in the context of pre- and post-remedial action surveys. Co-developer of MFG Inc.'s global positioning system-based field gamma scanning hardware/software systems. Currently Radiation Safety Officer (RSO) for the Highlands former uranium mill site (Wyoming) and the Felder Ray Point former uranium mill site (Texas). Co-editor and author of 900-page graduate textbook, "Radiological Assessment, A Textbook on Environmental Risk Analysis". MFG project leader on National Institutes of Occupational Safety and Health Atomic Energy Worker Compensation Project. Performing radiation measurements, human health risk and regulatory assessments of various facilities, including scanning, sampling and analysis. License-related assistance for uranium and related mine/mill facilities in western U.S. ASTM environmental site assessment professional. Environmental Impact Statement and related support. Accreditation Board on Engineering Technology, Health Physics Society university program evaluator. National Council on Radiation Protection and Measurements committee on radioactive metals recycling. Guest lecturer at Colorado State University.

Keystone Scientific, Inc.

President, Fort Collins, Colorado (1992–5/2000)

Performed radiation and chemical dose evaluation/reconstruction analyses at weapons complex facilities as a private consultant to the Centers for Disease Control and Prevention. Included research at Idaho National Engineering and Environment Laboratory, and the Savannah River Site near Aiken, South Carolina. Performed similar research for the Colorado Department of Public Health and Environment at the Rocky Flats Environmental Technology Site (Rocky Flats

Plant) near Denver, Colorado. Primary project-related public speaker at numerous risk-related meetings in South Carolina, Georgia and Colorado. Uranium mill tailings facility radiation protection licensing, environmental transport modeling and procedures development. NCRP committee member. Member, National Academy of Sciences Board on Radioactive Waste Management. Invited graduate school lecturer at Colorado State University.

Chem-Nuclear Systems, Inc.

Vice President, Harrisburg, Pennsylvania (1990–1992)

Responsible for initiation and management of a contract with the Commonwealth of Pennsylvania to site, design, construct, and operate a low-level radioactive waste facility. On-site reviews of all power reactor operations in the Compact region. Located and staffed a new office in Harrisburg, negotiated prime contract with State health department, and subcontracts with individual companies, developed and negotiated technical work plans including emergency preparedness plan, led the public involvement effort as primary project speaker for numerous presentations throughout the Appalachian Compact region; directed the project's first two years. Member, U.S. Environmental Protection Agency's Science Advisory Board. Guest lecturer, Harvard School of Public Health.

Chem-Nuclear Systems, Inc.

Executive Director, Albuquerque, New Mexico (1983–1990)

Developed and managed all aspects of environmental monitoring, dosimetry, radiation protection, verification, radiological emergency response and quality assurance programs for the U.S. Department of Energy's Uranium Mill Tailings Project (UMTRA Project, under subcontract to MK-Ferguson, Inc.). Responsible for uranium, radium, thorium-related radioactivity/radiation measurements at up to eight field sites simultaneously, managed 138 health physics field staff. Negotiated regulatory requirements and compliance specifics with USDOE, USNRC, USEPA, State health departments. Primary UMTRA project speaker at numerous public meetings in eight states. Consultant, International Atomic Energy Agency, Vienna, Austria. Guest lecturer, Harvard School of Public Health.

Oak Ridge National Laboratory

Research Staff Member, Oak Ridge, Tennessee (1976–1983)

Performed radionuclide and chemical environmental risk assessments of: proposed uranium and thorium ore mining, milling, and refining; fuel reprocessing and refabrication facilities; power reactor operations; breeder reactor fuel cycle; and high temperature gas-cooled reactor fuel recycling. Research also included assessments of non-nuclear energy sources, including toxics released during wood combustion, coal liquefaction, and coal gasification. Responsible for regular professional presentations related to research and publications.

Colorado State University

Graduate Research Assistant, Fort Collins, Colorado (1972–1976)

Prepared and presented laboratory and classroom lectures. Conducted Ph.D. research on plutonium uptake characteristics of bacteria immobilized on a polymer matrix.

U.S. Navy

Line Officer, Little Creek, Virginia (1969–1972)

Three years active duty. Shipboard experience: qualification as Command Duty Officer, Officer of the Deck, Engineering Watch Officer, Electrical Division Officer. Training in radiation contamination emergency response at Naval Damage Control Training Center, Camden NJ.

Patent

RTRAK autolocating mobile gamma scanning system, U.S. Patent #5,025,150, J. Oldham, R. Meyer, C. Begley, and C. Spencer, 1991.

Professional Activities

Accreditation Board for Engineering and Technology (ABETS) University Program Evaluation Team Leader, 2001 – present

National Council on Radiation Protection and Measurements, Subcommittee on Radioactive Metals Recycling, 1999 – 2002.

RESRAD model, training course at Argonne National Laboratory, 2001.

Certified Environmental Site Assessment Professional, ASTM training course, 2000.

Lecturer (occasional), Colorado State University, 1993-present.

National Academy of Sciences, Member, Board on Radioactive Waste Management (1992-1998)

National Academy of Sciences, Subcommittees: Review of the New York State Low Level Waste Siting Project, 1996; DOE Site Decommissioning, 1997; the National Low Level Waste Problem, 1998.

U.S. Environmental Protection Agency Science Advisory Board, Radiation Advisory Committee Member, 1990–1992.

High intensity training: "Dealing with the Media", interactive 6-student, 3-day course directed by Dr. Leonard Roller, 1989.

Invited lecturer, Harvard School of Public Health, 1988-1994.

Consultant to the International Atomic Energy Agency, Vienna. Co-authored IAEA Technical Report STI/DOC/10/327, "Planning for Cleanup of Large Areas Contaminated as a Result of a Nuclear Accident," 1988.

Consultant to the US EPA Science Advisory Board, technical review of National Emissions Standards for Hazardous Air Pollutants, 1988.

Consultant to the Centers for Disease Control, Fernald Dose Assessment Project, 1987.

Invited participant, "European Seminar on the Risks from Tritium Exposure," Mol, Belgium, November 1982.

Invited participant, "Light Water Reactor Accident Mitigation Workshop," West Germany, April 1981.

Faculty Affiliate, Colorado State University Ph.D. committee member, 1980–1982.

Governor's Planning Committee for the Management of Radioactive and Hazardous Wastes for the State of Tennessee, 1979–1980.

Health Physics Society, Environmental Section, Education and Training Committee.

Expert Testimony

"Review of the Radiological Hazard Associated with the Durango Uranium Mill Tailings Pile." Court testimony for the *State of Colorado vs. HECLA*. Durango, Colorado, April 20–22, 1987.

Honors and Awards

Society for Technical Communications 1985 Award for "Radiological Assessment–A Textbook on Environmental Dose Analysis," edited by John E. Till and H. Robert Meyer, NUREG/CR-3332.

Society for Technical Communications 1980 Award for "Radiological Impact of Thorium Mining and Milling," H.R. Meyer et al., *Nuclear Safety* 20 (3).

American Nuclear Society's P.W. Jacoe Award–outstanding nuclear science student, 1976.

Phi Kappa Phi Graduate Honor Society, 1976.

Distinguished Naval Graduate, Officer Candidate School, 1969.

NASA Summer Fellowship, 1966.

Selected Publications

Emery, R.M., M.L. Warner, **H.R. Meyer**, C.A. Little and J.E. Till. 1977. Environmental Assessment Strategies in Support of the Nonproliferation Alternative Systems Assessment Program (NASAP). PNL-2415. Battelle Pacific Northwest Laboratories. October.

Meyer, H.R., and J.E. Till. 1978. "Global/Generic Studies." In HTGR Fuel Recycle Development Program Annual Report. ORNL-5423. Oak Ridge National Laboratory.

Meyer, H.R., J.E. Till, E.A. Bondietti, D.E. Dunning, C.S. Fore, C.T. Garten, Jr., and S.V. Kaye. 1978. Nonproliferative Alternative Systems Assessment Program - Preliminary Environmental Assessment of Thorium/Uranium Fuel Cycle Systems. ORNL/TM-6069. Oak Ridge National Laboratory. June.

Meyer, H.R., and J.E. Till. 1978. "Radiological Hazards of Denatured U-233 Fuel." In Interim Assessment of the Denatured Fuel Cycle. Edited by L.S. Abbott, D.E. Bartine and T.J. Burns. ORNL-5388. Oak Ridge National Laboratory. December.

Tennery, V.J., E.S. Bomar, W.D. Bond, L.E. Morse, **H.R. Meyer** and J.E. Till. 1978. Environmental Assessment of Alternate FBR Fuels: Radiological Assessment of Reprocessing and Refabrication of Thorium/Uranium Carbide Fuels. ORNL/TM-6493. Oak Ridge National Laboratory. August.

Tennery, V.J., E.S. Bomar, W.D. Bond, L.E. Morse, **H.R. Meyer**, J.E. Till and M.G. Yalcintas. 1978. Environmental Assessment of Advanced FBR Fuels: Radiological Assessment of Airborne Releases from Thorium Mining and Milling. ORNL/TM-6474. Oak Ridge National Laboratory. October.

Braid, R.B., C.A. Little, **H.R. Meyer**, J.P. Witherspoon, A. Brandstetter, and R.M. Ecker. 1979. "Interim Report—Environmental Assessment of Alternative Reactor/Fuel Cycle Systems—NASAP." In Nuclear Proliferation and Civilian Nuclear Power. NE-001. Volume 6. U.S. Department of Energy. December.

Carnes, S.A., E.D. Copenhaver, L. Martin-Bronfman, **H.R. Meyer**, T.W. Oakes, D.C. Parzyck, L.W. Rickert, E.G. St. Clair, C.W. Tevepaugh, L.F. Willis, and D.W. Weeter. 1979. Report of the UCC-ND Task Force on Waste Management in Tennessee. September.

Dunning, D.E. and **H.R. Meyer**. 1979. "An Evaluation of Thorium-232 Dose Conversion Factors." In The Validation of Selected Predictive Models and Parameters for the Environmental

Transport and Dosimetry of Radionuclides. ORNL/TN-6663. Edited by C.W. Miller. Oak Ridge National Laboratory. July.

Faust, R.A., C.S. Fore, M.V. Cone, **H.R. Meyer** and J.E. Till. 1979. Biomedical and Environmental Aspects of the Thorium Fuel Cycle. ORNL/EIS-111. Oak Ridge National Laboratory. July.

Meyer, H.R. and D.E. Dunning. 1979. "Reevaluation of Dose Equivalent per Unit Intake for Th232." Health Physics 37 (4): 595–598. October.

Meyer, H.R. and J.E. Till. 1979. "Anticipated Radiological Impacts of the Mining and Milling of Thorium for the Nonproliferative Fuels." Proceedings of the Symposium–Radioactivity and Environment. Edited by W. Feldt. German-Swiss Society for Radiation Protection, Norderney, Federal Republic of Germany, October 2–6, 1978, IRPA.

Meyer, H.R, J.E. Johnson, R.P. Tengerdy, and P.M. Goldman. 1979. "Use of a Bacteria-Polymer Composite to Concentrate Plutonium from Aqueous Media." Health Physics 37 (3): 359–363. September.

Meyer, H.R, C.A. Little, J.P. Witherspoon and J.E. Till. 1979. "A Comparison of Potential Radiological Impacts of U233 and Pu239 Fuel Cycles." Transactions of the American Nuclear Society, Winter Meeting, November 12–16, 1979.

Meyer, H.R, J.E. Till, E.S. Bomar, W.D. Bond, L.E. Morse, V.J. Tennery, and M.G. Yalcintas. 1979. "Radiological Impacts of Thorium Mining and Milling." Nuclear Safety 20 (3). June.

Meyer, H.R, J.E. Till and E.L. Etnier. 1980. "Reprocessing Thorium-Based Fuels." and "Tritium Doses and Dosimetry." HASRD Technical Progress Report. ORNL-5595. Oak Ridge National Laboratory. January.

Meyer, H.R, D.E. Dunning, D.C. Kocher and K.K. Kanak. 1980. "Dose Conversion Factors." In Recommendations Concerning Models and Parameters Best Suited to Breeder Reactor Environmental Radiological Assessments. Edited by C.W. Miller. ORNL-5529. Oak Ridge National Laboratory. May.

Miller, C.W., D.E. Dunning, E.L. Etnier, D.C. Kocher, L.M. McDowell-Boyer, **H.R. Meyer** and P.S. Rohwer. 1980. Recommendations Concerning Research and Model Evaluation Needs to Support Breeder Reactor Environmental Radiological Assessments. ORNL/TM-7491. Oak Ridge National Laboratory. December.

Tennery, V.J., E.S. Bomar, W.D. Bond, **H.R. Meyer**, L.E. Morse, J.E. Till and M.G. Yalcintas. 1980. Summary of the Radiological Assessment of the Fuel Cycle for a Thorium-Uranium Carbide-Fueled Fast Breeder Reactor. ORNL/TM-6953. Oak Ridge National Laboratory. January.

Till, J.E., **H.R. Meyer** and E.L. Etnier. 1980. "Updating the Tritium Quality Factor—The Argument for Conservatism." Proceedings of Tritium Technology in Fission, Fusion, and Isotopic Applications. American Nuclear Society National Topical Meeting, Dayton, Ohio. U.S. Department of Energy CONF-800427.

Till, J.E., **H.R. Meyer**, V.J. Tennery, E.S. Bomar, M.G. Yalcintas, L.E. Morse, and W.D. Bond. 1980. "Reprocessing Nuclear Fuels of the Future: A Radiological Assessment of Advanced (Th, U) Carbide Fuel." Nuclear Technology 48 (1). April.

Till, J.E., **H.R. Meyer**, E.L. Etnier, E.S. Bomar, R.D. Gentry, G.G. Killough, P.S. Rohwer, V.J. Tennery, and C.C. Travis. 1980/. "Tritium—An Analysis of Key Environmental and Dosimetric Questions. ORNL/TM-6990. Oak Ridge National Laboratory. May.

Travis, C.C., **H.R. Meyer**, and C.S. Dudney. 1980. "Health and Environmental Effects of Residential Wood Heat." Proceedings of the National Conference on Renewable Energy Technologies. Honolulu, Hawaii, December 7–11, 1980.

Yalcintas, M.G., T. D. Jones, **H.R. Meyer**, H. Ozer, and S Unsal. 1980. "Estimation of Dose Due to Accidental Exposure to a Cobalt 60 Therapy Source." Health Physics 38 (2): 187–191. February.

Meyer, H.R. 1981. "Radiological Assessment of an Alternate Breeder Reactor Fuel Cycle." In Symposium on Intermediate Range Atmospheric Transport Processes and Technology Assessment. Edited by C.W. Miller, S.J. Cotter and S.R. Hanna. U.S. Department of Energy CONF-801064. October.

Meyer, H.R. 1981. "The Contribution of Residential Wood Combustion to Local Airshed Pollutant Concentrations." Proceedings of the International Conference on Residential Solid Fuels. Portland, Oregon, December.

Miller, C.W. and **H.R. Meyer**. 1981. Breeder Reactor Program Summary. HASRD Technical Progress Report. ORNL-5750. Oak Ridge National Laboratory. October.

Till, J.E., E.L. Etnier, and **H.R. Meyer**. 1981. "Methodologies for Calculating the Radiation Dose from Environmental Releases of Tritium." Nuclear Safety 22(2): 205–213. March–April.

Meyer, H.R. 1982. "Health and Environmental Effects." In Life Sciences Synthetic Fuels Semi-Annual Progress Report. Edited by K.E. Cowser. ORNL/TM-8229. Oak Ridge National Laboratory. May.

Meyer, H.R. 1982. "Coal Liquefaction: Health and Environmental Risk Analysis Program." Proceedings of the Third Annual Contractor's Meeting. Alexandria, Virginia, U.S. Department of Energy Document No. CONF-820250. July.

Meyer, H.R and F. O'Donnell. 1982. "University of Minnesota—Duluth Coal Gasification Project." In Life Sciences Synthetic Fuels Semi-Annual Progress Report. Edited by K.E. Cowser. ORNL/TM-8441. Oak Ridge National Laboratory. November.

Meyer, H.R., J.P. Witherspoon, J.P. McBride, and E.J. Frederick. 1982. Comparison of the Radiological Impacts of Thorium and Uranium Nuclear Fuel Cycles. NUREG/CR-2184. U.S. Nuclear Regulatory Commission. April.

Smith, W.J., F.W. Whicker, and **H.R. Meyer**. 1982. "A Review and Categorization of Saltation, Suspension, and Resuspension Models." Nuclear Safety 23 (6). November–December.

DesRosiers, A.E., **H.R. Meyer**, R.E. Swaja, and K. Brusserman. 1983. "Emergency Planning for Accident Mitigation." In Report of the Workshop on the Evaluation and Mitigation of the Consequences of Accidental Releases of Radioactivity: Identification of Uncertainties. Bad Munstereifel, Federal Republic of Germany.

Killough, G.G., **H.R. Meyer**, and D.E. Dunning. "Radionuclide Dosimetry." In Models and Parameters for Environmental Radiological Assessments. Edited by C.W. Miller. U.S. Department of Energy Critical Review Series.

Meyer, H.R, and G. Holton, "Modeling the Potential Public Health Impacts of Airborne Releases." In Proceedings of the Health and Environmental Risk Analysis Workshop. Brookhaven National Laboratory, Upton, New York.

Meyer, H.R., C.W. Miller, A.E. DesRosiers, G. Stoetzel, D. Strenge, and R.E. Swaja. 1983. "Assessment of Accidental Releases of Radionuclides." In Radiological Assessment: A Textbook on Environmental Dose Analysis. Chapter 14. Edited by J.E. Till and **H.R. Meyer**. NUREG/CR-3332, ORNL-5968. U.S. Nuclear Regulatory Commission.

Till, J.E. and **H.R. Meyer**, eds. 1983. Radiological Assessment: A Textbook on Environmental Dose Analysis. NUREG/CR-3332, ORNL-5968. U.S. Nuclear Regulatory Commission.

Coffman, J., **H.R. Meyer**, and D. Skinner. 1984. "Radiological Measurements to Support Remedial Action on Uranium Mill Tailings." Proceedings of the American Nuclear Society Annual Meeting.

Meyer, H.R., D. Skinner, J. Coffman, and J. Arthur. 1984. "Environmental Protection in the UMTRA Project." Proceedings of the Fifth U.S. Department of Energy Environmental Protection Information Meeting. CONF-841187, Volume 2. November.

Meyer, H.R. et al. 1984. Health and Environmental Effects Document for the Liquid Metal Fast Breeder Reactor Fuel Cycle-1982. ORNL/TM-8802. Oak Ridge National Laboratory. March.

Meyer, H.R and J. Purvis. 1985. "Development of an Interference-Corrected Soil Radium Measurement System." Proceedings of the American Nuclear Society Annual Meeting. San Francisco, California. November. 184–186.

Meyer, H.R, D. Skinner, and J. Coffman. 1985. "Environmental Monitoring in the UMTRA Project." Proceedings of the Health Physics Society Midyear Symposium on Environmental Radioactivity. Colorado Springs, Colorado. January.

Skinner, D. and **H.R. Meyer**. 1985. "Demonstration of 10CFR20 Air Particulate Compliance Requirements on the UMTRA Project." Proceedings of the Health Physics Society Midyear Symposium on Environmental Radioactivity. Colorado Springs, Colorado. January.

Travis, C.C., E.L. Etnier, and **H.R. Meyer**. 1985. "Health Risks of Residential Wood Heat." Environmental Management 9 (3).

Meyer, H.R and D. Skinner. 1986. "Public Information Experience in the UMTRA Project." Proceedings of the Health Physics Society Midyear Symposium. Knoxville, Tennessee. February.

Miller, C.W. and **H.R. Meyer**. 1986. "Estimated Doses and Risks Resulting from Routine Radionuclide Releases from Fast Breeder Reactor Fuel Cycle Facilities: A Summary." Nuclear Safety 27 (1): 28–35. January–March.

Skinner, D., **H.R. Meyer**, and L.G. Hoffman. 1986. "Environmental Monitoring Requirements During Remedial Action and Stabilization of the Uranium Mill Tailings Project." Proceedings of the Health Physics Society Midyear Symposium. Knoxville, Tennessee. February.

Holton, G.A., K.R. Meyer, and **H.R. Meyer**. 1987. "Siting a Radioactive Waste Facility: A Pathways Analysis Case Study." Proceedings of the Air Pollution Control Association Annual Meeting. New York, New York, June 21–26, 1987.

Meyer, H.R. 1987. "Hazardous and Radioactive Wastes: Public Health Issues and Concerns." Proceedings of the American Institute of Chemical Engineers Meeting. Houston, Texas. March.

Meyer, H.R. and C. Daily. 1987. "QA Verification Procedures in Uranium Mill Tailings Processing Site Remedial Action." Proceedings of the American Society for Quality Control, Second Topical Conference on Nuclear Waste Management Quality Assurance. Las Vegas, Nevada, February 9-11, 1987.

Meyer, H.R., C. Begley, and C. Daily. 1987. "Field Instruments Developed for Use on the UMTRA Project." Proceedings of the Waste Management 1987 Annual Meeting. University of Arizona, Tucson. March.

Reith, C.H., R. Richey, M. Matthews, **H.R. Meyer**, C. Daily, F. Petelka, W. Glover, D. Lechel, and J.E. Till. 1988. "Characterization and Remedial Planning for Non-Radiological Toxicants at UMTRA Project Sites." In Waste Management 88. Edited by R.G. Post and M.E. Wacks. Tucson, Arizona: University of Arizona Press.

Reith, C.H., J.E. Till, and **H.R. Meyer**. 1989. "DECHEM: A Program for Characterization and Mitigation." In Proceedings of the American Institute of Chemical Engineers. 1989 Summer Meeting, Philadelphia, Pennsylvania, August 20–23, 1989.

Reith, C.H., **H.R. Meyer**, J.E. Till, and M.L. Matthews. 1989. "DECHEM: A Program for Characterizing and Mitigating Chemical Contaminants at UMTRA Project Sites." In Waste Management 89, Proceedings. DOE Waste Management Meeting, Denver, Colorado, April.

Faraday, M.A., B. Legrand, and **H.R. Meyer**. 1991. Planning for Cleanup of Large Areas Contaminated as a Result of a Nuclear Accident. IAEA STI/DOC/10/327. Vienna.

Grogan, H., K. Meyer, P. Voillequé, S. Rope, M. Case, H. Meyer, R. Moore, T. Winsor, and J. Till. 1993. The Rocky Flats Nuclear Weapons Plant Dose Reconstruction Project - Task 2: Verify Phase I Source Term and Uncertainty Estimates. RAC Report No. CDH-1. Radiological Assessments Corporation, Neeses, South Carolina. December.

Meyer, H.R. et al. 1993. Program Plan—Siting a Low Level Radioactive Waste Facility in Pennsylvania. March.

Grogan, H.A, M.O. Langan, **H.R. Meyer**, E.A. Stetar, and J.E. Till. 1995. Savannah River Site Dose Reconstruction Project Phase I: Tasks 1 and 2, Identification and Cataloging of Information Sources. RAC Report No. 3-CDC-SRS-95-Final. Radiological Assessments Corporation, Neeses, South Carolina. June.

Stetar, E.A., M.J. Case, L.W. Bell, H.A. Grogan, K.R. **Meyer, H.R** Meyer, S.K. Rope, D.W. Schmidt, T.F. Winsor, and J.E. Till. 1995. Savannah River Site Dose Reconstruction Project Phase I: Task 4, Identifying Sources of Environmental Monitoring and Research Data. RAC Report No. 2 CDC-SRS-95-Final. Radiological Assessments Corporation, Neeses, South Carolina. June.

Meyer, H.R., S.K. Rope, T.F. Winsor, P.G. Voillequé, K.R. Meyer, L.A. Stetar, J.E. Till, and J.M. Weber. 1996. The Rocky Flats Plant 903 Area Characterization. RAC Report

No. 2-CDPHE-RFP-1996-Final. Radiological Assessments Corporation, Neeses, South Carolina. December.

Wiltshire, S., R. Ahrens, G. Anderson, C. Baskerville, R. Bassett, L. Brothers, H. Brown, G. Cederberg, J. Croes, W. Dornsife, J. Ebel, W. Freudenburg, R. Hatcher, C. Hornibrook, J. Johnson, L. Lehman, **H.R. Meyer**, D. Roy, M. Salamon, L. Slosky, and A. Socolow. 1996. Review of New York State Low-Level Radioactive Waste Siting Process. National Research Council, National Academy of Sciences. Washington, D.C.: National Academy Press.

Meyer, H.R. 1997. Savannah River Site Reactor Power and Canyon/Tritium Production Levels. Technical report. Radiological Assessments Corporation, Neeses, South Carolina. July 21.

Meyer, H.R. 1997. Book review of Radiation Risk, Risk Perception and Social Constructions. Health Physics 73 (3). September.

Weber J.M., A.S. Rood, J. Binder, and **H.R. Meyer**. 1998. Task 3: Development of the Rocky Flats Plant 903 Area Source Term. RAC Report No. 3-CDPHE-RFP-1999. Phase II, Rocky Flats Historical Public Exposure Studies. Radiological Assessments Corporation, Neeses, South Carolina. October.

Till, J. E., **H.R. Meyer**, Mohler, J., et al. 1999. Savannah River Site Dose Reconstruction Project Phase II Report. RAC Report No. 1-CDC-SRS-1999-Draft Final, Radiological Assessments Corporation, Neeses, SC. April 30. Published on paper and CD-ROM.

Meyer, H. R. 1998 – 2001. Book reviews published in Health Physics Journal.

Meyer, H.R. 2000-2001. Project research reports released as SMI documents, various topics and dates.

Till, JE, AS Rood, PG. Voillequé, PD McGavran, K.R. Meyer, H.A. Grogan, W.K. Sinclair, J.W. Aanenson, **H.R. Meyer**, S.K. Rope, and M.J. Case. 2002. Risks to the public from historical releases of radionuclides and chemicals at the Rocky Flats Nuclear Weapons Plant. *J of Exp. Analysis and Epidemiology* 12(5): 355-372.

Chen, Shih-Yew, D.J. Strom, J.G. Yusko, A. LaMastra, **H.R. Meyer**, D.W. Moeller. 2002. Managing potentially radioactive scrap metal. National Council on Radiation Protection and Measurements Report No. 141. November.

Meyer, H.R., J. Johnson, C. Little, R. Whicker. 2005. Use of a GPS-based gamma scanning system during field characterization activities. Proceedings, American Nuclear Society topical session, Denver, CO. July.

Meyer, H.R., M. Shields, S. Green. 2005. Scanning for radioactive contamination at remedial action facilities in the U.S. and Eurasia. 2005. Uranium mining remedial action conference, Friesing, Germany. September.

Selected Presentations

Meyer, H.R. et al. 1978. "Thorium Mining and Milling—An Analysis of Radiological Impacts." Health Physics Society Annual Meeting, Minneapolis, Minnesota, June.

Meyer, H.R. 1979. "An Overview of the Radiological Risks Associated with Thorium Mining in the Lemhi Pass Region." Department of Radiology and Radiation Biology Seminar Series, Colorado State University, Fort Collins, May.

Meyer, H.R., C.A. Little, J.P. Witherspoon, and J.E. Till. 1979. "A Comparison of Potential Radiological Impacts of 233U and 239Pu Fuel Cycles." American Nuclear Society Winter Meeting, San Francisco, California, November.

Meyer, H.R. et al. 1979. "Recycle of Thorium-Uranium Fuels—A Radiological Assessment." Health Physics Society Annual Meeting, July.

Meyer, H.R. 1980. "Radiological Assessment of an Alternate Breeder Reactor Fuel Cycle." Presented at the Symposium on Intermediate Range Atmospheric Transport Processes and Technology Assessment, Gatlinburg, Tennessee, October 1–3.

Meyer, H.R., J.E. Till, and E.L. Etnier. 1980. "Tritium—Potential Impacts of Nuclear Fuel Cycle Releases." Health Physics Society Annual Meeting, Seattle, Washington, July.

Meyer, H.R. 1981. "The Contribution of Residential Wood Combustion Emissions to Local Airshed Concentrations." Presented at the Conference on Residential Solid Fuels, Portland, Oregon, June 1–5.

Meyer, H.R. 1981. "The Human Health Risk Associated with Coal Liquefaction, Residential Wood Combustion and Nuclear Fuel Reprocessing." Department of Radiology and Radiation Biology Seminar Series, Colorado State University, Fort Collins, Colorado, July 30.

Meyer, H.R. 1981. "Coal Liquefaction." Presented at U.S. Department of Energy Health and Environmental Risk Analysis Program (HERAP) Annual Technical Review Session, Germantown, Maryland, December 7.

Meyer, H.R. 1982. "Coal Conversion Risk Assessment Research Requirements." Presented at the U.S. Department of Energy Retreat/Workshop, Warrenton, Virginia, January 26–28.

Meyer, H.R. 1982. "Breeder Reactor Risk Assessment." Presented at U.S. Department of Energy Annual Contractors Meeting for the Health and Environmental Risk Assessment Program, Alexandria, Virginia, February 16–18.

Meyer, H.R. 1982. "Reactor Emergency Planning—Analysis of Key Uncertainties." Presented at the Annual Health Physics Society Meeting, Las Vegas, Nevada, June 30.

Meyer, H.R. 1982. "Long Range Transport and Effects Modeling." Invited presentations at the U.S. Department of Energy Workshop on Risk Assessment Modeling, Airlie House, Virginia, August 2–4.

Meyer, H.R. 1982. "Assessment of Dose from Tritium Releases—Application of Environmental Transport Models" and "Tritium Source Terms." Invited presentations at the European Seminar on the Risks from Tritium Exposure. Sponsored jointly by CEC, CEN/SCK, Mol, Belgium, November 22.

Meyer, H.R. 1983. "The LMFBR Health and Environmental Effects Document Risk Assessment." Project Review for U.S. Department of Energy Health and Environmental Risk Assessment Program (HERAP), Washington, D.C., February 7.

Meyer, H.R. 1983. "Assessing the Environmental Impact of the LMFBR Fuel Cycle—A Multiple-Site Approach." Department of Radiology and Radiation Biology Seminar Series, Colorado State University, Fort Collins, Colorado, February 17.

Meyer, H.R. 1984. "Environmental Assessment in the UMTRA Project." Health Physics Society Annual Meeting, New Orleans, Louisiana, June.

Meyer, H.R. 1984. "Relative Risks Associated with the Uranium Mill Tailings Remedial Action (UMTRA) Program." Series of public meetings held in Canonsburg, Pennsylvania, before cleanup of the uranium mill tailings site. Separate presentations were made to the school board, teachers and administrators, nurses, realtors, and several mid school and high school classes, August 21–24.

Meyer, H.R. 1984. "Environmental Protection in the UMTRA Project." Fifth U.S. Department of Energy Environmental Protection Information Meeting, Albuquerque, New Mexico, November.

Meyer, H.R. 1984. "How to Communicate Health Effects Facts to Laymen." 1985 U.S. Department of Energy Remedial Action Annual Meeting, Albuquerque, New Mexico, November.

Meyer, H.R. 1985. "Analysis of Radon and Air Particulate Data in the UMTRA Project." Health Physics Society Midyear Symposium on Environmental Radioactivity, Colorado Springs, Colorado, January.

Meyer, H.R. 1985. "The UMTRA Project Health Physics Program." Presented to the U.S. Department of Energy Policy, Safety and Environment Appraisal Team, Carl Welty, Chairman, Albuquerque, New Mexico, April.

Meyer, H.R. 1985. "Relative Risks Associated with the Uranium Mill Tailings Remedial Action (UMTRA) Program." Presented in a series of public meetings held in Tuba City, Window Rock, and Moenkopi, Arizona, before the cleanup of mill tailings sites, October 8–9.

Meyer, H.R. and J. Purvis. 1985. "Development of an Interference-Corrected Soil Radium Measurement System." American Nuclear Society Annual Meeting (invited paper), San Francisco, November.

Meyer, H.R. 1986. "Review of Uranium Mill Tailings Remedial Action Project." Presented at the U.S. Department of Energy Remedial Action Contractors Annual Meeting, Oak Ridge, Tennessee, May 5–6.

Meyer, H.R. 1986. "Relative Risks Associated with the Uranium Mill Tailings Remedial Action (UMTRA) Program." Presented at a public meeting to explain the UMTRAP radiation protection program before cleanup work began. Lakeview, Oregon, May 20.

Meyer, H.R. 1986. "Health Risk Experience on the UMTRA Project." Presented at a U.S. Department of Energy Seminar on Concerns of Insurance Companies Regarding Remedial Action Risk, Denver, Colorado, November.

Meyer, H.R. 1987. "Instrumentation and Quality Control Techniques for Mill Tailings Remedial Action." Invited presentation at a U.S. Nuclear Regulatory Commission Workshop for mill owners, Denver, Colorado, June 3.

Meyer, H.R. 1987. "Relative Risks Associated with the Uranium Mill Tailings Remedial Action (UMTRA) Program." A series of public meetings held to discuss the UMTRAP radiation protection program before cleanup began. Held in Durango, Colorado, January 20; Rifle, Colorado, May 21; Gunnison, Colorado, July 7; and Mexican Hat, Utah, July 14.

Meyer, H.R. 1989. "Risk Assessment—Disposal in Arid Lands." American Association for the Advancement of Science, Southwest Chapter, topical meeting, Las Cruces, New Mexico, April 6.

Meyer, H.R. 1989. "Proposed LLRW Facility Contract Status and Schedule, Site Screening and Characterization, Design and Operation." Invited presentation, Penn State University, State College, Pennsylvania, November 4.

Meyer, H.R. 1989. "Site Screening and Characterization, Facility Design, Contract Status." Invited presentation, Sierra Club, Pennsylvania PA Chapter, and Environmental Coalition on Nuclear Power joint meeting, State College, Pennsylvania, November 18.

Meyer, H.R., V.J. Barnhart, and M.T. Ryan. 1989. "Developing a Low Level Radioactive Waste Site for the Commonwealth." A series of seven public meeting presentations throughout Pennsylvania, January–February.

Meyer, H.R. 1990. "Political, Administrative and Public Information Aspects." Invited lecture, Management and Disposal of Radioactive Wastes, Harvard School of Public Health, Boston, Massachusetts, July 18.

Meyer, H.R. 1990. "Status of Pennsylvania's Contract with Chem-Nuclear Systems." Invited presentation, Appalachian States Low-Level Radioactive Waste Compact Commission meeting, Harrisburg, Pennsylvania, September 24.

Meyer, H.R. 1990. "Status Report, Low-Level RadWaste Siting Project." Invited presentation to Pennsylvania's Citizens Low-Level Waste Advisory Committee, Harrisburg, Pennsylvania, October 5.

Meyer, H.R. 1990. "Progress Report, LLRW Siting." Presentation to CNSI's Citizens Task Force on Siting, Harrisburg, Pennsylvania, November 7.

Meyer, H.R. 1990. "Status of the Siting Plan." Presentation to CNSI's Citizens Low-Level Waste Advisory Committee, Harrisburg, Pennsylvania, December 13.

Meyer, H.R. 1991. "The LLRW Siting Plan Review Process" and "Site Design." Presentations to CNSI's Citizens Low-Level RadWaste Advisory Committee, Harrisburg, Pennsylvania, February 15.

Meyer, H.R. 1991. "Siting a Low-Level Radioactive Waste Facility for the Commonwealth." Invited presentation, Three Mile Island Alert Annual Meeting, Harrisburg, Pennsylvania, March 28.

Meyer, H.R. and T. Noel. 1991. "Progress in Siting Pennsylvania's LLRW Facility." Invited presentation, Appalachian Compact Users of Radioactive Isotopes Board of Directors Meeting, Allentown, Pennsylvania, April 10.

Meyer, H.R. 1991. "Siting a Low-Level Radioactive Waste Facility for the Commonwealth." Invited presentation, Headwaters Resource Conservation and Development Council, Clearfield, Pennsylvania, April 25.

Meyer, H.R. 1991. "Siting a Low-Level Radioactive Waste Facility for the Commonwealth." Invited presentation, East York Rotary Club, York, Pennsylvania, April 30.

Meyer, H.R. 1991. "The Pennsylvania Low-Level Radioactive Waste Facility Siting Process; Host Community Benefits." Invited presentation, NorthWest Planning Commission, Franklin, Pennsylvania, May 3.

Meyer, H.R. 1991. "The Low Level Radioactive Waste Site." Invited presentation, Limerick Community Advisory Council, Linfield, Pennsylvania, May 8.

Meyer, H.R. 1991. "Low Level Radioactive Waste." Invited presentation, Pennsylvania League of Women Voters Annual Meeting, Ligonier, Pennsylvania, May 11.

Meyer, H.R. 1991. "Siting a Low-Level Radioactive Waste Facility in Pennsylvania." Invited presentation, Peach Bottom Community Advisory Council, Peach Bottom, Pennsylvania, May 16.

Meyer, H.R. 1991. "A Program Overview for Siting the Appalachian States' LLRW Disposal Facility." Invited presentation, PELLRAD Annual Meeting, Penn State University, State College, Pennsylvania, May 23.

Meyer, H.R. 1991. "Status Report from Chem-Nuclear Systems, Inc." Invited presentation at Appalachian States Low-Level Radioactive Waste Compact Commission Meeting, Harrisburg, Pennsylvania, June 12.

Meyer, H.R., T. Loughead, K. Kingsley, and J. Barron. 1991. "The Revised Siting Plan." Invited presentation, Pennsylvania's Citizens Low-Level Waste Advisory Committee Meeting, Harrisburg, Pennsylvania, June 21.

Meyer, H.R. 1991. "Political, Administrative and Public Information Aspects." invited lecture in "Management and Disposal of Radioactive Wastes." Harvard School of Public Health, Boston, Massachusetts, July 17.

Meyer, H.R. 1991. "The Low Level Radioactive Waste Siting Process." Invited presentation at Penn State University Nuclear Concepts Program, State College, Pennsylvania, July 18.

Meyer, H.R. 1991. "Siting a Low Level Radioactive Waste Facility in Pennsylvania—Risk Communication in the Correct Direction." Opening invited paper, Plenary Session, Risk Communication for the 90's, Annual Health Physics Society National Meeting, Washington, D.C., July 22.

Meyer, H.R. 1991. "Risk Communication in the Right Direction." Invited presentation, joint meeting, American Nuclear Society Northern Ohio Section and Health Physics Society Northern Ohio Section, Independence, Ohio, September 11.

Meyer, H.R. 1991. "Low Level Radwaste Siting in Pennsylvania." Invited presentation at Appalachian Compact Users of Radioactive Isotopes breakfast for State Legislators, Harrisburg, Pennsylvania, September 24.

Meyer, H.R. 1991. "Low Level RadWaste." Invited presentation, American Nuclear Society Chapter Meeting, Allentown, Pennsylvania, September 25.

Meyer, H.R. 1991. "Status of the Low Level Radioactive Waste Project." Invited presentation at Appalachian Compact Users of Radioactive Isotopes breakfast for State Legislators, Harrisburg, Pennsylvania, October 23.

Meyer, H.R. and J. Barron. 1991. "Release of Stage One Disqualification Information." Press Conference, Pennsylvania State Capital Media Center, Harrisburg, Pennsylvania, November 13.

Meyer, H.R. and J. Barron. 1991. "Results of Stage One Disqualification." Invited presentation, meeting of Pennsylvania's Low Level Radioactive Waste Citizens' Advisory Committee, Harrisburg, Pennsylvania, November 13.

Meyer, H.R. and W. Dornsife. 1991. "Disposal of Low-Level Radioactive Waste in Pennsylvania." Invited presentation, PP&L media day, Berwick, Pennsylvania, September 26.

Meyer, H.R., K. Kingsley, and T. Loughead. 1991. "LLRW Project Overview." Presentation at bimonthly meeting of CNSI's Low Level Waste Citizens Advisory Committee, Harrisburg, Pennsylvania, June 5.

Meyer, H.R. 1992. "Siting Process Update." Invited presentation, Appalachian Compact Users of Radioactive Isotopes Board of Directors Meeting, King of Prussia, January 8.

Meyer, H.R. 1992. Series of public information presentations—status of the low level radioactive waste site selection process in Pennsylvania.

Meyer, H.R. and G. Longwell. 1992. "The Radioactive Waste Site Selection Process." Invited presentation at Leadership Lackawanna, City and County Government session, Scranton, Pennsylvania, January 9.

Meyer, H.R. 1993. Series of public information presentations—status of dose reconstruction research at the Savannah River Site.

Meyer, H.R. 1994. Series of public information workshops and presentations—status of dose reconstruction research at the Savannah River Site

Meyer, H.R. 1994. "Windblown Suspension of Plutonium from the Rocky Flats Plant." Public workshop, Boulder, Colorado, June.

Meyer, H.R. 1995. Instructor, personal computer laboratory and problem sessions, Radiological Assessments Corporation course in Chemical Risk Assessment, Kiawah Island, South Carolina, February 27–March 3.

Meyer, H.R. 1995. Series of public information workshops and presentations—status of dose reconstruction research at the Savannah River Site

Meyer, H.R. 1996. Series of presentations to the Savannah River Site Centers for Disease Control Citizens' Health Effects Subcommittee on the status of the dose reconstruction project.

Meyer, H.R. 1996. Series of public information workshops and presentations on the status of dose reconstruction research at the Savannah River Site.

Meyer, H.R. 1996. Series of presentations to the Rocky Flats Dose Reconstruction Project Citizens Health Advisory Panel on 903 area risk assessment research.

Meyer, H.R. 1997. Series of presentations to the Centers for Disease Control SRS Citizens' Health Effects Subcommittee.

Meyer, H.R. 1997. Series of public information workshops and presentations on the status of dose reconstruction research at the Savannah River Site.

Meyer, H.R. 1997. Series of presentations to the Rocky Flats Dose Reconstruction Project Citizens Health Advisory Panel on the 903 Area Risk Assessment.

Meyer, H.R. 1998. "The Savannah River Site Dose Reconstruction, a Summary." Presentations at public meetings held in Columbia and Aiken, South Carolina, and Savannah, Georgia, February 18–20.

Meyer, H.R. 1998. Instructor, Risk Assessment Modeling, RAC-sponsored public course in Radiological Risk Assessment, Seattle, Washington.

Meyer, H.R. 1999. "The Savannah River Site Dose Reconstruction Project." Presentations at public meetings held in Columbia SC, Aiken SC and Savannah GA, February 1999.

Meyer, H.R. 1999. Series of presentations to the Rocky Flats Dose Reconstruction Project Citizens Health Advisory Panel, and to members of the public, January - August, 1999.

JANET A. JOHNSON, Ph.D., CHP, CIH
SENIOR RADIATION SCIENTIST
Tetra Tech Inc. (formerly MFG, Inc.)

SUMMARY

Dr. Johnson has extensive experience in radiation health physics, specifically in the following areas:

- Radiological Site Surveys, including MARSSIM
- RSO 40-Hour Course Instructor
- Radon Measurements and Risk Assessment
- NRC License Applications for Consumer Products
- Radiation Risk Assessment
- Radiation Worker Training

Dr. Johnson has evaluated radiation exposure rate, dose and risk from facilities with residual radioactive materials from both licensed activities and from naturally occurring radioactive materials. Dr. Johnson was a member of the U.S. Environmental Protection Agency Science Advisory Board Radiation Advisory Committee (RAC) from 1995 to 2003. She chaired the EPA RAC from 1999 through 2003. During her tenure on the committee the RAC reviewed the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) and the Multi-Agency Radiation Laboratory Analytical Protocols Manual (MARLAP). Dr. Johnson is a member of Scientific Committee 64-22 of the National Council on Radiation Protection and Measurements (NCRP). She has experience in planning and conducting MARSSIM-based site surveys. She has also developed and implemented radiation safety training programs for workers and radiation safety officers. Dr. Johnson taught in the Department of Radiological Health Sciences at Colorado State University for fourteen years. She is currently working on radiological aspects of the reclamation plans for several uranium mills and has performed risk assessments for a variety of uranium recovery facilities. In addition, Dr. Johnson assessed the adequacy of the monitoring methods used at a former nuclear weapons production facility, the Rocky Flats plant, as a member of the Scientific Panel on Monitoring at Rocky Flats, an independent panel commissioned and appointed by the Governor of Colorado. Dr. Johnson is a member of the Colorado Radiation Advisory Committee and served on the Colorado Hazardous Waste Commission from 1993 to 1997. Dr. Johnson, with her colleagues at MFG, Inc. developed training manuals and visuals for radiation safety officers involved in NORM and uranium facilities. The MFG, Inc. team taught 40-hour 40-hour RSO refresher training classes in May 2003 and in May 2005.

Dr. Johnson managed the environmental health and safety program at Colorado State University from 1993 to 1995. The program included industrial hygiene, radiation protection, hazardous waste management, and biosafety.

Dr. Johnson assisted legal counsel for Rockwell International in regard to a class action suit against the corporation. Dr. Johnson served on the Westinghouse Government Operations Nuclear Safety and Environmental Oversight Committee. In that capacity she visited six of the major facilities for which Westinghouse was a contractor during the late 1980s and early 1990s.

Dr. Johnson is a Fellow of the Health Physics Society.

EDUCATION

Ph.D. Microbiology/Environmental Health, Colorado State University (1986)
M.S. Health Physics, AEC Health Physics Fellow, University of Rochester (1959)
B.S. Chemistry, University of Massachusetts (1958)

CERTIFICATIONS

- Certified in the Comprehensive Practice of Health Physics, American Board of Health Physics, 1976; Recertified 1985, 1989, 1993, 1997, 2002
- Certified Industrial Hygienist (Radiological Aspects), 1986; Recertified 1992, 1998

PROFESSIONAL SERVICE

- Colorado Radiation Advisory Committee, 1988-present
- Colorado Hazardous Waste Commission, 1993-1997
- National Academy of Sciences Committee on Low-Level Radioactive Waste Siting, New York State, 1993-1996
- EPA Science Advisory Board, Radiation Advisory Committee, 1994-2004, Chair 1999-2003
- EPA Science Advisory Board, Executive Committee, 1999 - 2003
- Governor's Rocky Flats Scientific Panel on Monitoring, 1989-1992. Chair, Radiation Committee
- NCRP Scientific Committee 64-22 (Environmental Measurements)

PROFESSIONAL SOCIETIES AND HONORS

- Health Physics Society
  Chair, Public Education Committee, 1992-1995
  Radon Section President 2000 – 2001; President-elect, 1998; Secretary Treasurer, 1996-1998
  Board of Directors – 2000 – 2002
  Fellow - 2002
- American Industrial Hygiene Association
- American Academy of Health Physics
- American Academy of Industrial Hygiene

PROFESSIONAL HISTORY

1995 - Present	MFG Inc. (formerly Shepherd Miller, Inc.) Fort Collins, Colorado	
	1998-present	Senior Technical Advisor
	1997-1998	Vice-president for Radiation and Risk Assessment Services
	1995-1997	Senior Radiation Scientist
1964 - 1995	Colorado State University, Fort Collins, Colorado	
	1995	Research Associate, Environmental Health Services
	1993-1995	Interim Director, Environmental Health Services
	1992-1993	Associate Director, Environmental Health Services
	1988-1992	Hazardous Waste Coordinator, Environmental Health Services
	1984	Instructor, Environmental Health and Microbiology (part time)
	1964-1979	Research Associate, Radiological Health Sciences (1/2 time)
1970-1995	Western Radiation Consultants, Inc., Fort Collins, Colorado President and Consultant	
1959	Student Intern, Brookhaven National Laboratory (3 months)	

PROJECT EXPERIENCE

- Radiological Site Assessment. Background radiation measurement and assessment of impacts of uranium mill operation in regard to the reclamation plan.
- Preparation and oversight of site characterization based on MARSSIM
- Preparation of NRC license applications for consumer products. Dose assessment, development of radiological safety and regulatory compliance programs.
- Risk assessment for uranium mill reclamation plans. Preparation of dose/risk assessment under routine operating conditions and potential accident scenarios for a reclamation plan which includes accepting off-site waste byproduct material.
- Risk assessment for uranium in water. Preparation of comments in regard to EPA and Colorado Water Quality Control Commission proposed regulations for uranium in drinking water and ground water.
- Uranium Mill Tailings Remedial Action Program Health and Safety Audit. Industrial hygiene and radiation protection.
- Radon measurements. Gamma and Ambient Radon Dosimeter (GARD).
- Westinghouse Government Operations Nuclear Safety and Environmental Oversight Committee. Review of safety and environmental programs at DOE sites managed and operated by Westinghouse, including evaluation of Total Quality Management programs as they pertained to environmental protection and safety.
- Radiological Health Consultant to legal counsel for Rockwell (Rocky Flats Plant).
- Health Risk Assessment Panel Subcommittee. Preparation of toxicity profiles and radiation risk assessment (Cotter Corporation Canon City Uranium Mill)

- Development and presentation of Radiation Safety Training and Hazardous Waste Operations Training, including training and regulatory compliance for radioactive materials licensees.
- Risk assessment for Naturally Occurring Radioactive Materials (NORM).
- Managed the environmental health and safety program for Colorado State University including routine operations, strategic planning, budgeting and personnel.
- Managed environmental restoration program.
- Managed hazardous waste program for Colorado State University including routine disposal, environmental restoration and emergency response.
- Taught basic industrial hygiene course.
- Taught radiation physics and radiochemistry laboratories and radiation chemistry course.
- Occupational health and safety review for a gold mine in Peru
- Baseline radiological survey for an *in situ* uranium recovery operation in Kazakhstan.
- Taught and developed the training manual for a 40-hour radiation safety officer (RSO) training class for NORM and Uranium facilities (May 2003 and December 2003)

REPRESENTATIVE JOURNAL PUBLICATIONS AND PROCEEDINGS

Johnson, J.A. Riding the RCRA Roller Coaster - Adventures in closing a micro-mixed waste site. Managing Radioactive and Mixed Waste, *Proceedings of the Twenty-seventh Midyear Topical Meeting of the Health Physics Society.* February 1994.

Johnson, J.A., R.M. Buchan and J.S. Reif. Effect of waste anesthetic gas and vapor exposure on reproductive outcome in veterinary personnel. *American Industrial Hygiene Association Journal* 48(1): 62-66, 1987.

Johnson, J.E. and J.A. Johnson: Radioactivity and detection limit problems of environmental surveillance at a gas-cooled reactor. *ACS symposium Series 361, detection in Analytical Chemistry, Importance, Theory, and Practice.* American Chemical Society, Washington, DC, 1988.

Borak, T.B., J.A. Johnson and K.J. Schiager. A comparison of radioactivity and silica standards for limiting dust exposures in uranium mines. In *Radiation Hazards in Mining: Control, Measurement and Medical Aspects*, M. Gomez, ed. Society of Mining Engineers. New York, NY, 1981.

Borak, T.B., E. Franko, K.J. Schiager, J.A. Johnson and R.F. Holub. Evaluation of recent developments in radon progeny measurements. In *Radiation Hazards in Mining: Control, Measurement and Medial Aspects,* M. Gomez, ed. Society of Mining Engineers, New York, NY, 1981.

Johnson, J.A., K.J. Schiager, T.B. Borak. Contribution of human errors to uncertainties in radiation measurements and implications for training. In Radiation *Hazards in Mining:*

Control, Measurement and Medical Aspects, M. Gomez, ed. Society of Mining Engineers, New York, NY, 1981.

Schiager, J.J., J.A. Johnson and T.B. Borak. Radiation monitoring priorities for uranium miners. In *Radiation Hazards in Mining: Control, Measurement and Medical Aspects*, M. Gomez, ed. Society of Mining Engineers, New York, NY, 1981.

Johnson, J.A. "Basic Radiation Protection for Use of Radionuclides in Laboratories," 1991. Teaching manual for forty-hour course.

Johnson, J.A. "Radiation Protection for Uranium Mills," 1997 (Revised 2000). Teaching manual for forty-hour course.

REPORTS

Hersloff, J., J.A. Johnson and S. Ibrahim. *Radiological Risk Assessment of Abandoned Mine Lands, Radium Land Clean-up Standard.* Wyoming Department of Environmental Quality, 1988.

Borak, T.B. and J.A. Johnson. *Estimating the Risk of Lung cancer from Inhalation of Radon Daughters Indoors: Review and Evaluation.* Colorado State University for USEPA, 1988.

Schiager, K.J., T.B. Borak and J.A. Johnson. *Radiation Monitoring for Uranium Miners: Evaluation and Optimization.* U.S. Department of the Interior, Bureau of Mines. Final Report on contract.

TECHNICAL PRESENTATIONS:

Dr. Johnson has presented numerous technical papers at Health Physics Society Annual Meetings, Mid-year Symposia, Mill Tailings Conferences, American Industrial Hygiene Association Conferences, European Conferences and a meeting of the American Veterinary Medicine Association. She presented a paper and a poster summary at a conference on uranium in groundwater in Freiburg Germany (1998) and presented an invited paper at a SCOPE Radsite meeting in Munich in September 2000. Dr. Johnson presented an invited paper on the effects of radon and smoking at the American Radiation Safety Conference and Exposition in San Diego in June 2003.

CRAIG A. LITTLE

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PROFESSIONAL EXPERIENCE

2002 – pres	Sr. Scientist, Tetra Tech Inc. (formerly MFG, Inc.). Conduct radiation risk assessments, dose calculations and field assessments of radioactivity for a variety of clients nationwide. Projects include field surveys of contaminated sites to design cleanup plans and to assure remedial action effectiveness, calculation of potential radiation dose and risk to members of the public and workers at radiation sites, and development of presentations to summarize results to public meetings. Write project proposals, develop work plans and cost estimates, produce site investigation reports, and write monthly reports. Manage projects.
2000 – 2001	Manager, Western Operations, Advanced Infrastructure Management Technologies, a division of the Department of Energy's Y-12 National Security Complex, Oak Ridge, Tennessee. Responsible for twenty-five project managers in offices in Grand Junction, Colorado; Sacramento, California; and Lancaster, California. Projects included a variety of site assessment, risk analysis, and infrastructure improvements at numerous federal facilities nationwide. Projects were funded by Dept. of Energy, Dept. of Defense, Environmental Protection Agency, and others.
1983 – 2000	Leader, Environmental Technology Section (ETS), Life Sciences Division, Oak Ridge National Laboratory located in Grand Junction. Originally established the group to support USDOE Uranium Mill Tailings Remedial Action Project (UMTRAP). Staff developed and applied technologies and methodologies to remedy chemical and radiological pollution at numerous locations nationwide. Section staff conducted over 12,000 field surveys of contaminated properties nationwide. Projects were funded by Dept. of Defense, Dept. of Energy, and other agencies.
1987 – 1998	Adjunct Professor, Department of Radiological Health Sciences, Colorado State University. Served on graduate research committees.
Fall 1979	Guest scientist, Federal Health Office, Munich, Federal Republic of Germany. Assisted in planning and implementing monitoring system for actinides released from nuclear power plants in the Federal Republic.
1976 – 1982	Research Staff, Health and Safety Research Division, ORNL. Developed and applied computer codes to predict transport of nuclear and non-nuclear pollutants through the environment and subsequent impacts on ecosystems and human systems. Conducted research to assess the accuracy of environmental transport models.
Fall 1976	Environmental Research Assistant, Department of Radiology and Radiation Biology, Colorado State University. Collected environmental samples of plutonium for analysis; analyzed, reduced and summarized subsequent data for publication.

EDUCATION AND TRAINING

1976	Ph.D., Radioecology. Department of Radiology and Radiation Biology, Colorado State University, Ft. Collins, CO. Dissertation title: *Plutonium in a Grassland Ecosystem.*
1971	M.S., Radiation Biology/Health Physics. Department of Radiology and Radiation

Biology, Colorado State University, Ft. Collins, CO.

1970	B. A., Biology. McPherson College, McPherson, KS.
1996	Leading Out Loud. TPG/Learning Systems. Knoxville, Tennessee.
1993	The Effective Executive. American Management Association, New York, NY
1990	Strategic Planning. American Management Association, New York, NY.
1989	Senior Project Management. American Management Association, New Your, NY.
1987	Cost and Schedule Control Systems Criteria (C/SCSC). Humphreys and Associates, Santa Clara, CA. Included project planning, work breakdown structures, and control systems.
1986	The Management Course. American Management Association, New York, NY. Four week course covering all aspects of management including financial analysis of businesses, human resource management, and business simulation.
1980	Modeling of Groundwater Flow. Holcomb Research Institute, Butler University, Indianapolis, IN. Two week course on computer models of groundwater flow.

PUBLICATIONS AND PRESENTATIONS

Author or co-author of more than seventy reports, journal articles, and book chapters on topics such as risk analysis, environmental transport processes, pollutants in the environment, radiological assessments, and computer programming. Presented numerous papers at professional meetings, as both contributing and invited speaker. Served on Oak Ridge Associated Universities speakers bureau for several different terms.

OTHER ACTIVITIES

2003 - pres	Member, Board of Directors, Marillac Clinic. Provides low-cost medical, dental and vision care to uninsured, low-income patients. Previously served as board president in earlier term.
1999 - pres	Member, Board of Trustees, McPherson College, McPherson, Kansas
2000 - 2003	Member, Board of Directors, Health Physics Society
1998 - 2001	Member, Board of Directors, Joint Utilization Commission and Riverview Technology Corp.; groups founded to negotiate and receive the DOE/Grand Junction property into private, non-for-profit ownership.
1991 - pres	Associate Editor, *Health Physics* journal.
2005 - pres	Editor-in-Chief, *Operational Radiation Safety* journal.
1996 - 2001	Member, Victim-Witness/Law Enforcement Board, Mesa County District Court. Provide court-raised funds to victim advocacy/services organizations.
1997 - 1999	Member, Environmental Pathways Modeling Working Group of Health Physics Standards Committee
1996 - 1999	Member, Program Committee, Health Physics Society.
1995 - 1999	Member, Program Advisory Board of Foster Grandparents, Inc. Served as Chair.
1994 - 1996	Member, Board of Directors, Environmental Radiation Section, Health Physics Society.
1991 - 1996	Member, Board of Directors, Public Radio of Colorado, Inc., operator of Colorado Public Radio network.
1990 - 1996	Member, Nominating Committee, Health Physics Society. Chair, 1994-1996.

1989 - 1995	Member, Board of Directors, Mesa County United Way. President, 1993-1994.
1987 - 1990	Chair, Public Information Committee, Environmental Radiation Section, Health Physics Society.
1988 - 1991	Member, Board of Directors, Chemrad Tennessee, Inc., manufacturer of ultrasonic-based system for transmitting environmental data to computers in the field.
1987 - 1991	Chairman, Board of Directors, Western Colorado Public Radio, Inc., operator of public radio station KPRN. Development and Planning chairman.
1986 - 1987	Member, Mesa County (CO) Task Force to Evaluate the Aid to Families with Dependent Children (AFDC) Program. Edited final report of task force.

Designer and Manufacturer of Scientific and Industrial Instruments

7 1

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 257407/303341

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 98616

Cal. Date 21-Jun-06 Cal Due Date 21-Jun-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 48 % Alt 697.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 497 V Ref./Inst. 2000 / 1996 V

COMMENTS: Firmware: 37122N26
ID Firmware: 37123N05
Resolution for Cs-137 ≈ 10%
Calibrated w/39" cable.
No as-founds (Loss of memory)

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR-102508	1000	100	7 / 1	1.629357E-05	1.000000E+00	
Detector # 2	LMI44-10	PR-102508	1000	100	4 / 2	1.629357E-05	5.568443E+10	✓
Detector # 3	PEAK	CS-137	694	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	40012 (0)	40012 (0)	400cpm	40 (0)	40 (0)
	40kcpm	4011 }	4011 }	40cpm	4 }	4 }
	4kcpm	401 }	401 }			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☒ Alpha S/N ☐ Beta S/N ☑ Other Am 241 ≈ 0.76 μCi

☑ m 500 S/N 50800 ☑ Multimeter S/N 83990502

Calibrated By: Charles Dick Date 21 Jun 06

Reviewed By: [signature] Date 22 June 06

FORM C44A 11/26/2003

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

MFG-3

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 263479/306131

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 98631

Cal. Date 25-Sep-06 Cal Due Date 25-Sep-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 33 % Alt 708.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 1997 V

COMMENTS: *Firmware: 37122N26*
I/O firmware:37123n05 Instrument calibrated with 39"C cable
resolution for Cs-137 9%
Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	RN011772	850	100	4 / 2	1.498379E-05	5.549865E+10	
Detector # 2	LMI44-10	RN011772	850	100	7 / 1	1.498379E-05	1.000000E+00	
Detector # 3	CS-137	662KEV	599	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	399243	399243	400cpm	399	399
	40kcpm	39926	39926	40cpm	40	40
	4kcpm	3993	3993			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N ☐ S-394 ☐ 1122 ☐ 781
☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304
☐ Alpha S/N ☐ Beta S/N ☑ Other Am-241 ~0.77uCi
☑ m 500 S/N 121025 ☑ Multimeter S/N 78846185

Calibrated By: [signature] Date 25-Sep-06
Reviewed By: [signature] Date 25 Sep 06

FORM C44A 06/02/2006 This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

4

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CERTIFICATE OF CALIBRATION

CUSTOMER MFG INC ORDER NO. 257271 / 303277

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 120625

Cal. Date 19-Jun-06 Cal Due Date 19-Jun-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 47 % Alt 700.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity

☑ F/S Resp. check ☑ Reset check ☑ Window Operation

☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC

☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check Threshold

☑ Data Log check ☑ Overload check ☑ Scaler Readout check Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 2000 / 1998 V

COMMENTS: *Firmware: 37122N28*

I/O Firmware: 37123N05

No "As Found" readings because of M2350-1 memory loss.

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 9.37%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR122614	900	100	4 / 2	1.290054E-05	5.418134E+10	✓
Detector # 2	LMI44-10	PR122614	900	100	7 / 1	1.290053E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	605	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm		39922 (0)	400cpm		40 (0)
	40kcpm	N/A	3994	40cpm	N/A	4
	4kcpm		400			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241 ≈ 0.83 µCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebasti Ceballos Date 19-Jun-06

Reviewed By: [signature] Date ?-Jun-06

FORM C44C 11/26/2003

#5

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 257273 / 303278

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 129426

Cal. Date 16-Jun-06 Cal Due Date 16-Jun-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 70 °F RH 36 % Alt 699.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 499 V Ref./Inst. 2000 / 1996 V

COMMENTS: *Firmware: 37122N21*

I/O Firmware: 37123N05

Resolution for Cs137 ≈ 9.67%.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR135855	1050	100	4 / 2	1.461701E-05	5.414237E+10	✓
Detector # 2	LMI44-10	PR135855	1050	100	7 / 1	1.461701E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	708	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	39978(0)	39978(0)	400cpm	40(0)	40(0)
	40kcpm	3996	3996	40cpm	4	4
	4kcpm	400	400			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241≈ 0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastn Ceballos Date 16-Jun-06

Reviewed By: [signature] Date 19 Jun 06

FORM C44C 11/26/2003

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

MFG-6

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 · PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 263479/306131

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 152361

Cal. Date 22-Sep-06 Cal Due Date 22-Sep-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 24 % Alt 693.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 1995 V

COMMENTS: *Firmware: 37122N24*
I/O firmware:37123n05 Instrument calibrated with 39"C cable
resolution for Cs-137 11%
Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR121036	1100	100	4 / 2	1.594473E-05	5.359899E+10	
Detector # 2	LMI44-10	PR121036	1100	100	7 / 1	1.594473E-05	1.000000E+00	
Detector # 3	CS-137PK	662KEV	799	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	400354	400354	400cpm	400	400
	40kcpm	39994	39994	40cpm	40	40
	4kcpm	3999	3999			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N ☐ S-394 ☐ 1122 ☐ 781
☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304
☐ Alpha S/N ☐ Beta S/N ☑ Other Am-241 = 0.77μCi
☑ m 500 S/N 121025 ☑ Multimeter S/N 78846185

Calibrated By: [signature] Date 22-Sep-06
Reviewed By: [signature] Date 25 Sep 06

FORM C44A 05/02/2006

MFG #8

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 261133 / 304908

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 134759

Cal. Date 24-Aug-06 Cal Due Date 24-Aug-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 40 % Alt 700.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check Threshold
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 2000 / 1997 V

COMMENTS: *Firmware: 37122N28*

```
I/O Firmware: 37123N05

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 10.12%

No "As Found" readings because of M2350-1 memory loss.
```

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR139483	950	100	4 / 2	1.218875E-05	5.244675E+10	✓
Detector # 2	LMI44-10	PR139483	950	100	7 / 1	1.218874E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	672	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	N/A	39966 (0)	400cpm	N/A	40 (0)
	40kcpm		3997	40cpm		4 ↓
	4kcpm		400 ↓			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241 ≈ 0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastn Ceballos Date 24-Aug-06

Reviewed By: [signature] Date 25 Aug 06

FORM C44C 11/26/2003

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CERTIFICATE OF CALIBRATION

MFG-9

CUSTOMER MFG INC ORDER NO. 263479/306131

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 129403

Cal. Date 22-Sep-06 Cal Due Date 22-Sep-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 24 % Alt 693.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 1997 V

COMMENTS: Firmware: 37122N21
I/O Firmware:371230n5 Instrument calibrated with 39" C cable
Resolution for Cs-137 11%
Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR135858	1150	100	4 / 2	1.307108E-05	5.294387E+10	
Detector # 2	LMI44-10	PR135858	1150	100	7 / 1	1.307108E-05	1.000000E+00	
Detector # 3	CS-137PK	662KEV	821	662	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
400kcpm	400222	400222	400cpm	400	400
40kcpm	39979	39979	40cpm	40	40
4kcpm	3998	3998			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N ☐ S-394 ☐ 1122 ☐ 781
☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am-241 ~0.77uCi

☑ m 500 S/N 121025 ☑ Multimeter S/N 78846185

Calibrated By: [signature] Date 22-Sep-06
Reviewed By: [signature] Date 25 Sep 06

FORM C44A 06/02/2006

MFG-12

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 257557 / 303433

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 134764

Cal. Date 13-Jul-06 Cal Due Date 13-Jul-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 49 % Alt 701.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 499 V Ref./Inst. 2000 / 1997 V

COMMENTS:

Firmware: 37122N21

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I/O Firmware: 37123N05

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 9.52%

No "As Found" readings because of M2350-1 memory loss.
```

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR139484	900	100	4 / 2	1.259847E-05	5.465646E+10	✓
Detector # 2	LMI44-10	PR139484	900	100	7 / 1	1.259846E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	596	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	N/A	39989(0)	400cpm	N/A	40(0)
	40kcpm		3995	40cpm		4
	4kcpm		400			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members; or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241≈0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastn Ceballos Date 13-Jul-06

Reviewed By: [signature] Date 13 Jul 06

FORM C44C 11/26/2003

MFG #13

CERTIFICATE OF CALIBRATION

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

USTOMER MFG INC ORDER NO. 261133/304908 261654 / 305206

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 129434

Cal. Date 24-Aug-06 Cal Due Date 24-Aug-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 40 % Alt 700.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 2000 / 1999 V

COMMENTS: *Firmware: 37122N21*

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I/O Firmware: 37123N05

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 9.97%
```

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR135854	1050	100	4 / 2	1.450212E-05	5.233001E+10	✓
Detector # 2	LMI44-10	PR135854	1050	100	7 / 1	1.450211E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	721	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	39979(0)	39979(0)	400cpm	40(0)	40(0)
	40kcpm	3993 ↓	3993 ↓	40cpm	4 ↓	4 ↓
	4kcpm	400 ↓	400 ↓			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241≈0.83 µCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastn Ceballos Date 24-Aug-06

Reviewed By: [signature] Date 25 Aug 06

FORM C44C 11/26/2003

MFG-15

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CERTIFICATE OF CALIBRATION

CUSTOMER MFG INC ORDER NO. 257557 / 303433

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 134768

Cal. Date 13-Jul-06 Cal Due Date 13-Jul-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 49 % Alt 701.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check Threshold
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 499 V Ref./Inst. 2000 / 1997 V

COMMENTS: *Firmware: 37122N21*

I/O Firmware: 37123N05

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 10.42%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR139491	1100	100	4 / 2	1.379348E-05	5.412704E+10	✓
Detector # 2	LMI44-10	PR139491	1100	100	7 / 1	1.379348E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	751	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	39990 (0)	39990(0)	400cpm	40(0)	40(0)
	40kcpm	3997 ↓	3997 ↓	40cpm	4 ↓	↓
	4kcpm	400 ↓	400 ↓			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N
☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241 ≈ 0.83 µCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastian Caballero Date 13-Jul-06
Reviewed By: [signature] Date 13 Jul 06

FORM C44C 11/26/2003

Designer and Manufacturer of Scientific and Industrial Instruments

#16

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 257271 / 303277

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 129405

Cal. Date 19-Jun-06 Cal Due Date 19-Jun-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 47 % Alt 700.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity

☑ F/S Resp. check ☑ Reset check ☑ Window Operation

☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC

☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check

☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 499 V Ref./Inst. 2000 / 1996 V

COMMENTS: *Firmware: 37122N21*

I/O Firmware: 37123N05

No "As Found" readings because of M2350-1 memory loss.

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 9.82%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR137085	900	100	4 / 2	1.444180E-05	5.491888E+10	✓
Detector # 2	LMI44-10	PR137085	900	100	7 / 1	1.444180E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	583	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm		39977 (o)	400cpm	N/A	40 (o)
	40kcpm	N/A	3993	40cpm		4 ↓
	4kcpm		400 ↓			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241 ≈ 0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastian Ceballos Date 19-Jun-06

Reviewed By: [signature] Date 19 Jun 06

FORM C44C 11/26/2003

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

17

CERTIFICATE OF CALIBRATION

USTOMER MFG INC ORDER NO. 257271 / 303277

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 120630

Cal. Date 19-Jun-06 Cal Due Date 19-Jun-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 47 % Alt 700.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 2000 / 2001 V

COMMENTS: *Firmware: 37122N21*

I/O Firmware: 37123N04

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 9.21%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR135847	900	100	4 / 2	1.313019E-05	5.377700E+10	✓
Detector # 2	LMI44-10	PR135847	900	100	7 / 1	1.313018E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	566	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 – rad, 1 – Gray, 2 – rem, 3 – Sv, 4 – R, 5 – C/Kg, 6 – Disintegrations, 7 – Counts, 8 – Ci/cm sq., 9 – Bq/cm sq.
Time Base: 0 – Seconds, 1 – Minutes, 2 – Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	39958 (0)	39959 (0)	400cpm	40 (0)	40 (0)
	40kcpm	3996	3996	40cpm	4 ↓	4 ↓
	4kcpm	400 ↓	400 ↓			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241≈ 0.83 µCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastn Ceballos Date 19-Jun-06

Reviewed By: [signature] Date 19 Jun 06

FORM C44C 11/26/2003

Reuter-Stokes

Calibration Certificate

Reuter-Stokes certifies that the Environmental Radiation Monitor, identified below, has been calibrated for output using the shadow shield technique*, and calibrated with radiation sources traceable to the National Institute of Standards and Technology.

Sensor Type:	100 mR/Hr
Serial Number:	98100046
Calibration Date:	9/8/06
Sensitivity:	12.24 mV/μR/h

Authorized Signature

*Calibration Procedure: RS-SOP 238.1

Reuter-Stokes

Calibration Data

Sensor Type:	100 mR/Hr	Source (CS-137):	BB-400
Serial Number:	98100046	Date of Certification:	12/1/94
Calibration Date:	9/8/06	Exposure Rate at 1 meter:	4.226 mR/h

Customer Name: MFG

Sensitivity (Ra-226): 12.24 mV/μR/h

Distance		Exposure Rate	P+S+A	S+A	P	k(CS-137)
Feet	cm	μR/h	V	V	V	mV/μR/h
11.8	359	244.936	3.840	0.807	3.033	12.38
13.8	420	178.300	2.913	0.708	2.205	12.37
15.8	481	135.430	2.307	0.631	1.676	12.38
17.8	542	106.250	1.887	0.571	1.316	12.39

k(CS-137) = 12.38 mv/μR/h

$\bar{k}$ = 12.38 mv/μR/h

k(Ra-226) = .9892 k(CS-137)

σ = .009 mv/μR/h

k(Ra-226) = 12.24 mv/μR/h

$V = \frac{\sigma}{k} =$ 0.075%

By: Wm Radwanski Date: 9/15/06

Reuter-Stokes

RSS-131 FIRMWARE PARAMETERS

S/N 98I00046

RAC	2.497E-08
ZLN	0.000E-00
ZMN	5.513E-02
ZHN	2.431E-04
ZLD	0.000E-00
ZMD	3.720E-05
ZHD	-5.600E-06
RLN	4.901E+11
RMN	2.016E+09
RHN	1.998E+07
RLV	-1.150E+08
RMV	2.520E+05
RHV	3.030E+03

Only change in constants is the RAC.
As found RAC 2.536E-08.

By: Wm Radwanski
Level 2 Nuclear / Electrical Inspector

Date: 9/15/06

Reviewed By: Ken Lambach
Senior Engineer

Page 1 of 2

CHAIN OF CUSTODY RECORD
REQUEST FOR ANALYSIS

MFG, Inc.
3801 Automation Way #100
Fort Collins, CO 80525
(970) 223-9600 Fax (970) 223-7171

MFG consulting scientists and engineers

Client/Project Name: Red Desert

MFG, Inc. Contact / Phone Number: Randy Whicker / 970-556-1174

Project Number: 181445

P.O. Number: 181445-10-5-06

Delivery Method / Shipping Document Number:

Send Results / Report To:
Randy Whicker
MFG Inc.
3801 Automation Way, Suite 100
Ft. Collins, CO 80525

Sampler (Print Name / Affiliation): Randy Whicker

Signature: [signature]

Analysis Requested: Ra-226 by HPGe Gamma spec; U-nat by wet radiochemistry methods

Preservative

Container Type and Size

Field Sample No./ Identification	Date	Time	Sample Matrix	Total No. of Cont.	Filt. Y	Filt. N	Filt. Y	Filt. N	Filt. Y	Filt. N	Filt. Y	Filt. N	Filt. Y	Filt. N	Filt. Y	Filt. N	Remarks
LC-1	9-29-06		Soil		X		X										These are composite samples -
LC-2					X		X										please dry, crush and grind
LC-3					X		X										all rocks, and thoroughly
LC-4					X		X										homogenize each sample.
LC-5					X		X										
LC-6					X		X										For Ra-226, allow 21 days
LC-7					X		X										after sealing containers
LC-8					X		X										to insure Rn-222 equilibrium
LC-9					X		X										
LC-10	↓		↓		X		X										

Relinquished by: (Print Name/Affiliation)	Date/Time	Received by: (Print Name/Affiliation)	Date/Time
Randy Whicker / MFG; Signature: [signature]	Date: 10-5-06; Time:	Signature:	Date: ; Time:
Signature:	Date: ; Time:	Signature:	Date: ; Time:
Signature:	Date: ; Time:	Signature:	Date: ; Time:

Analytical Laboratory (Destination): Energy Laboratories Incorporated, 2393 Salt Creek Highway, Casper, WY 82602

Condition/Temperature of Samples when Received:

Serial No.: № 005662

White: Return to MFG, Inc. Yellow: Laboratory Pink: Field Team

Matrix Codes: SW=Surface Water GW=Ground Water S=Soil Sediment ___ = ___

CHAIN OF CUSTODY RECORD
REQUEST FOR ANALYSIS

MFG, Inc.
3801 Automation Way #100
Fort Collins, CO 80525
(970) 223-9600 Fax (970) 223-7171

consulting scientists and engineers

Client/Project Name: Red Desert

MFG, Inc. Contact / Phone Number: Randy Whicker / 970-556-1174

Project Number: 181445

P.O. Number: 181445-10-5-06

Delivery Method / Shipping Document Number:

Send Results / Report To:
Randy Whicker
MFG Inc.
3801 Automation Way, suite 100
Ft. Collins, CO 80525

Sampler (Print Name / Affiliation): Randy Whicker

Signature: [signature]

Analysis Requested: Ra-226 by HPGe Gamma-Spec; U-Nat by Wet Radiochemistry methods

Preservative

Container Type and Size

Field Sample No./ Identification	Date	Time	Sample Matrix	Total No. of Cont.	Ra-226 by HPGe Gamma-Spec Filt. Y	Filt. N	U-Nat by Wet Radiochemistry methods Filt. Y	Filt. N	Filt. Y	Filt. N	Filt. Y	Filt. N	Filt. Y	Filt. N	Filt. Y	Filt. N	Remarks
LS-1	9-27-06		Soil		X		X										- Please follow special
LS-2	↓		↓		X		X										instructions on
LS-3	↓		↓		X		X										page 1 of 2
LS-4	↓		↓		X		X										
LS-5	9-28-06		↓		X		X										
LS-6	↓		↓		X		X										
LS-7	↓		↓		X		X										
LS-8	↓		↓		X		X										
LS-9	↓		↓		X		X										
LS-10	↓		↓		X		X										

Relinquished by: (Print Name/Affiliation)	Date/Time	Received by: (Print Name/Affiliation)	Date/Time
Randy Whicker / MFG; Signature: [signature]	Date: 10-5-06; Time:	Signature:	Date: Time:
Signature:	Date: Time:	Signature:	Date: Time:
Signature:	Date: Time:	Signature:	Date: Time:

Analytical Laboratory (Destination): Energy Laboratories, Inc. 2393 Salt Creek Highway Casper, WY 82602

Condition/Temperature of Samples when Received:

Serial No.: № 005663

8-28-06

Rhino-1 (main with winch)

	L	C	R
meter	MFG-12	MFG-15	MFG-3

Rhino-2 (2nd ATV)

L	C	R
MFG-9	MFG-5	MFG-6

8-29-06 sunny, mild ≈75°F
- Mobilized to Red Desert - arrived @ Lost Creek Site ≈ 10:30 am
- set up Rhinos & system checks
- ironing out problems most of day
- 3 ft & 6 ft grid meas.

8-30-06 RW
- switched detector MFG-9 on Rhino-2 (MFG-9 reading low)
- QC

		mean	σ	Battery	
(L)	MFG-12	~~23~~ 24.61	1.12		Rhino-1 after scans
(R)	MFG-3	23.8	0.93	5.6	
(C)	MFG-15	23.64	0.91	5.9	

QC (BKG)

		mean	σ	Battery	
(L)	MFG-17	23.4	5.5	5.7	Rhino-2 after scans
(C)	MFG-5	21.7	7.3	5.4	
(R)	MFG-6	19.9	4.6	5.7	

loose switch on probe? [illegible]

8-31-06 RW Sunny mild, windy

QC	BKG x̄	BKG σ	Source x̄	Source σ	Battery
(L) MFG-12	29.9	1.204	126.0	2.0	5.9
(R) MFG-3	22.5	5.3	112.4	2.6	6.0
(C) MFG-15	24.5	0.8	111.1	~~5?~~	5.7
(L) MFG-17	21.5	9.1	118	2.3	5.8
(C) MFG-5	25.2	1.1	109	2.5	6.2
(R) MFG-6	20.4	4.7	92	2.1	5.8

9-1-06 RW sunny mild, windy

QC	BKG x̄	BKG σ	Source x̄	Source σ	Battery
Rhino-1 MFG-12	24.8	1.1	122	2.5	5.7
MFG-3	21.5	9.1	110	2.53	5.8
MFG-16	22.0	7.4	115	2.7	5.9
MFG-17	26.0	0.9	113	2.6	6.2
MFG-5	22.0	7.4	110	2.5	6.0
MFG-6	21.6	5.1	123	2.4	6.2

switched detector 15 for detector 16 → bad switch
→ switched detector 6 for detector 15 - detector 6 is broken

9-6-06 RW Cloudy mild
- returned ATV's to site after repairs & revision of design & systems

Left QC for Rhino-2

MFG-17	BKG x̄	Source x̄	ore rock x̄	σ
1	24	83	1887.5	143
2	24.7	82.4		
3	24.9	81.9		
4	24.3	82.6		
5	23.0	80.5		
6	24.8	81.7		
7	24.6	82.6		
8	24.8	80.7		
9	24.6	80.9		
10	24.1	81.9		

Right

MFG-4	BKG x̄	Source x̄	ore rock x̄	σ
1	23.9	70.3	2312	28
2	24.1	69.2		
3	24.1	69.8		
4	24.0	69.0		
5	24.3	69.9		
6	23.7	69.9		
7	23.8	69.2		
8	23.8	69.5		
9	23.8	69.5		
10	23.9	69.6		

center

MFG-5	BKG (x̄)	source (x̄)	ore rock x̄	σ
1	24.6	73.7	2500	13
2	24.0	74.0		
3	23.4	75.6		
4	23.7	73.4		
5	24.1	73.8		
6	24.2	72.9		
7	23.9	74.6		
8	24.5	75.4		
9	23.7	71.7		
10	24.2	74.0		

9-7-06 RW P. sunny, mild, breezy

QC Rhino-2

		x̄ (BKG)	x̄ (Source)	Battery
Left	MFG-17	25.9	82.4	~~5.9~~ 6.2
Right	MFG-4	25.0	71.2	~~5.8~~ 6.0
Center	MFG-5	23.8	73.5	6.0

9-7-06 Cont....

Rhino-1 Control Limit measurements:

Left

MFG-12	BKG	Source	$\bar{x}$	ore 6	Battery 5.8
1	24.9	89.6	2255	304	
2	25.0	89.9			
3	25.1	88.7			
4	25.1	90.4			
5	24.8	88.3			
6	24.4	88.0			
7	24.6	88.8			
8	24.4	87.7			
9	23.9	88.8			
10	24.1	88.2			

Right

MFG-15					6.0
1	24.8	84.3	2335	32	
2	24.8	84.8			
3	24.5	84.1			
4	25.0	84.6			
5	24.9	84.7			
6	24.2	82.6			
7	24.4	83.1			
8	25.1	84.9			
9	24.4	83.8			
10	25.1	83.7			

Software says Right, but actual meter is Center.

Center

MFG-3	BKG	Source	$\bar{x}$	ore 6	Battery
1	25.5	76.0	2119	8.6	5.9
2	24.9	75.3			
3	25.4	76.5			
4	25.1	75.9			
5	25.1	76.7			
6	25.4	76.1			
7	25.0	77.0			
8	25.2	76.5			
9	24.9	76.5			
10	24.9	76.0			

9-8-06 RW cloudy/Hazy mild ≈ 70°F

QC Rhino-2 $\bar{x}$ (BKG) $\bar{x}$ (Source) Battery

		$\bar{x}$ (BKG)	$\bar{x}$ (Source)	Battery
Left	MFG-1	23.4	60.1	6.0
Right	MFG-4	24.7	74.23	
Center	MFG-5	software not reading MFG-5		

Rhino-1

Left	MFG-12	23.8	89.4
Right	MFG-15	24.4	85.6
Center	MFG-3	25.3	78.5

Replaced meter 17 w/ meter 1

9-9-06 RW cloudy cool, rain

QC Rhino-1		BKG	Source
Left	MFG-12	24.0	115.1
Right	MFG-15	23.9	119.1
Center	MFG-16	24.7	116.0

(Replaced MFG-3 w/ MFG-16)

* made all detector geometries same for Cs-137 source

QC Rhino-2			
Left	MFG-1	22.8	100.6
Right	MFG-4	24.3	108.6
Center	MFG-5	24.7	115.0

→ wiring switched Right is center & visa versa in software

9-10-06 RW sunny, mild

QC Rhino-1		BKG	Source	Battery
Left	MFG-12	24.8	116	>6
Center	MFG-15	25.1	120	>6
Right	MFG-16	25.5	118	>6

QC Rhino-2		BKG	Source
Left	MFG-1	23.9	105
Center *	MFG-4	N/A	N/A
Right (center)	MFG-5	25.6	114

*note: "center" is the right side detector which is not working

"Right" is the center detector which is working

9-11-06 RW sunny, mild

QC Rhino-1		BKG	Source
Left	MFG-12	27.2	117
Center	15	27.1	124
Right	16	26.8	119

QC Rhino-2		BKG	Source
L	MFG-1	24.9	106
C	MFG-4	N/A	N/A
R	MFG-5	22.8	114

(center detector is actual detector)

Lost Soldier - new staging location

9-19-06 RW sunny mild ≈ 70°F

QC Rhino-1		BK	Source
Left	MFG-12	18.1	113
Center	MFG-16	19.4	112
Right	MFG-15	19.3	116

QC Rhino-2		BKG	Source
Left	MFG-1	19.4	101
Center	MFG-5	24.0	110
Right	MFG-4	21.3	106

9-20-06 RW P. Cloudy mild

same detectors as day before

Rhino-1 Left		BKG	Source	Rhino-2	BKG	Source
9-20	1	19.9	115	9-20	18.0	97
9-25	2	19.5	115	9-25	18.8	100
9-26	3	19.7	118	9-26	17.7	99
	4	19.6	116		17.9	97
	5	19.5	118		18.3	99
	6	18.3	116		19.8	101
	7	18.3	114		19.6	98
	8	18.1	117		19.7	99
	9	19.6	116		19.6	99
	10	19.7	116		19.3	100

Center		BKG	Source		BKG	Source
9-20	1	20.0	109	9-20	18.3	111
9-25	2	18.0	113	9-25	20.2	111
9-26	3	17.7	106	9-26	20.4	108
	4	18.7	113		20.3	110
	5	18.3	112		21.4	111
	6	19.6	113		21.9	108
	7	19.4	112		21.9	111
	8	19.5	109		21.8	108
	9	18.1	110		20.6	112
	10	19.0	110		20.4	111

Rhino-1

Right		Bkg	Source	Rhino-2	Bkg Source
9-20	1	19.4	118		
9-25	2	19.7	118	9-25	not working
9-26	3	19.5	117	9-26	
	4	19.7	119		
	5	19.7	116		
	6	20.9	116		
	7	20.0	115		
	8	20.2	118		
	9	20.0	116		
	10	19.8	115		

9-27-06 RW P. Sunny Windy ≈60F

PIC X-calibrations

Location 1 N42.23550 W107.64167

x-cal → NaI mean (MFG-13) uR/hr = 103.9

PIC	mR/hr
1	.0605
2	.0601
3	.0599
4	.0601
5	.0593
6	.0575
7	.0593
8	.0599
9	.0605
10	.0617

Rhino Tie-in:

Rhino-1	MFG	uR/hr	MFG-13
Left	12	78.4	81.9
Center	16	57.0	59.4
Right	15	80.2	86.0

Location 2 N42.23539 W107.64165

MFG-13 uR/hr = 46.7 uR/hr

1	.0281
2	.0279
3	.0273
4	.0267
5	.0283
6	.0297
7	.0301
8	.0287
9	.0297
10	.0305

Rhino-1 tie in:

		uR/hr	MFG13
Left	12	49.4	50.5
Center	16	47.9	49.7
Right	15	46.5	47.9

Location 3 N42. W107.

use these counts

MFG-13 uR/hr = 56.3

		use these counts
1	.0328	.0354
2	.0318	.0336
3	.0326	.0340
4	.0340	.0363
5	.0342	.0377
6	.0373	.0375
7	.0342	.0363
8	.0348	.0350
9	.0350	.0346
10	.0324	.0344

Rhino-1 tie in

	uR/hr	MFG13
Left	46.6	48.5
Center	49.2	51.2
Right	54.4	56.2

Location 4 N42.23531 W107.64160

MFG 13 uR/hr = 34.5

1	.0259
2	.0252
3	.0230
4	.0224
5	.0234
6	.0228
7	.0244
8	.0246
9	.0240
10	.0246

Sputnik-1 tie in

	uR/hr	MFG13
Left	34.7	35.6
Center	35.7	36.9
Right	35.4	37.0

Location 5 N42.23392 W107.64408

1	.0216			
2	.0228			
3	.0234			
4	.0206			
5	.0210			
6	.0212			
7	.0216			
8	.0228			
9	.0246			
10	.0228			

MFG13
uR/hr= 29.9
Sputnik-1 tie in

	uR/hr	MFG13
Left	29.7	32.7
Center	29.4	31.1
Right	29.1	29.9

Location 6 N42.23128 W107.64904

1	.0177
2	.0165
3	.0157
4	.0163
5	.0169
6	.0173
7	.0175
8	.0159
9	.0148
10	.0150

MFG 13
uR/hr 21.1
Sputnik-1 tie in

	uR/hr	MFG13
Left	23.3	24.7
Center	21.1	22.1
Right	24.3	25.7

Collected soil samples
LS-1 through LS-4
with correlation grid scans
CATV + backpack

QC Rhino-1		Bkg	Source
Left	MFG-12	19.1	119
Center	"-16	18.4	111
Right	"-15	19.2	117

9-28-06 RW Sunny ≈65°F

QC: Rhino-1		Bkg	Source
Left	MFG-12	20.8	118
Center	"-16	19.5	113
Right	"-15	20.3	119

11-2-06 RW P Sunny ≈45°F
- PIC x-calibrations (Lost soldier)
QC: new control limits inside Hotel. mean ot ed + std. Dev.

	R1-L	R1-C	R1-R	R2-L	R2-C	R2-R
B	6.5	6.4	6.7	6.6	6.4	6.8
σ	0.35	0.47	0.62	0.51	0.38	0.72
S	112	105	113	97	107	114
σ	1.8	2.7	1.9	2.5	2.7	2.0
Baroil Stationary	MFG-12	MFG-16	MFG-15	MFG-1	MFG-5	MFG-8
	20.84	21.19	20.59	19.09	19.59	19.75

11-2 cont....

Location 1 [42.23560 / 107.67158]

Switched R2-R to MFG-17

PIC	mR/hr
1	.0305
2	.0282
3	.0268
4	.0266
5	.0293
6	.0280
7	.0305
8	.0295
9	.0299
10	.0278

	4.5ft uR/hr	3ft uR/hr
R1-L	40.6	40.22
R1-C	39.41	39.40
R1-R	39.82	40.13
R2-L	37.47	36.95
R2-C	39.10	38.28
R2-R	42.59	42.49

Location 2 [42.23552 / 107.64164]

PIC	
1	.0561
2	.0545
3	.0539
4	.0528
5	.0530
6	.0541
7	.0530
8	.0516
9	.0530
10	.0522

	4.5ft uR/hr	3ft uR/hr
R1-L	69.51	76.69
R1-C	71.62	80.64
R1-R	69.75	76.64
R2-L	66.00	74.01
R2-C	68.87	77.02
R2-R	74.37	81.83

11-3-06

Location 3 [42.25346 / 107.62907]

PIC	mR/hr
1	.0217
2	.0211
3	.0189
4	.0195
5	.0199
6	.0191
7	.0191
8	.0209
9	.0193
10	.0205

	4.5ft uR/hr	3ft uR/hr
R1-L	22.09	22.11
R1-C	21.40	21.32
R1-R	21.22	21.69
R2-L	20.49	20.26
R2-C	23.22	23.11
R2-R	21.27	20.44

Location 4 [~~42.24599~~ / 107.63345]

PIC	mR/hr
1	.0325
2	.0313
3	.0315
4	.0341
5	.0331
6	.0323
7	.0337
8	.0317
9	.0319
10	.0307

	4.5ft uR/hr	3ft uR/hr
R1-L	42.20	43.23
R1-C	41.9	43.99
R1-R	41.56	43.80
R2-L	39.41	41.58
R2-C	40.12	42.13
R2-R	43.61	46.38

11-3-06 Cont

42.24326
107.62296

Location 5

PIC	mR/hr
1	.0248
2	.0248
3	.0234
4	.0223
5	.0254
6	.0264
7	.0252
8	.0248
9	.0262
10	.0256

	4.5ft uR/hr	3-ft uR/hr
R1-L	36.37	36.70
R1-C	36.08	35.73
R1-R	35.78	36.13
R2-L	33.48	34.76
R2-C	35.32	35.71
R2-R	38.81	37.94

Location 6

42.23880
107.62864

PIC	mR/hr
1	.0238
2	.0240
3	.0229
4	.0221
5	.0238
6	.0244
7	.0240
8	.0234
9	.0240
10	.0225

	4.5ft uR/hr	3-ft uR/hr
R1-L	28.71	29.69
R1-C	28.27	28.37
R1-R	28.30	28.36
R2-L	26.58	27.38
R2-C	28.36	28.28
R2-R	30.46	30.65

42.23643
107.63219

Location 7

PIC	mR/hr	
1	.0228	.0219
2	.0274	.0246
3	.0256	.0242
4	.0272	.0252
5	.0295	.0244
6	.0211	.0236
7	.0221	.0211
8	.0211	.0266
9	.0223	.0284
10	.0205	.0252

	4.5ft uR/hr	3ft uR/hr
R1-L	34.74	36.08
R1-C	35.32	35.96
R1-R	34.21	35.56
R2-L	32.63	33.95
R2-C	34.79	35.03
R2-R	36.97	37.79

Location 8

42.23540
107.62983

Potential hot spot location

PIC	mR/hr
1	.0333
2	.0331
3	.0325
4	.0329
5	.0327
6	.0329
7	.0329
8	.0335
9	.0339
10	.0348

	4.5ft uR/hr	3-ft uR/hr
R1-L	44.16	47.16
R1-C	44.12	47.09
R1-R	42.76	46.12
R2-L	41.65	44.35
R2-C	42.35	45.92
R2-R	45.46	48.73

11-3-06 Cont

42.22788
107.63505

Location 9

PIC	?	mR/hr
1	.0128	.0185
2	.0126	.0172
3	.0138	.0187
4	.0140	.0175
5	.0144	.0183
6	.0115	.0183
7	.0174	.0197
8	.0175	.0199
9	.0187	.0201
10	.0183	.0177

	4.5ft uR/hr	3-ft uR/hr
R1-L	24.65	24.83
R1-C	23.41	24.18
R1-R	24.06	23.69
R2-L	22.58	23.02
R2-C	23.80	23.49
R2-R	25.94	25.59

Location 10

42.23467
107.62006

PIC	mR/hr
1	.0425
2	.0408
3	.0392
4	.0386
5	.0402
6	.0400
7	.0390
8	.0376
9	.0380
10	.0406

	4.5ft uR/hr	3ft uR/hr
R1-L	62.80	66.26
R1-C	63.03	65.43
R1-R	62.91	64.68
R2-L	60.07	63.70
R2-C	62.43	64.05
R2-R	66.99	68.79

11-3-06 RW Cloudy ≃ 45°F
QC lost soldier

	R1-L	R1-C	R1-R	R2-L	R2-C	R2-R
B	6.7	6.6	6.7	6.8	6.7	7.0±0.6
S	112	105	114	97	107	106±20
						MFG-17 (new detector)
Field	20.22	18.75	20.17	18.95	18.72	20.46

- PIC vs. 3' vs. 4.5' correlation measurements.

11-4-06 RW P. Sunny ≃ 45°F
QC Lost Soldier

	R1-L	R1-C	R1-R	R2-L	R2-C	R2R
B	7.2	6.8	6.5	6.3	6.5	7.2
S	112	107	115	98	105	106
Field	20.07	19.74	20.92	20.01	20.64	19.32

- Re-scans of central & east border areas

11-5-06 RW Lost Creek PIC vs. 4.5' vs. 3' meas.

QC:

	R1-L	R1-C	R1-R	R2-L	R2-C	R2-R
B	6.5	6.5	6.7	6.3	6.5	6.9
S	111	106	114	96	106	106
F	21.81	22.01	22.24	20.38	21.46	23.12

Lost creek
11-5-08 Cont...

42.11733
107.86353

Location 1

PIC	mR/hr		4.5ft uR/hr	3 ft uR/hr
1	.0219			
2	.0227			
3	.0225	R1-L	30.71	31.76
4	.0235	R1-C	30.12	31.23
5	.0251	R1-R	30.34	30.91
6	.0248	R2-L	29.06	30.34
7	.0245	R2-C	29.19	30.87
8	.0253	R2-R	32.03	33.14
9	.0223			
10	.0233			

Location 2 — local outcrop of source material [colored?] in wash

42.10687
107.87095

PIC	mR/hr		4.5ft uR/hr	3 ft uR/hr
1	.0341			
2	.0327			
3	.0327	R1-L	40.98	43.97
4	.0321	R1-C	42.48	44.75
5	.0321	R1-R	40.96	43.17
6	.0315	R2-L	39.88	42.62
7	.0329	R2-C	40.50	43.34
8	.0339	R2-R	43.45	46.01
9	.0341			
10	.0335			

Location 3

42.12827
107.87157

PIC	uR/hr		4.5ft uR/hr	3 ft uR/hr
1	.0207			
2	.0211			
3	.0209			
4	.0205			
5	.0207	R1-L	22.66	22.62
6	.0221	R1-C	21.71	21.83
7	.0225	R1-R	22.53	21.71
8	.0209	R2-L	21.04	20.56
9	.0193	R2-C	21.80	22.21
10	.0185	R2-R	23.49	23.95

Location 4

42.13093
107.85934

PIC	mR/hr		4.5ft uR/hr	3 ft uR/hr
1	.0260			
2	.0254			
3	.0240			
4	.0248			
5	.0264	R1-L	34.93	36.07
6	.0266	R1-C	34.43	35.21
7	.0262	R1-R	33.97	35.06
8	.0260	R2-L	32.39	33.65
9	.0252	R2-C	34.09	35.29
10	.0262	R2-R	36.59	37.67

Location 5

42.13122
107.85960

PIC	mR/hr		4.5ft uR/hr	3 ft uR/hr
1	.0386			
2	.0382			
3	.0378			
4	.0380			
5	.0372	R1-L	51.54	54.98
6	.0384	R1-C	50.37	53.97
7	.0378	R1-R	49.88	52.23
8	.0372	R2-L	49.42	52.64
9	.0366	R2-C	49.55	51.94
10	.0370	R2-R	52.23	54.89

Location 6

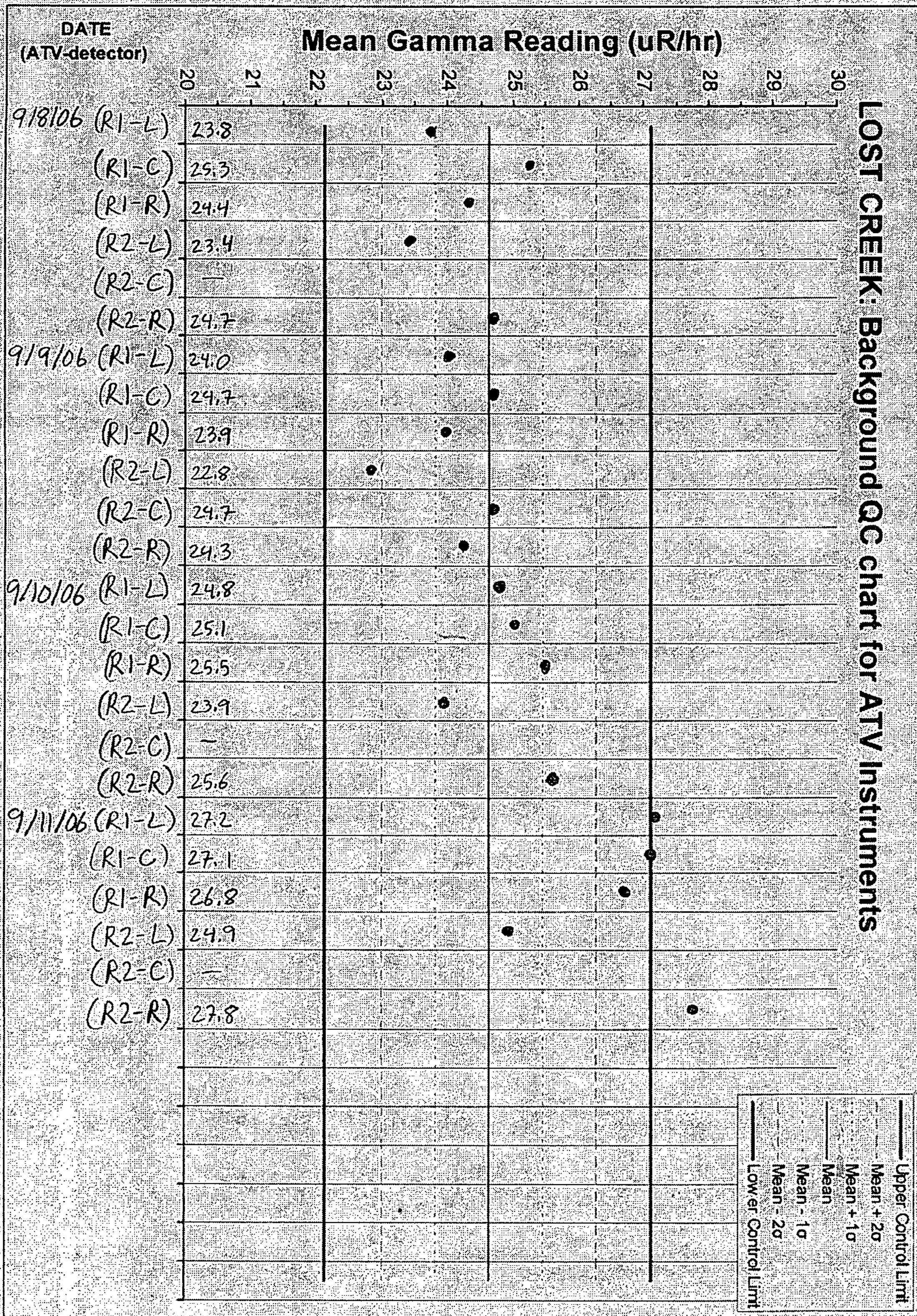
42.13195
107.84903

PIC	mR/hr		4.5ft uR/hr	3 ft uR/hr
1	.0237			
2	.0221			
3	.0213			
4	.0209	R1-L	25.49	25.88
5	.0215	R1-C	24.99	25.82
6	.0219	R1-R	24.29	25.10
7	.0211	R2-L	23.47	24.01
8	.0215	R2-C	24.37	24.73
9	.0211	R2-R	26.53	26.53
10	.0219			

Attachment 2.9-2 Data Quality Control Documentation

LOST CREEK: Background QC chart for ATV Instruments

DATE (ATV-detector)		Mean Gamma Reading (uR/hr)
9/8/06	(R1-L)	23.8
	(R1-C)	25.3
	(R1-R)	24.4
	(R2-L)	23.4
	(R2-C)	—
	(R2-R)	24.7
9/9/06	(R1-L)	24.0
	(R1-C)	24.7
	(R1-R)	23.9
	(R2-L)	22.8
	(R2-C)	24.7
	(R2-R)	24.3
9/10/06	(R1-L)	24.8
	(R1-C)	25.1
	(R1-R)	25.5
	(R2-L)	23.9
	(R2-C)	—
	(R2-R)	25.6
9/11/06	(R1-L)	27.2
	(R1-C)	27.1
	(R1-R)	26.8
	(R2-L)	24.9
	(R2-C)	—
	(R2-R)	27.8



LOST CREEK: Check Source QC chart for ATV Instruments

Mean Gamma Reading (uR/hr)

Scale: 80, 90, 100, 110, 120, 130, 140, 150, 160

DATE	(ATV-detector)	Mean Gamma Reading (uR/hr)
9/9/06	R1-L	115
	R1-C	116
	R1-R	119
	R2-L	100
	R2-C	115
	R2-R	109
9/10/06	R1-L	116
	R1-C	120
	R1-R	118
	R2-L	105
	R2-C	–
	R2-R	114
9/11/06	R1-L	117
	R1-C	124
	R1-R	119
	R2-L	106
	R2-C	–
	R2-R	114
	R1-L	
	R1-C	
	R1-R	
	R2-L	
	R2-C	
	R2-R	
	R1-L	
	R1-C	
	R1-R	
	R2-L	
	R2-C	
	R2-R	

Legend:
- Upper Control Limit
- Mean + 2σ
- Mean + 1σ
- Mean
- Mean - 1σ
- Mean - 2σ
- Lower Control Limit

ERGY LABORATORIES, INC. • 2393 Salt Creek Highway (82601) • P.O. Box 3258 • Casper, WY 82602
Toll Free 888.235.0515 • 307.235.0515 • Fax 307.234.1639 • casper@energylab.com • www.energylab.com

QA/QC Summary Report

Client: MFG Inc
Project: Red Desert 181445

Report Date: 11/14/06
Work Order: C06100413

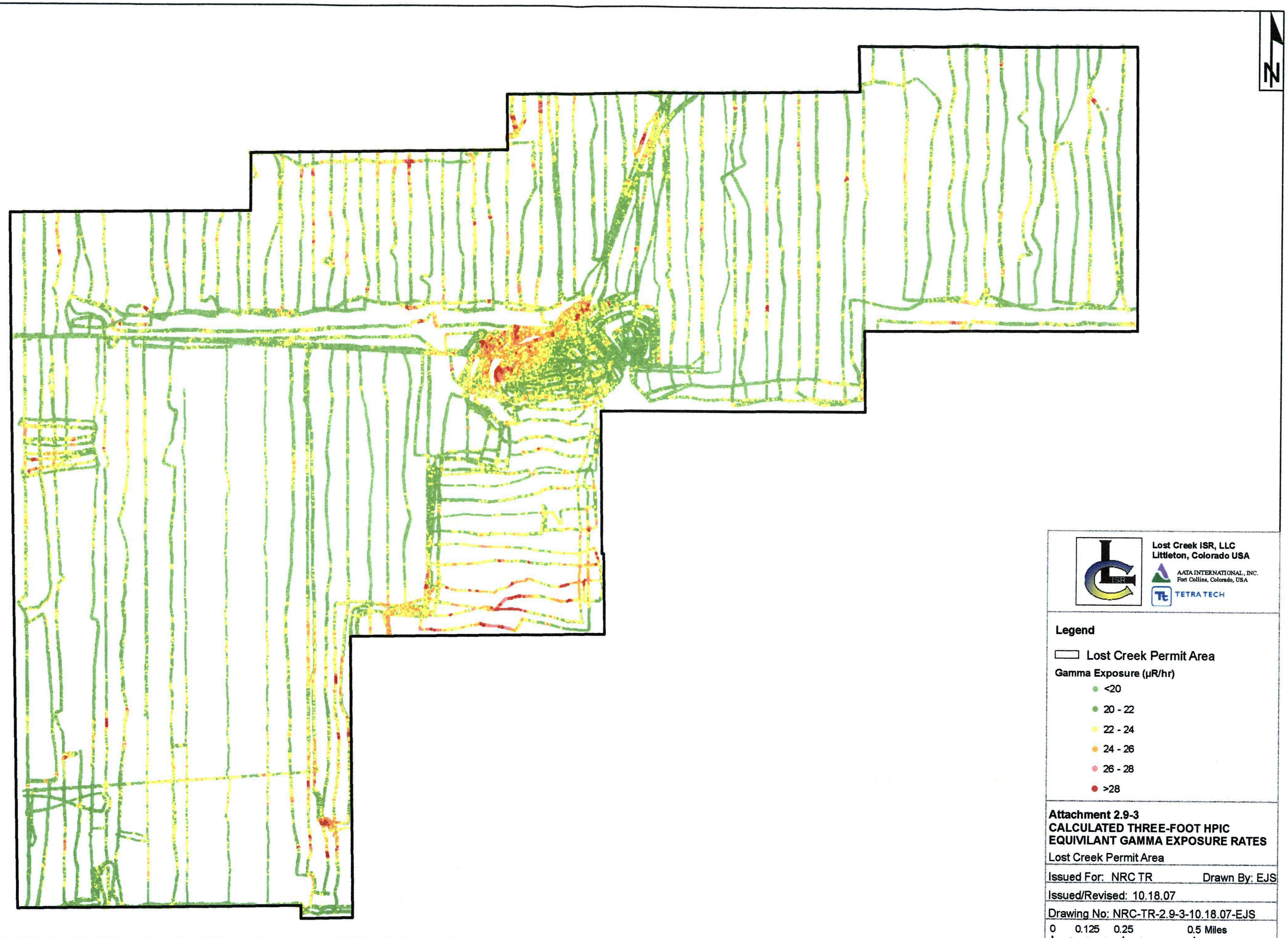
Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E901.1									Batch: 12393
Sample ID: LCS-R74833	Laboratory Control Sample				Run: GAMMA EGG-ORTEC_06102			10/25/06 10:40	
Radium 226	7.5	pCi/g-dry	1.0	87	80	120			
Sample ID: MB-R74833	Method Blank				Run: GAMMA EGG-ORTEC_06102			10/25/06 10:40	
Radium 226	ND	pCi/g-dry	1						
Sample ID: C06100332-001ADUP	Sample Duplicate				Run: GAMMA EGG-ORTEC_06102			10/25/06 10:40	
Radium 226	3400	pCi/g-dry	1.0				0.2	30	
Sample ID: C06100413-010ADUP	Sample Duplicate				Run: GAMMA EGG-ORTEC_06102			10/25/06 10:40	
Radium 226	4.8	pCi/g-dry	1.0				2.1	30	
Sample ID: C06100413-020ADUP	Sample Duplicate				Run: GAMMA EGG-ORTEC_06102			10/25/06 10:40	
Radium 226	4.5	pCi/g-dry	1.0				14	30	
Method: SW6020									Batch: 12397
Sample ID: MB-12397	Method Blank				Run: ICPMS2-C_061011A			10/11/06 18:29	
Uranium	ND	mg/kg-dry	0.003						
Sample ID: LCS1-12397	Laboratory Control Sample				Run: ICPMS2-C_061011A			10/11/06 18:33	
Uranium	1.06	mg/kg-dry	0.015	106	75	125			
Sample ID: C06100413-010A MS	Sample Matrix Spike				Run: ICPMS2-C_061011A			10/11/06 19:56	
Uranium	28.2	mg/kg-dry	0.031	104	75	125			
Sample ID: C06100413-010A MSD	Sample Matrix Spike Duplicate				Run: ICPMS2-C_061011A			10/11/06 20:00	
Uranium	28.5	mg/kg-dry	0.031	105	75	125	1.0	20	
Method: SW6020									Batch: 12398
Sample ID: MB-12398	Method Blank				Run: ICPMS2-C_061011A			10/11/06 16:29	
Uranium	ND	mg/kg-dry	0.003						
Sample ID: LCS1-12398	Laboratory Control Sample				Run: ICPMS2-C_061011A			10/11/06 16:33	
Uranium	1.12	mg/kg-dry	0.015	112	75	125			
Sample ID: C06100413-020A MS	Sample Matrix Spike				Run: ICPMS2-C_061011A			10/11/06 17:40	
Uranium	32.4	mg/kg-dry	0.031	104	75	125			
Sample ID: C06100413-020A MSD	Sample Matrix Spike Duplicate				Run: ICPMS2-C_061011A			10/11/06 17:44	
Uranium	32.6	mg/kg-dry	0.031	105	75	125	0.5	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Attachment 2.9-3 Final Baseline Gamma Survey and Ra-226 Soil Maps



Lost Creek ISR, LLC
Littleton, Colorado USA

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

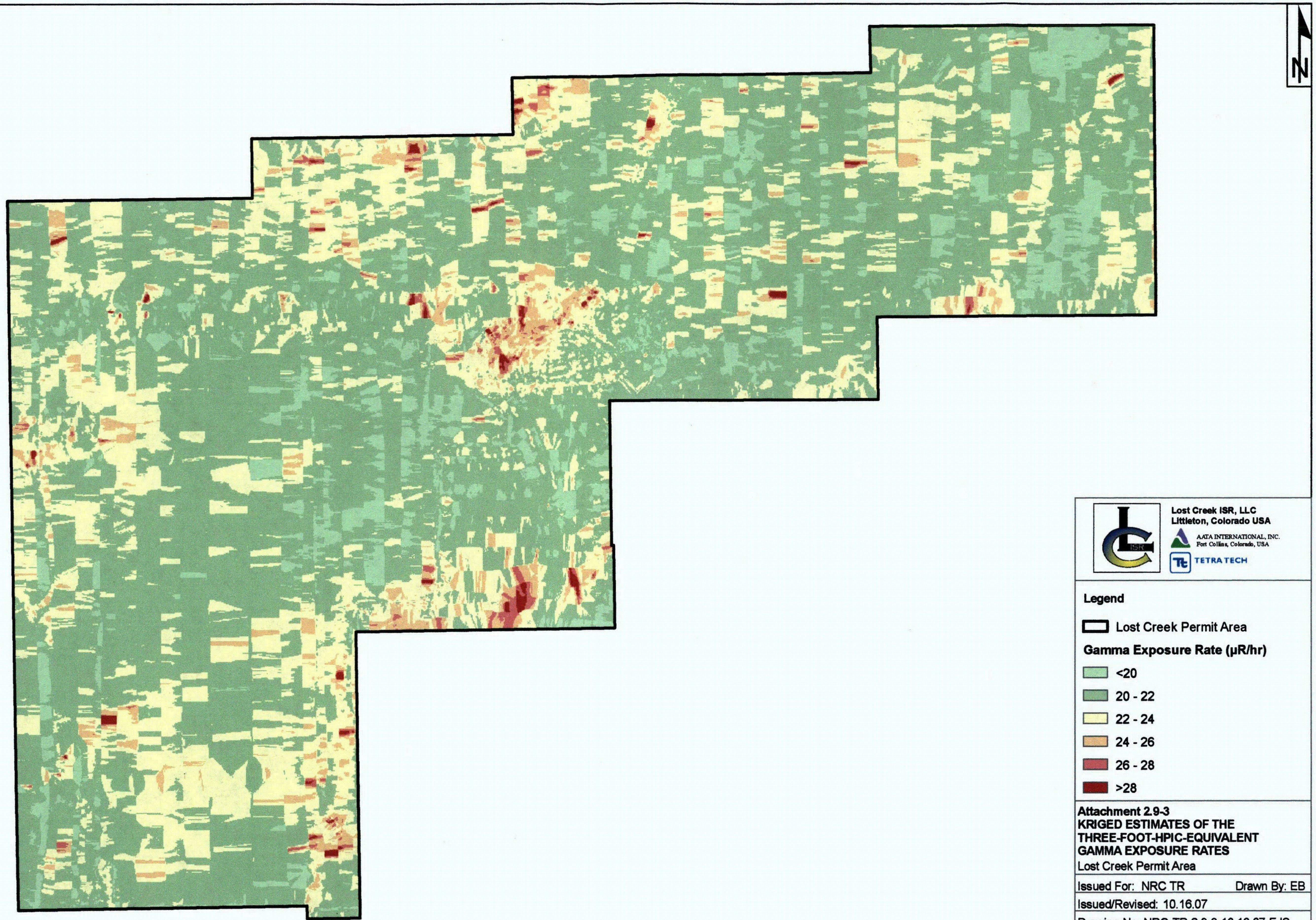
TETRA TECH

Attachment 2.9-3
CALCULATED THREE-FOOT HPIC EQUIVILANT GAMMA EXPOSURE RATES
Lost Creek Permit Area

Issued For: NRC TR | Drawn By: EJS

Issued/Revised: 10.18.07

Drawing No: NRC-TR-2.9-3-10.18.07-EJS



Lost Creek ISR, LLC
Littleton, Colorado USA

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

TETRA TECH

Legend

Lost Creek Permit Area

Gamma Exposure Rate (μR/hr)

- <20
- 20 - 22
- 22 - 24
- 24 - 26
- 26 - 28
- >28

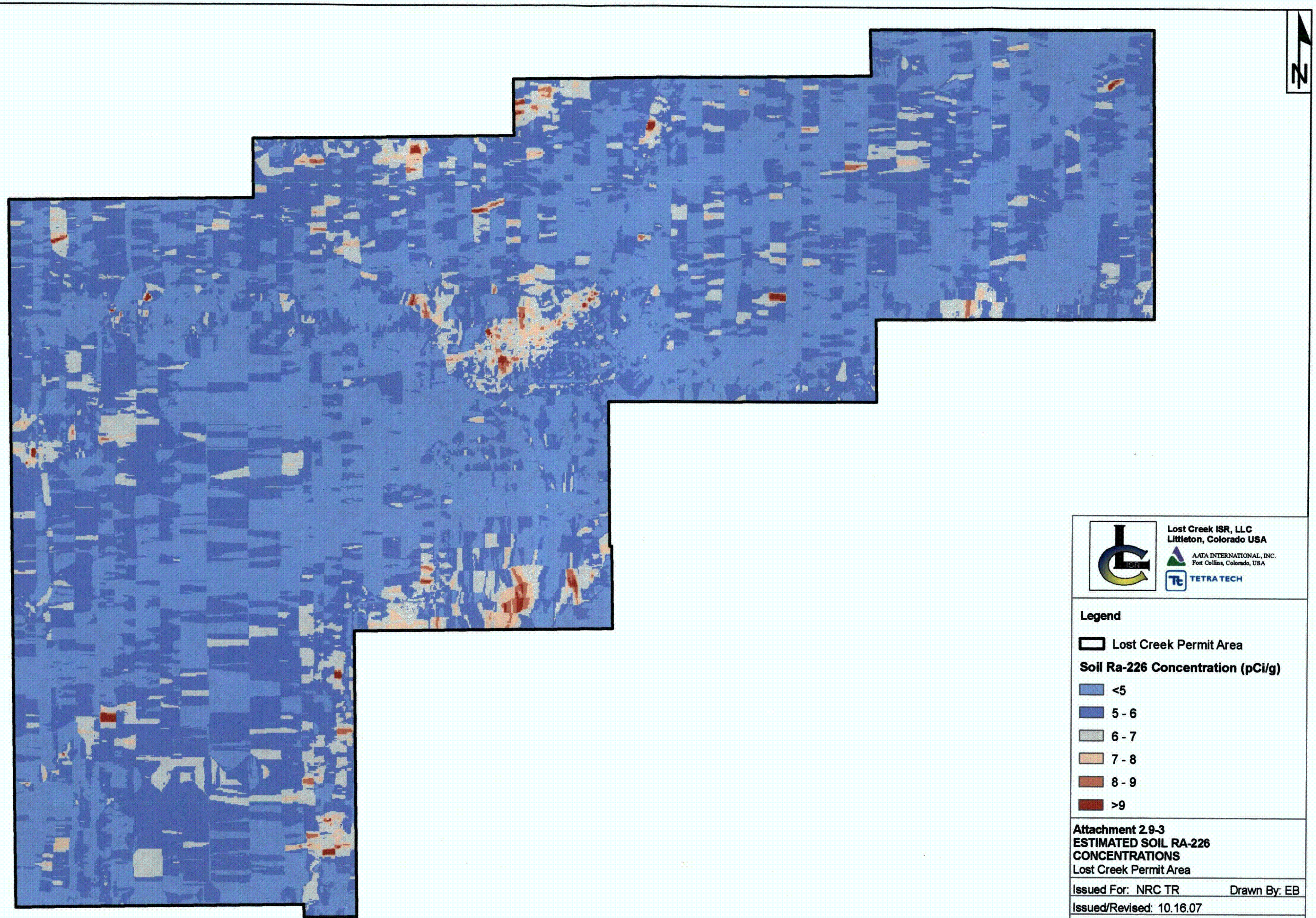
Attachment 2.9-3
KRIGED ESTIMATES OF THE THREE-FOOT-HPIC-EQUIVALENT GAMMA EXPOSURE RATES
Lost Creek Permit Area

Issued For: NRC TR — Drawn By: EB

Issued/Revised: 10.16.07

Drawing No: NRC-TR-2.9-3-10.16.07-EJS

0 0.125 0.25 0.5 Miles



Lost Creek ISR, LLC
Littleton, Colorado USA

AATA INTERNATIONAL, INC.
Fort Collins, Colorado, USA

TETRA TECH

Legend

Lost Creek Permit Area

Soil Ra-226 Concentration (pCi/g)

- <5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- >9

Attachment 2.9-3
ESTIMATED SOIL RA-226 CONCENTRATIONS
Lost Creek Permit Area

Issued For: NRC TR   Drawn By: EB

Issued/Revised: 10.16.07

Drawing No: NRC-TR-2.9-3-10.16.07-EJS

0 0.1 0.2 0.4 Miles

Attachment 2.9-4 HPIC-Adjusted Gamma Datasets

TABLE OF CONTENTS

2.10 Other Environmental Features

The environmental features of the Permit Area have been characterized in the previous sections. No other environmental features remain to be addressed.