10.0 Routine Sampling of NTS Biota

Biota sampling is a newly implemented activity described fully in the Routine Radiolgical Environmental Montoring Plan (RREMP). Preliminary sampling procedures for vegetation and animals were developed to guide field sampling (Analytical Services Laboratory LID L-E10.6 .P). Five sites were selected for sampling over the next five years. These sites are considered the most contaminated sites and are considered representative of the five types of contaminated sites present on the Nevada Test Site (NTS). These sites include E Tunnel Ponds, PALANQUIN, SEDAN, T2, and Plutonium Valley. Each site will be sampled once each five years to confirm low radionuclide levels (more frequently and intensely if levels are found to be higher than action levels).

Monitoring in 1999 was restricted to two contaminated locations: Cambric Ditch and E Tunnel Ponds, and two control sites, Cane Spring and Camp 17 Pond, respectively (Figure 10.1). Routine radiological monitoring of biota at the NTS in Fiscal Year (FY) 1999 commenced on August 8, 1999, and continued through October 14, 1999. A late summer to early fall sampling period corresponded to times of the year when tritium levels have been seasonally highest on the NTS (Hunter and Kinnison, 1998). This appears to be due to reduced precipitation and increased evapotranspiration which result in a higher fraction of residual tritium in soil water than during winter or spring when there is greater non-tritiated water in the soil from precipitation.

Cambric Ditch located in Area 5 just west of Frenchman Flat, was selected for initial sampling even though it was not one of the five selected sites for long-term monitoring. It was selected because it was close to the base of operations at Mercury and would permit validation of animal trapping techniques without extensive travel. Groundwater, soil, and vegetation at Cambric Ditch had historically high levels of tritium due to prolonged pumping (1973 to 1992) from a contaminated underground water supply (Hunter and Kinnison, 1998). Additionally, it was scheduled for short-term discharge of well water during the fall of 1999 which provided an opportunity to evaluate the sensitivity of sampling and laboratory techniques. Cane Spring, a naturally occurring spring also in Area 5, was selected as a control site for Cambric Ditch. Vegetation at the Cane Spring was described by Hansen et al., (1997).

10.1 Vegetation Sampling

Woody vegetation was selected for sampling because it was reported to have deeper-penetrating roots with higher concentrations of tritium (Hunter and Kinnison, 1998), and additionally serves as a major source of browse for game animals that might eat such vegetation and migrate offsite.

Samples of salt cedar (*Tamarix ramosissima*), one of the more deeply rooted shrubs, were taken at four locations along the Cambric Ditch and at Cane Spring. No other living vegetation was observed at Cambric Ditch in the Fall of 1999. The first vegetation sample was near the well at the head of the ditch (Figure 10.2, see Table 10.1 for Universal Transverse Mercator [UTM] location coordinates). The second

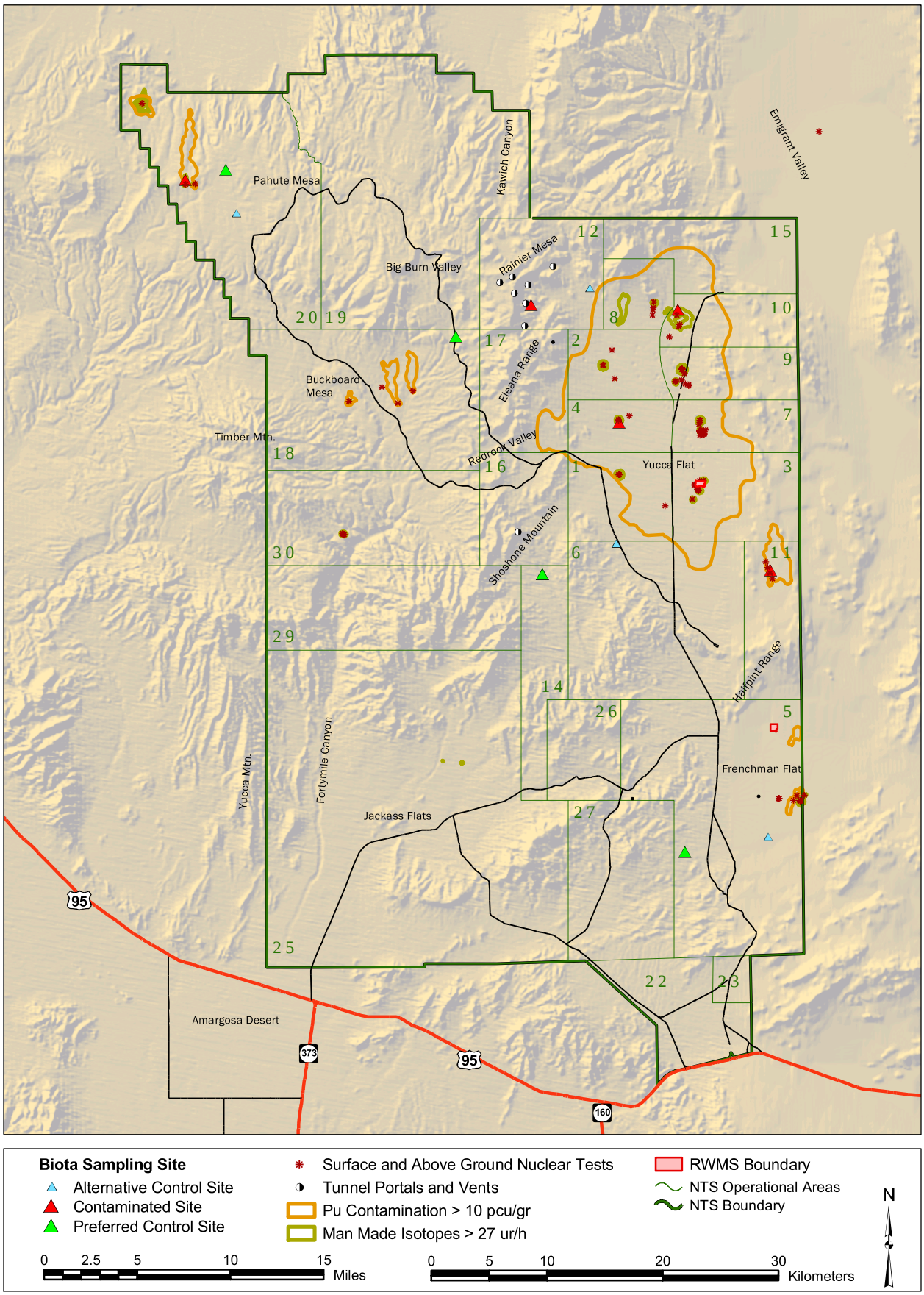

Figure 10.1 NTS Onsite Surface Biota Radiological Monitoring Sites - 1999

Figure 10.2 Salt Cedar Shrubs (Foreground) Sampled Near the Well Head at Cambric Ditch

sample was collected about 0.48 km (0.3 mi odometer reading) down stream from the well head. The third sample was taken approximately 1.13 km (0.7 mi) down stream from the well head. The fourth sample was collected approximately 1.61 km (1.0 mi) down stream from the well head near the dry pond (Figure 10.3) at the end of the ditch.

Vegetation was collected from shrubs adjacent to the ditch, but not located within the ditch because there was a high probability shrubs within the ditch would be removed by ditch-cleaning activities scheduled in the Fall of 1999. About 300 to 500 grams of fresh-weight plant material were collected from the current year's growth of green-leaf materials. Samples were stored in an ice chest and kept frozen until analyzed (DOE 1998a).

Plant samples of salt cedar were taken from Cane Spring (Figure 10.4) at one location. Samples were also taken of sandbar willow (*Salix exigua*) a codominant shrub species at another location at the control site and Goodding's willow (*Salix gooddingii*) was taken at a third location and was the dominant tree at the site.

Samples were taken on October 14, 1999, of dominant trees and shrubs at E Tunnel Ponds (Figure 10.5). Samples included saltcedar, rubber rabbitbrush (*Ericameria nauseosa*), and fourwing saltbush (*Atriplex canescens*). No dominant forbs were observed or sampled. Collection of plant samples within the restricted fenced area was taken at the same time as routine water samples and with the assistance of a radiological control technician.

Plant samples were taken on October 14, 1999, of dominant shrubs and one tree at the control site at Camp 17 Pond (Figure 10.6). These samples included rubber rabbitbrush *(Ericameria nauseosa*), big sagebrush (*Artemisia tridentata*), sandbar willow (*Salix exigua*), and Chinese elm (*Ulmnus parvifolia*), the dominant tree. No dominant forbs were observed or sampled at the pond.

Figure 10.3 Salt Cedar Shrub Sampled Approximately One Mile Downstream Near the Dry Pond

Figure 10.4 Cane Spring Showing Relative Location of Tall Woody Vegetation Sampled in 1999 (9-19-98)

Figure 10.5 E Tunnel Ponds Showing Adjacent Vegetation (7-23-97)

Figure 10.6 Camp 17 Pond Showing Adjacent Vegetation with Chinese Elm Tree on Back Side of Pond (8-4-88)

10.2 Animal Sampling

Animal trapping in FY 1999 consisted of about 20 trapping days. Trapping was directed to mourning doves (*Zenaida macroura*) and cottontail rabbits (*Sylvilagus audubonii*). Mourning doves are one of the few game animals that forage on the NTS and migrate offsite, thereby providing a possible pathway of radionuclides from the NTS to the public. The ecology of mourning doves is described in a report that also reports that a majority of mourning doves in Nevada migrate out of state and end up in south central Arizona, although evidence was also presented that some mourning doves maintain resident, non-migratory populations where there is sufficient water, feed, and mild climate (Baskett and et al.,1993).

Rabbits were chosen as surrogates for big game animals (deer and antelope) because they browse on similar vegetation. They have small home ranges and also forage longer in contaminated sites, thereby, giving them a higher potential than deer for being a "worst-case" (i.e., highest concentrations of radioisotopes) scenario at the selected site. In a study conducted by Giles and Cooper (1985) more than 62 buck, 51 does, and 10 fawns were tagged, about two-thirds of them fitted with radio telemetry, and monitored weekly for more than 4 years. They reported most deer migrating within the NTS between summer ranges on Rainier Mesa and Pahute Mesa and their wintering areas at Timber Mountain and Shoshone Mountain, thereby minimizing the chances of migrating offsite where they might be shot and taken as game.

Two wire traps were used for trapping mourning doves on the NTS. Eight additional traps were made with slight modifications in the openings to restrict the size of birds and other animals entering the traps. The traps were placed at the same location as the bait containers. Dead shrubs and trees were also occasionally used to camouflage the wire traps.

Predation of the bait was a problem at all sites. Bait was removed by small mammals, ants, and passerine birds. Even bait in a bird feeder on the top of 1-meter tall metal fence posts was removed by mice. There was also evidence that some trapped animals had been eaten in the trap during the night, leaving only feathers or fur. An abundance of passerine birds were both observed during the pre-bait and trapping periods. Several types of passerine birds were also caught in the traps. Brown-headed cowbirds (*Molothrus ater*) were the most abundant species during trapping. While a few doves were observed in the general vicinity of the site, no doves were actually observed at the pre-bait stations nor caught in any of the traps. No doves were observed after September 30 and it was presumed that doves had left the NTS in their southern migration. The low mourning dove abundance noted this year on the NTS probably was a significant factor influencing poor trapping success.

Several cottontail rabbits were caught at Cambric Ditch, although none were caught at other sites. Only one rabbit was taken at Cambric Ditch for analyses prior to removal of vegetation within the ditch, the others were released. Trapping for doves and rabbits was also done at Camp 17 Pond, E Tunnel Ponds, and Well 5B unsuccessfully. No trapping was done at Cane Spring.

Future sampling efforts will be directed at increasing trap efficiency. Trap materials and design will be tested to determine the most suitable design. Baits will also be evaluated to determine the most cost-effective types and how to effectively bait the area prior to and during trapping. State and Federal permits will be secured to take other birds during FY 2000.

Results

Radionuclide activities in NTS Biota Samples in 1999 are shown in Table 10.1. While above background levels of activity for gamma emitters were detected for ^{40}K, a naturally occurring radioisotope, at some

sites in vegetation samples during 1999, all samples had either no detectable or less than MDC concentrations of ^{137}Cs. Vegetation analyzed for ^{90}Sr had less than M.C. for all samples from Cambric Ditch and Cane Spring. Other samples collected at E Tunnel Ponds and Camp 17 Pond were also very low and near the levels of M.C.. The highest value for ^{90}Sr was 0.0736 $\pm$ 0.023 pCi/g at the Camp 17 Pond (control site). With one exception, all samples of ^{238}Pu and $^{239+240}Pu$ had less than M.C.. The exception was one sample of vegetation about 1.13 km (0.7 miles) down stream from the well at Cambric Ditch which had a $^{239+240}Pu$ activity of 0.000687 ± 0.00092 pCi/g with a minimum detectable concentration (M.C.) of 0.00045 pCi/g.

With one exception, vegetation samples analyzed for tritium from the control sites of Cane Spring and Camp 17 Pond had less than M.C.. The exception was a vegetation sample of rubber rabbitbrush taken from an upland area about 30 to 50 meters east of the Camp 17 Pond. It is not known why the sample was higher than other samples in the area, although Hunter and Kinnison (Hunter and Kinnison 1998) also reported unexplained higher levels of tritium than background levels in some areas not previously reported to have levels greater than detection levels of tritium.

Tritium activity levels at Cambric Ditch and E Tunnel ponds ranged from less than M.C. in rubber rabbitbrush at E Tunnel ponds to 659,000 $\pm$ 4,100 x 10^{-9} µCi/mL. The reported activity of water in the E Tunnel Pond 4 was 944,000 $\pm$ 0.489 x 10^{-9} µCi/mL and 912,000 x 10^{-9} µCi/mL for effluent coming out of the pipe into E Tunnel Pond 4 sampled on the same day. All tritium concentrations in the vegetation were less than those reported for the water and may suggest that vegetation may have been utilizing soil water from prior precipitation that had lower tritium concentrations. Site environmental reports suggest that the mean tritium in the E Tunnel to be gradually increasing since 1995.

Tritium activity at Cambric Ditch ranged from 103,000 $\pm$ 1,600 x 10^{-9} µCi/mL to 415,000 $\pm$ 3,100 x 10^{-9} µCi/mL along a decreasing gradient downstream from the well. It is uncertain why samples taken in 1999 were nearly an order of magnitude higher than those reported by Hunter and Kinnison in 1998. It is possible that the random nature of their sampling versus the more deliberate location of samples taken in 1999 may help explain the difference.

Tritium activity in the only desert cottontail collected at Cambric Ditch was 34,400 $\pm$ 990 x 10^{-9} µCi/mL for muscle tissue. This value indicates that the animal was acquiring tritium either from the vegetation or from water sources in the area. It should be noted that no water had flowed in Cambric Ditch prior to the time of sampling since 1992 or during the sampling.

Table 10.1 Radionuclide Activities in NTS Biota Samples in 1999

Location	GPS Coordinates (UTM 1983, Zone 11, meters) Easting	Northing	Scientific Name[a] Common Name	Genus	Species	% H_2O (%)	Conc., x 10^{-9} µCi/mL Tritium[b]	Concentration, pCi/g ^{40}K	^{137}Cs	^{238}Pu[b]	$^{239,240}Pu$[b]	^{90}Sr[b]
PLANT SAMPLES												
Cambric Ditch												
Out of ditch near well head	592,059	4,075,671	saltcedar	Tamarix	ramosissima	59.5	103,000 ± 1,600	4.25 ± 4.0C	No Nucl Det	-0.0000917 ± 0.00018C	0.0000184 ± 0.00058C	0.0102 ± 0.0099C
0.3 miles down stream	592,572	4,075,334	saltcedar	Tamarix	ramosissima	61.9	122,000 ± 1,700	No Nucl Det	No Nucl Det	-0.0000982 ± 0.0002C	-0.0000982 ± 0.0002C	-0.00342 ± 0.0094C
0.7 miles down stream	592,950	4,075,037	saltcedar	Tamarix	ramosissima	61.2	134,000 ± 1,800	No Nucl Det	No Nucl Det	0.000172 ± 0.00054C	0.000687 ± 0.00092	0.00286 ± 0.0080C
1.0 miles down stream	593,375	4,074,660	saltcedar	Tamarix	ramosissima	59.5	415,000 ± 3,100	No Nucl Det	No Nucl Det	-0.0000865 ± 0.00017C	0.000173 ± 0.00055C	0.00261 ± 0.011C
Cane Spring												
Near dry pond	580,775	4,072,800	saltcedar	Tamarix	ramosissima	57.7	11.7 ± 440[C]	1.23 ± 0.39	No Nucl Det	-0.0000869 ± 0.00017[C]	-0.0000869 ± 0.00017[C]	0.00328 ± 0.0095[C]
East of dry pond	580,835	4,072,800	sandbar willow	Salix	exigua	62.9	-123 ± 430[C]	1.65 ± 0.165	No Nucl Det	-0.0000868 ± 0.00017[C]	-0.0000868 ± 0.00017[C]	0.00101 ± 0.0067[C]
East of spring (fenced area)	580,775	4,072,800	Goodding's willow	Salix	gooddingii	65.3	468 ± 450[C]	2.08 ± 0.53	0.0385 ± 0.024[C]	-0.0000786 ± 0.00016[C]	-0.0000786 ± 0.00016[C]	0.00176 ± 0.0090[C]
E-Tunnel Ponds												
Pond 4 (lower pond)	571,832	4,116,049	rubber rabbitbrush	Ericameria	nauseosa	55.0	605,000 ± 3,900	12.1 ± 6.2	No Nucl Det	0.000248 ± 0.00086[C]	0.000248 ± 0.00086[C]	0.0126 ± 0.017[C]
Pond 4 (lower pond)	571,832	4,116,049	fourwing saltbush	Atriplex	canescens	39.6	17,300 ± 800	17.9 ± 7.8	No Nucl Det	0[C]	0.00025 ± 0.00087[C]	0.0300 ± 0.044[C]
Pond 3 (middle pond)	571,778	4,116,049	rubber rabbitbrush	Ericameria	nauseosa	45.8	-36.9 ± 460[C]	No Nucl Det	No Nucl Det	-0.000289 ± 0.00058[C]	0.000289 ± 0.001[C]	0.0665 ± 0.018
Pond 3 (middle pond)	571,778	4,116,049	fourwing saltbush	Atriplex	canescens	58.6	659,000 ± 4,100	22.3 ± 7.6	No Nucl Det	-0.000814 ± 0.0012[C]	0.000543 ± 0.0011[C]	0.0222 ± 0.11[L]
Pond 3 (middle pond)	571,778	4,116,049	saltcedar	Tamarix	ramosissima	57.4	12,500 ± 720	No Nucl Det	No Nucl Det	0.000567 ± 0.0011[C]	0[C]	0.0671 ± 0.037
Pond 2 (dry upper pond)	571,743	4,116,058	saltcedar	Tamarix	ramosissima	48.7	237,000 ± 2,500	No Nucl Det	No Nucl Det	0[C]	0.0014 ± 0.0013[C]	0.0525 ± 0.024
Camp 17 Pond												
East end of pond near water	565,421	4,113,305	rubber rabbitbrush	Ericameria	nauseosa	55.7	-172 ± 450[C]	14.0 ± 4.8	No Nucl Det	0.000234 ± 0.00081[C]	0[C]	0.0207 ± 0.022[C]
East end of pond--upland	565,431	4,113,306	rubber rabbitbrush	Ericameria	nauseosa	49.7	2,360 ± 520	12.9 ± 4.5	No Nucl Det	0.000456 ± 0.00091[C]	0.000228 ± 0.00079[C]	0.0207 ± 0.025[C]
East end of pond near water	565,421	4,113,305	big sagebrush	Artemisia	tridentata	57.0	246 ± 470[C]	17.1 ± 5.6	No Nucl Det	-0.000327 ± 0.00066[C]	0.000655 ± 0.0013[C]	-0.00224 ± 0.015[C]
East end of pond--upland	565,431	4,113,306	big sagebrush	Artemisia	tridentata	46.7	-55.4 ± 460[C]	13.8 ± 5.4	No Nucl Det	0[C]	0.000896 ± 0.0011[C]	0.0447 ± 0.032[C]
East end of pond near water	565,421	4,113,305	sandbar willow	Salix	exigua	58.4	252 ± 470[C]	No Nucl Det	No Nucl Det	0[C]	0.000589 ± 0.0012[C]	0.0736 ± 0.023
West end of pond near water	565,359	4,113,223	Chinese elm	Ulmus	parvifolia	51.8	-73.8 ± 460[C]	No Nucl Det	No Nucl Det	0[C]	0.000225 ± 0.00078[C]	0.0704 + 0.032
ANIMAL SAMPLES												
Cambric Ditch												
Out of ditch near well head	592,059	4,075,671	Desert cottontail	Sylvilagus	audubonii	76.1	34,400 ± 990					

± Error is the 2.0 Sigma Error, % H_2O is the percent water of sample on a dry weight basis, [L] = Low Recovery for Sample, No Nucl Det = No Nuclide Detected, ^{40}K is a naturally occurring radiosotope

[a] U. S. Department of Agriculture. 1996. The PLANTS database. National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

[b] Activity levels result from subtracting background levels and may occasionally yield negative values

[C] Value was less than Minimum Detectable Activity