Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.01

LANDFILL OPERATIONS

1.0 OBJECTIVE

To state procedures for disposing of radioactive materials within the Clean Harbors Deer Trail (CHDT) landfill cells.

2.0 SCOPE

This standard operating procedure (SOP) describes procedures for proper operation of the landfill, and procedures for unloading and placement of waste subject to the license.

3.0 POLICY

Landfill operations shall be performed so as to properly maintain the landfill and minimize the release of radioactive material to unrestricted areas.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the *Radiation Protection Plan* (DR 15.RPP.01).

5.0 LANDFILL OPERATIONS

5.1 Unloading Waste in the landfill

All waste in the landfill will be covered after placement per the requirements of the RCRA permit. Trucks delivering waste to the landfill will drive only on haul roads and daily cover material. Radioactive materials placed in the landfill will be covered with non-radioactive materials or daily cover material. Large waste objects will not be subject to daily cover requirements as long as they do not have removable contamination above site limits. Trucks will dump waste in grid areas as directed by the landfill operator. Drivers will stay in their vehicles during dumping operations. Dumping will be conducted by the Clean Harbors operator. Trucks will be inspected after dumping to make sure they are empty. Trucks will then be directed back to the sample station or other areas for inspection and release survey.

5.2 Survey Procedures for Off Site Trucks

The interior surface of off-site bulk conveyances of wastes such as dump trailers or roll-off bins will be surveyed for residual radioactive material in accordance with SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*. If contamination is detected above the site limits, the interior of the truck dump trail or roll-off bin trailer will be swept and/or washed and re-surveyed, until the interior of the truck dump trailer or roll-off bin is determined to meet the release criteria in SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*.

5.3 Waste Placement and Compaction

Wastes will be placed in the landfill in lifts of 2-4 feet high. Waste locations are measured on a 50-foot by 50-foot grid system. The location of each load of waste shall be recorded. Location is determined by a number and letter sequence for north-south, and east-west grids. The grid location and the elevation level of the top of the lift will document the location of each load. Waste shall be compacted in place to meet the standards required by the RCRA permit. Debris-like waste shall be mixed with soil like waste and compacted in place. No debris placement shall be permitted near the liner of the landfill. In order to protect the synthetic liner from possible punctures, a two-foot thick protective soil layer will be placed and maintained on the immediate liner surface. All waste placement and compaction shall be done in compliance with the requirements of the RCRA Operating permit.

5.4 Prevention of Wind Dispersal

Wind dispersal will be prevented by limiting the area of exposed waste at any one time and suitable use of cover. Dumping and placement of waste will be limited to only one or two 50'X50" grid areas at any particular time. Radioactive materials will be covered with non-radioactive materials as soon as practical. Large objects that do not have removable contamination above site limits are not subject to cover requirements. Once a grid area is covered by non-radioactive material, other grid areas may be used for dumping and placement of wastes. Other control measures or means of cover may be used to prevent wind dispersal as needed. If sustained wind speed exceeds 30 miles per hour, truck-unloading operations in the landfill will cease and any exposed areas of radioactive materials will be covered as soon as practical.

5.5 Heavy Equipment

Heavy equipment contaminated by radioactive materials shall be surveyed for contamination and if necessary decontaminated before removal from the landfill. Equipment release surveys (SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*) will be performed following decontamination if needed.

5.6 Site Haul Trucks

Site haul trucks may enter and leave the landfill as needed, provided travel is on haul roads and/or daily cover. Site haul trucks that become contaminated will be surveyed and decontaminated as needed.

5.7 Run-On/ Run-Off Controls

Run-On/Run-Off Controls and procedures are presented in detail in Section VI of the RCRA operating permit.

5.8 Leachate Collection

Requirements for leachate collection are presented in detail in Section VI of the RCRA operating permit

6.0 PERSONAL PROTECTIVE EQUIPMENT

PPE must be worn by CHDT workers in the landfill when radioactive materials are uncovered. Standard personal protective equipment (PPE) for use in the landfill consists of a full face air purifying respirator and combination cartridges, a porous disposable Tyvek suit, plastic liner gloves with cloth or leather over gloves, and boots. Additional discussion of PPE requirements at CHDT is presented in SOP 15.RPP.09, *Personal Protective Equipment,* and the other documents listed in Section 8. Off site truck drivers are not subject to the PPE requirements in the landfill but must stay in their vehicle during dumping operations. PPE is not needed in the landfill after all waste is covered with daily cover.

7.0 REFERENCES

CHDT RCRA Permit, current version

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.02
WASTE TREATMENT

1.0 OBJECTIVE

Define operational procedures for waste treatment operations in the CHDT treatment building.

2.0 SCOPE

This standard operating procedure (SOP) directs procedures for radioactive material storage and treatment operations. It addresses waste unloading, mixing and loading in the treatment building. It does not cover treatment formulas and chemical additives.

3.0 POLICY

Treatment operations will be conducted so as to keep radiation dose to workers and the general public as low as reasonable achievable (ALARA). See facility ALARA goal in the CHDT Radiation Protection Plan ALARA SOP (15.RPP.07).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (15.RPP.01).

5.0 UNLOADING AND TREATMENT OPERATIONS

5.1 Description

The treatment building is constructed over a lined surface impoundment with a leak detection system. It contains nine bulk treatment and storage basins with an aggregate capacity of 2400 cubic yards. The building is equipped with two independent emission control air scrubber systems. Access to the treatment building is restricted to trained CHDT workers, contractors and drivers under supervision. Drivers must stay in the cabs of their trucks while unloading in the treatment building.

5.2 Posting and Maintenance

The Treatment Building is posted “Caution Radioactive Materials”. The Treatment Building will be used for storage and treatment of radioactive materials as needed. The floor of the unloading area in the treatment building will be washed regularly. This will ensure that vehicles will drive only on clean surfaces. The wash water will be directed into the treatment basin, and treated by solidification and land-filled. Exit areas outside the treatment building will be surveyed during routine clean area surveys to ensure that radioactive materials are not being released to unrestricted areas.

5.3 Unloading Operations

CHDT facility personnel will direct waste trucks into the proper entrance of the treatment building. Trucks will back into the unloading area and the waste will be unloaded into the treatment basin. After the truck has been unloaded, the truck will be inspected for the presence of visible amounts of waste. If visible waste is observed, it will be removed via washing, sweeping, etc.

5.4 Exit Procedures for Waste Trucks

Waste trucks leaving the site will be surveyed for contamination in accordance with SOP 15.OPS.13, *Equipment Surveys*. If contamination is detected, trucks will be cleaned and resurveyed until they meet CHDT release criteria.

5.5 Mixing Operations

Mixing operations in the treatment building are conducted using an excavator and various chemical reagent additives. Normally, the waste is placed in the treatment basin, reagents are added, and the waste mixture is mixed until treatment is complete. Samples will be taken if needed to verify proper treatment. All treatment operations must be conducted with the emission control system properly operating to control releases of waste materials.

5.6 On-Site Transfer and Landfill Operations

After waste has been treated in the treatment basin and meets specifications for landfill, the waste will be loaded into site haul trucks using an excavator. Haul trucks will then transport the waste to the landfill for disposal. Waste will be unloaded into the active section of the landfill and the waste will be covered and compacted.

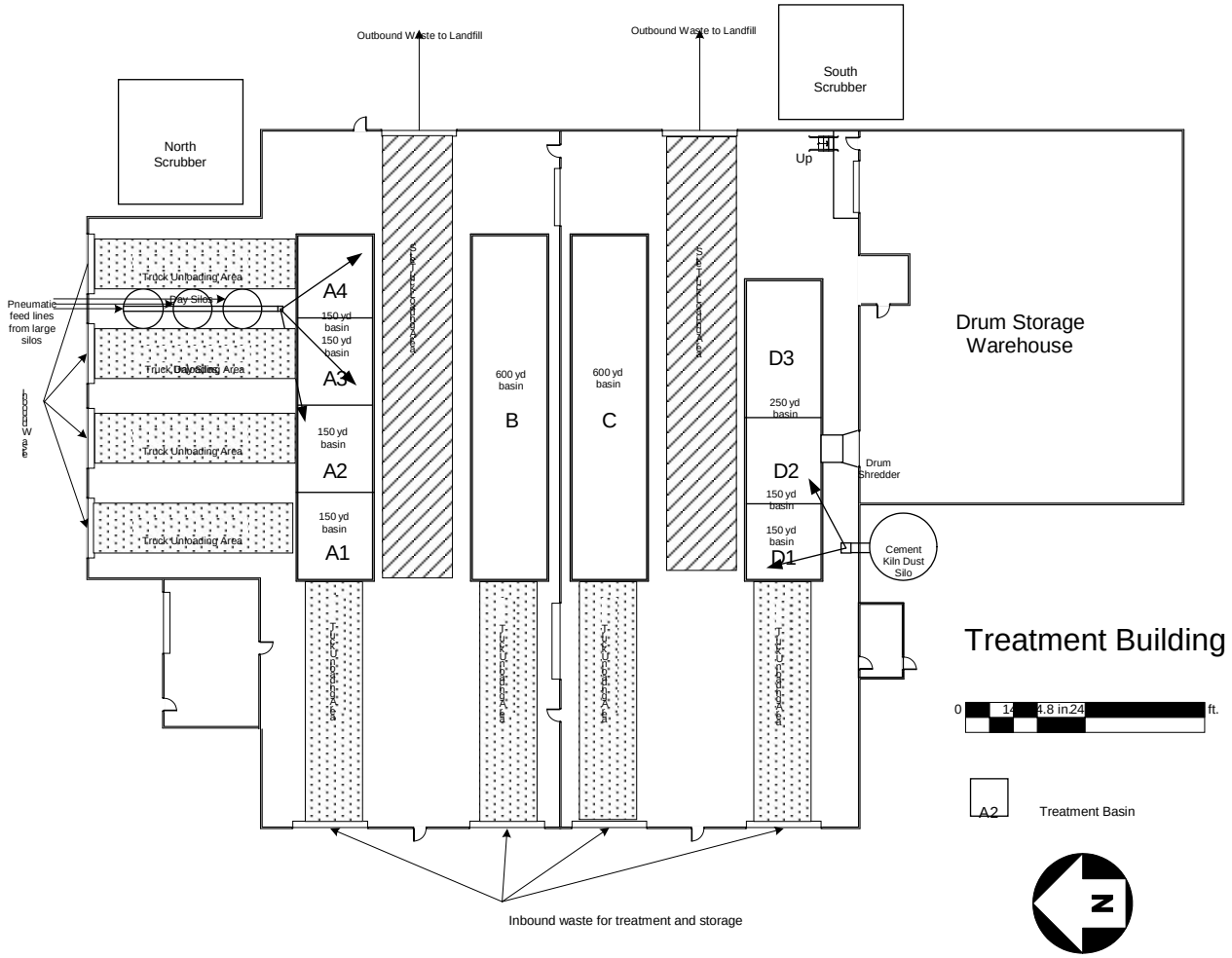
5.7 PPE and Personnel Decontamination

Consistent with 15.RPP.09, *Personal Protective Equipment,* standard PPE for use in the treatment building consists of a full face air purifying respirator and combination cartridges, a porous disposable Tyvek suit, plastic liner gloves with cloth or leather over gloves, and boots. Drivers delivering waste to the treatment building are not required to wear PPE but may not leave the cab of their vehicles until they have exited the treatment building. CHDT trained employees and contractors working with radioactive materials in the treatment building shall doff their PPE and undergo frisk out procedures before doing other work or leaving the immediate area around the building unless they are in a vehicle such as a haul truck. These procedures are delineated in SOP 15.OPS.12, *Personnel Surveys*. Reusable PPE such as boots and respirators may be reused but should be washed off before reuse or stored in the decon area. Other PPE may be used as long as they provide equivalent protection. Contaminated PPE will be disposed of in the landfill.

6.0 STANDARDS AND CRITERIA

Standards and criteria for free release are addressed in SOP's 15.OPS.13 ((Equipment and Vehicle Release Surveys) and 15.OPS.18. (Decontamination of Surfaces and Equipment).

Figure 1. Map of Treatment Building



Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.03

OPERATION OF PORTABLE GAMMA SPECTROSCOPY UNIT

1.0 OBJECTIVE

Define procedures for the operation of portable gamma spectroscopy units to identify radionuclides in waste received at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

2.0 SCOPE

This standard operating procedure (SOP) applies to all activities associated with the use of portable gamma spectroscopy units and associated software.

3.0 POLICY

Qualitative confirmation measurements using the portable gamma spectroscopy system will be performed on all incoming shipments of radioactive materials prior to disposal to confirm the presence of naturally occurring radionuclides. Measurements will also verify that radionuclides from other sources are not present within the disposed materials. Use of the portable gamma spectroscopy units will be limited to those instruments approved by the Colorado Department of Public Health and Environment (CDPHE).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT *Radiation Protection Plan* (15.RPP.01).

5.0 GENERAL SURVEY METHODS

5.1 Instrument Description

Hand Held portable gamma spectroscopy units allow for identification and quantification of gamma energies. The units also have the ability to measure exposure rates. The units contain a digital display which can allow the user to view collected spectra. The detectors are supplied with the appropriate software and can be connected to a computer to allow for printable spectra.

5.2 Operating Procedure

Approved hand held portable gamma spectrometers shall be used by trained CHDT staff to determine the relative contribution of radionuclides in waste received at the CHDT landfill. Unless otherwise directed by the CHDT RSO or designee, the measurements shall not be used to establish personnel dose rates. Specific operating procedures and step-by-step instructions for operation of hand held portable gamma spectrometers are contained in the respective operating instruction manuals supplied by the manufacturers.

Shipments with very low radiation levels may require an increased sample analysis time to properly identify the radioisotopes present. In such cases, the count time can be extended for improved analytical results.

5.3 Downloading and Saving Spectrum Files

Unless otherwise directed by the CHDT RSO or designee, download, print and review data for each spectrum immediately following collection.

6.0 STANDARDS AND CRITERIA

At a minimum, hand held portable gamma spectrometers shall require calibration according to manufacturer's recommendations.

7.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.04

OPERATION OF ALPHA-BETA COUNTER

1.0 OBJECTIVE

To define general and specific methods and procedures for conducting sample analysis for detection of alpha and beta radiation using the Ludlum 3030 alpha-beta tray counter in support of radioactive material disposal operations at the Clean Harbors Deer Trail (CHDT) landfill.

2.0 SCOPE

This SOP covers the operation of the Ludlum 3030 Alpha Beta Counter, quality control of the analysis, and calculation of instrument MDA. Release criteria for removable contamination are defined in SOP 15.OPS.13, Equipment and Vehicle Release Surveys and several additional survey SOPs.

3.0 POLICY

Radiation surveys for removable radioactive material shall be conducted by trained CHDT staff to verify that exposure from radioactive materials to CHDT workers and the public is kept as low as reasonable achievable (ALARA). Surveys will also ensure CHDT compliance with License requirements and State and Federal regulations. Use of the 3030 Alpha Beta counter will be in compliance with this SOP.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan.

5.0 GENERAL METHODS FOR ALPHA-BETA SAMPLE ANALYSIS

5.1 General Discussion

Surface contamination samples shall be collected on two inch diameter filter media and counted with the Ludlum Model 3030 Alpha Beta Scaler using the following procedure:

a. Verify that the Ludlum Model 3030 has power and is ready to count samples

b. Perform the quality control (QC) daily check as described in the instrument manual. With the system in automatic mode, a QC check will be automatically required every 24 hours, and the instrument will be inoperable in the absence of a satisfactory QC check.

- Change the count time dial to 5 minutes, and depress the “QC” button on the unit to start the instrument’s automatic daily QC routine. The first required measurement is alpha, which will require the thorium-230 (^{230}Th) source.

- After satisfactory completion of the ^{230}Th measurement, the display will indicate that a beta source measurement is required. A technicium-99 (^{99}Tc) source should be used for another 5-minute count.
- After satisfactory completion of the ^{99}Tc measurement, a 20-minute background measurement is required.

c. Set the "background subtract" mode to subtract background for alpha and beta radiation.

d. For measurements of smears, the count time dial should be set to 1-minute, or as directed by the CHDT RSO. The measurement will be logged, and should be recorded on the appropriate form.

e. If smear results are elevated, bias from radon progeny may be a factor. Allow 5 to 10 minutes of decay time for the smear and conduct a recount. If the count results remain in excess of the survey limit, notify the individual performing the survey and the CHDT RSO.

f. Determine if the sample is less than the survey limits defined for the specific survey being conducted. Radioactivity limits are described in the appropriate SOPs. Note that the sum of fractions rule is used to determine overall compliance for alpha and beta emitting radionuclides.

g. Using the PC based software, details for each sample count for later reference and analysis may be recorded if necessary.

5.2 Data Download

On a weekly basis, the data logged on each counter must be downloaded. The memory has a limit of 600 measurements, and measurements collected after the memory is full will not be logged. The laboratory desktop computer will be the primary location for downloading data. To download data, attach the serial cable to the back of the 3030 unit, attach it to a USB port on the computer using the serial-to-USB converter, and double-click on the Ludlum 3030 software. Click on the Data Logging tab, and the "Get Samples" button – the data will download from the unit, with a progress bar at the bottom of the window. A numerical count will also appear on the 3030 display. Following complete download, click the "Save Samples" button and save the file in the folder for that instrument with the filename in the following format: "XXXXXX MMDDYY Download" – where XXXXXX is the six-digit serial number and MMDDYY is the date (without spaces, dashes, or slashes). The file will save as a text/Excel spreadsheet.

Double-click on the data file to confirm that it has been completely saved. Once confirmed that the data are complete, click on the "Clear Samples" button in the 3030 software to clear the 3030 memory.

6.0 QUALITY CONTROL AND MDA CALCULATION

6.1 Quality Control

Quality control (QC) measurements will be collected on a daily basis. The 3030 has a built-in feature that requires a QC measurement every 24-hour period. Checks will be performed with plated alpha (^{230}Th) and beta (^{99}Tc) sources that are National Institute of Standards and Technology (NIST)-traceable. The QC tolerances will be set at +/- 15%. If the daily QC check fails, the instrument will not be used and will be taken out of service until the RSO is able to determine a cause.

6.2 Minimum Detectable Concentration

The minimum detectable concentration (MDC) (or minimum detectable activity [MDA]) of the instrument should be known prior to its use to verify that the measurement sensitivity is sufficient for the application. The Ludlum 3030 uses a software routine to calculate the MDC, or it may be calculated manually. The MDC for a static measurement when background and sample count times are the same may be calculated using the following equation from Abelquist 2001:

$$Static\ MDC\left(\frac{dpm}{100\ cm^2}\right)=\frac{3+4.65\sqrt{C_B}}{\varepsilon_S\varepsilon_i\left(\frac{A}{100}\right)T}$$

Where:

C_B = background counts in time T

T = time period over which counts were recorded, in minutes (for one-minute counts, this value is 1)

ε_s = surface efficiency; values default to 1.0 for alpha and beta if no other information is available

ε_i = instrument efficiency; values default to 0.39 for alpha and 0.29 for beta if no other information is available

A = the physical (or "active") probe area in cm^2

The static measurement MDC when background and sample counting times are different may be calculated using the following equation:

$$Static\ MDC\left(\frac{dpm}{100\ cm^2}\right)=\frac{3+3.29\sqrt{R_B T_{S+B}\left(1+\frac{T_{S+B}}{T_B}\right)}}{\varepsilon_S\varepsilon_i\left(\frac{A}{100}\right)T_{S+B}}$$

Where:

R_B = background count rate, cpm

T_B	=	background count time, minutes
T_{S+B}	=	sample count time, minutes
ε_s	=	surface efficiency; values default to 1.0 for alpha and beta if no other information is available
ε_i	=	instrument efficiency; values default to 0.39 for alpha and 0.29 for beta if no other information is available
A	=	the physical (or "active") probe area in cm^2

The equation used by the Ludlum 3030 to calculate the MDC automatically is as follows:

$$MDC(dpm) = \frac{2.71 + CL * \sqrt{R_B \times T_{S+B} \times \left(1 + \frac{T_{S+B}}{T_B}\right)}}{E \times T_{S+B}}$$

Where:

CL	=	Confidence Level; for 95% CL = 3.290
E	=	Overall instrument efficiency

As there is little difference between the results of the two calculations, either equation can be used when manually calculating the MDC.

7.0 REFERENCES

Abelquist, 2001. *Decommissioning Health Physics: A Handbook for MARSSIM Users*, Institute of Physics Publishing, Philadelphia, Pennsylvania.

Ludlum Measurements, Inc., Instruction Manual Model 3030 Alpha Beta Sample Counter Meter, Current Version.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.05

OPERATION OF GATE MONITOR DETECTORS

1.0 OBJECTIVE

Provide a procedure for using the Clean Harbors Deer Trail (CHDT) gate monitor systems to monitor incoming waste shipments and provide a procedure for screening NORM/TENORM waste at the generating site to ensure that it meets CHDT's acceptance criteria.

2.0 SCOPE

This standard operating procedure (SOP) applies to the operation of the Ludlum 3502 gate monitor and the Ludlum 375-20 gate monitor at CHDT or waste generating sites. This SOP may be used for alternate or backup systems at the discretion of the CHDT Radiation Safety Officer (RSO) or designee.

3.0 POLICY

Incoming waste shipments to the CHDT landfill will be monitored for gamma radiation levels by the Ludlum 3502 gate monitor system, the Ludlum 375-20 gate monitor system, or its equivalent. Incoming wastes not classified as radioactive will be subject to a limit of 16 microRoentgens per hour (µR/hr), or another value set by the CHDT RSO. The system will be used to monitor incoming radioactive loads to identify any exposure concerns or noncompliance with Department of Transportation (DOT) regulations. The CHDT RSO will be notified of any incoming shipments greater than 500 µR/hr. The equipment and procedure may also be utilized at waste generating sites to monitor waste shipments. For large projects, waste specific and geometry specific exposure rate limits may be designated by the CHDT RSO.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 GENERAL PROCEDURE

5.1 Instrument Description

The Ludlum 3502 gate monitor system consists of two sodium-iodide (NaI) detectors mounted approximately 6 feet above the incoming scale at CHDT. The detectors are each coupled with an alarming analog exposure rate meter in the scale house. The Ludlum 375-20 gate monitor system consists of two sodium-iodide (NaI) detectors also mounted approximately 6 feet above the incoming scale. The 375-20 utilizes an alarming digital rate meter that provides the average of the measurements of the two detectors.

The 375-20 also contains an internal battery which allows for remote operations in areas without line power. Quality control (QC) measurements consisting of a background check and measurement with a known cesium-137 (^{137}Cs) source will be conducted and recorded every workday. Daily measurements are expected to be within plus or minus 20% of the established background and source measurements. The CHDT RSO or designee must be notified of any deviations outside the expected parameters.

5.2 Routine Operations

Each waste shipment shall pass slowly (at a speed less than 5 miles per hour) between the detectors. During this time, staff within the guard house will monitor the meter displays to identify the maximum reading for each detector. The maximum results will be recorded on the weight ticket. If the shipment is a radioactive shipment, the measurements will also be recorded on a Radiation Survey Report.

6.0 STANDARDS AND CRITERIA

6.1 Quality Control

In addition to the daily QC measurements required by each individual instrument, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

An annual instrument calibration must be performed by a qualified vendor. Copies of the instrument calibration certificates must be maintained for a period of five years. Current calibration certificates should be maintained with the instrument daily QC measurement logs.

6.2 Rejected Wastes

Any waste shipments that are not profiled as radioactive shipments with gate measurements at 16 µR/hr or greater, or NORM/TENORM shipments that are not in compliance with (DOT) regulations, will be subject to the following procedures:

- Step 1 - Record the gate monitor measurements on a Radiation Survey Report along with the hauler's identity and truck number.
- Step 2 – Perform isotopic identification survey using portable gamma spectroscopy units per SOP 15.OPS.03.
- Step 3 – Perform package receipt survey for exposure rate and removable contamination per SOP 15.OPS.21.
- Step 4 - Inform the hauler and the waste generator that the waste load exceeds CHDT policy limits for radioactive materials. Attempt to determine the source of the radioactivity and if possible more accurately profile the waste. If CHDT management believes the waste can meet the CHDT License waste acceptance criteria (WAC), and suitable arrangements are made with the waste generator, the waste may be stored at CHDT without being disposed of until all documentation and analytical requirements are met. If this is not possible, arrangements to reject the shipment back to the waste generator will be made.

- Step 5 - If the shipment must be rejected, contact CDPHE Radiation Management Unit to notify them of the issue and if needed, obtain a special DOT permit to transport the waste back to the generating site.

Radioactive shipments with measured exposure rates greater than 500 uR/hr will be further inspected by the CHDT RSO or designee with handheld instruments to determine if the shipment is in compliance with the CHDT waste acceptance criteria and DOT regulations.

7.0 REFERENCES

49 CFR 173. *Shippers – General Requirements for Shipments and Packagings*. Current Version.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.06
OPERATION OF DIGITAL WASTE MONITOR

1.0 OBJECTIVE

Provide a procedure for using the Clean Harbors Deer Trail (CHDT) digital waste monitor system to monitor incoming waste shipments and provide a procedure for screening NORM/TENORM waste at the generating site to ensure that it meets CHDT's acceptance criteria.

2.0 SCOPE

This standard operating procedure (SOP) applies to the operation of the Ludlum 375-20 gate monitor at CHDT or waste generating sites. This SOP may be used for alternate or backup systems at the discretion of the CHDT Radiation Safety Officer (RSO) or designee.

3.0 POLICY

Incoming waste shipments to the CHDT landfill will be monitored for gamma radiation levels by the Ludlum 3502 gate monitor system, the Ludlum 375-20 gate monitor system, or its equivalent. Incoming wastes not classified as radioactive will be subject to a limit of 16 microRoentgens per hour (µR/hr), or another value set by the CHDT RSO. The system will be used to monitor incoming radioactive loads to identify any exposure concerns or noncompliance with Department of Transportation (DOT) regulations. The CHDT RSO will be notified of any incoming shipments greater than 500 µR/hr. The equipment and procedure may also be utilized at waste generating sites to monitor waste shipments. For large projects, waste specific and geometry specific exposure rate limits may be designated by the CHDT RSO.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 GENERAL PROCEDURE

5.1 Instrument Description

The Ludlum 375-20 Digital Wall Mount Area Monitor consists of two 2" X 2" Sodium Iodide Scintillation Detectors and an instrument box. The detectors are equipped with lead shielding that shields them from most background radiation that is not coming directly from the front. The detectors are connected to the instrument box with cables. The instrument box is equipped with a low radiation alarm (yellow), a high radiation alarm (red), an instrument failure alarm (red), and a low battery alarm (yellow). A green

status light indicates positive operation. The instrument runs on 120 AC current and can be plugged into a convenient outlet. The instrument comes equipped with a built-in battery backup that should last for 48 hours in a non-alarm condition and 12 hours in alarm condition. When the battery is getting low a light will show in the low battery window of the instrument box.

5.2 Routine Operations

Each waste shipment shall pass slowly (at a speed less than 5 miles per hour) between the detectors. During this time, staff within the guard house will monitor the meter displays to identify the maximum reading for each detector. The maximum results will be recorded on the weight ticket. If the shipment is a radioactive shipment, the measurements will also be recorded on a Radiation Survey Report.

6.0 STANDARDS AND CRITERIA

6.1 Quality Control

In addition to the daily QC measurements required by each individual instrument, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

An annual instrument calibration must be performed by a qualified vendor. Copies of the instrument calibration certificates must be maintained for a period of five years. Current calibration certificates should be maintained with the instrument daily QC measurement logs.

6.2 Rejected Wastes

Any waste shipments that are not profiled as radioactive shipments with gate measurements at 16 µR/hr or greater, or NORM/TENORM shipments that are not in compliance with (DOT) regulations, will be subject to the following procedures:

- Step 1 - Record the gate monitor measurements on a Radiation Survey Report along with the hauler's identity and truck number.
- Step 2 – Perform isotopic identification survey using portable gamma spectroscopy units per SOP 15.OPS.03.
- Step 3 – Perform package receipt survey for exposure rate and removable contamination per SOP 15.OPS.21.
- Step 4 - Inform the hauler and the waste generator that the waste load exceeds CHDT policy limits for radioactive materials. Attempt to determine the source of the radioactivity and if possible more accurately profile the waste. If CHDT management believes the waste can meet the CHDT License waste acceptance criteria (WAC), and suitable arrangements are made with the waste generator, the waste may be stored at CHDT without being disposed of until all documentation and analytical requirements are met. If this is not possible, arrangements to reject the shipment back to the waste generator will be made.

- Step 5 - If the shipment must be rejected, contact CDPHE Radiation Management Unit to notify them of the issue and if needed, obtain a special DOT permit to transport the waste back to the generating site.

Radioactive shipments with measured exposure rates greater than 500 uR/hr will be further inspected by the CHDT RSO or designee with handheld instruments to determine if the shipment is in compliance with the CHDT waste acceptance criteria and DOT regulations.

7.0 REFERENCES

49 CFR 173. *Shippers – General Requirements for Shipments and Packagings*. Current Version.

Ludlum Measurements, Inc., 2006. *375-20, 375-30, 375-32 and 375-34 Digital Wall Mount Area Monitors*, July.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.07

OPERATION OF EXPOSURE / DOSE RATE METERS

1.0 OBJECTIVE

To provide instruction for the operation of exposure rate or dose rate survey meters for the measurement of gamma radiation levels for receiving, free release, routine, and health and safety surveys.

2.0 SCOPE

This standard operating procedure (SOPs) applies to the operation of survey meters which may be used to determine ambient gamma radiation levels and to predict worker exposure in facility areas and from packages or vehicles. Examples of such instruments used at CHDT include Ludlum Models 3, 19, 19A, 193-6, etc. These instruments may only be used in low radiation environments. Radiation environments which exceed the capabilities of these instruments are not anticipated.

3.0 POLICY

Instruments will be used in accordance with manufacturer's recommendations, SOPs, and site-specific requirements by trained personnel. The use of an instrument outside of its intended capabilities requires approval by the CHDT Radiation Safety Officer (RSO) or designee. Radiation detection instruments shall not be used in lieu of dosimetry for determining employee occupational dose.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 SURVEY DATA COLLECTION

5.1 Use of Exposure Rate Meters

5.1.1 Instrument Descriptions

All of the exposure rate instruments in use at CHDT are "MicroR" instruments that measure gamma radiation in units of microRoentgens per hour (µR/hr). The front panel controls typically include a rotary switch for selecting the range and instrument shut off, an audio on/off switch, a fast/slow response switch, and push buttons for activating the meter lamp, count reset, and battery test. The meter scale and scale settings may vary depending on the specific instrument.

5.1.2 Typical Instrument Setup and Initial Quality Control

Upon receipt of the instrument through purchase, rental, or receipt from annual calibrations, the following steps should be taken to initially setup the instrument and verify that it is in good working order.

a. Verify that the instrument calibration is current; confirm that serial number on instrument matches that on the calibration certificate.

b. Perform ten (10) initial background quality control (QC) measurements

- Use location away from radioactive sources
- Set response to "S" for slow meter response
- Using the appropriate scale, depress the reset button ("RES") and allow the needle to come to a rest (approximately 20 to 30 seconds). Record the measurement to the nearest tick mark, and repeat for 10 measurements.
- Calculate the average plus and minus 20%. Subsequent background QC measurements must fall within this range. Typical background is between 5 and 20 μR/hr.

c. Perform ten (10) initial source QC measurements

- Use cesium-137 source in a repeatable geometry (i.e., orientation of the source relative to the meter).
- Use same location as background measurements
- Using an appropriate scale, depress the reset button ("RES") and allow the needle to come to a rest (approximately 20 to 30 seconds). Record the measurement to the nearest tick mark, and repeat for 10 measurements.
- Calculate the average plus and minus 20%. Subsequent source QC measurements must fall within this range.

5.1.3 Daily Instrument Quality Control

Each day that the instrument is used, the following QC checks and measurements must be performed and recorded.

a. Check the battery by depressing the "BAT" button, or turn the selctor switch to "BAT".

b. Perform background QC measurement

- Use same location as with initial QC measurements
- Measurement must be within plus or minus 20% of the initial average

c. Perform source QC measurement

- Use same location and source geometry as with initial QC measurements
- Measurement must be within plus or minus 20% of the initial average

If either measurement does not fall within the required tolerances, turn the unit off, turn it back on, and repeat the measurement(s). If the unit fails a second consecutive time, remove the unit from service and notify the CHDT RSO or designee.

5.1.4 Collection of Survey Measurements

Survey measurements may be collected as part of equipment or routine surveys. If the ambient radiation level of an area is being measured, the measurement should be collected at waist-level, or at a height of approximately 1 meter. If a package, container, or vehicle is being measured, the instrument should be placed in contact with the surface, provided that doing so does not present a cross-contamination concern.

When collecting a measurement of an unknown radiation field, use the "fast" response on the instrument and start with the highest scale setting, working downward until the lowest setting the measurement falls within is reached. At that point, switch the response to "slow" and read and record the measurement to the nearest tick mark.

5.1.5 Evaluation of Results

The use of survey data in units of µR/hr is acceptable for use in predicting worker exposures under most circumstances. However, the use of exposure rate meters may not be substituted for required dosimetry.

Measurements of naturally-occurring radioactive materials or of materials shielded by containers may result in an overly conservative estimate of the true radiation levels. The CHDT RSO or designee should be consulted if this appears to be an issue.

6.0 STANDARDS AND CRITERIA

Specific exposure or dose rate limits may be established for the type of survey being performed. The CHDT RSO or designee should be consulted to determine the appropriate limits for any new activity. If the ambient radiation level exceeds 2000 microR/hr (2mR) the CHDT RSO or designee should be notified and work in the area should cease until further direction is received.

An annual instrument calibration must be performed by the instrument manufacturer or other qualified vendor. Copies of the instrument calibration certificates must be maintained for a period of five years. Current calibration certificates should be maintained with the instrument daily QC measurement logs.

7.0 REFERENCES

Ludlum Measurements, Inc., Instruction Manuals, various models

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.08

OPERATION OF ALPHA-BETA SCINTILLATION DETECTORS

1.0 OBJECTIVE

To provide instruction for the operation of dual alpha and beta radiation detectors for the measurement of surface radioactivity for incoming, free release, routine, and health and safety surveys.

2.0 SCOPE

This standard operating procedure (SOP) applies to the operation of radiation survey meters with external scintillation probes to measure alpha and/or beta radiation. These instruments may be used to determine surface alpha or beta radioactivity levels. These instruments may only be used where surface geometry and other environmental conditions permit. The instrument specifically referenced by this SOP is the Ludlum 43-93 alpha-beta scintillation detector with Ludlum 2360 alpha-beta data logger.

3.0 POLICY

Instruments will be used in accordance with manufacturer's recommendations, SOPs, and site-specific requirements by trained personnel. The use of an instrument outside of its intended capabilities requires approval by the CHDT Radiation Safety Officer (RSO) or designee.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP DR 15.RPP.01).

5.0 SURVEY DATA COLLECTION

5.1 Instrument Description

The Ludlum Model 43-93 contains a plastic scintillator in a 100 square centimeter active detector window. The detector has a thin mylar covering along with a protective screen. The 43-93 is used with a 2360 alpha-beta data logger. The front panel controls on the 2360 include a rotary switch for selecting the 4 decade range and instrument shut off, an audio on/off switch, a fast/slow response switch, a toggle switch for the alpha, beta, and dual (alpha+beta) channels, and a rotary switch for scaler counting time, ranging from 0.1 to 60 minutes, with an option for a user-defined time set by the system software on a computer. The scaler count is enabled by a button on the top of the meter handle. The 2360 also has a data logging feature, which can store up to 550 measurements and which may be downloaded to a computer by the RS-232 port at the base of the unit.

5.2 Instrument Setup and Initial Quality Control

Upon receipt of the instrument through purchase or rental, the following steps should be taken to initially setup the instrument and verify that it is in good working order.

a. Verify that the instrument calibration is current; confirm that serial number on instrument matches that on the calibration certificate; confirm high voltage (HV) setting on instrument with calibration

b. Perform ten (10) initial background quality control (QC) measurements

- Use a location away from radioactive sources in a consistent geometry
- Use the 1- or 2-minute scaler count setting, based on requirements determined by the CHDT RSO.
- Depress the scaler count button to initiate the count. Colons (":") will be present in the digital readout during the scaler count. After the count is complete, record the measurement, and repeat for 10 measurements.
- For background, a single count will record the background alpha and beta measurements; record each individually.
- Calculate the average plus and minus 20%. Subsequent background QC measurements must fall within this range. Typical alpha background is between 0 and 2 counts per minute (cpm); beta backgrounds may range from 100 to 300 cpm, depending on location.

c. Perform ten (10) initial source QC measurements

- Use thorium-230 source for alpha measurements and technicium-99 source for beta measurements in a repeatable geometry (i.e., orientation of the source relative to the meter).
- Use same location as background measurements
- Depress the scaler count button to initiate the count. Colons (":") will be present in the digital readout during the scaler count. After the count is complete, record the measurement, and repeat for 10 measurements. Record the alpha measurement when using the thorium-230 source, and the beta measurement when using the technicium-99 source.
- Calculate the average for each radiation plus and minus 20%. Subsequent source QC measurements must fall within this range.

5.2.1 Daily Instrument Quality Control

Each day that the instrument is used, the following QC checks and measurements must be performed and recorded.

a. Check the battery by depressing the "BAT" button

b. Check the HV against the calibrated HV

c. Perform background QC measurement

- Use same location as with initial QC measurements
- Measurement must be within plus or minus 20% of the initial average

d. Perform alpha and beta source QC measurement

- Use same location and source geometry as with initial QC measurements
- Measurement must be within plus or minus 20% of the initial average

If either measurement does not fall within the required tolerances, turn the unit off, turn it back on, and repeat the measurement(s). If the unit fails a second consecutive time, remove the unit from service and notify the CHDT RSO or designee.

5.2.2 Collection of Survey Measurements

Measurements may be collected with the 43-93 either by scanning (using the ratemeter on the 2360) or by direct counting (using the scaler count feature of the 2360). Scanning measurements are typically not effective in detecting alpha radiation due to its short range in air; however, scanning may be performed for beta radiation. When conducting scanning measurements, the audio output of the meter should be audible to the technician so that changes in count rate may be identified without looking away from the surface being surveyed. The mylar window is very thin and fragile, and may be easily torn if it comes into contact with a rough surface. The technician should be familiar with the typical beta count rates expected in the survey environment, which will assist in identifying anomalous count rates. Scanning measurements are collected by moving the detector slowly over the surface, noting any increases in count rate.

Scaler measurements are collected by leaving the probe stationary over a given location, and initiating a scaler count with the meter (typically one minute in length). To allow for consistent measurement geometry, it may be necessary to rest the probe on the surface being measured. However, please note that this action *may result in contamination of the probe* and appropriate precautions should be taken to prevent cross contamination (e.g., the use of removable spacers on the probe, routine wipe and decontamination of probe surfaces, etc). For scaler measurements with the 43-93, record both the alpha and beta measurements.

5.2.3 Evaluation of Results

The 43-93 and 2360 report results in units of cpm. For a meaningful comparison with surface radioactivity limits, the measurement units of cpm will require conversion to decays per minute per 100 square centimeters (dpm/100 cm^2). The following equation will be used to convert the raw measurement in cpm to dpm/100 cm^2:

$$\frac{dpm}{100\,cm^2} = \frac{\frac{C_S}{T_S}}{\varepsilon_T \times (A/100)}$$

Where:

C_S = integrated counts by the instrument

T_S = time period over which the counts were recorded, in minutes

ε_T = total efficiency of the instruments in counts per disintegration; effectively the product of the instrument efficiency (ε_i) and the source efficiency (ε_s)

A = the physical (or "active") probe area in cm^2

Instrument efficiencies may be determined from QC data, from annual instrument calibration certificates, or from the manufacturer's published values. The CHDT RSO or designee will determine the appropriate efficiency to use for a given application. In the absence of application-specific values, standard instrument efficiencies of 0.15 cpm/dpm for alpha radiation and 0.20 cpm/dpm for beta radiation will be used. The measurement may be corrected for background by subtracting an appropriate background value (e.g., representative of the surface or environment) from the raw measurement.

6.0 STANDARDS AND CRITERIA

Specific surface radioactivity limits may be established for the type of survey being performed. The CHDT RSO or designee should be consulted to determine the appropriate limits for any new activity. Release criteria are listed in SOP DR.OPS.13, *Equipment Surveys*, and in other SOPs.

The minimum detectable concentration (MDC) (or minimum detectable activity [MDA]) of the instrument should be known prior to its use to verify that the measurement sensitivity is sufficient for the application. The MDC for a static measurement when background and sample count times are the same may be calculated using the following equation from Abelquist 2001:

$$Static\ MDC\left(\frac{dpm}{100\ cm^2}\right)=\frac{3+4.65\sqrt{C_B}}{\varepsilon_S\varepsilon_i\left(\frac{A}{100}\right)T}$$

Where:

C_B = background counts in time T

T = time period over which counts were recorded, in minutes (for one-minute counts, this value is 1)

ε_s = surface efficiency; values default to 0.25 for alpha and 0.50 for beta if no other information is available

ε_i = instrument efficiency; values default to 0.15 for alpha and 0.20 for beta if no other information is available

A = the physical (or "active") probe area in cm^2

The static measurement MDC when background and sample counting times are different may be calculated using the following equation:

$$Static\ MDC\left(\frac{dpm}{100\ cm^2}\right)=\frac{3+3.29\sqrt{R_B T_{S+B}\left(1+\frac{T_{S+B}}{T_B}\right)}}{\varepsilon_S \varepsilon_i \left(\frac{A}{100}\right) T_{S+B}}$$

Where:

R_B = background count rate, cpm

T_B = background count time, minutes

T_{S+B} = sample count time, minutes

ε_s = surface efficiency; values default to 0.25 for alpha and 0.50 for beta if no other information is available

ε_i = instrument efficiency; values default to 0.15 for alpha and 0.20 for beta if no other information is available

A = the physical (or "active") probe area in cm^2

Measurements for release of equipment or materials should be conducted so that the MDCs reflect sufficient sensitivity for the release criteria. Only results from static measurements may be compared with release criteria; due to higher MDCs, scanning measurements should not be used to determine compliance with release criteria unless project- or task-specific scanning MDCs have been developed by the CHDT RSO.

7.0 REFERENCES

49 CFR 173. *Shippers – General Requirements for Shipments and Packagings*. Current Version.

Abelquist 2001. *Decommissioning Health Physics: A Handbook for MARSSIM Users*, Institute of Physics Publishing, Philadelphia, Pennsylvania.

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Ludlum Measurements, Inc., Instruction Manual Model 43-93 Alpha Beta Scintillation Detector, Current Version.

Ludlum Measurements, Inc., Instruction Manual Model 2360 Alpha Beta Data Logger, Current Version.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.09

OPERATION OF GEIGER MUELLER PANCAKE PROBE

1.0 OBJECTIVE

To provide instruction for the operation of Geiger Mueller (GM) pancake-type probes for the measurement of surface radioactivity levels for receiving, free release, routine, and health and safety surveys.

2.0 SCOPE

This standard operating procedure (SOP) applies to the operation and use of survey meters with GM pancake probes only, such as the Ludlum Model 44-9. These instruments may be used to identify and quantify surface radioactivity levels. These instruments may only be used in low radiation environments. Radiation environments which exceed the capabilities of these instruments are not anticipated.

3.0 POLICY

Instruments will be used in accordance with manufacturer's recommendations, SOPs, and site-specific requirements by trained personnel. The use of an instrument outside of its intended capabilities requires approval by the CHDT Radiation Safety Officer (RSO) or designee.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP DR 15.RPP.01).

5.0 SURVEY DATA COLLECTION

5.1 Instrument Description

The Ludlum Model 44-9 GM pancake probe is a small area (15 square centimeters [cm^2]) probe with an inert gas filled tube. The GM pancake probe may detect alpha, beta, and gamma radiation, but is most efficient in detecting beta and low-energy gamma radiation. Radiation incident upon the tube produces a response in the meter, which may display the results in counts per minute (cpm), microroentgens per hour (µR/hr), or other units. ***The preferred units for this instrument are cpm.***

The GM pancake probe may be used with a number of different meters (e.g., Ludlum Model 3, Ludlum Model 12, and Ludlum Model 177), provided that the meter has been specifically calibrated to do so. Meters may not be interchanged with probes; a calibration must be performed prior to use of a meter with a second probe. The front panel controls on the meter generally include a rotary switch for selecting the 5 decade range and instrument shut off, an audio on/off switch, a fast/slow response switch, and push buttons for activating the meter lamp, count reset, high voltage display and battery test.

5.2 Instrument Setup and Initial Quality Control

Upon receipt of the instrument through purchase or rental, the following steps should be taken to initially setup the instrument and verify that it is in good working order.

a. Verify that the instrument calibration is current; confirm that serial number on instrument matches that on the calibration certificate; confirm high voltage (HV) setting on instrument with calibration

b. Perform ten (10) initial background quality control (QC) measurements

- Use location away from radioactive sources
- Set response to "S" for slow and use
- Using the lowest meter scale, depress the reset button ("RES") and allow the needle to come to a rest (approximately 20 to 30 seconds). Record the measurement to the nearest tick mark, and repeat for 10 measurements.
- Calculate the average plus and minus 20%. Subsequent background QC measurements must fall within this range. Typical background for a GM pancake probe is between 40 and 80 cpm.

c. Perform ten (10) initial source QC measurements

- Use cesium-137 source in a repeatable geometry (i.e., orientation of the source relative to the meter).
- Use same location as background measurements
- Using an appropriate scale, depress the reset button ("RES") and allow the needle to come to a rest (approximately 20 to 30 seconds). Record the measurement to the nearest tick mark, and repeat for 10 measurements.
- Calculate the average plus and minus 20%. Subsequent source QC measurements must fall within this range.

5.2.1 Daily Instrument Quality Control

Each day that the instrument is used, the following QC checks and measurements must be performed and recorded.

a. Check the battery by depressing the "BAT" button

b. Check the HV against the calibrated HV

c. Perform background QC measurement
   - Use same location as with initial QC measurements
   - Measurement must be within plus or minus 20% of the initial average

d. Perform source QC measurement
   - Use same location and source geometry as with initial QC measurements
   - Measurement must be within plus or minus 20% of the initial average

If either measurement does not fall within the required tolerances, turn the unit off, turn it back on, and repeat the measurement(s). If the unit fails a second consecutive time, remove the unit from service and notify the CHDT RSO or designee.

5.2.2 Collection of Survey Measurements

Survey measurements with the GM pancake probe may be collected as part of equipment or routine surveys for surface contamination. The probe should be placed in contact with or as close as possible to the surface being surveyed, keeping in mind that direct contact may present a cross-contamination concern. To perform scanning measurements, the probe should be moved slowly across the surface at a consistent distance. The technician should use the instrument's audio response to initially identify potential contamination. If the count rate is heard to increase, the probe should be returned to the affected area and held over for a longer time period to determine if the readings are consistent. The range of observed count rates should be noted and recorded on the appropriate survey form, along with the instrument's make and model, serial numbers, and calibration due date.

5.2.3 Evaluation of Results

In most circumstances, measurements collected with a GM pancake probe will be qualitatively evaluated with background. As a result, the technician must have a thorough understanding of the background associated with the instrument and the audio response. When evaluating GM pancake probe data qualitatively, a measurement greater than 1.5 or 2 times background is typically indicative of contamination. The specific criteria will be determined by the CHDT RSO or designee.

In the event that a quantitative evaluation of survey data is required, the following calculation is required to convert the instrument response in units of cpm to the standard units of surface radioactivity of decays per minute per 100 cm^2.

$$Net\ Activity\left(\frac{dpm}{100cm^2}\right)=\frac{Measurement-Background\ (cpm)}{Efficiency\left(\frac{cpm}{dpm}\right)\times\left(\frac{\mathrm{Pr}obe\ Area\ cm^2}{100\ cm^2}\right)}$$

For a standard GM pancake probe, the general efficiency may be estimated to be 15% (0.15 cpm/dpm) and the probe area is 15 cm^2.

6.0 STANDARDS AND CRITERIA

Specific surface contamination limits may be established for the type of survey being performed. The CHDT RSO or designee should be consulted to determine the appropriate limits for any new activity.

An annual instrument calibration must be performed by the instrument manufacturer or other qualified vendor. Copies of the instrument calibration certificates must be maintained for a period of five years. Current calibration certificates should be maintained with the instrument daily QC measurement logs.

7.0 REFERENCES

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Ludlum Measurements, Inc., Instruction Manual Model 44-9 Geiger Mueller Pancake Probe, Current Version.

Ludlum Measurements, Inc., Instruction Manual Model 3 Survey Meter, Current Version.

Ludlum Measurements, Inc., Instruction Manual Model 12 Rate Meter, Current Version.

Ludlum Measurements, Inc., Instruction Manual Model 177 Rate Meter, Current Version.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.10
OPERATION OF GAMMA SCINTILLATION DETECTORS

1.0 OBJECTIVE

To provide instruction for the operation of gamma scintillation detectors for the measurement of gamma radiation levels for environmental characterization, remediation support, and contamination monitoring surveys.

2.0 SCOPE

This standard operating procedure (SOP) applies to the operation of gamma scintillation detectors using external probes with sodium iodide (NaI) crystals or plastic scintillators. These instruments may be used to determine ambient gamma radiation levels and/or worker exposure in facility areas and from packages or vehicles.

3.0 POLICY

Instruments will be used in accordance with manufacturer's recommendations, SOPs, and site-specific requirements by trained personnel. The use of an instrument outside of its intended capabilities requires approval by the CHDT Radiation Safety Officer (RSO) or designee.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP DR 15.RPP.01).

5.0 SURVEY DATA COLLECTION

5.1 Instrument Description

Gamma scintillation detectors are a group of instruments that utilize an external gamma scintillation crystal with a ratemeter or scaler detector. NaI crystals that are present within the detectors may range in size from 1-inch by 1-inch (1x1) to 3-inches by 3-inches (3x3). Thinner NaI crystals or plastic scintillators may also be used to preferentially detect lower-energy gamma radiation and x-rays. The CHDT RSO or designee should be consulted for the appropriate crystal size for the specific application.

The meters typically used with gamma detectors provide measurements in units of counts per minute (cpm), although some meters may be calibrated to provide measurements in units of exposure (such as microRoentgens per hour [μR/hr]). Gamma detectors may be used with a global positional system (GPS) device to allow for data logging and subsequent mapping of surface gamma radiation levels.

5.2 Instrument Setup and Initial Quality Control

Upon receipt of the instrument through purchase or rental, the following steps should be taken to initially setup the instrument and verify that it is in good working order.

a. Verify that the instrument calibration is current; confirm that serial number on instrument matches that on the calibration certificate; confirm high voltage (HV) setting on instrument with calibration

b. Perform ten (10) initial background quality control (QC) measurements
   - Use location away from radioactive sources
   - Depress the scaler count button to collect a one-minute count. Record the measurement, and repeat for 10 measurements.
   - Calculate the average plus and minus 20%. Subsequent background QC measurements must fall within this range.

c. Perform ten (10) initial source QC measurements
   - Use cesium-137 source in a repeatable geometry (i.e., orientation of the source relative to the meter). Other gamma radiation sources may also be applicable depending on the specific instrument used.
   - Use same location as background measurements
   - Depress the scaler count button to collect a one-minute count. Record the measurement, and repeat for 10 measurements.
   - Calculate the average plus and minus 20%. Subsequent source QC measurements must fall within this range.

d. If the meter used with the instrument does not perform scaler measurements (i.e., only has ratemeter function), consult SOPs 15.OPS.07, *Operation of Exposure Rate/ Dose Rate Meter*, and 15.OPS.09, *Operation of GM Pancake Probe*, for instruction on conducting QC measurements on a ratemeter instrument.

5.2.1 Daily Instrument Quality Control

Each day that the instrument is used, the following QC checks and measurements must be performed and recorded.

a. Check the battery by depressing the “BAT” button

b. Check the HV against the calibrated HV

c. Perform background QC measurement
   - Use same location as with initial QC measurements
   - Measurement must be within plus or minus 20% of the initial average

d. Perform source QC measurement
   - Use same location and source geometry as with initial QC measurements

- Measurement must be within plus or minus 20% of the initial average

If either measurement does not fall within the required tolerances, turn the unit off, turn it back on, and repeat the measurement(s). If the unit fails a second consecutive time, remove the unit from service and notify the CHDT RSO or designee.

5.2.2 Collection of Survey Measurements

While scaler measurements can be collected with a gamma scintillator, it is primarily a scnning tool. Survey measurements with a gamma scintillator may be collected in exterior locations as part of a gamma walkover survey (GWS) or as part of a contamination survey. Scanning measurements collected during a GWS rely on the technician's monitoring of the audio output of the meter to identify elevated areas. Data logging by a GPS system is used to log individual measurements and locations, and can be used to determine scanning speeds. When scanning, the technician should keep the detector approximately 6 inches from the ground surface, moving the detector in a "Z"-pattern while walking forward. If the survey goal is to identify contamination, any locations with increases in count rates should be re-surveyed at a slower pace in order to pinpoint the source location.

5.2.3 Evaluation of Results

Logged scanning measurements can be evaluated for outliers by generating contour maps and or performing statistics on the data. Calculation of the Z-score (i.e., number of standard deviations from the mean) of each measurement in the data set can identify statistical anomalies. In addition, a time series plot of the logged data versus collection time may also identify anomalies and or fluctuations in naturally-occurring background.

The scanning data may also be evaluated against the observed ambient background in the area. In addition, it may be possible to correlate the instrument response to concentrations of radionuclides in soil using the Microshield modeling software and procedures developed in NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* (NRC 1998). The CHDT RSO should be consulted on project- or task-specific data evaluation requirements.

6.0 STANDARDS AND CRITERIA

Specific evaluation criteria may be established for the type of survey being performed. The CHDT RSO or designee should be consulted to determine the appropriate limits for any new activity.

7.0 REFERENCES

Detector-specific instrument operation manuals

NRC 1998. *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG-1507, June.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.11
ROUTINE CONTAMINATION SURVEYS

1.0 OBJECTIVE

To define general and specific methods and procedures for conducting routine surveys for radioactive contamination at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

2.0 SCOPE

This standard operating procedure (SOP) addresses the performance of routine contamination surveys to determine and document ambient radiation and contamination levels in locations around and within the CHDT landfill and to evaluate if controls are necessary when performing routine maintenance or other tasks that could encounter radioactive materials. This standard operating procedure (SOP) does not apply to special or emergency situations.

3.0 POLICY

Contamination surveys will be conducted or performed in areas potentially impacted by radioactive materials on a routine basis to identify contamination issues and verify that worker exposure is maintained as low as reasonably achievable (ALARA). In addition, routine contamination surveys that demonstrate an absence of contamination will serve to demonstrate the effectiveness of contamination control methods and will be used as a baseline of surface radioactivity levels if a contamination event is suspected.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (DR.RPP.01).

5.0 GENERAL SURVEY METHODS

Direct surveys may be conducted using a Ludlum Model 44-9 Geiger Mueller (GM) “pancake”-type probe with Ludlum Model 3 survey meter (or equivalent) for surface beta-gamma measurements; a Ludlum 43-93 alpha-beta scintillation detector with Ludlum 2360 survey meter (or equivalent) for surface alpha-beta measurements; a Ludlum Model 19 (or equivalent) for ambient exposure rate measurements; a Ludlum Model 193-6 Survey Wand (or equivalent) for large area gamma scanning measurements; or any other radiation measuring instrument appropriate for the task. Equipment surveys will be supported by smear sample analyses for removable radioactivity using the Ludlum 3030 alpha-beta sample counter (or equivalent).

5.1 Pre-Survey Instrument Check List

Prior to use of any field instrument, the operation of the probe and survey meter used shall be checked using the following general procedure. Specific direction is provided in the SOP for each individual instrument.

a. Check Batteries

- Turn the switch to "BAT" or flip the "BAT" switch to "ON."
- The needle on the meter face should move to a position within or beyond the indicated area on the meter scale.
- Replace batteries if needed before use.

b. Check Count Rate Meter Speaker

- Turn the audio switch, if present, to ON.
- Set the Fast-Slow toggle switch to the F position (for fast response).
- Set the count rate meter scale to X1.
- The rate meter should "chirp" or "click."
- If the speaker does not function, the survey meter can be used, but the survey technician will need to check the meter reading or display frequently.

c. Background Check

- Conduct background check during daily quality control (QC) measurements.
- On most instruments, the background count rate is observed when the survey meter scale is set to the lowest scale setting – X0.1 or X1.
- Prior to conducting surveys, verify background at that location.
- Most surveys rely upon the technician to identify contamination above background. Therefore, *the survey technician must have a strong understanding of what background is for the instrument being used*.
- Do not use the meter if it does not register a background reading.

d. Source Check

- Conduct source check during daily QC measurements.
- Use the same source in the same geometry for all QC measurements.
- The technician should be familiar with the detector response to a source.
- Do not use the instrument if the QC falls out of requirements.

5.2 Routine Contamination Surveys

Routine contamination surveys will be performed to verify the absence of contamination in high-traffic portions of the site, areas where eating, drinking, or washing may occur, or other areas that may be susceptible to cross contamination. Routine surveys shall be recorded in ink on appropriate survey forms, which shall document the following:

- Time and date of the survey
- Technician(s) performing the survey
- Instrument(s) used, with serial number, calibration due date
- Measurement locations, with pictures or drawings as necessary
- Background and efficiency information for the instruments, as appropriate
- Raw measurements, including measurement type and count time (if necessary)

Where necessary, surveys may be documented in a field logbook in the absence of a survey form. Pictures or drawings of equipment, vehicles, or frequently surveyed items may be electronically inserted into the survey form to facilitate documentation. For frequent routine surveys, specific survey forms may be developed by the CHDT RSO or designee to facilitate data collection.

5.3 Routine Survey Frequency

The frequency of routine surveys will be dependent on the frequency of radioactive material receipt at the CHDT landfill. Surveys will be conducted according to the frequencies listed in Table 1. A minimum of five locations (subject to each of the measurements indicated) will be required for each area in Table 1.

Table 1. Frequency of Routine Contamination Surveys

Area	Minimum Survey Frequency	Survey Type
Disposal cell, before and after installation of daily cover	Daily during radioactive materials emplacement	Exposure rate (Ludlum 193-6 or Model 19) or gamma
Cell truckwash	Daily during radioactive materials emplacement	Exposure rate or gamma; removable alpha/beta
Cell sample shack	Weekly during receipt of radioactive materials; otherwise monthly	Exposure rate or gamma; fixed alpha/beta; removable alpha/beta

Area	Minimum Survey Frequency	Survey Type
Sample station	Weekly during receipt of radioactive materials; otherwise monthly	Exposure rate or gamma; fixed alpha/beta; removable alpha/beta
Laboratory area	Weekly during receipt of radioactive materials; otherwise monthly	Exposure rate or gamma; fixed alpha/beta; removable alpha/beta
Men's locker room	Weekly during receipt of radioactive materials; otherwise monthly	Exposure rate or gamma; fixed alpha/beta; removable alpha/beta
Operations building lunch room	Weekly during receipt of radioactive materials; otherwise monthly	Exposure rate or gamma; fixed alpha/beta; removable alpha/beta

Other areas or buildings may be subject to contamination surveys on an as-needed basis or randomly, based on radioactive materials handling activities. The CHDT RSO or designee will determine if additional areas require routine surveys.

5.4 Exposure Rate Measurements

Exposure or dose rate measurements should be operated according to SOP 15.OPS.07, *Operation of Exposure Rate/ Dose Rate Meters*. Ambient exposure rate measurements using the Model 19 or similar instrument during routine contamination surveys should be collected at waist level to provide a measurement of the external trunk dose to a worker. Exposure rate measurements collected with the 193-6 should be collected at a distance of 6 inches or less from the ground surface.

5.5 Measurements for Fixed Contamination

Measurements for fixed contamination can be directly collected by scaler or scanning measurements with field instruments. Scaler measurements are collected by leaving the probe stationary over a given location, and initiating a scaler count with the meter (typically one minute in length). To allow for consistent measurement geometry, it may be necessary to rest the probe on the surface being measured. However, please note that this action *may result in contamination of the probe* and appropriate precautions should be taken to prevent cross contamination (e.g., the use of removable spacers on the probe, routine wipe and decontamination of probe surfaces, etc).

Scanning measurements are collected by slowly moving the probe over a given surface. The instrument's audio response and meter reading are monitored to identify any anomalies. Typically scanning measurements are performed to increase survey coverage over an area. The probe is held approximately 1 centimeter from the surface being surveyed and is moved at a rate of approximately 2 inches per second. If the count rate audibly increases, or if the alarm sounds, pause for 5 to 10 seconds over the area to provide for adequate time for instrument response. Scanning measurements may be recorded as a range of measurements for a given surface or area, and are generally evaluated to identify any outliers above background.

5.6 Measurements for Removable Contamination

Measurements for removable contamination are measured indirectly by the collection of smear or wipe samples. Smears are collected with a 47-millimeter smear filter. Using evenly applied pressure, the smear should be collected with an S-shape over approximately 100 square centimeters. The smear may then be removed from the paper folder, adhered to an aluminum planchet and counted in the alpha-beta sample counter.

If directed by the CHDT RSO or designee, large-area smears may be collected on a larger surface area using masselin or other absorbent cloth. The large area smear may then be checked using a field instrument for any radioactivity above background. A large area smear should be considered to be a qualitative measurement only.

6.0 STANDARDS AND CRITERIA

6.1 Data Conversion

For comparison with the measurement criteria listed in Section 6.2, surface measurements in counts per minute (cpm) must be converted to units of decays per minute per 100 square centimeters (dpm/100cm^2). Procedures for data conversion are provided in SOPs 15.OPS.08, *Operation of Alpha-Beta Scintillation Detector,* and 15.OPS.09, *Operation of GM Pancake Probe*.

6.2 Surface Contamination Levels

Fixed radioactivity measured by direct measurements and removable activity measured by smear samples will be evaluated against the values listed in Table 1, from ANSI/HPS N13.12-1999 (ANSI/HPS 1999). In the absence of radionuclide data to establish the appropriate screening group, the most conservative screening levels will be used.

Table 1 – Surface Contamination Limits for Free Release Surveys

Radionuclide Group	Surface Screening Levels (Bq/cm^2)	Surface Screening Levels ($dpm/100cm^2$)[a]	Removable Contamination Limits ($dpm/100cm^2$)
Group 1 Radium and Thorium: ^{210}Po, ^{210}Pb, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and associated decay chains[b]	0.1	600	60 alpha
Group 2 Uranium: ^{234}U, ^{235}U, ^{238}U, natural uranium[c], and associated decay chains	1	6,000	600 alpha
Group 3 General Beta-Gamma Emitters: ^{24}Na, ^{36}Cl, ^{59}Fe, ^{109}Cd, ^{131}I, ^{129}I, ^{144}Ce, ^{198}Au, ^{241}Pu, and others	10	60,000	600 beta
Group 4 Other Beta-Gamma Emitters: ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{45}Ca, ^{51}Cr, ^{55}Fe, ^{63}Ni, ^{89}Sr, ^{99}Tc, ^{111}In, ^{125}I, ^{147}Pm, and others	100	600,000	600 beta

(a) Rounded to one significant figure.
(b) For decay chains, the screening levels represent the total activity (i.e. the activity of the parent plus the activity of all progeny) present.
(c) Where the Natural Uranium activity equals 48.9% from ^{238}U, plus 48.9% from ^{234}U, plus 2.25% from ^{235}U.

6.3 Exposure Rate Limits

For areas with no known radioactive source, exposure rates are expected to be at background levels. If above-background levels are observed, the CHDT RSO should be notified.

For release of the disposal cell following daily cover, the exposure rates should be no greater than 1.5X the average background measurement.

Other exposure rate limits may apply depending on the situation or activity. The CHDT RSO may establish additional limits as necessary to provide additional worker protection.

6.4 Quality Control

In addition to the daily QC measurements required by each individual instrument SOP, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

7.0 REFERENCES

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.12
PERSONNEL CONTAMINATION SURVEYS

1.0 OBJECTIVE

To define general and specific methods and procedures for personnel contamination surveys at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

2.0 SCOPE

This standard operating procedure (SOP) applies to the release of personnel following decontamination activities, from radioactive materials handling areas, and after an emergency response event.

3.0 POLICY

Personnel surveys are required when personnel contamination is suspected to prevent further contamination of personnel, equipment, and/or facilities. In addition, personnel surveys are required to verify and document that worker exposures are maintained as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan SOP 15.RPP.01.

5.0 GENERAL SURVEY METHODS

Direct surveys of personnel ("frisks") may be conducted using a Geiger Mueller (GM) "pancake"-type probe (or equivalent) for beta-gamma measurements; or an alpha-beta scintillation detector (or equivalent) for alpha-beta measurements. Other instruments that measure ambient, rather than surface, radioactivity, such as a Ludlum Model 19 (or equivalent) for ambient exposure rate measurements, or a Ludlum Model 193-6 Survey Wand (or equivalent) for large area gamma scanning measurements, are not appropriate for conducting personnel contamination surveys.

5.1 Pre-Survey Instrument Check List

Prior to use of any field instrument, the operation of the probe and survey meter used shall be checked using the following general procedure.

a. Check Batteries
   - Turn the switch to "BAT" or flip the "BAT" switch to "ON."
   - The needle on the meter face should move to a position within or beyond the indicated area on the meter scale.
   - Replace batteries if needed before use.

b. Check Count Rate Meter Speaker
   - Turn the audio switch, if present, to ON.
   - Set the Fast-Slow toggle switch to the F position (for fast response).
   - Set the count rate meter scale to X1.
   - The rate meter should "chirp" or "click."
   - If the speaker does not function, the survey meter can be used, but the surveyor will need to check the meter reading or display frequently.

c. Background Check
   - Conduct background check during daily quality control (QC) measurements.
   - On most instruments, the background count rate is observed when the survey meter scale is set to the lowest scale setting – X0.1 or X1.
   - Prior to conducting surveys, verify background at that location.
   - Most surveys rely upon the technician to identify contamination above background. Therefore, *the survey technician must have a strong understanding of what background is for the instrument being used*.
   - Do not use the meter if it does not register a background reading.

d. Source Check
   - Conduct source check during daily QC measurements.
   - Use the same source in the same geometry for all QC measurements.
   - The technician should be familiar with the detector response to a source.
   - Do not use the instrument if the QC falls out of requirements.

5.2 General Personnel Surveys

Where possible, CHDT personnel should conduct the survey measurements themselves. Activities that may require a second or support technician will be identified in advance. The general scanning or frisk procedure is as follows:

a. Prior to initiating the activity, verify that the instrument is turned on, the audio response is audible, and the probe is face up so that the hands may be scanned without touching the instrument.

b. After completion of the activity, start the frisk by scanning the fronts and backs of hands without touching the instrument. After the hands have been determined to be free of contamination, the instrument may be picked up to conduct the remainder of the frisk.

c. Hold the probe 1 cm from the body surface being surveyed and move the probe slowly over the surface, approximately 2 inches per second.

d. If the count rate increases, pause for 5 to 10 seconds over the area to provide for adequate time for instrument response.

e. If consistent count rates in excess of background are detected, decontamination according to SOP 15.OPS.19 shall be followed prior to re-surveying.

f. The remaining survey order will be from head to foot, *prior to the removal of personal protective equipment (PPE),* as follows:

- Head – pause at the mouth and nose for five seconds; conduct thorough scan of respirator cartridges and faceshield, if present
- Neck
- Arms
- Chest and abdomen
- Back, hips, and seat of pants
- Legs – pause at the knees and cuffs for five seconds
- Tops of shoes or shoe coverings
- Bottom of shoes or shoe coverings
- Personal items – hats, gloves, notebooks, equipment, etc.

g. If measurements on PPE are at background levels, the PPE may be removed under the constraints of the hazardous materials handling requirements (i.e., without regard to radioactivity)

h. If measurements that exceed background are found on personnel, contact the CHDT RSO. Decontamination of personnel will be performed according to SOP 15.OPS.19, *Decontamination of Personnel*. Decontamination surveys shall be recorded in ink on appropriate survey forms, which shall document the following:

- Time and date of the survey
- Technician(s) performing the survey
- Instrument(s) used, with serial number, calibration due date
- Measurement locations, with pictures or drawings as necessary
- Background and efficiency information for the instruments, as appropriate
- Raw measurements, including measurement type and count time (if necessary)

Where necessary, surveys may be documented in a field logbook in the absence of a survey form. Pictures or drawings of the affected personnel may be electronically inserted into the survey form to facilitate documentation.

5.3 Additional Personnel Surveys

In some cases, additional measurement sensitivity may be required. An integrated scanning count may be collected using the 43-93 alpha/beta probe and 2360 scaler/data logger. The collected measurement is essentially a timed scan, where the scaler count is initiated and the detector is slowly moved at a consistent distance over a selected portion of the body (e.g., the feet). The total number of counts over a set time, such as one or two minutes, may be used for compliance with surface activity limits. The total counting time, which is greater than what is done with a typical scan, allows for a lower calculated minimum detectable concentration (MDC). MDC calculations for the 43-93 are described in SOP 15.OPS.08, *Operation of Alpha-Beta Scintillation Detector*.

6.0 STANDARDS AND CRITERIA

6.1 Indistinguishable from Background

Personnel contamination surveys will be performed with the criterion of no contamination present, or no radioactivity above background. Therefore, the technician must have a clear understanding of the appropriate background levels for the instrument being used and for the location of the survey.

6.2 Data Conversion

For comparison with the measurement criteria listed in Section 6.3, surface measurements in counts per minute (cpm) must be converted to units of decays per minute per 100 square centimeters (dpm/100cm^2). Procedures for data conversion are provided in SOPs 15.OPS.08, *Operation of Alpha-Beta Scintillation Detector,* and 15.OPS.09, *Operation of GM Pancake Probe*.

6.3 Surface Contamination Limits

Fixed and removable activity that may be present on PPE will be evaluated against the values listed in Table 1, from ANSI/HPS N13.12-1999 (ANSI/HPS 1999). In the absence of radionuclide data to establish the appropriate screening group, the most conservative screening levels will be used. PPE may also be assumed to be contaminated and properly disposed of if desired.

Table 1 – Surface Contamination Limits for Free Release Surveys

Radionuclide Group	Surface Screening Levels (Bq/cm^2)	Surface Screening Levels ($dpm/100cm^2$)[(a)]	Removable Contamination Limits ($dpm/100cm^2$)
Group 1 Radium and Thorium: ^{210}Po, ^{210}Pb, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and associated decay chains[(b)]	0.1	600	60 alpha
Group 2 Uranium: ^{234}U, ^{235}U, ^{238}U, natural uranium[(c)], and associated decay chains	1	6,000	600 alpha
Group 3 General Beta-Gamma Emitters: ^{24}Na, ^{36}Cl, ^{59}Fe, ^{109}Cd, ^{131}I, ^{129}I, ^{144}Ce, ^{198}Au, ^{241}Pu, and others	10	60,000	600 beta
Group 4 Other Beta-Gamma Emitters: ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{45}Ca, ^{51}Cr, ^{55}Fe, ^{63}Ni, ^{89}Sr, ^{99}Tc, ^{111}In, ^{125}I, ^{147}Pm, and others	100	600,000	600 beta

(a) Rounded to one significant figure.
(b) For decay chains, the screening levels represent the total activity (i.e. the activity of the parent plus the activity of all progeny) present.
(c) Where the Natural Uranium activity equals 48.9% from ^{238}U, plus 48.9% from ^{234}U, plus 2.25% from ^{235}U.

6.4 Quality Control

In addition to the daily QC measurements required for each individual instrument, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

7.0 REFERENCES

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.13
EQUIPMENT AND VEHICLE RELEASE SURVEYS

1.0 OBJECTIVE

To define general and specific methods and procedures for conducting radiation surveys for release of equipment from restricted areas at the Clean Harbors Deer Trail (CHDT) landfill or other job sites, or following decontamination.

2.0 SCOPE

This standard operating procedure (SOP) applies to the release of equipment or vehicles following their use in restricted areas at the CHDT facility, or following decontamination.

3.0 POLICY

Radiological contamination surveys will be performed on all equipment leaving restricted areas to verify surface contamination levels meet appropriate release limits. In addition, contamination surveys will be performed following the decontamination of equipment to document the effectiveness of decontamination prior to unrestricted release.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (15.RPP.01).

5.0 GENERAL SURVEY METHODS

Direct surveys of equipment may be conducted using a Ludlum Model 44-9 Geiger Mueller (GM) “pancake”-type probe with Ludlum Model 12 survey meter (or equivalent) for surface beta-gamma measurements; a Ludlum 43-93 alpha-beta scintillation detector with Ludlum 2360 survey meter (or equivalent) for surface alpha-beta measurements; a Ludlum Model 19 (or equivalent) for ambient exposure rate measurements; a Ludlum Model 193-6 Survey Wand (or equivalent) for large area gamma scanning measurements; or any other radiation measuring instrument appropriate for the task. Equipment surveys will be supported by smear sample analyses for removable radioactivity using the Ludlum 3030 alpha-beta sample counter (or equivalent).

5.1 Pre-Survey Instrument Check List

Prior to use of any field instrument, the operation of the probe and survey meter used shall be checked using the general guidelines provided in SOP’s 15.OPS.07, 15.OPS.08, 15.OPS.09, and 15.OPS.10 depending on the type of instruments to be used. .

5.2 Equipment and Vehicle Release Surveys

Release surveys will be performed to free-release equipment, containers and vehicles exiting restricted areas of the site or when leaving the facility. Where possible, surveys will be conducted in dedicated areas. Equipment and vehicle surveys shall be recorded in ink on appropriate survey forms, which shall document the following:

- Time and date of the survey
- Technician(s) performing the survey
- Instrument(s) used, with serial number, calibration due date
- Measurement locations, with pictures or drawings as necessary
- Background and efficiency information for the instruments, as appropriate
- Raw measurements, including measurement type and count time (if necessary)

Where necessary, surveys may be documented in a field logbook in the absence of a survey form. Pictures or drawings of equipment, vehicles, or frequently surveyed items may be electronically inserted into the survey form to facilitate documentation.

For free release surveys of vehicles containers, and equipment, a minimum of five locations will be measured for fixed and/or removable contamination. The CHDT RSO or designee will determine additional survey requirements as necessary. Measurements for fixed contamination will be collected prior to the collection of smear samples. Specific measurement locations are to be determined at the discretion of the survey technician; however, measurements should be biased toward the most likely areas of contamination to provide conservative survey results. These areas may include the tires or treads; undercarriage of the vehicle; within the cab of the vehicle; within equipment buckets; or on other surfaces potentially contacted by contaminated material.

5.3 Class 7 Empty Package Survey Procedures

Class 7 waste conveyances and waste containers may be returned to the waste generator without undergoing complete free release procedures if they are shipped as Class 7 Empty Packages.

Requirements for these shipments are governed by the US DOT regulations of 49CFR 173.428. Trained CHDT employees will ensure that Class 7 empty packages will not leave the facility unless these requirements are met. The following procedures will be used to ensure compliance.

5.3.1 Class 7 Empty Packages must be subject to an exclusive use agreement. The CHDT RSO or designee will ensure that proper instructions are on file and carried with the shipping papers.

5.3.2 The package will be marked as appropriate (UN2908). This will be verified at the time the shipment leaves the facility.

5.3.3 An “Empty” Label will be affixed to the packaging; all other labels must be removed, obliterated, or covered. This will be verified at the time the shipment leaves the facility.

5.3.4 Surveys of radiation levels of the external surface of the package will be done to ensure that radiation levels are less than or equal to 0.5mR/hr. Radiation levels will be documented on the survey report.

5.3.5 The external surface of the container will be surveyed for removable contamination to ensure that it is less than or equal to 220 dpm/cm^2. Internal surface of the package will be surveyed to ensure that it is less than 22,000dpm/cm^2. Surface contamination will be documented on the survey report.

5.3.6 The packaging must be in unimpaired condition and securely closed to prevent the leakage of radioactive material under normal conditions. This will be verified by inspection.

5.3.7 Training – CHDT employees will be properly trained in the requirements of shipping excepted packaging empty containers.

5.4 Measurements for Fixed Contamination

Measurements for fixed contamination can be directly collected by scaler or scanning measurements with field instruments. Scaler measurements are collected by leaving the probe stationary over a given location, and initiating a scaler count with the meter (typically one minute in length). To allow for consistent measurement geometry, it may be necessary to rest the probe on the surface being measured. However, please note that this action *may result in contamination of the probe* and appropriate precautions should be taken to prevent cross contamination (e.g., the use of removable spacers on the probe, routine wipe and decontamination of probe surfaces, etc).

Scanning measurements are collected by slowly moving the probe over a given surface. The instrument's audio response and meter reading are monitored to identify any anomalies. Typically scanning measurements are performed to increase survey coverage over an area. The probe is held approximately 1 centimeter from the surface being surveyed and is moved at a rate of approximately 2 inches per second. If the count rate audibly increases, or if the alarm sounds, pause for 5 to 10 seconds over the area to provide for adequate time for instrument response. Scanning measurements may be recorded as a range of measurements for a given surface or area, and are generally evaluated to identify any outliers above background.

5.5 Measurements for Removable Contamination

Measurements for removable contamination are measured indirectly by the collection of smear or wipe samples. Smears are collected with a 47-millimeter smear filter. Using evenly applied pressure, the smear should be collected with an S-shape over approximately 100 square centimeters. The smear may then be removed from the paper folder, adhered to an aluminum planchet and counted in the alpha-beta sample counter.

If directed by the CHDT RSO or designee, large-area smears may be collected on a larger surface area using masselin or other absorbent cloth. The large area smear may then be checked using a field instrument for any radioactivity above background. A large area smear should be considered to be a qualitative measurement only.

6.0 STANDARDS AND CRITERIA

6.1 Data Conversion

For comparison with the measurement criteria listed in Sections 6.2 and 6.3, surface measurements in counts per minute (cpm) must be converted to units of decays per minute per 100 square centimeters (dpm/100cm^2). Procedures for data conversion are provided in SOPs 15.OPS.08, *Operation of Alpha-Beta Scintillation Detector,* and 15.OPS.09, *Operation of GM Pancake Probe*. The Ludlum 3030 used at CHDT provides measurements in units of dpm.

6.2 Surface Contamination Levels

Fixed radioactivity measured by direct measurements and removable activity measured by smear samples will be evaluated against the values listed in Table 1, from ANSI/HPS N13.12-1999 (ANSI/HPS 1999). In the absence of radionuclide data to establish the appropriate screening group, the most conservative screening levels will be used.

Table 1 – Surface Contamination Limits for Free Release Surveys

Radionuclide Group	Surface Screening Levels (Bq/cm^2)	Surface Screening Levels (dpm/100cm^2)[(a)]	Removable Contamination Limits (dpm/100cm^2)
Group 1 Radium and Thorium: ^{210}Po, ^{210}Pb, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and associated decay chains[(b)]	0.1	600	60 alpha
Group 2 Uranium: ^{234}U, ^{235}U, ^{238}U, natural uranium[(c)], and associated decay chains	1	6,000	600 alpha
Group 3 General Beta-Gamma Emitters: ^{24}Na, ^{36}Cl, ^{59}Fe, ^{109}Cd, ^{131}I, ^{129}I, ^{144}Ce, ^{198}Au, ^{241}Pu, and others	10	60,000	600 beta
Group 4 Other Beta-Gamma Emitters: ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{45}Ca, ^{51}Cr, ^{55}Fe, ^{63}Ni, ^{89}Sr, ^{99}Tc, ^{111}In, ^{125}I, ^{147}Pm, and others	100	600,000	600 beta

(a) Rounded to one significant figure.
(b) For decay chains, the screening levels represent the total activity (i.e. the activity of the parent plus the activity of all progeny) present.
(c) Where the Natural Uranium activity equals 48.9% from ^{238}U, plus 48.9% from ^{234}U, plus 2.25% from ^{235}U.

6.3 Transportation – Non-Fixed Contamination

Contamination control limits for non-fixed (i.e., removable) surface contamination are established by the Department of Transportation (DOT) in 49 CFR 173.443. Additional requirements for empty packaging are established in 49 CFR 173.428. These limits are summarized in Table 2.

Table 2 – DOT Non-Fixed Surface Contamination Limits

Radionuclide Group	Maximum Permissible Limit (Bq/cm^2)	Maximum Permissible Limit (dpm/cm^2)[(a)]	Maximum Permissible Limit ($dpm/100\ cm^2$)[(a)]	Maximum Permissible Internal Limit for Empty Packaging ($dpm/100\ cm^2$)[(a)]
1. Beta and gamma emitters and low-toxicity alpha emitters	4	220	22,000	220,000
2. All other alpha-emitting radionuclides	0.4	22	2200	22,000

(a) Averaged over 300 cm^2.

In addition, there are exposure rate limits associated with different types of shipments. Task-specific direction will be provided by the CHDT RSO or designee regarding these limits.

6.4 Quality Control

In addition to the daily QC measurements required for each individual instrument, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

7.0 REFERENCES

49 CFR 173. *Shippers – General Requirements for Shipments and Packagings*. Current Version.

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.14
SPILL SURVEYS

1.0 OBJECTIVE

To define general and specific methods and procedures for conducting radiation surveys at locations of spills of radioactive materials at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

2.0 SCOPE

This standard operating procedure (SOP) applies to radiological surveys of areas where spills of radioactive materials have occurred. Both initial response surveys (to characterize the extent of the spill) and post-cleanup survey (to verify that cleanup criteria are met) are addressed.

3.0 POLICY

Inadvertent or unplanned releases of radioactive materials in the form of spills can present both real and perceived contamination concerns. Spills of radioactive materials will be managed to prevent the spread of radioactive contamination and keep worker and public exposures as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (15.RPP.01).

5.0 GENERAL SURVEY METHODS

Direct surveys of areas with spills may be conducted using a Ludlum Model 44-9 Geiger Mueller (GM) “pancake”-type probe with Ludlum Model 3 survey meter (or equivalent) for surface beta-gamma measurements; a Ludlum 43-93 alpha-beta scintillation detector with Ludlum 2360 survey meter (or equivalent) for surface alpha-beta measurements; a Ludlum Model 19 (or equivalent) for ambient exposure rate measurements; a Ludlum Model 193-6 Survey Wand (or equivalent) for large area gamma scanning measurements; a Ludlum 44-2 gamma scintillation detector (or equivalent) for ambient gamma scanning measurements; or any other radiation measuring instrument appropriate for the task. Spill surveys may be supported by smear sample analyses for removable radioactivity using the Ludlum 3030 alpha-beta sample counter (or equivalent).

5.1 Pre-Survey Instrument Check List

Prior to use of any field instrument, the operation of the probe and survey meter used shall be checked using the following general procedure. Specific direction for quality control measurements is provided in the SOP for each individual instrument.

a. Check Batteries

- Turn the switch to "BAT" or flip the "BAT" switch to "ON."
- The needle on the meter face should move to a position within or beyond the indicated area on the meter scale.
- Replace batteries if needed before use.

b. Check Count Rate Meter Speaker

- Turn the audio switch, if present, to ON.
- Set the Fast-Slow toggle switch to the F position (for fast response).
- Set the count rate meter scale to X1.
- The rate meter should "chirp" or "click."
- If the speaker does not function, the survey meter can be used, but the surveyor will need to check the meter reading or display frequently.

c. Background Check

- Conduct background check during daily quality control (QC) measurements.
- On most instruments, the background count rate is observed when the survey meter scale is set to the lowest scale setting – X0.1 or X1.
- Prior to conducting surveys, verify background at that location.
- Most surveys rely upon the technician to identify contamination above background. Therefore, the survey technician must have a strong understanding of what background is for the instrument being used.
- Do not use the meter if it does not register a background reading.

d. Source Check

- Conduct source check during daily QC measurements.
- Use the same source in the same geometry for all QC measurements.
- The technician should be familiar with the detector response to a source.
- Do not use the instrument if the QC falls out of requirements.

5.2 Initial Response Surveys

Before any initial response surveys are performed, the following actions should be taken when a spill occurs:

a. If the spill is liquid, immediately stop the flow of liquid using towels, absorbent materials, or other means

b. Isolate the area using tape, rope, signs, or other means to warn others and prevent access

c. Notify the CHDT RSO, facility general manager, and/or plant foreman

After the above steps are performed, initial response surveys will be performed to determine the extent and radioactivity levels of the spill to aid in cleanup planning. Survey data shall be recorded in ink on appropriate survey forms, which shall document the following:

a. Time and date of the survey

b. Technician(s) performing the survey

c. Instrument(s) used, with serial number, calibration due date

d. Measurement locations, with pictures or drawings as necessary

e. Background and efficiency information for the instruments, as appropriate

f. Raw measurements, including measurement type and count time (if necessary)

Where necessary, surveys may be documented in a field logbook in the absence of a survey form. Pictures, photographs, or drawings of impacted equipment or areas may be used to facilitate documentation.

Static measurements for fixed contamination, smear samples for removable contamination, exposure rate measurements, and scanning measurements should be collected to adequately characterize the area. As spills may vary in size and type, no specific number of measurements is prescribed; rather the CHDT RSO should be consulted as to the appropriate level of effort to provide sufficient data.

Generally, areas that require cleanup following a spill are those with above-background surface radioactivity levels. Maintaining contamination controls to an indistinguishable from background standard will ensure that exposures are ALARA. In limited cases following a spill, dose-based release criteria (Section 6.3) may be applicable.

5.3 Decontamination Support and Verification Surveys

Radiological surveys should be conducted to support decontamination efforts (performed per SOP 15.OPS.18, Decontamination of Surfaces and Equipment) to verify successful removal or cleanup of contamination. Following decontamination to background levels (or other criteria, as directed by the CHDT RSO), a final verification survey should be performed and appropriately documented on a survey form or in a field logbook.

If necessary, the CHDT RSO will use the data from spill surveys to evaluate worker or public dose during the response actions.

6.0 STANDARDS AND CRITERIA

6.1 Indistinguishable from Background

The majority of personnel contamination surveys will be performed with the criterion of no contamination present, or no radioactivity above background. Therefore, the technician must have a clear understanding of the appropriate background levels for the instrument being used and for the location of the survey.

6.2 Data Conversion

For comparison with the measurement criteria listed in Section 6.3, surface measurements in counts per minute (cpm) must be converted to units of decays per minute per 100 square centimeters (dpm/100cm^2). Procedures for data conversion are provided in SOPs 15.OPS.08, *Operation of Alpha-Beta Scintillation Detector,* and 15.OPS.09, *Operation of GM Pancake Probe*. The Ludlum 3030 used at CHDT provides measurements in units of dpm.

6.3 Surface Contamination Levels

Removable activity measured by smear samples will be evaluated against the values listed in Table 1, from ANSI/HPS N13.12-1999 (ANSI/HPS 1999). In the absence of radionuclide data to establish the appropriate screening group, the most conservative screening levels will be used.

Table 1 – Surface Contamination Limits for Free Release Surveys

Radionuclide Group	Surface Screening Levels (Bq/cm^2)	Surface Screening Levels (dpm/100cm^2)[(a)]	Removable Contamination Limits (dpm/100cm^2)
Group 1 Radium and Thorium: ^{210}Po, ^{210}Pb, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and associated decay chains[(b)]	0.1	600	60 alpha
Group 2 Uranium: ^{234}U, ^{235}U, ^{238}U, natural uranium[(c)], and associated decay chains	1	6,000	600 alpha
Group 3 General Beta-Gamma Emitters: ^{24}Na, ^{36}Cl, ^{59}Fe, ^{109}Cd, ^{131}I, ^{129}I, ^{144}Ce, ^{198}Au, ^{241}Pu, and others	10	60,000	600 beta
Group 4 Other Beta-Gamma Emitters: ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{45}Ca, ^{51}Cr, ^{55}Fe, ^{63}Ni, ^{89}Sr, ^{99}Tc, ^{111}In, ^{125}I, ^{147}Pm, and others	100	600,000	600 beta

(a) Rounded to one significant figure.

(b) For decay chains, the screening levels represent the total activity (i.e. the activity of the parent plus the activity of all progeny) present.
(c) Where the Natural Uranium activity equals 48.9% from ^{238}U, plus 48.9% from ^{234}U, plus 2.25% from ^{235}U.

6.4 Quality Control

In addition to the daily QC measurements required by each individual instrument SOP, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

7.0 REFERENCES

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.15
AIR MONITORING FOR RADIOACTIVE MATERIALS

1.0 OBJECTIVE

To define the methods and requirements for conducting air particulate and radon monitoring at the Clean Harbors Deer Trail (CHDT) facility or other job sites

2.0 SCOPE

This standard operating procedure (SOP) applies to the performance of general area and breathing zone air monitoring for airborne radioactive materials, and to radon monitoring during normal operations at the CHDT facility.

3.0 POLICY

Air monitoring will be performed to assess potential environmental impacts from site operations, to verify the effectiveness of engineered contamination control or containment systems, and to evaluate worker and public exposures from site operations. All worker and public exposures will be maintained as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 AIR MONITORING PROCEDURES

5.1 General Area Air Monitoring

5.1.1 Monitoring Locations and Equipment

Meteorological study has determined the prevailing wind speeds and directions at CHDT. Continuous particulate air monitoring will be performed at three general locations at the facility. Location A is the north or downwind background air sampling station, located at some distance to the northeast of the current active disposal cell. Location B is the south or upwind background air sampling station, located south of the current active disposal cell. Locations C and D are side by side locations adjacent to the north rim of the current active disposal cell. The current airborne sampling systems consist of a Hi-Q model VS23-1023CV ¾ HP oil-less rotary vane pump, flow rate rotometer and calibration knob, elapsed timer, 47 mm diameter filter holder with 3/8 inch quick disconnect, stainless steel gooseneck to set sample point approximately 59 inches above ground, rain and wind shield, outdoor instrument weather house.

Flow rates on the air samplers are recorded from the rotometer. Flow rates are checked against the data shown by a Hi-Q Air Flow Calibrator (AFC) Complete-6. The AFC measures the true flow rate in actual and in standard temperature and pressure (STP) units. Flow calibration will be performed a minimum of once per month, per Section 5.1.5. Upgrades or changes to the sampling equipment will be made by the CHDT RSO as needed in consultation with CDPHE.

5.1.2 Sample Collection

Air sample pumps will be run during daylight hours during sample collection periods. Samples will be collected from each location after a time period designated by the RSO that adequately samples air during representative work activity and allows sufficient sample loading to analyze. The pumps will be inspected a minimum of weekly during the sample collection to verify that the pumps are in working order. The date and time of the pump inspection and pump flow rate will be recorded in the air monitoring logbook or attached example form (Attachment 1) to document the inspection.

When filters are collected, appropriate precautions will be taken to minimize the potential for cross-contamination of samples and equipment. Nitrile or latex gloves will be worn when handling the filters and pumps. The final flow rate, elapsed time, and filter collection date and time will be recorded in a dedicated log book or on the example form included as Attachment 2.

5.1.3 Off-Site Sample Analysis

Filters will then be sent to an offsite analytical laboratory for the following analyses:

- Gross Alpha/Beta with a desired detection limit of 2 pCi/g of sample
- Radium-226 by wet chemistry method E903.0 or equivalent, with a desired detection limit of 0.1 pCi/g.
- Isotopic thorium (Th-232, Th-230, Th-228) with a detection limit of 1 pCi/g of sample
- Isotopic uranium (U-238, U-235, U-234) with a detection limit of 1 pCi/g of sample

If multiple filters are collected from a single location over a month, the filters will be composited for offsite analysis.

5.1.4 Pump Calibration and Maintenance

Flow rates on the Hi-Q sampling pumps will be checked once a month during the filter change out, using the AFC-Complete-6. During calibration, the following procedure will be followed:

- Unplug the air monitor and remove the sample holder containing the used filter. Connect the hose to the AFC and the air inlet.
- Prior to starting the flow, turn on the AFC and turn the knob to allow it to zero itself with no flow
- Plug in the pump and start the airflow
- Record the following information:

- Date/time
- Flow measured by the rotometer on the pump (CFM)
- Flow measured by AFC (CFM) for both STP and actual settings
- Stop the flow and disconnect the calibrator

As necessary, the pump rotometer may be adjusted to match the AFC measurement for STP. Alternatively, values recorded from the AFC unit may be used to calculate the correct flow rate on the pump.

Maintenance will be performed as necessary on the pumps. Rebuild kits will be kept on hand at the facility. Pump maintenance will be documented in the air monitoring log book.

5.2 Breathing Zone Air Monitoring

5.2.1 Monitoring Procedures and Equipment

Breathing zone monitoring will be performed as directed by the CHDT RSO or designee to determine exposures of specific personnel to airborne radioactivity in the current active landfill, in the treatment building and at other work-zone locations as designated by the RSO. Monitoring will be performed with portable lapel air samplers and 37 mm filters with cartridges placed near the breathing zone of the air monitoring subject. The samplers may also be placed in specific areas, or in cabs of equipment, in order to obtain a longer sample. Other types of air sampling equipment may be used such as semi-portable hi flow or low flow sampling stations, and or direct reading air samplers.

5.2.2 Sample Collection

Samples will be collected over a period of time determined by the RSO that adequately represents work activities and that collects sufficient sample for analysis. At a minimum, the following information will be collected in the air monitoring logbook or form:

- Sampled individual/activity/area
- Start date/time, and starting flow rate (including units)
- Stop date/time, and ending flow rate (including units)
- Total sampling time
- Calibration information, including pre- and post- sampling flow rate check, if performed.

When filters are collected, appropriate precautions will be taken to minimize the potential for cross-contamination of samples and equipment. Nitrile or latex gloves will be worn when handling the filters and pumps.

5.2.3 On-Site Sample Analysis

Air filters may be counted on-site using the 3030 counter, and converted to an activity concentration in µCi/ml using the following equation from Section 5.1.3:

$$C = \frac{M}{EF_{lpm}\left(1000\frac{ml}{l}\right)T_S\left(2.22\times10^6\frac{dpm}{\mu Ci}\right)}$$

Where M is the 3030 measurement in dpm. The airflow rate also requires conversion from the standard lapel sampler units of liters per minute (lpm) to milliliters, as shown in the equation.

5.2.4 Off-Site Sample Analysis

Personal air samples will be sent off-site for radiochemical analysis when determined to be required by the CHDT RSO or designee. If off-site analytical is required one or more of the following analyses may be performed:

- Gross Alpha/Beta with a desired detection limit of 2 pCi/g of sample
- Radium-226 by wet chemistry method E903.0 or equivalent, with a desired detection limit of 0.1 pCi/g.
- Isotopic thorium (Th-232, Th-230, Th-228) with a detection limit of 1 pCi/g of sample
- Isotopic uranium (U-238, U-235, U-234) with a detection limit of 1 pCi/g of sample

5.2.5 Pump Calibration and Maintenance

Pump calibration and maintenance will be performed in accordance with manufacturer's recommendations and the user's manual for the equipment. Where possible, the air sampler will be calibrated on-site, but calibration by a rental vendor is acceptable. In addition, battery life will be extended by following the user manual recommendations for charging.

5.3 Radon Monitoring

5.3.1 Monitoring Equipment

Radon monitoring will be performed at the CHDT facility using Landauer Radtrak alpha-track radon monitors. The Radtrak is a passive radon gas monitor that records the alpha tracks from radon gas decay. The tracks are counted and correlated with a known air concentration of radon, which is averaged over the sampling time.

5.3.2 Deployment Procedure

The radon monitors will be deployed at the following locations:

1	Active Landfill Cell
2	Active Landfill Cell

3	Perimeter Fence Background
4	Perimeter Fence (Background)
5	Perimeter Fence (Background)
6	Perimeter Fence (Background)

The Radtrak detectors will be positioned upside down inside the plastic cup. The serial numbers of the outgoing and incoming detectors will be recorded, as will the deployment date and time. Detectors will be changed out at the start of each quarter, or as close as possible – January 1, April 1, July 1, and October 1. When removed, the foil stickers provided by Landauer will be placed over the openings on the detector face.

5.3.3 Off-Site Analysis

Detectors will be sent to Landauer for analysis. The manufacturer's report of analysis will be sent to CHDT for review. The report will include the detector number/location, exposure in picocuries per liter (pCi/l)-days, and the average radon concentration in pCi/l.

6.0 STANDARDS AND CRITERIA

6.1 Ambient Air Sampling

Analytical results from the ambient air samples will be used to estimate the committed effective dose equivalent (CEDE) for site workers, per 15.RPP.05, *Estimation of Inhalation Dose.*

6.2 Breathing Zone Air Sampling

Results from breathing zone air sampling will be compared with the derived air concentration (DAC) or air effluent limits from 10 CFR 20 to determine potential worker exposure and dose.

6.3 Radon Sampling

The quarterly analytical report of measured radon concentrations will be evaluated by the CHDT RSO. Background radon levels will be statistically evaluated in order to determine average and peak natural radon levels. Radon effluent levels in the open landfill cell(s) will be compared with background levels in order to evaluate the effectiveness of the interim cover and to ensure that worker protection is adequate. If excessive levels are encountered, the landfill operations will be reviewed and modified, as appropriate, to limit radon effluents. Radon effluent levels in the treatment building will be evaluated to ensure that worker protection is adequate.

7.0 REFERENCES

10 CFR 20. *Standards for Protection Against Radiation*. Current Version.

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

NRC 1993. *Air Sampling in the Workplace.* NUREG-1400. September.

Ludlum Measurements, Inc., Instruction Manual Model 3030 Alpha Beta Sample Counter Meter, Current Version.

8.0 ATTACHMENTS

Attachment 1 Air Monitor Weekly Inspection Checklist

Attachment 2 Monthly Air Monitor Filter Collection Form

Clean Harbors Deer Trail LLC

Approved by:		
	General Manager	Radiation Safety Officer

Groundwater Sampling Standard Operating Procedure 15.Env.2

1.0 **Objective:** To establish groundwater sampling and analysis procedures that will provide quality data for evaluation of waste treatment and disposal unit integrity and environmental quality. The plan is consistent with and will run concurrently with the groundwater-monitoring program defined in the State RCRA Permit.

2.0 **Scope:** This procedure applies to all environmental monitoring samples collected from the groundwater monitoring wells and the secure cell leachate collection system, leak detection system and permanent sumps as well as the leak detection system in the treatment building.

3.0 **Policy:** All Deer Trail activities that could result in discharges of regulated waste to groundwater or effluents are subject to the groundwater-monitoring program.

4.0 **Responsibilities:** Responsibilities of the Deer Trail Radiation Safety Officer (RSO), the facility Compliance Manager, other management and staff are defined in the Deer Trail Radiation Safety Plan.

5.0 Groundwater Sampling Procedures

5.1 Container Preparation

5.1.1 The containers will be constructed of a material compatible and non-reactive with the expected sample aliquots. Consult Section 6.0, Table 4.0, Recommended Sample Handling, Preservation, and Instrumentation, to determine the number, type and volume of containers needed. Metal lids should not be utilized. Plastic lids with polyethylene or Teflon liners are acceptable in most cases.

5.1.2 Individual aliquot containers are not required for each determination or test. If two or more tests require the same container and preservation, and a container of sufficient size is available, the sample aliquots may be combined.

5.1.3 Generally the analytical laboratory will supply the sample containers. The laboratory will clean the containers before shipment to the Facility in accordance with the laboratory's quality assurance program. The Laboratory will provide documentation certifying the containers to be analyte-free. Alternatively, the laboratory may provide sample containers that have been purchased from a vendor, provided the vendor can provide documentation certifying the containers to be analyte-free. If the Laboratory and/or vendor do not supply sample containers the containers shall be cleaned in accordance with Section 5.6.

5.1.4 If the sample locations and tests are known prior to collection, the container labels may be partially completed and the chemical preservatives added to the containers (where applicable) before sampling.

5.1.5 The Laboratory will generally supply sample shuttle kits (each) consisting of an insulated cooler, pre-cleaned containers, labels, seals, and Chain-of-Custody, field log, and shipping forms. The sampling crew will supply refrigerant at the time of sampling.

5.2 Well Inspection

The monitoring wells shall be inspected prior to each groundwater-sampling event. During the well inspection, water levels will be measured to determine which wells contain water and which wells are dry. The depth to water, if any, and total well depth shall be measured during the inspection. These data will be recorded on the form provided in Section 7.0. Personnel will also note well conditions, as appropriate, on this form.

5.3 Well Evacuation

Prior to purging the well in preparation for sampling, the groundwater personnel will perform the following tasks:

- Measure depth to water and total well depth.

The procedures to perform these tasks are described in Section 5.4.

6 CCR 1007-3 264.97 (a)(2) requires that groundwater samples must represent the quality of water passing the point of compliance to ensure that the water sampled is not stagnant and therefore representative of the surrounding groundwater conditions. To meet this requirement, the following protocol shall be followed for purging or evacuating wells:

5.3.1 Rapidly recovering wells are defined as those wells, which recover at least 90% of one well volume in less than 12 hours.

- Rapidly recovering wells shall have approximately three well volumes removed prior to sampling.
- Sampling of these wells shall be completed within 24 hours from the time that the last well volume is purged.

5.3.2 Low yield or slowly recovering wells are those wells, which take longer than 12 hours but less than 48 hours to recover at least 90% of one well volume of water. Sampling of low yield wells will be following the Ground water Sampling Procedure for Low Stress (Low Flow) Purging and Sampling Procedure contained in Section 8.0.

- Low yield wells shall be totally evacuated (to the extent practicable) only one time prior to sampling.
- Sampling of these wells shall be completed within 48 hours of the well evacuation.

5.3.3 Dry wells are defined as a well, which contains no water. These wells shall not be sampled.

5.3.4 During each sampling event each previously dry well shall have been checked during the well inspection procedure to determine if water is present in the well. If water is present it shall be purged as described above.

5.3.5 During the first sampling event all inspection and detection monitoring wells shall be classified as a rapidly recovering, low yield or no-yield well.

The first sampling event classifications and measurement of well recovery data shall be recorded on the form in Section 7.0. The form presents a protocol for classifying the wells relative to recovery. The results of this well recovery classification shall be included in the Monitoring Report.

During the second sampling event each well will be evacuated and sampled in accordance with the procedures applicable to that well's recovery classification, which was determined in the first sampling event. Well evacuation procedures and data for those quarterly events will be recorded on the form presented in Section 7.0.

5.3.6 In order to prevent well contamination, one of the following well purging procedures will be utilized:

5.3.7 A dedicated bailer, constructed of the same material as the well casing, Teflon, or stainless steel, attached to the reel with a single strand of stainless steel wire or a monofilament line, shall be used. If necessary, the reel will be mounted on a tripod and set directly above the well opening. The bailer and cable should only contact the internal well casing. The reel's monofilament line will be wiped with a clean towel moistened with de-ionized water as the bailer line is retrieved. As the last bailer-full is pulled, the cable will be wiped away from the well casing opening with a freshly prepared reagent grade methanol/D.I. water saturated cloth. Care must be exercised not to permit excessive methanol/water to drop into the well, possibly resulting in contamination of the well. Well water will be evacuated from the uppermost part of the water column to assure that fresh water moves upward from the screen.

5.3.8 A dedicated system composed of either an electrically powered submersible pump, a gas operated positive displacement (bladder or piston) pump, or a gas lift purge pump may be used. The pump intake will be located approximately a foot above the bottom of the screened area to minimize the potential for electrically powered submersible pumps to burnout upon total evacuation. Electrically powered submersible pumps will not be operated when the water level in the well drops below the pump intake.

5.3.9 If non-dedicated equipment is used in well purging, that equipment will be cleaned before evacuating each well. The equipment shall be cleaned and stored per the procedures outline in Section 5.6. (Note: All groundwater wells at the Deer Trail Facility, except the dry wells, utilize dedicated purging and sampling equipment.)

5.3.10 All dedicated bailers will be inspected at the time of well purging for cleanliness and functionality.

5.3.11 All dedicated equipment temporarily removed from its well for repair (i.e. Maintenance Building or Off-site) shall be decontaminated as described in Section 5.6. Equipment blank samples shall be taken on all dedicated equipment that has been temporarily removed from the well for repairs in Maintenance Building or Off-site and after it has been decontaminated.

5.3.12 All purge water shall be collected in a calibrated container to determine evacuation rate and volume. Well water not used for sampling will be transferred to a central collection point (portable collection tanks), and evaluated for proper wastewater management.

5.4 Field Records (Evacuation)

A separate evacuation field log for each well shall be maintained to record all pertinent information regarding the evacuation and sampling of monitor wells. Sample forms are presented in Section 7.0. The form will be utilized during the first sampling event for classifying wells according to their recovery characteristics. The form in Section 7.0 will be utilized for all other sampling events. This recorded information is necessary to maintain well sampling data and becomes part of the analytical report. The sample collector shall sign and date each page of the field log (see Section 7.0). The following data shall be determined and recorded upon the evacuation of each well:

- Sample collector's name, date and time that evacuation was initiated and completed.
- Site and Location
- Event and Year
- Well Identification - i.e., monitor well number, code or name.
- Well Depth - Measure from a marked reference point at the top of the casing to the bottom of the well to the nearest 0.01 foot with a clean weighted measuring tape or a calibrated water level indicator. The tape or water level indicator shall be wiped with a clean cloth saturated with reagent grade methanol and de-ionized water following each measurement of well depth. Wells with dedicated pumps will be re-developed at a minimum once a year during the second quarter, or at any time should excessive silting occur. Well depth will be measured after re-development and recorded on the sampling log.
- Water Level Depth - Measure from the marked reference point at the top of the well casing to the water surface to the nearest 0.01-foot with a calibrated water level indicator. The water level indicator shall be calibrated and any correction factors noted on the meter, and the factor, if any, will be applied to the water level depth measurements. Each well shall have a marked measurement reference point at the top of the casing from which its water level is taken. An elevation/location reference point shall be established in relation to mean sea level by a licensed surveyor for each well, the marker is typically located on the concrete well pad. The reference point shall be established in relation to mean sea level and the survey shall also note the well location coordinates.
- Measure and record well casing inside diameter to the nearest 0.1 inch.
- Record total gallons evacuated - Well yield

- Record water level (in feet) following evacuation.
- Record method of evacuation - type of bailer, pump, etc.
- Comments - Any deviation from standard sampling procedures, unusual conditions, damage or problems encountered at each well should be recorded completely, clearly and concisely.

5.5 Sampling the Monitor Wells

After the wells have been evacuated, the containers and sampling equipment shall be prepared and the initial log data entered. Those wells that meet the recovery criteria specified in Section 5.3 shall be sampled as follows:

5.5.1 Re-measure the water level depth to the nearest 0.01-foot and record on the field sampling log (Section 7.0).

5.5.2 All non-dedicated equipment used to sample the well (e.g., bailer, funnel, etc.) must be cleaned and stored per the procedures outlined in Section 5.6.

5.5.3 During the normal course of sampling equipment blanks will not be taken from wells utilizing dedicated sampling equipment. If the dedicated equipment is removed from the well for any reason other than the normal course of sampling or well purging, then the equipment will be decontaminated and an equipment blank will be collected from the final rinse of the decontamination process which was performed in accordance with Section 5.6.

5.5.4 If the well is equipped with a dedicated submersible pump, it will be used to sample the well. Wells shall be sampled within the time periods specified in Section 5.3.

5.5.5 Wells not equipped with a pump system will be sampled utilizing a bailer. The bailers will be constructed of stainless steel, Teflon or of the same material as the well casing, attached to a reel with a clean single strand stainless steel wire or a monofilament line. The reel will be mounted on a tripod if necessary and set directly above the well opening. Except as specified in Section 5.3.7 the first bailer-full collected shall be used to rinse the bailer and managed as described in paragraph 5.3.12. If the well has recharged sufficiently to collect all samples required. If the well contains insufficient water to generate the necessary aliquots, then the first bailer-full may be used to collect the sample, rather than discarding it as rinse water. Samples will be transferred, with as little agitation as possible, from the bailer to the sample containers and immediately preserved according to the specific test requirements. Upon withdrawing the last bailer-full, the cable will be wiped away from the well casing opening with a fresh clean cloth saturated with deionized water and reagent grade methanol. Care must be taken not to allow any excess methanol/water mixture to enter the well.

5.5.6 All samples collected for transport to the Laboratory shall be chemically preserved (if applicable). See Section 6.0, Table 4.0, for specific requirements.

5.5.7 The following determinations will be made in the field at the time of sampling and recorded on the field logs:

- pH
- Specific Conductance
- Temperature
- Redox Potential
- Calibration checks
- Turbidity

Field monitoring instruments including pH, specific conductance, and turbidity meters, shall be calibrated each day of sample collection prior to sampling. In addition, the calibration of these instruments shall be verified using certified standards prior to the sampling of each well. All calibration verifications will be recorded in the designated logbook.

5.5.8 Sample Shipment - Samples will be shipped in sealed insulated shipping containers, ice chests or coolers supplied by the analytical laboratory conducting the analyses. Shipment and receipt of samples must be coordinated with the laboratory to minimize time in transit. To insure arrival at the laboratory in good condition, the samples will be sent in sturdy insulated ice chests (coolers). An air courier or equivalent overnight courier service will be utilized, if necessary.

5.5.9 One well field duplicate will be obtained for 20 wells (batch) in each scheduled sampling event. Duplicated sampling of wells will be determined by the random sampling method discussed in Appendix 8 of this plan. Only those wells that have traditionally produced a sufficient volume of water to fill a complete Background Parameters (Groundwater Protection Program Table 2.0) or Detection Monitoring (Groundwater Protection Program Table 3.0) bottle set will be included as potential duplicate well candidates. Duplicate sample aliquots (except for volatile analysis samples) will be collected in quarter-bottle increments to ensure inter-sample homogeneity.

5.6 Decontamination of Non-Dedicated Evacuation and Sampling Equipment and Non-Laboratory Supplied Sampling Equipment

The cleanliness of the containers, evacuating and sampling equipment is most important.

5.6.1 Bottles and lids to contain samples must be hand washed with a liquid hand dishwashing detergent, rinsed in hot tap water, rinsed with chemically pure or reagent grade nitric acid, rinsed at least four times with tap water and four times with distilled or deionized water and allowed to air dry.

5.6.2 Glass bottles used to collect samples for analysis shall be washed with a liquid hand dishwashing detergent, rinsed with hot tap water, rinsed with reagent grade methanol, finished with D.I. water (at least six rinses), and kiln baked at 300° C. Caps and teflon liners, shall be prepared in the same manner, except without the kiln bake. When the bottles are cool and the caps and liners are completely dry, cap the bottles and store them in a clean and dry environment.

5.6.3 All non-dedicated equipment used to bail or sample a well must be cleaned in the same manner prescribed for cleaning the bottles and lids for conventional analysis described in A. above, and stored in a clean and dry environment. Clean bailers must be wrapped in new aluminum foil with the bright side out, or high-grade paper for storage.

5.7 Field Records (Sampling)

5.7.1 It is most important to maintain an accurate and thorough field log in case one is required to recall particular detailed information concerning the evacuation and sampling of a monitor well. As mentioned earlier, these logs become part of the analytical report. In addition to the information recorded during the purging process, the following information will be also be recorded on the field log at the time of sampling:

- Sample collector's name, date and time of sampling.
- Water Level Depth - Measure from the reference point at the top of casing to the water surface to the nearest 0.01-foot with a calibrated water level indicator.
- Reason for sampling - e.g., semi-annual sampling, special problem
- Initiator requesting the well sampling.
- Sample identification number for each set of samples taken from a single sample source.
- Sample pH, specific conductance, temperature, turbidity, Redox Potential and calibration documentation.
- Method of sample collection - type of bailer, pump, etc.
- Sample characteristics such as color, odor, sediment, surface oil, etc.
- Sample volume, containers, and preservatives.
- Test to be performed on each sample (if known).
- The weather conditions at the time of sampling.
- Sample sequence number - Order in which well was sampled with respect to other wells onsite. If more than one sampler or sampling team are participating in the sampling event, each sampler or team shall record the sequence or order in which each well was sampled with respect to the other wells they have sampled.
- Any additional field observations, comments or recommendations - e.g., split sampling (with whom), re-sampling, equipment failures, condition of the well, etc.
- Sample Custody Statement - If the samples are transferred to the receiving laboratory by the collector and are in his or her possession at all times, a statement to this effect shall be noted.

5.7.2 The samples must be sealed to protect their value. If the sample shuttle kit (cooler) does not employ a tamper proof seal, the collector is to date, sign and identify each sample on a seal and attach it to each sample container and lid. A waterproof adhesive seal and pen must be used.

5.7.3 Prepare a sample label for each sample container employing a waterproof pen and adhesive label. The following is to be indicated on the label -

- Collector's name, date and time of sampling.
- Sample source.
- Sample identification number.
- Sample preservatives.
- Test(s) to be performed on the sample, if known.

5.8 Chain-of-Custody

Chain-of-Custody records will be used to insure the integrity of the sampling event and the analyses.

5.8.1 The sample collector will complete a Chain-of-Custody record (Section 7.0 or equivalent) for all monitoring well samples.

5.8.2 The sample collector will retain a copy of the Chain-of-Custody record, and forward the original with the sample to the laboratory performing the analyses.

5.8.3 Upon receipt of the samples, the laboratory manager or representative will complete the Chain-of-Custody record, make a copy for his or her files, and return the original with the analytical data.

5.9 Instructions to the Laboratory

The results of the analysis of the blanks should not be used to correct the ground water data. If contaminants are found in the blanks, the source of the contamination must be identified and corrective action, including re-sampling, must be initiated. Other quality control samples (e.g., standards, spikes, performance evaluation samples) must be prepared and analyzed as part of the laboratory operation.

5.10 Laboratory Requirements

The laboratory shall have the capabilities to analyze for most monitor well parameters. Some samples submitted to the laboratory for analysis may be subcontracted to another independent commercial laboratory. Any samples submitted to the Lab must be properly preserved, accompanied with completed Chain-of-Custody records. If an independent, subcontracted laboratory is utilized, the procedures recommended for sample preservation will be followed, Chain-of-Custody records, and a completed Sample Analysis Request form will accompany the samples.

5.10.1 Laboratory: Laboratory QA/QC plan applicable to the Groundwater Analysis performed by CHDT will be in accordance with the facilities approved QA/QC plan and standard operating procedures. These standard operating procedures will include, but are not limited to, the following:

- The use of Standard Reference Materials, intra-laboratory samples, laboratory blanks, duplicate and spike samples for calibration and matrix interference identification.
- Statistical procedures and accuracy control charts to monitor and document laboratory performance and define analysis acceptance criteria.
- Programs for instrument calibration and maintenance control.
- Sample receipt and documentation.

5.10.2 Outside Laboratory – CHDT will submit to the Department a QA/QC plan or verification of independent laboratory certification for each outside laboratory contracted to perform groundwater analysis. The outside laboratories QA/QC plan and/or certification shall meet or exceed those required of CHDT by the Colorado Department of Public Health.

5.11 Analytical Parameters

The analytical parameters to be analyzed for in groundwater samples collected at the facility are given in Section 6.0 - Tables 2.0 and 3.0. Listed are each parameter, their respective analytical methods and levels of Reporting Detection Limits and if they are background or detection monitoring parameters, or both. The parameters pH, specific conductance and turbidity will be determined in the field.

6.0 Tables

6.1 Table 1.0 – Frequency of Data Collection and Evaluation
6.2 Table 2.0 – Background Monitoring Parameters
6.3 Table 3.0 – Detection Monitoring Parameters
6.4 Table 4.0 – Sample Handling, preservation, and Instrumentation

7.0 Forms

7.1 Monitoring Well Field Log – Sampling
7.2 Monitoring Well Field Log – Evacuation and Recovery Classification (1st event)
7.3 Monitoring Well Field Log – Evacuation and Recovery Classification (2nd event)
7.4 Sample Chain –of – Custody

8.0 Groundwater Sampling Procedure for Low Stress (Low Flow) Purging and Sampling Procedure, U.S. EPA Region II, March 16, 1998

TABLE - 1.0
Frequency of Data Collection and Evaluation

Monitoring Location	Monitoring Program	Data Collection Frequency		Data Evaluation Frequency		
		Hydraulic Measurements	Sampling and Lab Analysis (if appropriate)	Descriptive Statistics	Comparative Statistics	Trend Analyses
Closed Secure Cell LCS	Secure Cell Performance Monitoring	Weekly	Quarterly	NA	NA	NA
Active Secure Cell LCS	Secure Cell Performance Monitoring	Weekly	Quarterly	NA	NA	NA
Secure Cell LDS	Secure Cell Performance Monitoring	Weekly	Quarterly	NA	NA	NA
Secure Cell Permanent Sump	Secure Cell Performance Monitoring	Weekly	Quarterly	NA	NA	NA
Treatment Building LDS	Surface Impoundment Performance Monitoring	Weekly	Quarterly	NA	NA	NA
Level 3 Wells	Inspection Monitoring	Quarterly	Quarterly	Semiannually	Semiannually	Semiannually
Level 4A Wells	Detection Monitoring	Quarterly	Quarterly	Semiannually	Semiannually	Semiannually
Level 4 Wells	Detection Monitoring	Quarterly	Quarterly	Semiannually	Semiannually	Semiannually
Level 5 Wells	Detection Monitoring	Quarterly	Quarterly	Semiannually	Semiannually	Semiannually
Level 6 Wells	Inspection Monitoring	Quarterly	Quarterly	Semiannually	Semiannually	Semiannually

TABLE 2.0
Background Monitoring Parameters

ANALYTE	Instrumentation [1]	GW Reporting Limit (pCi/L)	CDPHE Groundwater Standard (pCi/L)
RADIOACTIVITY			
Gross Alpha	A, B, or G	3.0	15 (excludes U and Rn)
Gross Beta	A or G	4.0	50 (pCi/L) (screening level)
Lead-210	E	3.0	
Thorium-228	H	1.0	
Thorium-230 and 232	H	1.0	60
Uranium-234	H	1.0	30 (ug/l) (Total)
Uranium-235	H	1.0	See above
Uranium-238	H	1.0	See above
Radium-226 and 228	A, B, D, or G	1.0	5.0
H-3 (Tritium)	E	500	20,000
C-14	E	20	
K-40	C	250	
Co-60	C	30	
Cs-137	C	20	80 (as Cs-134)
Sr-90	A or G	3.0	8.0
Pu-238	E or H	0.1	
Pu-239	E or H	0.1	0.15 (Pu-239 and Pu240)
Pu-241	E or H	5.0	
Am-241	H	0.1	0.15

[1] A = Low background proportional system; B = Alpha and beta scintillation system; C = Gamma spectrometer [Ge(Hp) or Ge(Li)]; D = Scintillation cell system; E = Liquid scintillation system; F = Fluorometer; G = Low background alpha and beta counting system other than gas-flow proportional; H=Alpha spectrometry system.

TABLES 3.0
Detection Monitoring Parameters

ANALYTE	Instrumentation [1]	GW Reporting Limit	CDPHE Groundwater Standard
RADIOACTIVITY			
Gross Alpha	A, B, or G	3.0 (pCi/L)	15 (pCi/L) (excludes U and Rn)
Gross Beta	A or G	4.0 (pCi/L)	50 (pCi/L) (screening level)
Uranium-Total	F	1.0 (ug/l)	30 (ug/l) (Total)
Radium-226 and 228	A, B, D, or G	1.0 (pCi/L)	5.0 (pCi/L) (combined)

[1] A = Low background proportional system; B = Alpha and beta scintillation system; C = Gamma spectrometer [Ge(Hp) or Ge(Li)]; D = Scintillation cell system; E = Liquid scintillation system; F = Fluorometer; G = Low background alpha and beta counting system other than gas-flow proportional; H=Alpha spectrometry system.

Table 4.0
Sample Handling, Preservation, and Instrumentation

Parameter	Preservative [1]	Container [2]	Maximum Holding Time[3]	Instrumentation[4]
Gross Alpha	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A, B, or G
Gross beta	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Strontium-89	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Strontium-90	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Radium-226	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A, B, D or G
Radium-228	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Cesium-134	Conc. HCl to pH <2[5]	P or G	90 Days	A, C or G
Iodine-131	None	P or G	8 Days	A, C or G
Tritium	None	G	90 Days	E
Uranium	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A, B, F, H
Photon emitters	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	C

[1] It is recommended that the preservative be added to the sample at the time of collection unless suspended solids activity is to be measured. If the sample has to be shipped to a laboratory or storage area unpreserved, acidification of the sample (in its original container) may be delayed for a period not to exceed 5 days. A minimum of 16 hours must elapse between acidification and analysis.

[2] P = Plastic, hard or soft; G = Glass, hard or soft.

[3] Holding time is defined as the period from time of sampling to time of analysis. In all cases, samples should be analyzed as soon after collection as possible. Exceptions will require approval by CDPHE.

[4] A = Low background proportional system; B = Alpha and beta scintillation system; C = Gamma spectrometer [Ge(Hp) or Ge(Li)]; D = Scintillation cell system; E = Liquid scintillation system; F = Fluorometer; G = Low background alpha and beta counting system other than gas-flow proportional; H=Alpha spectrometry system.

[5] If HCl is used to acidify samples, which are to be, analyzed for gross alpha or gross beta activities, the acid salts must be converted to nitrate salts before transfer of the samples to planchets.

108555 East Hwy 36
Deer Trail, CO 80105
970.386.2293
Fax 970.386.2262

September 11, 2006

Mr. Steve Tarlton
Unit leader
Radiation Management Unit
Hazardous Waste and Waste Management Unit
Colorado Dept. of Public Health and Environment
4300 Cherry Drive South
Denver, CO 80246-1530

Re: Groundwater Sampling Standard Operating Procedure 15 Env. 2

Dear Mr. Tarlton:

Please find enclosed Revision 1 of the above referenced document. This revision was made to incorporate those modifications noted in the Departments letter dated August 24, 2006.

Should you have any questions please contact me at 970-386-2293.

Sincerely,

Michael Webb
Senior Facility Compliance Manager

Enclosure

cc: Jennifer Opila, CDPHE
Tanell Roberts, CDPHE

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.17

VOLUMETRIC AND MATERIAL SAMPLING

1.0 OBJECTIVE

To provide instruction in techniques for collecting volumetric or material samples from radioactive materials.

2.0 SCOPE

This standard operating procedure (SOP) establishes the requirements for performance, documentation, and review of radiological sampling activities for bulk samples. The collection of samples is used to quantify radioactivity that may be present to comply with Clean Harbors Deer Trail (CHDT) waste acceptance criteria.

3.0 POLICY

Random confirmation sampling will be performed on incoming wastes to comply with CHDT waste acceptance criteria. CHDT personnel will take appropriate precautions to maintain exposures to radioactive materials as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 PROCEDURE

5.1 Personal Protective Equipment

Latex or nitrile gloves shall be worn (and changed when contaminated or torn) when taking samples where radiological contamination is present or suspected. A pair of cotton gloves may be worn under the latex or nitrile gloves. Additional personal protective equipment (PPE) may be required based on the specific requirements of the sampling location (e.g., within the cell, treatment building, etc).

Soil samples and PPE used during sample collection are potentially contaminated materials and should be handled and disposed of as such. The potential contamination may be associated with radiological, chemical, and/or biological contaminants dependent on the source location.

5.2 Sampling Equipment

Sampling equipment used shall be sufficient to collect a representative sample from the materials under investigation. Dedicated or disposable sampling equipment should be used to minimize decontamination requirements. Absorbent wipes or cloths should be available to clean spills and minimize cross contamination concerns. Typical sampling materials include scoops and telescoping poles, but specialized sampling equipment like drum samplers may also be used. Prior to the initiation of a long-term waste stream that will require multiple random confirmation samples, the sampling requirements should be reviewed, and sufficient sample containers for the duration of the project should be obtained.

Following sample collection, the jar or container should be placed into a clean 1 gallon Ziploc bag to contain any potential contamination present on the outside of the container.

5.3 Sample Identification

The sample should be labeled with the CHDT sequential sample number, load number (if applicable), drum number, and profile number. The sample collection date and time should also be printed legibly on the sample label.

5.4 Sample Volume

Typically the minimum sample volume for radiological analyses is 500 milliliters, but additional sample is almost always appropriate. The sample should be representative of the load or shipment being sampled.

5.5 Sample Screening

The sample should be screened with hand-held instrumentation and/or be subject to smear samples to determine if contamination is present on the outside surfaces of the sample containers.

6.0 STANDARDS AND CRITERIA

None.

7.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.18

DECONTAMINATION OF SURFACES AND EQUIPMENT

1.0 OBJECTIVE

Provide instruction in techniques for removing radioactive contamination from surfaces or equipment following routine use and spills.

2.0 SCOPE

This standard operating procedure (SOP) applies to decontamination of surfaces and equipment following routine use and spills and is intended to be used in conjunction with other CHDT and Clean Harbors procedures.

3.0 POLICY

Decontamination of surfaces and equipment is required to prevent the spread of radioactive contamination, and to maintain worker and public exposures as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 PROCEDURE

5.1 Decontamination Following Spills

Decontamination following spills should be supported and verified by radiological surveys conducted per SOP 15.OPS.14, *Spill Surveys*.

5.1.1 Liquid Spills

A liquid spill must be addressed immediately to stop the flow of liquid. Towels, absorbent material (such as Speedi-Dry), or dams should be used to contain the liquid. Using appropriate personal protective equipment (PPE), mop and dry the liquid, placing the spent material into an appropriate container. If necessary, the liquid may be vacuumed using equipment appropriate to do so.

If the spilled liquid has penetrated into soils or other surfaces, additional removals may be required to remediate the area. Specific requirements for more involved decontamination or remediation efforts will be developed on a case-by-case basis by the CHDT RSO.

5.1.2 Solid Spills

Depending on the size of the spill, material may be cleaned using manual means (e.g., shovels, brushes, brooms, etc.) or mechanically (e.g., vacuums or heavy equipment). If the solid material is fine and may become airborne, dust suppression techniques should be used. Small spills of solid material may be cleaned using masselin cloths, or duct tape or other sticky material. Collected decon materials should be placed into appropriate containers for subsequent transport and disposal.

5.2 Equipment Decontamination

Equipment includes backhoe, trucks, and front loader, machine tools, hand tools, and any reusable device. The following steps should be followed when decontaminating equipment:

a. Remove visible dirt or other visible contamination from the equipment using washing, sweeping, wiping or other cleaning methods.

b. Survey the equipment for radioactive contamination, per SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*. If contamination limits are met, equipment may be released.

c. If contamination limits are not met, continue cleaning operations. After cleaning, re- survey the equipment for radioactive contamination, per SOP 15.OPS.13, Equipment and Vehicle Release Surveys. If contamination limits are met, equipment may be released. If contamination limits are not met, continue cleaning followed by surveying until limits are met. If limits cannot be met, consult the RSO. Equipment may be properly disposed of if decontamination is not feasible.

d. Appropriate PPE and dosimetry must be worn during decontamination operations.

e. All waste produced from decontamination must be disposed of properly.

f. All decontamination surveys will be recorded on a radiation survey report.

g. Areas where decontamination operations have taken place must be surveyed after use as appropriate.

6.0 STANDARDS AND CRITERIA

Specific criteria for radiological surveys that support decontamination activities are listed in SOPs 15.OPS.13, *Equipment and Vehicle Release Surveys*, and 15.OPS.14, *Spill Surveys.*

7.0 REFERENCES

Additional discussion of decontamination techniques beyond the scope of this SOP may be found in the following reference:

U.S DOE 1994. *Decommissioning Handbook*. DOE/EM-0142P. U.S. Department of Energy, Office of Environmental Restoration. April.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.19
DECONTAMINATION OF PERSONNEL

1.0 OBJECTIVE

To provide instruction on specific actions to be taken upon detection of personnel contamination.

2.0 SCOPE

This standard operating procedure (SOP) applies to all workers at the Clean Harbors Deer Trail (CHDT) facility that may potentially be contaminated by radioactive materials. As noted in SOP 15.RPP.06, *Emergency Response*, life-threatening injuries in an emergency situation may supersede contamination concerns, as dictated by the CHDT Radiation Safety Officer (RSO) or designee.

3.0 POLICY

Radiation exposures for CHDT and other personnel will be maintained as low as reasonably achievable (ALARA). Decontamination will be performed on personnel who become contaminated with radioactive materials. Emergency medical care should be administered immediately for injuries affected by radioactive materials. Medical treatment of injuries shall take precedence over potential radioactive contamination concerns. This SOP is intended to comply with the current version of Clean Harbors procedure HS 0.00021.T25-10HS, *Decontamination Standards.*

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (DR 15.RPP.01).

5.0 DECONTAMINATION TECHNIQUES

If contamination is a potential issue, appropriate personal protective equipment (PPE) should be worn.

5.1 General Decontamination of Personal or Protective Clothing

Contamination may be removed from personnel clothing by patting the affected area with sticky tape (e.g., duct tape), followed by a resurvey to determine if additional decontamination is necessary. If contamination can not be reduced to background levels below the applicable levels and ALARA, the clothing will be removed from service (either entirely or with the affected portion cut out) for disposal as radioactive material.

5.2 General Decontamination of Skin

If personnel require skin decontamination, they shall be decontaminated by the following methods. *Situations that require more than removal with adhesive or soap and water are rare and are unlikely to be encountered by CHDT or other Clean Harbors personnel.*

a. Personnel skin contamination above 1.5X background must be reported to the CHDT RSO or designee. The CHDT RSO will determine if a skin dose assessment must be performed.

b. Survey the affected area and record the types and initial levels of contamination. If possible, remove particles of contamination with tape and save the particles for evaluation as necessary.

c. Attempt localized washing with warm water and soap ensuring the contamination is not spread to uncontaminated parts of the body.

d. Resurvey the affected area to determine if the contamination has been reduced to background levels and ALARA.

e. If contamination persists, decontamination attempts and resurveys may be repeated multiple times but should stop if these methods are ineffective or skin irritation occurs.

f. If the area can not be decontaminated sufficiently with soap and water, the area may be covered (e.g. with plastic or by wearing latex gloves) to allow contamination to be removed through perspiration. Notify the CHDT RSO or designee if contamination cannot be removed.

5.3 Decontamination in Situations Requiring Medical Treatment

As noted above, the response to life-threatening emergency situations must take precedence over any potential radioactive contamination concerns that may be encountered by CHDT or other Clean Harbors personnel. Personnel decontamination in situations where medical treatment is required should proceed according to the following:

a. Emergency medical care should be administered immediately for injuries affected by radioactive materials.

b. Medical treatment of injuries shall take precedence over radiological considerations.

c. The CHDT RSO or designee will provide medical personnel with any necessary radiological support in regards to contamination control and monitoring of the patient and medical staff.

d. The treatment of radioactively-contaminated injuries should include the following:

- Treatment of contaminated wounds by medically qualified individuals,
- Monitoring of wounds, bandages, and medical instruments and equipment for contamination, and
- Radionuclide identification

e. Contaminated wounds of any kind will be decontaminated under the supervision of the CHDT RSO or designee. Severe wounds will be decontaminated under the supervision of medical personnel.

f. Depending on the levels of contamination encountered, an internal dosimetry evaluation and/or bioassay may be required.

6.0 RECORDKEEPING

Records of contamination events must be maintained in the employee's occupational exposures file. Information regarding a contamination event may be recorded in a field logbook or on a form – an example is provided in Attachment A. Following decontamination, a report should be prepared and submitted to the CHDT RSO or designee. At a minimum, the information provided in this report will consist of the following:

a. Employee name, date, time, radiation work permit number (if appropriate), project name and number, and technician/supervisor,

b. When contamination occurred, description of the cause, where happened/what specific task,

c. A comments/additional information section,

d. How contamination could have been prevented /corrective actions,

e. A drawing of a human figure (front and back views) to document the location of contamination,

f. Survey data – instrument information, pre-decontamination, after each decontamination attempt, radionuclide/form, decontamination method(s), bioassay results (if applicable), and

g. Surveyor and CHDT RSO or designee signatures with signature dates

The information requested in this report must be provided as completely and accurately as possible for evaluation of subsequent actions, personnel dose, and for required documentation.

7.0 REFERENCES

Clean Harbors Environmental Services. HS 1.11, *Decontamination Guidelines*, Current Version.

ATTACHMENT A – PERSONNEL CONTAMINATION FORM
(Page 1 of 2)

Contaminated Individual's Name:	Date:	Time:	RWP/Task #:
Project Name/Number:	Approx. surface area of contamination (cm^2):		Technician/Supervisor:

Approximate length of time that individual remained contaminated, including decontamination attempts:	**Type of Contamination:** ☐ Localized ☐ Discrete Particle ☐ Distributed

PPE Level	☐ Level D	☐ Level C	☐ Level B	☐ Level A	☐ Other (describe below)
Description of PPE:					

Probable Reason for Contamination:

☐ Poor Work Practices ☐ Inadequate HP Controls ☐ Inadequate PPE

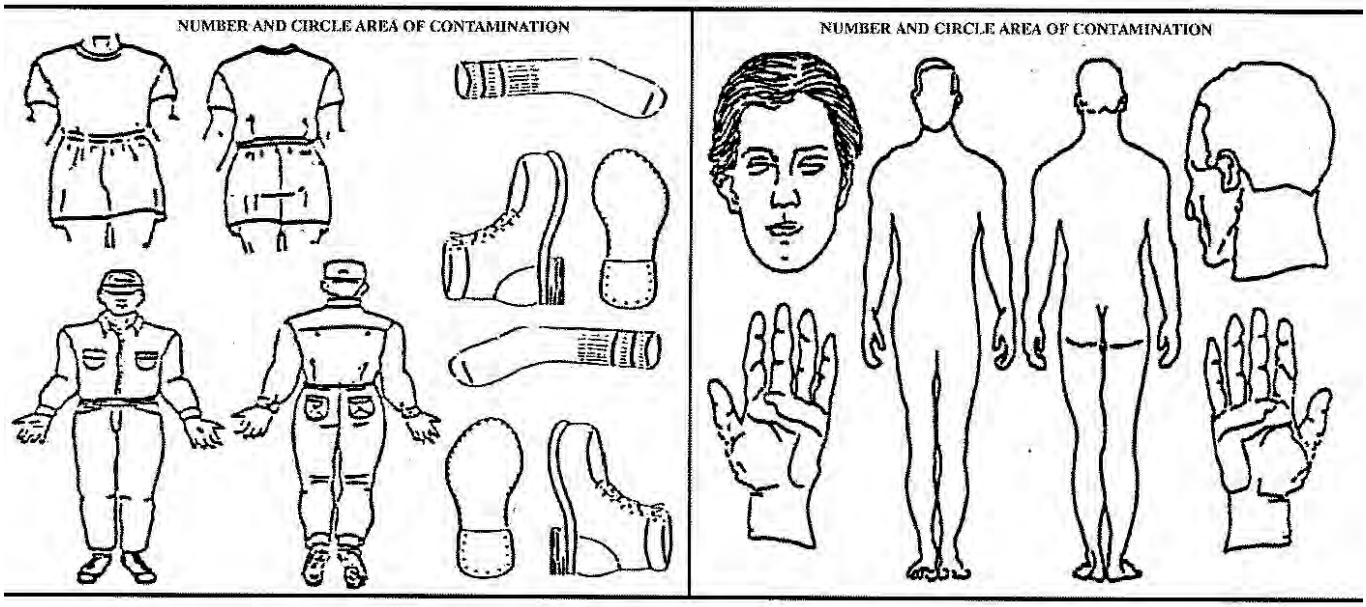
☐ PPE Failure ☐ Contaminated PPE ☐ Perspiration Through PPE

☐ Planned Contamination ☐ Accidental Contamination ☐ Spread From Adjacent Work Area

Comments:
Action Taken:

ATTACHMENT A – PERSONNEL CONTAMINATION FORM
(Page 2 of 2)

☐ CLOTHING CONTAMINATION ☐ SKIN CONTAMINATION



If a discrete particle is on clothing, provide survey through clothing, if possible.

Initial Measurement		1st Decon		2nd Decon		3rd Decon	
Location (note above)	**cpm**	**Method**	**cpm**	**Method**	**cpm**	**Method**	**cpm**

Instrument Type:	Serial No.	Calibration Due Date	Efficiency	Background (cpm)

Disposition of Clothing:

Surveyed by: _____
Print Sign Date

Reviewed by: _____
Print Sign Date

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.20

HANDLING OF LIQUIDS CONTAINING RADIOACTIVE MATERIAL

1.0 OBJECTIVE

Define procedures for handling and disposal of liquids containing radioactive material.

2.0 SCOPE

This standard operating procedure (SOP) applies to the handling of liquids containing radioactive material for treatment and disposal at the Clean Harbors Deer Trail (CHDT) facility.

3.0 POLICY

Liquids containing radioactive material will be handled in a manner to minimize the potential for spills, and maintain worker and public exposures as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (15.RPP.01).

5.0 PROCEDURES

5.1 Waste Receipt

Liquid wastes will typically be shipped in drums, totes, tankers, or vacuum boxes. Drums and totes will typically arrive on-site in covered semi-trailers, while tankers and vacuum boxes will be self-contained. All wastes will be received in accordance with SOP 15.WAC.02, *Waste Tracking*.

5.2 Treatment of Liquids

Treatment operations will be conducted according to the provisions of SOP 15.OPS.02, *Waste Treatment*. Liquid wastes are turned into solids suitable for landfill by the addition of Pozzolanic reagents such as cement kiln dust, Portland cement, lime, lime kiln dust, and fly ash. Pozzolanic reagents function not just by absorption but also by chemically combining with free water in the waste to form a stable solid. Specific treatment formulas will be dependent upon the specific components of the waste stream and will be created on a case-by-case basis and documented as part of the approved waste profile. Liquids with radioactive material will be solidified in treatment basins in the Treatment Building as needed.

5.3 Tanker and Vacuum Box Unloading Operations

Facility personnel will direct the transporter to the unloading area. The truck will back into the unloading area directly up to the edge of the basin. The truck will dump the waste directly into the treatment basin. Trucks will be rinsed using water with the rinsate directed into the treatment basin. Waste trucks leaving the facility will be surveyed for contamination per SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*. If radioactive material is detected above site survey limits, the truck will be decontaminated by washing with water, and the rinsate will be directed into the treatment basin. The truck will then be re-surveyed as needed.

5.4 Small Container Processing Operations

Drums will normally be unloaded using a drum-tipping machine. This machine has arms that grab the drum by the side. Drums will have the lids removed or the bungs opened. They will then be picked up by the drum tipper, turned upside down, and dumped into the treatment basin. Tote tanks will normally be unloaded using the bottom outlet and the liquid waste will be drained into the treatment basin. Alternatively, drums and totes may be processed through the drum shredder with shredded residue directed into a treatment basin where they can be processed with other waste. Shredding drums and totes reduces the empty containers to small pieces that can be processed with the rest of the waste. Empty containers will normally be crushed and disposed of in the landfill, filled with absorbent and disposed of in the landfill, or decontaminated for other uses if they are returnable containers per SOP 15.OPS.18, *Decontamination of Surfaces and Equipment*. Crushing of containers will preferentially take place in the landfill, in the treatment basins, and on the floor of the treatment building in that order.

5.5 Mixing Operations

Mixing operations in the treatment building are conducted using a backhoe and chemical reagent additives, typically cement kiln dust or other Pozzolanic reagents. Waste is placed in the treatment basin, reagents are added, and the waste mixture is mixed until treatment (solidification) is complete. The treatment building is a totally enclosed building with two emission control systems consisting of a bag house and a wet scrubber. All treatment operations must be conducted with the emission control system properly operating to control releases of waste materials. Treatment and hauling the treated waste to the landfill will be conducted according to the provisions of SOP 15.OPS.02 *Waste Treatment.*

5.6 Release of Liquid Containers

A radiological release survey per 15.OPS.13, *Equipment and Vehicle Release Surveys*, will be performed prior to return of the waste container. (This procedure is usually only performed on large tankers and vacuum trucks. Smaller containers that are not released for return will be disposed in the active CHDT disposal cell.) The release process will be performed by an evaluation of the radiological conditions of accessible areas. Smear and direct surveys of the inlet, outlet, cleanouts, and other access points will be performed. Remote survey equipment such as extendable Geiger Mueller (GM) probes and smear collection devices will be used as needed. If the results of the surveys of the accessible areas indicate radioactivity levels consistent with facility release limits, no further survey is required. If contamination is detected, further surveys of the equipment will be directed by the RSO. Decontamination methods include, but are not limited to, entry into the tanker to perform physical decontamination and

release and/or performing an interior rinse or wash. All rinsate will be directed into a treatment basin, solidified and land-filled.

6.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.21
PACKAGE RECEIPT SURVEYS

1.0 OBJECTIVE

To define general and specific methods and procedures for conducting radiation surveys for receipt of packages containing radioactive material in compliance with Colorado Regulations.

2.0 SCOPE

This standard operating procedure (SOP) applies to the receipt of bulk and containerized shipments of waste known to contain radioactive materials and receipt of waste samples known to contain radioactive materials. Most waste samples containing radioactive materials sent to CHDT are exempt quantity non-DOT labeled shipments. Similarly, most waste shipments containing radioactive materials acceptable to DR under the License are either non-DOT regulated, limited quantity, or LSA-1 shipments not requiring labels. While most of these shipments would appear not to require package receipt surveys under Colorado Regulations (RH Part 4.32), Licensees must "Monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are crushed, wet, or damaged". (RH 4.32.2.3). In the interest of complying with this part, CHDT will conduct receipt surveys on all packages and waste shipments known to contain radioactive materials.

3.0 POLICY

CHDT will conduct receipt surveys on all packages and waste shipments known to contain radioactive materials in accordance with the provisions of this SOP and Colorado Regulations. All packages known to contain radioactive materials will be monitored for radioactive contamination, radiation levels, and package integrity.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (15.RPP.01).

5.0 GENERAL SURVEY METHODS

Direct surveys of packages may be conducted using a Ludlum Model 44-9 Geiger Mueller (GM) "pancake"-type probe with Ludlum Model 12 survey meter (or equivalent) for surface beta-gamma measurements; a Ludlum 43-93 alpha-beta scintillation detector with Ludlum 2360 survey meter (or equivalent) for surface alpha-beta measurements; a Ludlum Model 19 (or equivalent) for ambient exposure rate measurements; or any other

radiation measuring instrument appropriate for the task. Package surveys will be supported by smear sample analyses for removable radioactivity using the Ludlum 3030 alpha-beta sample counter (or equivalent).

5.1 Pre-Survey Instrument Check List

Prior to use of any field instrument, the operation of the probe and survey meter used shall be checked in accordance with SOP's 15.OPS.7 and 15.OPS.08 and 15.OPS.09.

5.2 Package Receipt Surveys

Receipt surveys will be performed on incoming packages and waste shipments known to contain radioactive materials. Where possible, surveys will be conducted in dedicated areas. Survey results shall be recorded in ink on appropriate survey forms, which shall document the following:

- Time and date of the survey
- Technician(s) performing the survey
- Instrument(s) used, with serial number, calibration due date
- Measurement locations, with pictures or drawings as necessary
- Background and efficiency information for the instruments, as appropriate
- Raw measurements, including measurement type and count time (if necessary)

Where necessary, surveys may be documented in a field logbook in the absence of a survey form. Pictures or drawings of equipment, vehicles, or frequently surveyed items may be electronically inserted into the survey form to facilitate documentation.

A minimum of four locations will be measured for removable contamination. The CHDT RSO or designee will determine additional survey requirements as necessary. Specific measurement locations are to be determined at the discretion of the survey technician; however, measurements should be biased toward the most likely areas of contamination to provide conservative survey results.

5.3 Package Integrity Inspection

A visual inspection of the package or container holding radioactive materials will include checking for damage such as signs of crushing, wet spots or evidence of leakage. If any damage is found, the CHDT RSO or designee will be notified immediately, and the package will be segregated from other packages until the extent of damage has been determined. Any damage will be noted on the inspection form. The CHDT RSO or designee will determine what actions need to be taken and any notifications that need to be made to the carrier and regulatory agencies.

5.4 Measurements of Radiation Levels

Radiation levels will normally be measured according to the procedures in SOP 15.OPS.07, Operation of Exposure Rate/ Dose Rate Meters. Radiation levels will be measured on at least two sides of the package.

5.5 Measurements of Removable Contamination

Measurements for removable contamination will normally be performed according to the procedures in SOP 15.OPS.04 Operation of Alpha Beta Counter. Measurements for removable contamination are measured indirectly by the collection of smear or wipe samples. Smears are collected with a 47-millimeter smear filter. Using evenly applied pressure, the smear should be collected with an S-shape over approximately 100 square centimeters. The smear may then be removed from the paper folder, adhered to an aluminum planchet and counted in the alpha-beta sample counter.

6.0 STANDARDS AND CRITERIA

6.1 Data Conversion

For comparison with the measurement criteria listed in Sections 6.2 and 6.3, surface measurements in counts per minute (cpm) must be converted to units of decays per minute per 100 square centimeters (dpm/100cm2). Procedures for data conversion are provided in SOPs 15.OPS.08, Operation of Alpha-Beta Scintillation Detector, and 15.OPS.09, Operation of GM Pancake Probe. The Ludlum 3030 used at CHDT provides measurements in units of dpm.

6.2 Package Receipt Non-Fixed Contamination Levels

Contamination control limits for non-fixed (i.e., removable) surface contamination are established by the Department of Transportation (DOT) in 49 CFR 173.443. These limits are summarized in Table 1.

Table 1 – DOT Non-Fixed Surface Contamination Limits

Radionuclide Group	Maximum Permissible Limit (Bq/cm^2)[a,b]	Maximum Permissible Limit (dpm/cm^2)[a,b]	Maximum Permissible Limit ($dpm/100\ cm^2$)[a,b]
1. Beta and gamma emitters and low-toxicity alpha emitters	0.4	24.0	2,400
2. All other alpha-emitting radionuclides	0.04	2.4	240

(a) Averaged over 300 cm^2
(b) Divided by 10 to account for default efficiency required by 49 CFR 173.443(a)(1)(i)

In addition, there are exposure rate limits associated with different types of shipments. Task-specific direction will be provided by the CHDT RSO or designee regarding these limits.

6.3 Quality Control

In addition to the daily QC measurements required for each individual instrument, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

7.0 REFERENCES

49 CFR 173. Shippers – General Requirements for Shipments and Packagings. Current Version.

CO 6 CCR 1007-1 Part 4.32. Procedures for Receiving and Opening Packages.

RADIATION PROTECTION PLAN
FOR
CLEAN HARBORS DEER TRAIL, LLC

15.RPP.01 Revision 3
December 31, 2014

Clean Harbors Environmental Services

108555 East Highway 36

Deer Trail, CO 80105-9611

APPROVALS

By signature below, the undersigned attest that the Radiation Protection Plan (RPP) documented herein meets or exceeds all applicable regulatory requirements for radiological activities at the Clean Harbors Deer Trail (CHDT), LLC RCRA Subtitle C landfill. The RPP is designed to protect employees, the public, and the environment from the potentially harmful effects of exposure to ionizing radiation from radioactive materials disposed in accordance with the limits of License 1102-01. CHDT is committed to meeting all applicable State and Federal regulatory requirements and to keeping worker and public doses from radioactive materials as low as reasonably achievable (ALARA). The license activity addressed by this Plan is the disposal of limited quantities of naturally-occurring radionuclides under 6 CCR 1007-1, Part 14. Because of the site location, the engineered design of the disposal cells, and the low concentrations of radionuclides in the materials to be disposed under the license, the relevant performance objectives will be met.

As part of this Radiation Protection Plan, the Company provides:

- Personnel instruction in radiation safety, as given by safety staff and field supervisors,
- Relevant manuals, installation and test instructions, and Standard Operating Procedures (SOPs) for equipment and activities at the Deer Trail landfill,
- Radiation safety seminars,
- A personnel monitoring system, as required (thermoluminescent dosimeters [TLDs]),
- Gate monitors, radiation monitors, air sampling, and radiation survey meters when required, and
- This Radiation Protection Plan

This RPP has been approved by CHDT corporate staff and CHDT Radiation Safety Officer (RSO).

Approved by:

_____

Phil Retallick - Senior Vice President, Regulatory Affairs

_____

John H (Jack) Kehoe, MS - Facility General Manager

_____

Clyde Christman, RRPT - Radiation Safety Officer

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REFERENCED STANDARD OPERATING PROCEDURES

SOP Number	Title
15.RPP	**Radiation Protection Program**
15.RPP.01	Radiation Protection Plan
15.RPP.02	Radiation Safety Training
15.RPP.03	Worker Protection Records
15.RPP.04	Individual and Area Dosimetry
15.RPP.05	Estimating Inhalation Doses
15.RPP.06	Emergency Response
15.RPP.07	ALARA
15.RPP.08	Radiation Work Permits
15.RPP.09	Personal Protective Equipment
15.RPP.10	Determination of Prior Occupational Dose
15.WAC	**Waste Acceptance and Analysis**
15.WAC.01	Radioactive Materials Acceptance
15.WAC.02	Waste Tracking
15.WAC.03	Survey of Radium Scale Waste[a.]
15.OPS	**Facility and Field Operations**
15.OPS.01	Landfill Operations
15.OPS.02	Waste Treatment Activities
15.OPS.03	Operation of Portable Gamma Spectroscopy Unit
15.OPS.04	Operation of Alpha-Beta Smear Counter
15.OPS.05	Operation of Gate Monitor Detectors
15.OPS.06	Operation of Digital Waste Monitor
15.OPS.07	Operation of Exposure Rate/ Dose Rate Meters
15.OPS.08	Operation of Alpha-Beta Scintillation Detector
15.OPS.09	Operation of GM Pancake Probe
15.OPS.10	Operation of Gamma Scintillation Detectors
15.OPS.11	Routine Contamination Surveys
15.OPS.12	Personnel Contamination Surveys
15.OPS.13	Equipment and Vehicle Release Surveys
15.OPS.14	Spill Surveys

SOP Number	Title
15.OPS.15	Air Monitoring for Radioactive Materials
15.OPS.16	Groundwater Monitoring[a.]
15.OPS.17	Volumetric and Material Sampling
15.OPS.18	Decontamination of Surfaces and Equipment
15.OPS.19	Decontamination of Personnel
15.OPS.20	Handling of Liquids
15.OPS.21	Package Receipt Surveys

[a.] Previously submitted, awaiting comments.

1.0 PURPOSE AND SCOPE

The purpose of this Radiation Protection Plan is to establish all necessary precautions, procedures, and plans to be observed when working directly with radioactive materials during treatment and disposal operations. This plan, supporting policies, and standard operating procedures (SOPs) comprise the Clean Harbors Deer Trail (CHDT) Radiation Protection Program (RPP), and all procedures set forth shall be strictly adhered to, by each and every designated employee, site visitor, or outside contractor who works with and around radioactive materials. It is the responsibility of the CHDT Radiation Safety Officer (RSO) to ensure that all employees, visitors, or outside contractors understand and will comply with the procedures and conditions defined in the RPP.

The procedures and policies in the RPP apply primarily to operations at the CHDT facility. Some of the SOPs are more general in nature and may be used at other Clean Harbors facilities or job sites as directed by the CHDT RSO or other Clean Harbors health and safety personnel.

2.0 ORGANIZATION AND RESPONSIBILITIES

The responsibilities for maintaining radiation safety at the CHDT facility are assigned to the following individuals:

1. CHDT Facility General Manager
2. CHDT RSO
3. CHDT Environmental Compliance Manager
4. CHDT Lab Supervisor
5. CHDT Plant Foreman
6. CHDT Employees

The duties and responsibilities of these individuals are described below.

2.1 Facility General Manager

The Deer Trail General Manager is responsible for overall site operations. He shall ensure that supervisory and operating staff are trained in the procedures and understand them. He shall ensure that the staff have adequate resources to implement the SOPs. He shall ensure that proper procedures are followed. He has the authority to cease operations in the landfill if it becomes evident that the procedures are not being followed or do not achieve their goals. Note that these operations are consistent with those required for RCRA landfill operations, as tailored for the presence of radioactive materials.

2.2 Radiation Safety Officer (RSO)

The CHDT RSO is responsible for directing the CHDT Radiation Protection Program. The RSO is responsible for all aspects of radiation safety and for monitoring compliance with the radiation protection SOPs. He is responsible for: 1) developing the radiation safety SOPs and ensuring that the procedures are adequate to achieve their goals, 2) conducting or supervising the conduct of radiological surveys and monitoring, and 3) keeping appropriate records. He is responsible for implementing the procedures and

modifying or updating the procedures, if needed. He has the authority to cease operations in the landfill if it becomes evident that the radiation protection procedures are not being followed or do not achieve their radiological safety goals. Specifically, the Deer Trail RSO shall:

1. Direct the operations of the staff regarding radiation safety;
2. Be empowered to impose conditions of work, restrictions on work, and termination of work involving regulated waste as necessary to protect personnel, the public, or the environment or to ensure regulatory compliance;
3. Review the Radiation Protection Program at least annually;
4. Serve as the CHDT's point of contact with state and federal regulatory agencies on all matters related to radiation safety;
5. Maintain a personnel dosimetry program, including evaluation of the need for issuance of dosimetry, maintain a contract for commercial dosimetry services, maintain dose records, and provide reports to individuals consistent with Colorado Regulations 6 CCR 1007-1, § 4.56 (Reports of Individual Monitoring);
6. Maintain radiation protection records including approved procedures, amendments, revisions and renewals consistent with Colorado Regulations 6 CCR 1007-1, § 4.40, 4.41, 4.42, 4.44, 4.47, and 4.50;
7. Provide radiation safety training for Company personnel;
8. Provide information and consultation on matters related to radiation safety.

2.3 Environmental Manager

The Environmental Manager shall report issues of environmental radiological noncompliance or other radiological issues to the RSO and the General Manager. (The General Manager is currently filling the position of the Environmental Manager at the time of this application.)

2.4 Lab Supervisor

The Lab Supervisor will supervise all laboratory activities including waste acceptance sampling and analysis. The Lab Supervisor is also responsible for ensuring and documenting quality control in the waste receiving process and all laboratory operations.

2.5 Plant Foreman

The plant foreman shall supervise the operating staff and make sure that proper radiation safety procedures are followed. He shall report any radiological noncompliance to the RSO and General Manager. He shall communicate problems in following the radiation procedures to the RSO and General Manager. He shall request resources to fully implement the SOPs, if needed, from the General Manager. He shall make sure that the operating staff are trained and understand the procedures. He shall suggest modification to the procedures, if needed.

2.6 Deer Trail Employees

Each CHDT employee who works with radioactive materials as outlined in this plan shall take responsibility for his or her own protection and for reporting any condition, which, in the individual's opinion, constitutes unsafe or improper working conditions. Each individual is responsible for:

1. Maintaining their own exposures to radioactive materials ALARA;
2. Following procedures and accepted safe work practices so as not to endanger him or her, the public, or the environment;
3. Reporting any unsafe working conditions, violations of the rules prescribed in this document, or violations of the applicable regulations of the state to their supervisor and/or to the CHDT RSO and;
4. Employees who may serve as visitor escorts shall point out any hazardous area that a visitor may be entering and shall ensure that all Company radiation safety rules and precautions are observed.

3.0 CONTROL AND LIMITATION OF RADIATION EXPOSURES

State and federal regulations establish a system of radiation dose justification, limitation and optimization. Individual doses are limited to ensure that immediate, deterministic effects (such as radiation burns, or skin erythema) are avoided and that total lifetime risks of chronic or stochastic effects (such as cancer and hereditary effects) do not exceed overall health risks for those persons working in safe industries. However, regulations also require that licensees further minimize radiation doses to individuals and to groups of individuals to the extent practical, which is known as the ALARA philosophy.

3.1 Radiation Dose Limits

For exposure to radioactive materials, CHDT workers shall be considered as occupational radiation workers, subject to a total effective dose equivalent (TEDE) of 5,000 millirem per year (mrem/yr) per 6 CCR 1007-1, § 4.6 in the Colorado regulations for radiation control. However, CHDT intends to maintain radiation exposures to its workers at levels ALARA, with a goal of 25 mrem/yr TEDE or less. Employee doses, both internal and external, shall be evaluated by the RSO on a quarterly basis. If it is determined from worker dosimetry results that selected worker doses could exceed 25 mrem/yr, the RSO shall conduct an evaluation of the potential for other occupational exposures for these workers to ensure that maximum individual doses shall not exceed 5,000 mrem/yr.

3.2 Planned Special Exposures

The provisions of 6 CCR 1007-1, § 4.11 allow licensees to authorize an adult worker to receive doses in addition to and accounted for separately from the doses received under normal conditions. These provisions relate to the occupational dose limits of 5,000 mR/yr plus ALARA. However, because of the limited concentrations of radioactive materials to be treated and disposed under the license, it is highly unlikely that exposure situations will arise that could require imposition of these provisions. When special conditions are encountered that may result in significant worker exposures, exposure rates, contamination levels, and potential exposure conditions shall be determined,

documented, and discussed in advance of performing the activity using SOP 15.RPP.08, *Radiation Work Permits*. The CHDT RSO shall evaluate the survey data and evaluate which controls will be required for a specific task. The CHDT RSO will gather and maintain information regarding Prior Occupational Dose in accordance with the requirements of SOP 15.RPP.10, and institute administrative controls regarding planned special exposures for individuals if needed.

3.3 Protection of the Embryo/Fetus

The provisions of 6 CCR 1007-1, § 4.13 require licensees to ensure that the dose equivalent to an embryo/fetus during the entire pregnancy, due to the occupational exposure of a declared pregnant woman, does not exceed 500 mrem, with monitoring requirements imposed under § 4.18 for those that could be exposed in excess of 100 mrem. Declared pregnant worker exposures shall be tracked and reported under the CHDT SOPs, evaluated by the CHDT RSO, and information about protection of the embryo/fetus shall be included in the CHDT training, as outlined in SOP 15.RPP.02, *Radiation Safety Training*.

3.4 Posting

Because of the anticipated low dose rates (average dose rates of less than 0.1 mrem/hr), there should be no need for posting radiation areas because of dose rates. However, posting shall be required where radioactive materials are treated or disposed. This shall include areas within the lab, treatment building, and the landfill disposal cells.

3.5 Routes of Exposure

Exposures to radioactive materials may be received from radiation fields that are external to the body (external exposure), from radioactive materials that are inside the body (internal exposure following inhalation), or both. Inhalation of dust particles is the primary potential route of internal exposure.

3.6 Respiratory Protection

Exposure of workers to airborne radioactive materials shall be controlled through the use of full-face respirators that filter airborne particulate materials. These masks are required under the RCRA Permit as part of the CHDT Health and Safety Plan for in-cell disposal operations, waste sampling operations, and all operations in the treatment building. These masks are NIOSH-approved for particulates under the 42 CFR 84 P100 classification and are 99.7% efficient in removing particles of 0.3 microns or greater in diameter. As described in 6 CCR 1007-1, § 4, Appendix A, these respirators have a respiratory protection factor of 50. An evaluation was conducted per the guidance in 6 CCR 1007-1, § 4.24.2.1 to determine the adequacy of this mandatory respiratory protection equipment. For this evaluation, natural uranium, with a specific activity of 2,000 pCi/g was assumed with the most restrictive DAC (i.e., Class Y material, with a value of 2E-11 µCi/mL in air). For dusty outdoors operations, air concentrations range from about 100 to 500 $\mu g/m^3$ (NUREG/CR-5512; Kennedy and Strenge 1992). Assuming a conservative, long-term air concentration of 500 $\mu g/m^3$, the estimated activity concentration is air is 1E-12 µCi/mL. This concentration is about 5% of the DAC, which supports the conclusion that the respiratory protection would not be needed

for protecting CHDT workers from airborne particulate radioactive material. However, since this equipment is mandatory under the RCRA Permit, further assurance is provided that worker inhalation exposures will be quite low. Procedures for estimating airborne concentrations are provided in SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*. The procedure for estimating worker inhalation doses is provided in SOP 15.RPP.05, *Estimating Inhalation Doses*. Procedures for recording those doses, on a quarterly and annual basis, are detailed in SOP 15.RPP.04, *Individual and Area Dosimetry*.

3.7 Determination of Internal Exposure

Per 6 CCR 1007-1, § 4.9, estimates of internal exposure shall be made using the measured airborne concentrations at appropriate work locations to perform an assessment of the committed effective dose equivalent (CEDE). Procedures for estimating airborne concentrations are provided in SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*. These airborne concentration estimates shall be used as described in SOP 15.RPP.05, *Estimating Inhalation Doses* and worker inhalation doses recorded on an annual basis, as described in SOP 15.RPP.04, *Individual and Area Dosimetry*. Because of the relatively low concentrations of radioactive materials to be disposed, and because of the use of mandatory respiratory protection under the RCRA Permit, no bioassays will be conducted.

3.8 Means of Exposure Control

Common external exposure controls include the use of time, distance, and shielding to minimize radiation doses. These concepts are thoroughly presented in CHDT radiation safety training courses but should also be continually reinforced by field personnel through daily or weekly radiation safety briefings. Common control measures to reduce inhalation exposures include the use of protective equipment and engineering controls. Personal protective equipment (PPE) required under the RCRA Permit, including disposable coveralls, gloves, and boot covers, provide protection against skin contamination. Required protective equipment used in these operations is detailed in SOP 15.RPP.09, *Personal Protective Equipment,* the CHDT Facility Health and Safety Plan, and other corporate procedures. Engineering controls utilized to control exposure include dust control measures in the landfill cell and the air filtration system in the treatment building.

3.9 Minors

Minor visitors to the facility shall be escorted within the site and shall not be allowed in restricted areas. Minors are not employed at the CHDT facility.

3.10 Waste Tracking

All waste that is received, treated, and disposed at the CHDT facility is tracked through operational procedures, largely developed for the RCRA permit. These procedures are provided in SOP 15.WAC.02, *Waste Tracking*, which defines the procedures, electronic files, hardcopy forms and their use in tracking waste at CHDT.

4.0 RADIATION DOSIMETRY

The purpose of the radiation dosimetry program is to measure radiation dose equivalent received by Deer Trail employees during the handling and disposal of regulated waste. The results serve to verify and document compliance with the applicable dose limits (see Section 3) and to identify problems and monitor the effectiveness of radiation safety controls. Radiation doses may be received in two ways: 1) from radioactive materials that are external to the body (external dose) or 2) from radioactive materials that are inside the body (internal dose). These doses shall be monitored when required by regulation and as described below:

4.1 External Radiation Dosimetry

Radiation dosimeters shall be issued by the CHDT RSO and worn by individual workers, visitors, and outside contractors who have been appropriately trained and who may routinely come into contact with or are in the proximity of, radioactive materials, consistent with 15.RPP.04, *Individual and Area Dosimetry*.

4.2 Internal Radiation Dose Assessment

Consistent with the 6 CCR 1007-1, § 4.9 (Determination of Internal Exposure), for purposes of assessing internal radiation doses from the inhalation of airborne radioactive materials, suitable and timely measurements of the concentrations of airborne materials in workplace air shall be made and recorded. Airborne concentrations shall be determined consistent with SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*. These airborne concentrations, in combination with estimates of the duration of exposure and the impact of respiratory controls (as appropriate), with assumptions about the physical and chemical nature of the airborne regulated waste, shall be used to assess internal dose to workers from inhalation, in accordance with SOP 15.RPP.05, *Estimating Inhalation Doses*.

5.0 RECORDS

All records of exposure, internal and external, are legal and personal documents and shall be controlled to preclude release of personnel information. All radiation protection records including individual worker records, approved procedures, amendments, revisions and renewals shall be maintained consistent with the Colorado Regulations 6 CCR 1007-1, § 4.40, 4.41, 4.42, 4.44, 4.47, and 4.50.

6.0 RADIATION SURVEYS AND INSTRUMENTATION

Radiation surveys are used to identify and quantify radiation hazards, verify contamination control, and to support the documentation of regulatory compliance. The CHDT RSO and all field personnel must work together to ensure safety in the workplace and to protect both the public and the environment from the harmful effects of radiation.

6.1 Types of Surveys

Several types of radiation surveys shall be performed supporting specific operations at CHDT. In summary, these include:

1. Waste Receipt – surveys shall be conducted to verify that incoming radioactive materials will meet the CHDT waste acceptance criteria and do not present an exposure or contamination concern. The surveys shall include:
   a. Screening at the facility gate for gamma radiation per SOP 15.OPS.05, *Operation of Gate Monitor Detectors*.
   b. Qualitative gamma spectroscopy screening, per SOP 15.OPS.03, *Operation of Portable Gamma Spectroscopy Unit*.
   c. Removable contamination surveys, per SOP 15.WAC.01, *Waste Acceptance*, and 15.OPS.04, *Operation of Alpha-Beta Smear Counter*.
2. Contamination surveys for different areas at the facility, per SOP 15.OPS.11, *Routine Contamination Surveys*.
3. Personnel contamination surveys using SOP 15.OPS.12, *Personnel Contamination Surveys*.
4. Spill response surveys using SOP 15.OPS.14, *Spill Surveys*.
5. Equipment contamination surveys using SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*.

Surveys may be conducted with portable, stationary, or laboratory survey equipment. Individual SOPs for the use of each type of instrument are to be referenced prior to their use.

6.2 Requirements on Maintaining Radiation Detection Instrumentation

The CHDT RSO shall ensure that the facility maintains radiation detection equipment that is appropriate for detecting the types of radiation emitted by radioactive materials received for disposal. All radiation detection instruments shall be calibrated, as appropriate for the use of the instrument, or after repair of the instrument, to the manufacturer's specifications. Battery replacement is not cause for performing a calibration.

On each day of use, a quality control check using a check source of known radioactivity will be performed for each instrument. In addition, a background measurement will be collected. These measurements will be compared against established operating parameters to verify that the instrument is operating appropriately and consistently.

7.0 TRAINING

All CHDT employees, visitors, and outside contractors who work with or near regulated waste are required to complete radiation safety training, as described in SOP 15.RPP.02, *Radiation Safety Training*. The depth of the training shall be commensurate with the level of hazard to which the individual is exposed. All training shall be documented. No individual shall be allowed to work unsupervised until that person completes appropriate radiation safety training.

7.1 Basic Radiation Safety Training

All individuals who work with radioactive materials are required to satisfactorily complete appropriate radiation safety training course offered by or at the direction of the CHDT RSO and/or demonstrate competence on that subject matter by scoring at least 70% on a test administered or directed by the CHDT RSO. CHDT RSO-provided refresher training shall be conducted at least once each year for all individuals who work with radioactive materials. All training shall be documented and maintained on file by the CHDT RSO. Training documentation shall include content of the training (outline, course description, etc.); instructor name; date and duration of training; and the printed name and signature of trainee(s). Copies of individual employee training records are available from the CHDT RSO. Visitors who work with radioactive materials shall be required to complete training similar to that of employees. Visitors who will not be working with radioactive materials but who will enter restricted areas shall be required to be escorted at all times and undergo basic training commensurate with their potential exposure.

7.2 Hazard Communication Program

The CHDT facility has a hazard communication program as part of the Facility Health and Safety Plan maintained under the RCRA Permit. The hazard communication program utilizes waste profiles, MSDS's, labels and formal training to inform employees of any hazards of the waste materials with which they will be working. The hazard communication program shall be utilized to convey information on the specific hazards of regulated waste handled at the facility.

8.0 INCIDENTS AND EMERGENCIES

General procedures for dealing with emergency situations such as spills or accidents are detailed in the CHDT RCRA Permit Attachment 4, "Contingency Plan." The Contingency Plan contains procedures for spill cleanup, notification of authorities, and other responses. It also provides a description of the equipment and staff available to deal with such situations. In addition, SOP 15.RPP.06, *Emergency Response,* provides additional direction on emergency response activities after an incident involving radioactive materials. In the event of a radiological incident, such as a spill or other emergency, the CHDT RSO shall be notified immediately. In instances where there is doubt about whether such notification is necessary, contact should be made to allow the CHDT RSO to assess the situation and initiate the appropriate response. If appropriate, the measures described in SOP 15.RPP.06 and the Contingency Plan shall be implemented. Radiation surveys following spills of regulated waste shall be conducted according to SOP 15.OPS.14, *Spill Surveys*.

What Constitutes an Incident or Emergency?

1. Loss, theft, or misuse of any radioactive material.
2. High or potentially high radiation exposure to an individual or to a member of the public; for example greater than 10 mrem to any offsite member of the public from an incident.

3. Intake or potential intake of radioactive materials by inhalation, ingestion, or injection through skin or wound.
4. Deceptive or potentially deceptive exposure of a dosimeter.
5. Personnel contamination that cannot be completely removed after three washes with only soap and water.
6. Any personnel injuries that may involve radioactive contamination or radiation exposure.

9.0 RECORD KEEPING

Record-keeping requirements vary and are maintained along with actual records by the Deer Trail RSO consistent with Colorado Regulations 6 CCR 1007-1, § 4.40, 4.41, 4.42, 4.44, 4.47, and 4.50. Record keeping requirements are provided in SOP 15.RPP.03, *Worker Radiation Protection Records*.

9.1 General Record-Keeping Requirements

1. The CHDT RSO shall maintain the following records in a clear, concise, and orderly format. Retention periods are included in parentheses.
   a. Radiation surveys, as required (3 years)
      i. Radiation field surveys for areas in proximity to regulated waste for disposal,
      ii. Ambient radiation field surveys in unaffected areas, and
      iii. Contamination surveys for release of trucks and equipment.
   b. Survey instrument calibrations, as required by the manufacturer (3 years)
   c. Personnel records (1 year post termination of employment)
      i. Worker/user lists,
      ii. Training records.
   d. Individual monitoring results, for routine, planned special exposures, accidents, and emergency conditions as provided by the CHDT Standard Operating Procedure on Individual and Area Dosimetry (duration of license)
   e. Records of waste disposal as required by regulation
   f. Annual ALARA program audits (duration of license)
   g. Incident investigation reports (duration of license)
   h. Declarations of pregnancy (duration of license)
   i. Environmental monitoring data and reports (duration of license)
   j. Operating and emergency procedures (current)
   k. Procedure manuals from CHDT RSO (current)

2. In addition to maintaining all records in step 1, the Deer Trail RSO shall maintain the following records, which are available for review during normal office hours.
   a. Copies of current state regulations relating to regulated waste,
   b. Inspection reports and copies of all "Notices of Violation" issued by state regulatory agencies and the Deer Trail responses to those Notices,
   c. Current version of all policy manuals and standard operating procedure manuals,
   d. Dosimetry records, and
   e. Survey instrument calibrations records.

9.2 Information Required on Specific Records

1. Radiation surveys
   a. Records shall be in units of dpm, Ci, µCi, mR/h, mrem/h, etc., as appropriate. Units of "cpm" or "counts" are not acceptable for quantitative survey records,
   b. Records shall clearly indicate the areas surveyed,
   c. Records shall indicate the person performing the survey and date of survey, and
   d. Records shall uniquely identify the survey instrument used, i.e., serial number, or other unique description.
2. Training records are specified in Section 6.

9.3 Audits

The CHDT RSO or designee will conduct periodic informal audits of the CHDT RPP throughout the year. A formal audit of the program will be conducted annually to coincide with the ALARA audit performed for the Annual Report. The audit will identify any items of concern, any equipment needs, or any other issue impacting the program.

10.0 GLOSSARY OF TERMS

"Absorbed dose" means the energy imparted by ionizing radiation per unit mass of irradiated material. The unit of absorbed dose is the Rad.

"Activity" means the rate of disintegration or transformation or decay of radioactive material. The units of activity are "disintegrations per second (or minute)" (dps or dpm) and curie (Ci).

1 Ci = 37,000,000,000 dps (3.7E10 dps)

1 Ci = 2,220,000,000,000 dpm (2.22E12 dpm)

"Agreement State" means a state that has executed an agreement with the U.S. Nuclear Regulatory Commission transferring to the state the responsibility for regulating uses of certain radioactive materials within its borders. Colorado is an agreement state.

"Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, particles, mists, vapors, or gases.

"As low as reasonably achievable (ALARA)" means making every reasonable effort to maintain exposures to radiation as far below regulatory dose limits as is practical, consistent with the purpose for which the licensed or registered activity is undertaken, taking into account the state of technology, the economics of improvements in relation to benefits to public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of ionizing radiation and licensed sources of radiation in the public interest.

"Background radiation" means radiation from cosmic sources; non-technologically enhanced naturally occurring radioactive material, including radon, except as a decay product of source or special nuclear material, and including global fallout as it exists in the environment from the testing of nuclear explosive devices. "Background radiation" does not include sources of radiation from radioactive materials regulated by the State of Colorado.

"Committed dose equivalent (HT, 50 or CDE)" means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

"Committed effective dose equivalent (HE,50 or CEDE)" means the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues.

"Curie (Ci)" means a unit of measurement of activity. One curie (Ci) is that quantity of radioactive material that decays at the rate of 3.7E10 disintegrations per second (dps). Commonly used sub-multiples of the curie are the millicurie, the microcurie, the nanocurie, and the picocurie.

"Dose" is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, total organ dose equivalent, or total effective dose equivalent.

"Dose equivalent (HT)" means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are rem or mrem.

"Dosimeter" means devices designed to be worn by a single individual for the assessment of dose equivalent. Examples of individual monitoring devices are film badges, thermoluminescent dosimeters (TLDs), and pocket ionization chambers.

"Effective dose equivalent (HE)" means the sum of the products of the dose equivalent to each organ or tissue (HT) and the weighting factor (WT) applicable to each of the body organs or tissues that are irradiated.

"Exposure rate" means the exposure per unit of time, typically milliRoentgens per hour (mR/h) or microRoentgens per hour (µR/h).

"External dose" means that portion of the dose equivalent received from any source of radiation outside the body.

"Internal dose" means that portion of the dose equivalent received from radioactive material taken into the body.

"Ionizing radiation" means any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter. Ionizing radiation includes gamma rays and x rays, alpha and beta particles, high-speed electrons, neutrons, and other nuclear particles.

"Lost or missing source of radiation" means a source of radiation whose location is unknown. This definition includes licensed material that has been shipped but has not reached its planned destination and whose location cannot be readily traced in the transportation system, and sources that may be detected and recovered by the Deer Trail gate monitors.

"Natural radioactivity" means radioactivity of naturally occurring nuclides whose location and chemical and physical form have not been altered by man.

"Quality factor (Q)" means the modifying factor that is used to derive dose equivalent from absorbed dose, per the table below:

Radiation	Quality Factor
Beta	1
Gamma	1
X-ray	1
Alpha	20
Neutron	Varies from 3 to 10

"Rad" means the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs per gram.

"Radiation" means one or more of the following:

(1) gamma and x-rays, alpha and beta particles, and other atomic or nuclear particles or rays; or

(2) stimulated emission of radiation from any electronic device to such energy density levels as to reasonably cause bodily harm.

"Radiation Safety Officer (RSO)" is an individual, designated by the Company, who has the required training, knowledge authority and responsibility to apply appropriate radiation protection rules, standards, and practices.

"Rem" means the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor.

"Roentgen (R)" means the special unit of exposure. One roentgen (R) equals 2.58E-4 coulombs/kilogram of air.

"Sealed source" means radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions that are likely to be encountered in normal use and handling.

"Survey" means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, and/or presence of sources of radiation. When appropriate, such evaluation includes, but is not limited to, tests, physical examination of location of materials and equipment, and measurements of levels of radiation or concentration of radioactive material present.

"Technologically Enhanced Naturally Occurring Radioactive Material (or TENORM)" means naturally occurring radioactive material whose radionuclide concentrations are increased by, or as a result of, past or present human practices. "TENORM" does not include:

(a) Background radiation or the natural radioactivity of rocks or soils;

(b) "Byproduct material" or "source material," as defined by Colorado statute or rule; or

(c) Enriched or depleted uranium as defined by Colorado or federal statute or rule

"Total effective dose equivalent (TEDE)" means the sum of the deep dose equivalent (DDE) for external exposures and the committed effective dose equivalent for internal exposures.

TEDE = DDE + CEDE

"Whole body" means, for purposes of external exposure, head, trunk (including male gonads), arms above the elbow, and legs above the knees.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.02
RADIATION SAFETY TRAINING

1.0 OBJECTIVE

To define general and specific radiation safety training requirements for employees at the Clean Harbors Deer Trail (CHDT) facility or other temporary job sites to ensure that workers can safely work with radioactive materials.

2.0 SCOPE

This standard operating procedure (SOP) applies to all workers who may be exposed to radioactive materials brought onsite. Additional radiation safety training beyond the scope of this procedure may be prescribed by the CHDT Radiation Safety Officer (RSO) as necessary.

3.0 POLICY

All workers who may potentially be exposed to radioactive materials at the CHDT landfill or other job sites shall attend a General Employee Radiation Protection Training course and refresher training each year, and demonstrate competence by scoring at least 70% on a test administered or directed by the CHDT RSO or designee.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 RADIATION SAFETY TRAINING PROCEDURE

5.1 Criteria for Determining Radiation Safety Training Requirements

Training requirements are based on job descriptions and types of areas that workers are required to access to perform their assigned duties. Training may be adjusted to be commensurate with the individual's job category, assigned duties, and previous training and experience. All CHDT workers who may be exposed to radioactive materials as part of their routine employment shall be part of the General Employee Radiation Protection Training program. The following factors shall be considered to determine the appropriate level of knowledge and training for individual CHDT workers:

- The individual's job assignment (i.e., activities in or near the weight station, waste sampling and analysis operations, waste treatment facility when radioactive materials could be present, and disposal cell operations),

- The nature of the radiation hazards that could be present (dependent on waste form, type of treatment if any, and disposal configuration), and
- The type and complexity of any protective actions that the individual might be expected to execute (i.e., the need to limit the duration of an activity, provide temporary shielding, or observe special procedures for some types of radioactive materials). Note that workers in the CHDT landfill are required to wear personal protective equipment (PPE) and respiratory protection under the Resource Conservation and Recovery Act (RCRA) Permit.

5.2 Training Requirements for Radiation Workers

General employees whose job assignments indicate the potential for exposure to radioactive materials shall receive the General Employee Radiation Protection Training prior to conducting those assignments. The CHDT RSO is responsible for ensuring that all workers receive the appropriate training before conducting their assigned duties.

5.3 Training for Site Visitors or Contractors

Visitors or contractors who work with radioactive materials at the CHDT landfill or who enter areas restricted because of the presence of radioactive materials shall complete a radiation safety briefing and shall be escorted by trained CHDT staff.

5.4 Evaluating the Adequacy of Current Training for Individual Workers

The CHDT RSO shall:

- Ensure that all new hires who will work with radioactive materials receive the General Employee Radiation Protection Training followed by annual refresher courses.
- Periodically check the training records and determine current levels of Radiation Protection Training for individual workers and their training expiration dates to ensure that workers are adequately trained.
- Compare the individual's current training to the required training, especially in cases where workers change job assignments.
- Ensure that special periodic retraining occurs in the event of changes to CHDT policies, procedures, and practices that affect radioactive material disposal.

5.5 Training Records

Records certifying completion of each part of the required training shall be maintained as part of the CHDT records retention program and within each individual worker's employment file, as required by SOP 15.RPP.03, *Worker Radiation Protection Records*.

6.0 TRAINING SYLLABUS

Radiation safety training for CHDT workers will be commensurate with their responsibilities. Training course and quiz content are revised annually to reflect areas of improvement identified through observation and evaluation conducted by the RSO. The CHDT General Employee Radiation Protection Training program shall cover radiation safety basics, and is required for all workers performing activities with radioactive materials. Additional training in site operations, SOPs, and the application and use of radiation survey instruments comprise the remainder of the program that may be required based on the job responsibilities of the employee.

7.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.03
WORKER RADIATION PROTECTION RECORDS

1.0 OBJECTIVE

To define general and specific worker radiation protection records that shall be generated and maintained for Clean Harbors Deer Trail (CHDT) employees who may be exposed to radiation and radioactivity from site activities.

2.0 SCOPE

This standard operating procedure (SOP) applies to all worker radiation protection records generated for workers at the CHDT facility. These records include, but are not limited to, the following:

- Sign-in sheets for training sessions
- On-the-job training records
- Annual dosimetry records and dose calculations
- Historical individual dose records
- Personnel decontamination forms
- Memoranda to file regarding worker exposure

3.0 POLICY

All records of exposure, internal and external, are legal and personal and shall be controlled to preclude release of personnel information to non-authorized personnel. All radiation protection records including individual worker records, approved procedures, amendments, revisions and renewals shall be maintained consistent with the Colorado Regulations 6 CCR 1007-1, § 4.40, 4.41, 4.42, 4.44, 4.47, and 4.50. Individual forms are subject to change as needed. Records retention requirements will remain unchanged.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

Approved by:		
	General Manager	Radiation Safety Officer

5.0 WORKER RADIATION PROTECTION RECORDS PROCEDURE

5.1 Requirements

Record keeping requirements are defined in the RPP, including identified retention periods. The CHDT RSO shall maintain records in a clear, concise, and orderly format. Retention periods are included in parentheses.

5.2 Training

The CHDT RSO shall ensure that all staff radiation protection training records are dispositioned, controlled, and maintained as described in this procedure:

- Upon completion of the training roster form, it shall be checked for completeness, accuracy, and legibility before disposition:
- Ensure the form has been signed and dated,
- Ensure that changes to the document are legible, with a simple line through deletions, and clearly printed inserts. All deletions and insertions shall include the initials of the individual making the changes.
- Training forms shall be filed as part of the CHDT Administrative filing system and shall include:
- Course title, name of instructor, and date(s) of training,
- Course completion rosters,
- Test scores for each class member, and
- Documentation of any waivers, exceptions, or extensions.

5.3 Individual and Area Dosimetry Results

The Deer Trail RSO shall ensure that all individual worker and area dosimetry results obtained using SOP 15.RPP.04, *Individual and Area Dosimetry*, are recorded and filed in the Deer Trail Administrative filing system:

- Individual dosimetry results shall be filed in each worker's personnel file
- Area dosimetry results shall be filed in a separate administrative file so that trending analyses over time can be performed.

5.4 Individual Radiation Doses

The Deer Trail RSO shall ensure that all individual worker quarterly and annual radiation doses obtained using the SOP 15.RPP.04, *Individual and Area Dosimetry*, and SOP 15.RPP.05, *Estimating Inhalation Doses*, are recorded on the appropriate forms and filed in the CHDT Administrative filing system. Individual radiation dose results shall be filed in each worker's personnel file.

Approved by:		
	General Manager	Radiation Safety Officer

6.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.RPP.04

INDIVIDUAL AND AREA DOSIMETRY

1.0 OBJECTIVE

To describe the procedures for conducting individual and area dosimetry for worker and environmental exposures associated with the Clean Harbors Deer Trail (CHDT) landfill.

2.0 SCOPE

This standard operating procedure (SOP) applies to CHDT workers who may be exposed to radioactive materials and for identified areas within and in the immediate area around the CHDT landfill.

3.0 POLICY

Individual and area monitoring shall be performed to verify that radiation doses to CHDT workers and members of the public are maintained as low as reasonably achievable (ALARA), with an ALARA total effective dose equivalent (TEDE) goal of 25 millirem per year (mrem/yr). All full-time CHDT staff that have undergone the radiation safety training are considered to be radiation workers and are subject to the occupational dose limit of 5,000 mrem/yr per 10 CFR 20.1201.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 INDIVIDUAL DOSIMETRY PROGRAM

5.1 Dosimeter Issue

Personnel with the potential to receive > 100 millirem/yr. or working in the proximity of radioactive materials, shall be issued and wear an individual dosimeter. Additional personnel may also be issued dosimeters at the discretion of the CHDT RSO or designee. Dosimeters are issued to only one person and shall not be shared. The individual dosimeters shall be worn at the location on the body likely to receive the highest dose, consistent with manufacturer specifications, which is typically on the chest area or between the waist and the neck, underneath the outside layer of PPE, if worn. Lost or damaged dosimeters shall be reported to the CHDT RSO as soon as possible. Persons who have lost or damaged their dosimeters shall be required to provide documentation of work activities and radiation exposures as necessary for the CHDT RSO to assess doses. Individual dosimeters shall be issued only to personnel formally instructed in their use, and those dosimeters shall be worn only by those to whom the dosimeters were issued.

In addition, dosimeters shall not be:

a. Removed from the CHDT facility;

b. Deceptively exposed;

- Employees shall notify the Deer Trail RSO immediately upon learning of possible deceptive exposures of dosimeters.
- Intentional deceptive exposures of dosimeters are forbidden and may result in reprimands or termination of employment.

c. Stored near radiation sources;

d. Exposed to high heat, chemical or physical insults, or washed in a washing machine; or,

e. Worn during or after medical administration of radioactive materials (thyroid ablation therapy, cardiac stress tests, diagnostic nuclear medicine tests, etc.) until approved by the CHDT RSO.

5.2 Changes in Worker Job Status

If a worker's job status changes, the CHDT RSO shall:

a. Remove the employee from the individual dosimeter program if the employee has terminated employment or if the employee's job has changed such that the worker is no longer in the proximity of radioactive materials.

b. Add an employee to the individual dosimeter program if the employee's job has changed such that the worker will now be working in the proximity of radioactive materials.

5.3 Non-occupational Radiation Doses

a. Dosimeter users:

- Are responsible for ensuring that dosimeters are not exposed to non-occupational sources of radiation (e.g., medical or security x-ray devices, therapeutic medical sources, or radiation from medical radionuclides injected into the body).
- Shall notify the CHDT RSO prior to receiving medical injections of radionuclides.
- Shall notify the CHDT RSO if their dosimeter is exposed to non-occupational radiation sources.

b. The CHDT RSO shall:

- Determine a course of action that shall prevent exposure of an individual dosimeter and problems with personnel surveys for employees who report receiving medical injections of radionuclides.

- Will investigate the cause of the exposure from non-occupational sources and determine the corrections that are necessary for recording the employee's radiation dose.

5.4 Quarterly Dosimeter Exchange

Personnel dosimeter badges will be exchanged quarterly. Employees shall return used dosimeters to the CHDT RSO promptly after receiving replacement dosimeters at the beginning of a new wear period. The CHDT RSO shall:

a. Be responsible for establishing a program for dosimeter exchange, processing (consistent with the manufacturer's specifications), and recording and reporting of the results.

b. Ensure dosimeters are exchanged on a quarterly basis, unless the CHDT RSO or his designee determines a change in exchange frequency is warranted to ensure radiation doses to workers and the public are maintained ALARA.

c. Verify that all dosimeters are exchanged and either note that dosimeters are in good condition or note the damage if they are not.

d. Note the actual date of dosimeter exchange.

e. Verify that all dosimeter results are recorded.

f. Modify the annual doses to include potential inhalation doses, as estimated using the CHDT 15.RPP.05, Estimating Inhalation Doses.

g. Develop and report all dose results to the employees on an annual basis.

h. Serve as the CHDT point of contact for individual dosimetry issues.

i. Ensure that individual worker doses are recorded, by quarter and annually using the form in Attachment 1 (or equivalent), and maintained in their personnel file.

j. Ensure that the doses to declared pregnant workers are tracked on the dosimetry forms in Attachments 1 and 2 (or equivalent) and maintained at levels not to exceed 500 mrem during the pregnancy, plus ALARA.

k. Ensure that a corporate record of worker doses, by quarter and annually, including doses to declared pregnant workers, is developed using the form in Attachment 2 (or equivalent) consistent with the CHDT records management procedures.

5.5 Data Evaluation

The RSO shall review all dosimetry records on a quarterly and annual basis and shall:

a. Perform a dosimetry investigation if a worker's dosimeter cannot be read, is lost, has an anomalous result, or equals or exceeds an administrative control level of 25 millirem in any quarter.

b. Evaluate the work duties for individual workers whose annual radiation dose equals or exceeds 100 millirem/yr to reduce their exposure to radioactive materials.

c. Monitor annual worker radiation doses against the ALARA goal and take appropriate measures, such as modifying job assignments or specific work procedures, when this goal is challenged.

5.6 Record Requests

Any person who was issued and wore a dosimeter may request a copy of his or her dosimetry records at any time. These records are maintained by and are available from the CHDT RSO upon written request. All contact with the dosimetry service provider is to be made through the CHDT RSO.

5.7 Employment Termination Dose Report

After termination of employment, a dose report (termination report) shall be provided to anyone who was issued and wore a dosimeter. This report shall be provided using the latest copy of Attachment 1 (or equivalent) found in the employee's personnel file, updated to show doses through the date of employment termination.

6.0 AREA DOSIMETRY PROGRAM

6.1 Program Requirements

Dose rates shall be measured on a fequency determined by the CHDT RSO, using special-issue dosimeters in locations:

a. Where workers are routinely in the proximity of bulk radioactive materials, such as the weight station and disposal cell,

b. Where it is unlikely that radioactive materials would be present such as the change room, lunch room, and maintenance areas, and

c. Remote from radioactive materials that will record the ambient background.

6.2 Responsibilities

The CHDT RSO shall:

a. Determine the number and location of the area dosimeters in and around the CHDT landfill and provide a facility map indicating the location of each area dosimeter.

b. Ensure that each identified location has at least one area dosimeter.

c. Maintain a map of the location of each dosimeter.

d. Ensure that area dosimeters are placed 1 to 1.5 meters (40 to 60 inches) above the ground or floor level.

e. Provide protection for area dosimeters against heat, moisture, and direct sunlight.

f. Exchange the dosimeters on a basis as determined by the CHDT RSO.

g. Maintain records for each area dosimeter location.

h. Note any special conditions including tampering, damage, or loss of dosimeter, in the records.

i. Investigate any missing or damaged dosimeters.

j. Resolve anomalous data, and track and trend data for routine annual and other special reports, as required.

k. Serve as the point of contact for area dosimetry issues. Ensure that a corporate record of area radiation doses is developed using the form provided as Attachment 4 (or equivalent) and maintained consistent with SOP 15.RPP.03, *Worker Protection Records*.

7.0 REFERENCES

10 CFR 20.1201. *Occupational Dose Limits for Adults.* Current Version.

ATTACHMENT 1 – EXAMPLE ANNUAL INDIVIDUAL DOSIMETRY RECORD

Clean Harbors Deer Trail LLC
ANNUAL INDIVIDUAL DOSIMETRY RECORD

Individual _____ Payroll No. _____ Year _____

Was this individual a declared pregnant worker during the calendar year? ☐ Yes ☐ No

Exchange Dates for Calendar Year _____ (a)	From/To:	From/To:	From/To:	From/To:	
Individual/ (Dosimeter No.)	1st Quarter Dose Rate (millirem)	2nd Quarter Dose Rate (millirem)	3rd Quarter Dose Rate (millirem)	4th Quarter Dose Rate (millirem)	Annual Total Dose Rate (millirem)
Exchange Dates for Calendar Year _____ (a)	From/To:	From/To:	From/To:	From/To:	
Individual/ (Dosimeter No.)	1st Quarter Dose Rate (millirem)	2nd Quarter Dose Rate (millirem)	3rd Quarter Dose Rate (millirem)	4th Quarter Dose Rate (millirem)	Annual Total Dose Rate (millirem)

(a) Enter year of employment and provide exact dates for those employees whose deployment and exchange dates differ from the company standard.

Comments: (add additional pages, if necessary)

For declared pregnant workers, note the duration of the pregnancy relative to the recorded quarters.

Annual Log Completed By:	Annual Log Reviewed By:
Name (Print) _____	Name (Print) _____
Signature _____	Signature _____

ATTACHMENT 2 – EXAMPLE ANNUAL WORKER DOSIMETRY LOG

Clean Harbors Deer Trail LLC
ANNUAL WORKER DOSIMETRY LOG

Exchange Dates[(a)]	From/To:	From/To:	From/To:	From/To:	
Individual Name/ (Dosimeter No.)	1st Quarter Dose Rate (millirem)	2nd Quarter Dose Rate (millirem)	3rd Quarter Dose Rate (millirem)	4th Quarter Dose Rate (millirem)	Annual Total Dose Rate (millirem)

Declared Pregnant Workers					
Individual Name/ (Dosimeter No.)	1st Quarter Dose Rate (millirem)	2nd Quarter Dose Rate (millirem)	3rd Quarter Dose Rate (millirem)	4th Quarter Dose Rate (millirem)	Annual Total Dose Rate (millirem)

(a) Provide exact dates for those employees whose deployment and exchange dates differ from the company standard.

Comments: (add additional pages, if necessary)

Annual Log Completed By:	Annual Log Reviewed By:
Name (Print) _____	Name (Print) _____
Signature _____	Signature _____

ATTACHMENT 3 – EXAMPLE OCCUPATIONAL EXPOSURE RECORD REPORT FORM

OCCUPATIONAL EXPOSURE RECORD FOR A MONITORING PERIOD

1. NAME (LAST, FIRST, MIDDLE INITIAL)	2. IDENTIFICATION NUMBER	3. ID TYPE	4. SEX ☐ MALE ☐ FEMALE	5. DATE OF BIRTH (MM/DD/YY)

6. MONITORING PERIOD	7. LICENSEE OR REGISTRANT NAME	8. LICENSE OR REGISTRATION NUMBER(S)	9A.	9B.
	Clean Harbors Environmental Services (Deer Trail RCRA Subtitle C Landfill)		☐ RECORD ☐ ESTIMATE	☐ ROUTINE ☐ PSE

INTAKES

10A. RADIONUCLIDE	10B. CLASS	10C. MODE	10D. INTAKE IN µCi

DOSES in mrem

DEEP DOSE EQUIVALENT (DDE)	11.
EYE DOSE EQUIVALENT TO THE LENS OF THE EYE (LDE)	12.
SHALLOW DOSE EQUIVALENT (SDE, WB)	13.
SHALLOW DOSE EQUIVALENT, MAX EXTREMITY (SDE, ME)	14.
COMMITTED EFFECTIVE DOSE EQUIVALENT (CEDE)	15.
COMMITTED DOSE EQUIVALENT MAXIMALLY EXPOSED ORGAN	16.
(BLOCKS 11+15) (TEDE)	17.
MAX ORGAN *(BLOCKS 11+15) (TODE)*	18.
19. COMMENTS	

20. SIGNATURE – LICENSEE OR REGISTRANT	21. DATE PREPARED

INSTRUCTIONS FOR COMPLETION OF THE OCCUPATIONAL EXPOSURE RECORD

All doses should be stated in mrem.

1. Type or print the full name of the monitored individual in the order of last name (including "Jr.," "Sr.," "III," etc), first name, middle initial (if appropriate).

2. Enter individual's identification number, including punctuation. This number should be the 9-digit social security number if at all possible. If the individual has no social security number, enter the number from another official identification such as a passport or work permit.

3. Enter the code for the type of identification used as shown below:

CODE	ID TYPE
SSN	U.S. Social Security Number
PPN	Passport Number
CSE	Canadian Social Insurance Number
WPN	Work Permit Number
IND	INDEX Identification Number
OTH	Other

4. Check the box that denotes the sex of the individual being monitored.

5. Enter the date of birth of the individual being monitored in the format MM/DD/YY.

6. Enter the monitoring period for which this report is filed. The format should be MM/DD/YY – MM/DD/YY.

7. Enter the name of the licensee or registrant (already entered).

8. Enter the Department license or registration number.

9A. Place an "X" in Record or Estimate. Choose "Record" if the dose data listed represent a final determination of the dose received to the best of the licensee's or registrant's knowledge. Choose "Estimate" only if the listed dose data are preliminary and will be superseded by a final determination resulting in a subsequent report. An example of such an instance would be dose data based on self-reading dosimeter results and the licensee intends to assign the record dose on the basis of TLD results that were not yet available.

9B. Place an "X" in either Routine or PSE. Choose "Routine" if the data represent the results of monitoring for routine exposures. Choose "PSE" if the listed dose data represents the results of monitoring of planned special exposures received during the monitoring period. If more than one PSE was received in a signle year, the licensee or registrant should sum them and report the total of all PSEs.

FOR ITEMS 10D – 18, ENTER SPECIAL UNITS OF mrem

10A. Enter the symbol for each radionuclide that resulted in an internal exposure recorded for the individual using the format "Xx-###x," for instance, Cs-137 or Tc-99m.

10B. Enter the lung clearance class as listed in Appendix B to Part D (D, W, Y, V, or O for other) for all intakes by inhalation.

10C. Enter the mode of intake. For inhalation, enter "H." For absorption through the skin, enter "B." For oral ingestion, enter "G." For injection, enter "J."

10D. Enter the intake of each radionuclide in µCi.

11. Enter the Deep Dose Equivalent ((DDE) to the whole body.

12. Enter the Eye Dose Equivalent (LDE) recorded for the lens of the eye.

13. Enter the Shallow Dose Equivalent recorded for the skin of the whole body (SDE, WB).

14. Enter the Shallow Dose Equivalent recorded for the skin of the extremity receiving the maximum dose (SDE, ME).

15. Enter the Committed Effective Dose Equivalent (CEDE) or "NR" for "Not Required" or "NC" for "Not Calculated."

16. Enter the Committed Dose Equivalent (CDE) recorded for the maximally exposed organ or "NR" for "Not Required" or "NC" for "Not Calculated."

17. Enter the total effective dose equivalent (TEDE). The TEDE is the sum of items 11 and 15.

18. Enter the total organ dose equivalent (TODE) for the maximally exposed organ. The TODE is the sum of items 11 and 16.

19. Signature of the person designated to represent the licensee or registrant.

20. Enter the date this form was prepared.

21. COMMENTS.

In the space provided, enter additional information that might be needed to determine compliance with limits. An example might be to enter the note that the SDE, ME was the result of exposure from a discrete hot particle. Another possibility would be to indicate that an overexposure report has been sent to the Department in reference to the exposure report.

ATTACHMENT 4 – EXAMPLE QUARTERLY AND ANNUAL AREA DOSIMETRY LOG

Clean Harbors Deer Trail LLC QUARTERLY AND ANNUAL NORM/TENORM AREA DOSIMETRY LOG					
Exchange Dates:	From/To:	From/To:	From/To:	From/To:	
Location	1st Quarter Dose Rate (millirem)	2nd Quarter Dose Rate (millirem)	3rd Quarter Dose Rate (millirem)	4th Quarter Dose Rate (millirem)	Annual Total Dose Rate (millirem)
Comments: (add additional pages, if necessary)					

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.05
ESTIMATION OF INHALATION DOSE

1.0 OBJECTIVE

To define specific methods and procedures for estimating the inhalation dose for workers at the Clean Harbors Deer Trail (CHDT) landfill or other job sites from inhalation of airborne radioactive material.

2.0 SCOPE

This standard operating procedure (SOP) addresses the calculation of radionuclide intakes and committed effective dose equivalent (CEDE) for CHDT or other applicable workers and members of the general public.

3.0 POLICY

Estimates of inhalation dose to CHDT landfill workers shall be conducted to verify that annual CEDE are below annual occupational limits per 10 CFR 20.1201 and maintained as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 GENERAL PROCEDURE

5.1 Calculation of Radionuclide Intake

Corrected workplace airborne concentrations from radioactive materials shall be established, on a quarterly basis, from the airborne monitoring program, consistent with SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*. Breathing zone air monitoring shall be conducted in the landfill and in the treatment building during radioactive materials disposal operations. Breathing zone monitoring will be conducted at frequencies and for time periods specified by the RSO. Radon monitoring shall be conducted in the landfill and treatment building on a continuous basis. Monthly, quarterly or other data, in units of picocuries (pCi) per cubic meter of air, shall be specific to work location and shall be corrected for background ambient concentrations.

For workers who are potentially exposed to airborne radioactive materials, internal exposure estimates are determined using radionuclide air concentrations, respirator protection factors, and occupancy factors appropriate for the workgroup.

The analytical results in picocuries (pCi) are converted to an air concentration as follows:

$$Concentration\left(\frac{\mu Ci}{ml}\right) = \frac{\mathrm{Re}\,sult(pCi)}{\left(10^6\,\frac{pCi}{\mu Ci}\right)\times T(hr)\times\left(60\,\frac{\min}{hr}\right)\times F\left(\frac{cubic\ feet}{\min}\right)\times\left(28316.846592\,\frac{ml}{cubic\ feet}\right)}$$

where

T = sample collection time

F = average flow rate over the sample collection time

Once the estimated radionuclide mixtures and corrected airborne contamination levels are established, individual worker intake by inhalation can be estimated. The intake from inhalation of a radionuclide *i* is estimated using the following equation:

$$I_i = T \times Breathing\ Rate \times C_{a,i}$$

where: I_i = intake of radionuclide *i* by inhalation, pCi,

T = the duration of inhalation, hours,

Ventilation Rate = amount of air inhaled per time, cubic meters per hour, and

$C_{a,i}$ = concentration of radionuclide *i* in air, pCi per cubic meter (following a conversion from units of µCi/ml).

Based on information provided by the International Commission on Radiation Protection (ICRP) in Publication 66, the adult male ventilation rate during light exercise is 1.5 cubic meters per hour (ICRP 1993).

5.2 Calculation of Inhalation Dose

CEDEs to workers shall be calculation using the following equation:

$$H_{E,50} = \Sigma_i\, \Sigma\, W_T\, H_{T,50,i}$$

where: $H_{E,50}$ = the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the CEDE to each of these organs or tissues,

W_T = weighting factors for each specific body tissue or organ, and

$H_{T,50,i}$ = CEDE for radionuclide *i* (millirem).

The CEDE for radionuclide *i* ($H_{T,50,i}$) is found by multiplying the intake of each radionuclide (I_i) by the unit intake committed dose conversion factor for each radionuclide and tissue or organ ($DCF_{T,i}$) as shown in the following equation:

$$H_{T,50,i} = I_i \times DCF_{T,i}$$

To streamline the process, and for consistency with the doses recorded by the external dosimetry program, unit intake effective dose coefficients by radionuclide *i* (i.e., $DCF_{E,i} = \Sigma T\ DCF_{T,i}$, where T is for each tissue or organ) tabulated by the U.S. Environmental Protection Agency (EPA) shall be used. Modifying the above equations to account for the use of unit inhalation intake effective dose coefficients is shown in the following equation.

$$H_{E,50} = (T_w \times Breathing\ Rate)\ \Sigma_i\ (C_{a,i} \times DCF_{E,i})$$

The unit inhalation intake effective dose coefficients, taken from Federal Guidance Report No. 11 (Eckerman et al. 1988) are provided in Attachment 1 for the radionuclides of concern. These values are the most conservative (highest) across all solubility classes considered by the EPA.

6.0 RESPIRATORY PROTECTION:

The CHDT RCRA permit requires the use of respiratory protection for all activities when workers are in close proximity to the waste. These activities include sampling, treatment (when required), and in-cell disposal. Full-face air-purifying respirators are used by CHDT workers for these activities. Consistent with 6 CCR-1007-1, § 4.24 and Part 4 - Appendix A, a respiratory protection factor of 50 shall be applied to all appropriate work when the use of respirators is mandatory.

7.0 INHALATION DOSE WORKSHEET

An example worksheet for calculating inhalation CEDEs is provided in Attachment 2. The sum of the inhalation doses for each quarter is used to produce the annual inhalation dose estimate for each worker. This value is then added to the annual external dose for each worker to produce the estimated annual total CEDE. Similar calculations may be performed in a spreadsheet or using other means.

8.0 REFERENCES

10 CFR 20.1201. *Occupational Dose Limits for Adults.* Current Version.

Eckerman, K. F., A. B. Wolbarst, and A. C. B. Richardson. 1988. Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion. Federal Guidance Report No. 11, EPA-520/1-88-020, U.S. Environmental Protection Agency, Washington, D.C.

International Commission on Radiation Protection (ICRP). 1993. Human Respiratory Tract Model for Radiological Protection. ICRP Publication 66, Annals of the ICRP, Vol. 23, Nos. 1-3.

ATTACHMENT 1 – UNIT INTAKE COMMITTED EFFECTIVE DOSE EQUIVALENT COEFFICIENTS

Radionuclides	$DCF_{E,i}$ [(a)] (seiverts/becquerel inhaled)	$DCF_{E,i}$ [(b)] (millirem/picocurie inhaled)
Uranium Series		
^{238}U	3.20E-05	1.18E-01
^{234}Th	9.47E-09	3.50E-05
^{234}U	3.58E-05	1.32E-01
^{230}Th	8.80E-05	3.26E-01
^{226}Ra	2.32E-06	8.58E-03
^{214}Pb	2.11E-09	7.81E-06
^{214}Bi	1.78E-09	6.59E-06
^{210}Pb	3.67E-06	1.36E-02
^{210}Bi	5.29E-08	1.96E-04
^{210}Po	2.54E-06	9.40E-03
Actinium Series		
^{235}U	3.32E-05	1.23E-01
^{231}Th	2.37E-10	8.77E-07
^{231}Pa	3.47E-04	1.28E+00
^{227}Ac	4.65E-04	1.72E+00
^{227}Th	4.37E-06	1.62E-02
^{223}Ra	2.12E-06	7.84E-03
^{211}Pb	2.35E-09	8.70E-06
Thorium Series		
^{232}Th	4.43E-04	1.64E+00
^{228}Ra	1.29E-06	4.77E-03
^{228}Ac	8.33E-08	3.08E-04
^{228}Th	9.23E-05	3.42E-01
^{224}Ra	8.53E-07	3.16E-03
^{212}Pb	4.56E-08	1.69E-04
^{212}Bi	5.83E-09	2.16E-05

(a) Based on data from Federal Guidance Report No. 11 (Eckerman et al. 1988).

(b) Converted from units of sievert per becquerel to units of millirem/picocurie by multiplying by a conversion factor of 3,700.

ATTACHMENT 2 – EXAMPLE DEER TRAIL WORKER QUARTERLY INHALATION WORKSHEET

Employee Name: _____ Payroll Number: _____ Reporting Period: _____ Date: _____

Estimated inhalation exposure duration for this worker during the reporting period	500 hours per Quarter	Respiratory protection used?	(Y/N)		
Inhalation Dose Calculations:	**Column 1**	**Column 2**	**Column 3**	**Column 4**	**Column 5**
	Identified Radionuclides[1]	**Estimated Airborne Concentration by Radionuclide[2] (picocuries/cubic meter)**	**Estimated Intake by Radionuclide[3] (picocuries)**	**Unit Intake Inhalation Dose Conversion Factors[4] (millirem/picocurie)**	**Estimated CEDE[5] (millirem)**
				Total:	

Prepared by: _____ (Signature) Reviewed by: _____ (Signature)

[1] List the radionuclides reported by the analytical laboratory for the air sample with the highest reported activity to which this worker was exposed.
[2] Enter the corrected airborne concentration for this quarter, by radionuclide, from data collected per SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*
[3] Multiply the entries in **Column 2** by a ventilation rate of 1.5 cubic meters per hour, and by 500 hours (per quarter).
[4] Insert the unit intake inhalation dose conversion factors from Attachment 1 in units of mrem/pCi inhaled.
[5] Multiply the entries in **Column 3** by the entries in **Column 4**, and divide by 50 if this worker used respiratory protection during the exposure. Total the entries in this column at the bottom of the column.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.06
EMERGENCY RESPONSE

1.0 OBJECTIVE

To define specific requirements for employees at the Clean Harbors Deer Trail (CHDT) facility or other temporary job sites in addressing emergency situations involving radioactive materials.

2.0 SCOPE

This standard operating procedure (SOP) applies to emergency situations involving radioactive materials at the CHDT facility or other job sites.

3.0 POLICY

This SOP should be used along with the Deer Trail Emergency Response Plan (April 2005) and the facility's RCRA Contingency Plan for emergency response training and planning purposes. Clean Harbors personnel will take appropriate steps to protect worker and public health during an emergency situation involving radioactive materials. No employee will perform emergency rescue or aid beyond the training and ability of that employee. All worker exposures will be maintained as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 GENERAL PROCEDURES

5.1 Communications

Communications during or after an emergency event are essential for appropriate response and documentation. In the event of a spill, injury, or other event at the CHDT facility, the CHDT RSO (or designee), the facility general manager, and/or site foreman must be notified as soon as it safe to do so. Additional notifications within the Clean Harbors organization will be made as required according to Corporate procedures.

For other job sites, the appropriate emergency contacts must be established at the start of the project, with contact information available to all site personnel. Notifications must be made to the emergency contacts as soon as it is safe to do so.

5.2 Spill Response

All equipment used to handle a radiological spill response shall be surveyed in accordance with SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*. All personnel exiting the spill response area shall perform an exit survey in accordance with the SOP 15.OPS.12, *Personnel Surveys*. All equipment and spill response items that are expended or cannot be decontaminated shall be disposed in the active CHDT disposal cell.

Surveys to verify successful cleanup should be performed per SOP 15.OPS.14, *Spill Surveys.* All information pertaining to the spill, cleanup, and survey activities will be collected and filed to document the event. If necessary, the CHDT RSO will prepare a worker or public exposure assessment if the spill resulted in potential dose.

5.2.1 Spills of Solid Materials

Spills are the most likely form of emergency to occur with the bulk radioactive materials being disposed at CHDT. While not life-threatening, they may result in real or perceived contamination concerns if not addressed appropriately from the outset. For spills of bulk solids, the area should be cordoned off with tape, cones, or other means to prevent unauthorized access. If the spill occurs on a public road, additional precautions must be taken to work safely around traffic. The spilled material should be cleaned as quickly as possible using appropriate means. Worker exposures should be mitigated through the techniques of time, distance, and shielding, as appropriate.

5.2.2 Spills of Liquids

Liquid spills will be addressed utilizing the **SWIM** technique. The SWIM technique follows the following steps.

- **S**top the spill – for small spills, use absorbent pads, for larger spills, absorbent booms or the use of a solidifying agent such as polymers or cement kiln dust may be necessary.
- **W**arn others in the area and notify supervision – used in conjunction with the first step.
- **I**solate the area – use ropes, flagging tape, or other means to warn any approaching personnel
- **M**inimize exposure – avoid contact with liquids. Minimize the number of personnel who enter the spill area.

The primary goal of a liquid spill response is to contain the liquid and prevent the liquid from traveling off-site or contaminating the environment. To accomplish this goal, multiple methods may be employed. Methods include, but are not limited to, the following:

- Trenches may be created to divert liquid from traveling off-site
- Dikes or berms may be created to contain liquids from traveling away from the point of the spill
- Pumps may be used to pump liquids into containment

- Absorbent pads, berms, or solidifying agents may be used to absorb or retain the liquids in place

Any collected absorbent materials or recovered liquid should be placed into appropriate containers for transport and disposal. Liquid spills that result in contamination of soils or other porous surfaces may require additional remediation activities after the emergency situation (i.e., the immediate spread of contamination) is addressed which are beyond the scope of this SOP. A remediation plan to prescribe the remediation activities, cleanup levels, and confirmation surveys or sampling activities may be required.

5.3 Injuries

Emergencies involving injuries to workers or members of the general public in areas where radioactive materials exist may present challenges in working with emergency medical personnel if the perceived contamination level is high. Radioactivity levels in materials handled by CHDT are low, and the potential exposure during the treatment of an injury is also low. Unlike hazardous materials handled at CHDT, under no circumstances will a radioactive environment that is immediately hazardous to human health be present at CHDT. Unless specifically directed otherwise by the CHDT RSO prior to an activity involving radioactive materials, the treatment of life-threatening injuries should supersede any radioactive contamination concerns. The CHDT RSO will routinely work with local emergency medical personnel to address their questions and concerns.

When life-threatening injuries are addressed and stabilized, or in situations where injuries are not life threatening, workers may be assessed for contamination according to SOP 15.OPS.12, *Personnel Surveys*, and if necessary decontaminated according to SOP 15.OPS.19, *Decontamination of Personnel*.

6.0 DOCUMENTATION

All information regarding the emergency, including worker statements, photographs, survey documentation, and other pertinent information, must be collected and filed.

7.0 REFERENCES

Clean Harbors Deer Trail Emergency Response Plan, April 2005.

Clean Harbors RCRA Contingency Plan, Current Version.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.RPP.07

ALARA

1.0 OBJECTIVE

To define specific requirements for conducting As Low As Reasonably Achievable (ALARA) program reviews, briefings, and audits.

2.0 SCOPE

This standard operating procedure (SOP) applies to all operations at the CHDT landfill involving radioactive materials.

3.0 POLICY

All occupational doses received by CHDT workers will be maintained ALARA. The CHDT ALARA program will be reviewed periodically to identify any potential shortcomings or areas of improvement.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 REVIEWS AND BRIEFINGS

ALARA reviews by the CHDT RSO and follow-up briefings with CHDT staff are required when:

- An individual worker's annual dose exceeds or is anticipated to exceed 100 millirem
- Exposure rates exceed 2 milliRoentgens per hour (mR/hr)
- Removable contamination levels exceed 10X the values listed in SOP 15.OPS.13, *Equipment Surveys,* and others.
- Any other potential worker exposure event is anticipated

The ALARA review will be conducted by the CHDT RSO and will identify any specific contamination control procedures, exposure control procedures, or other task-specific requirements. A radiation work permit (RWP) will be created per SOP 15.RPP.08, *Radiation Work Permits*, if required. Following the review, the CHDT RSO will hold a pre-task briefing with affected staff members to present the potential exposure concerns, information in the RWP, and other details regarding the task. A post-task briefing will also be held to present any collected data and to describe any lessons learned. Documentation regarding the review and briefings will be collected in a memorandum to file for later reference.

6.0 ALARA PROGRAM AUDITS

At a minimum, the CHDT RSO will conduct a quarterly review of CHDT worker external and internal exposures to identify any ALARA concerns. An audit of the ALARA program will be performed and documented as part of the CHDT Annual Report. Any ALARA reviews and briefings conducted in the calendar year will be identified and discussed in the Annual Report.

7.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.08
RADIATION WORK PERMITS

1.0 OBJECTIVE

To define the circumstances in which a Radiation Work Permit (RWP) is required and address the requirements for planning, issuing, modifying, and terminating RWPs at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

2.0 SCOPE

This standard operating procedure (SOP) shall be used at the discretion of the CHDT Radiation Safety Officer (RSO) or designee to initiate job- or task-specific requirements to mitigate potential worker exposures. Examples of where an RWP may apply include areas with high airborne radioactivity or areas with radioactive material that presents a high or unique contamination concern. High Airborne Radioactivity as referenced in this SOP applies only to levels defined as an Airborne Radioactivity Area, 6 CCR 1007-1, Rules and Regulations Pertaining to Radiation Control, Part 1, Section 1.2, Definitions:

"Airborne radioactivity area" means a room, enclosure, or area in which airborne radioactive materials exist in concentrations:

(1) In excess of the derived air concentrations (DACs) specified in Appendix 4B, Table 4B1, or

(2) To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC hours"

In the absence or real time air monitoring, the airborne radioactivity concentration can be estimated using re-suspension factors and removable contamination levels.

3.0 POLICY

RWPs will be used where necessary to maintain worker exposures as low as reasonably achievable (ALARA) by presenting job- or task-specific information regarding airborne radioactivity concentrations or contamination levels.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 GENERAL PROCEDURE

5.1 Initiation and Briefing

Upon identification of a high airborne radioactivity hazard or other significant radiation hazard, the CHDT RSO will initiate a RWP using the RWP form included as Attachment 1 as a starting point. If necessary, the form may be modified or additional sheets may be added as necessary to provide additional information to workers.

The RWP form will be prepared by the CHDT RSO and reviewed by the CHDT general manager (or designee). Both the CHDT RSO and general manager will sign the RWP after any comments have been resolved.

The CHDT RSO or designee will provide a briefing to affected workers prior to the start of activities to be performed under the RWP. All workers working under the RWP will be required to sign the Briefing Sign-In form (Attachment 2) before any work is performed.

5.2 Work Activities

The RWP will be posted in a visible area for affected workers to periodically review over the course of activities. The CHDT RSO will monitor activities and if necessary revise the RWP. If revisions are performed, an additional briefing will be performed and Briefing Sign-In form generated.

5.3 Termination

Upon completion of activities performed under the RWP, the CHDT RSO may terminate the RWP. Originals of all associated information collected during the RWP activities, including survey and monitoring data, field notes, briefing sheets, and other materials, will be filed and maintained to document the RWP.

6.0 REFERENCES

6 CCR 1007-1, Rules and Regulations Pertaining to Radiation Control

Radiation Work Permit (RWP)

RWP Number: 15.RPP.08, Rev.2, Attachment 1

Work Description: ☐ General ☐ Specific

Work Location

Est. Start Date/Time

Requested By

Request Date

Hazardous Conditions

Radionuclides Present	Radiation Levels	Other (Safety, etc.)

Surveys

Type	Number	Date	By

REQUIRED PERSONNEL PROTECTIVE CLOTHING AND EQUIPMENT

Head/Eyes		Feet/Legs		Body	
Hard Hat	☐	Safety Work Shoes	☐	Cotton Coveralls	☐
Safety Glasses	☐	Disposable Boot Covers	☐	Tyvek Coveralls	☐
Monogoggles	☐	Tyvek Booties	☐	Polypropylene	☐
Face Shield	☐	Rubber Boot Covers	☐	Water Proof Coveralls	☐
Other (Specify):	☐	Other (Specify)	☐	Other (Specify)	☐
Respiratory		**Hands**		**Miscellaneous**	
Full-face (Negative Pressure)*	☐	Cotton Liners (optional)	☐	Tape Gloves & Boots to Coveralls	☐
Powered Air Purifying*	☐	Latex Gloves	☐	Safety Belt With Lanyard	☐
* Specify Cartridge or Canister Type Below		Rubber Gloves	☐	Hearing Protection	☐
Other (Specify):	☐	Leather Work Gloves	☐	Face Shield	☐
		Cotton Work Glove	☐	Other (Specify):	☐

Special Instructions and Requirements

Dosimetry	Indiv.	Group
TLD Badge		
Extremity TLD		
Other (Specify):		
Lapel Air Sampler		
IH Monitoring	**Indiv.**	**Group**

Expiration Date/Time

Approvals	Date	Termination	Date
CHDT HP/RSO		CHDT HP/RSO	
Site S & H Officer		Reason:	

ATTACHMENT 2

RWP BRIEFING SIGN-IN SHEET

RWP Number: _____

Briefing Conducted by: _____

Date/Time: _____

Attendees:

By signing this sheet, I attest that I have reviewed and understand the contents of the RWP listed above, and will comply with its requirements.

Employee ID	Printed Name	Signature

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.09
PERSONAL PROTECTIVE EQUIPMENT

1.0 OBJECTIVE

To define the requirements for and usage of personal protective equipment (PPE) while working in radioactively contaminated environments.

2.0 SCOPE

This standard operating procedure (SOP) applies to all workers who may be exposed to potential contamination from radioactive materials at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

3.0 POLICY

All workers who may potentially be exposed to radioactive contamination at CHDT or other job sites will take appropriate precautions to minimize exposure and the spread of contamination. The requirements of this SOP are intended to be consistent with other applicable Clean Harbors procedures, including the most current version of the *US Landfill Division PPE Hazard Assessment Summary*.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), CHDT management, and other Clean Harbors staff are defined in the *Radiation Protection Plan* (SOP 15.RPP.01).

5.0 GENERAL PPE REQUIREMENTS

5.1 PPE Selection

Protective clothing will be selected to provide an appropriate barrier between personnel clothing/ skin and radioactive contamination that may exist. The level of PPE selected is based on the level of risk or potential exposure.

Minimum PPE requirements for handling radioactive materials with the potential for dispersal (e.g, non-sealed sources) include protective gloves and eyewear. Operations in the CHDT landfill or treatment facility will be conducted with tyvek coveralls, gloves, boots, and respiratory protection. CHDT personnel may upgrade PPE requirements if desired. Downgrade of PPE requirements for radiological operations at the CHDT landfill may be prescribed by the CHDT RSO or designee.

5.2 PPE Usage

Work activities will be planned and, if appropriate, practiced prior to donning PPE to minimize the amount of time spent in PPE. Contaminated areas will be delineated and support areas will be established at the contaminated area boundary to allow for personnel contamination surveys and PPE donning/doffing support upon exit.

Site-specific PPE requirements at temporary job sites will be defined and documented in job hazard analyses or site safety and health plans.

5.3 Respiratory Protection

Respiratory protection requirements for radiological operations at the CHDT landfill are defined in the most current version of *US Landfill Division PPE Hazard Assessment Summary* and other procedures. In addition, respiratory protection will be required when airborne contamination levels exceed 10-percent of the Derived Air Concentration (DAC) for radioactive materials, as listed in 10 CFR 20, Appendix B, Table 1, Column 3. Appropriate air sampling will be performed at CHDT or temporary job sites to establish airborne contamination levels and potential worker exposures when new activities are performed or when determined by the CHDT RSO or designee.

Respirator selection, fit testing, and usage will be consistent with the most current version of the *Respiratory Protection Guidelines* and other general Clean Harbors procedures.

6.0 REFERENCES

10 CFR 20. *Standards for Protection Against Radiation.* Current Version.

Clean Harbors Environmental Services. *Personal Protective Equipment Guidelines,* Current Version.

Clean Harbors Environmental Services. *Respiratory Protection Guidelines,* Current Version.

Clean Harbors Environmental Services. *US Landfill Division PPE Hazard Assessment Summary,* Current Version.

STANDARD OPERATING PROCEDURE

15.RPP.10

DETERMINATION OF PRIOR OCCUPATIONAL DOSE

1.0 OBJECTIVE

Collect prior occupational dose information which could be needed in the event of a planned special exposure, and to comply with Colorado Regulations. Details of Planned Special Exposures are to be found in SOP 15.RPP.08 Radiation Work Permits.

2.0 SCOPE

This standard operating procedure (SOP) governs the collection and maintenance of prior occupational dose information which is required by the Colorado Regulations. It governs how the information will be collected and how prior dose will be estimated in the event that more accurate information is unavailable.

3.0 POLICY

The RSO will collect and maintain Prior Occupational Dose Information in compliance with Colorado Regulations. Prior Dose Information will be collected for all employees and temporary employees that may reasonably be expected to receive an occupational dose beyond that permitted to the general public.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01). The CHDT RSO shall be responsible for collecting and maintaining prior occupational dose information.

5.0 GENERAL PROCEDURE

5.1 Current and Prior Years

For each individual who is likely to receive, in a year, an occupational dose requiring monitoring pursuant to 4.18, the licensee or registrant shall determine the occupational radiation dose received during the current year; and attempt to obtain the records of lifetime cumulative occupational radiation dose.

5.2 Planned Special Exposures

Prior to permitting an individual to participate in a planned special exposure, the licensee or registrant shall determine: the internal and external doses from all previous planned special exposures; and all doses in excess of the limits, including doses received during accidents and emergencies, received during the lifetime of the individual; and all lifetime cumulative occupational radiation dose.

5.3 Written Statement

The RSO may accept, as a record of the occupational dose that the individual received during the current year, a written signed statement from the individual, or from the individual's most recent employer for work involving radiation exposure, that discloses the nature and the amount of any occupational dose that the individual received during the current year.

5.4 Documented Cumulative Exposure History

The RSO may accept, as the record of lifetime cumulative radiation dose, an up-to-date Department Form R-16, Cumulative Occupational Exposure History, or equivalent, signed by the individual and countersigned by an appropriate official of the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant.

5.5 Request Records From Employer

The RSO may obtain reports of the individual's dose equivalent from the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant, by telephone, telegram, facsimile, or letter. The licensee or registrant shall request a written verification of the dose data if the authenticity of the transmitted report cannot be established.

5.6 Department Form R-16

The RSO shall record the exposure history, on Department Form R-16, or other clear and legible record, of all the information required on that form. The form or record shall show each period in which the individual received occupational exposure to radiation or radioactive material and shall be signed by the individual who received the exposure. For each period for which the licensee or registrant obtains reports, the licensee or registrant shall use the dose shown in the report in preparing Department Form R-16 or equivalent. For any period in which the licensee or registrant does not obtain a report, the licensee or registrant shall place a notation on Department Form R-16 or equivalent indicating the periods of time for which data are not available.

5.7 Assumed Dose Limit

If the RSO is unable to obtain a complete record of an individual's current and previously accumulated occupational dose, the licensee or registrant shall assume that for the current year, the allowable dose limit for the individual is reduced by 12.5 mSv (1.25 rem) for each quarter for which records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure. The individual will not be available for planned special exposures during the current year.

5.8 Record Retention

Records of Form R-16 or equivalent will be retained per SOP 15.RPP.03.

6.0 REFERENCES

6 CCR 1007-1

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.WAC.01
RADIOACTIVE MATERIALS ACCEPTANCE

1.0 OBJECTIVE; DEFINITIONS; REFERENCES TO REGULATIONS

Define the requirements for screening or otherwise determining that shipments of radioactive materials proposed for acceptance, treatment, storage, and disposal at the Clean Harbors Deer Trail ("CHDT") Facility ("Facility") comply with the definition of Regulated Wastes set forth in the Amended and Restated Certificate of Designation issued by the Adams County Board of County Commissioners on November 14, 2012 ("Amended CD"). In the event of any conflict between the requirements of this standard operating procedure ("SOP") and the requirements of the Amended CD, the requirements of the Amended CD shall govern. Terms used herein shall have the meanings ascribed to them in the Amended CD. Reference herein to the Colorado Code of Regulations ("CCR") or the Code of Federal Regulations ("CFR") shall be deemed to mean such regulations as they existed as of September 1, 2011, and no later date.

2.0 SCOPE OF SOP

This SOP applies to the Regulated Wastes allowed for acceptance, treatment, storage, and disposal at the Facility under the Amended CD and the State of Colorado Radioactive Materials License 1102-01 at the Facility, which include radionuclides associated with naturally-occurring radioactive materials ("NORM"), technologically-enhanced NORM ("TENORM"), and radium processing wastes.

3.0 POLICY

Wastes will be evaluated for acceptability at the Facility according to the procedures in this SOP.

4.0 RESPONSIBILITIES OF CHDT

Responsibilities of the CHDT Radiation Safety Officer ("RSO"), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01). CHDT's RSO, management and staff are responsible for, and shall follow, all requirements of this SOP; such responsibilities include, without limitation, notifying Adams County (the "County") and the Colorado Department of Public Health and Environment ("CDPHE") of the receipt at the Facility of any waste that does not conform to the terms of the Amended CD regarding Regulated Wastes prior to the acceptance of any such non-conforming waste for storage, treatment or disposal at the Facility.

5.0 WASTE ACCEPTANCE CRITERIA

The physical properties of wastes that can be accepted for treatment, storage, or disposal at the Facility are defined in the Colorado Hazardous Waste Act Permit No. CO-05-12-21-01 ("Permit") and the Amended CD. The radiological component, if any, of waste that can be accepted for treatment, storage, or disposal at the Facility is regulated by the Amended CD, License 1102-01, and this SOP. Any received radioactive materials must meet the following additional acceptance criteria:

a. Acceptable Radionuclides

Acceptable radionuclides are limited to naturally-occurring radionuclides only, including the radionuclides in the decay series for uranium-238 (U-238), uranium-235 (U-235), thorium-232 (Th-232), and potassium-40 (K-40). No man-made radionuclides shall be accepted, stored, or disposed at the Facility, except for expected background levels resulting from radioactive fallout.

b. Activity Limits

The total activity per gram of all radioactive materials (including all decay progeny) shall not exceed 2,000 pCi/g, and the radium-226 (Ra-226) activity per gram shall not exceed 222 pCi/g. Potassium-40 (K-40) below background levels of 40 pCi/g will not be used in calculating total activity of waste streams nor the Facility Lifetime Total Activity. Uranium and thorium shall not be accepted, treated, nor disposed at the Facility at source material levels as defined per 6 CCR 1007-1, Part 1.2.

The activity limits for the CHDT facility for specific radionuclides are set forth in Table 1 as follows: Table 1. Summary of Accepted Activity Levels

Radionuclide	Limit (pCi/g)
Natural Uranium (48.83% U-238, 48.83% U-234, 2.34% U-235)	340[ab]
Natural Uranium expressed as U-238 concentration	165[ab]
Natural Uranium expressed as a mass percentage	0.05%[ab]

Radionuclide	Limit (pCi/g)
Natural or Processed Thorium (Th-232 (50%) and Th-228 (50%))	110[ab]
Natural Thorium expressed as Th-232 concentration	55[ab]
Natural Thorium expressed as a mass percentage	0.05%[ab]
Ra-226	222[b]
Pb-210	666[b]

Notes to Table 1:

a – Concentration limits are expressed as a sum of fractions for uranium and thorium as calculated in the following equation:

$$\frac{Conc_{Uranium}}{Limit_{Uranium}} + \frac{Conc_{Thorium}}{Limit_{Thorium}} \leq 1$$

The result of the calculation must be less than unity (1) for the waste to be acceptable at CHDT.

b – In secular equilibrium with shorter lived progeny.

If the waste does not exceed the limits presented in Table 1 for individual radionuclides, the radionuclides listed in Table 1 are to be summed to determine compliance with the 2000 pCi/g overall limit for acceptance at CHDT. A shipment of wastes may have isolated areas of activity exceeding the limit, but the mean concentration of the shipment based on radioanalytical sample results shall not exceed the limits presented in Table 1. Concentration limits are based on an "as received" (wet weight) basis.

c. Lower Limits of Radioactive Material Subject to the License

Wastes that have measured activity concentrations at or below the levels providing for unrestricted disposal in the Interim Policy and Guidance Pending Rulemaking for Control and Disposition of Technologically Enhanced Naturally Occurring Regulated Wastes in Colorado, shall not be subject to this SOP nor will such wastes require tracking toward the Facility Lifetime Total Activity Limit. Such wastes shall be subject to the Waste Acceptance Criteria and procedures for Hazardous Waste set forth

in the Amended CD and the Permit. For such wastes to be non-Regulated Wastes, Ra-226 shall be less than 4.4 pCi/g (with a background concentration of 1.4 pCi/g included), Ra-228 shall be less than 4.3 pCi/g (with a background concentration of 1.3 pCi/g included), natural Uranium shall be less than 32.4 pCi/g (with a background concentration of 2.4 pCi/g included), and natural Thorium shall be less than 5.4 pCi/g (with a background concentration of 1.3 pCi/g included). These activity concentrations include background concentrations of the respective radionuclides. If any of the aforementioned activity concentration limits are exceeded, the waste shall be immediately subject to this SOP as Regulated Wastes.

d. Acceptable Physical Form

The physical form of Regulated Waste shall be limited to soils, sludge(s), process residues, resins, filters, debris, liquids and contaminated media that are compatible with the design and operational criteria required by 6 CCR 1007-1, Part 14.

6.0 PRE-ACCEPTANCE REQUIREMENTS

Any waste generator proposing to send waste to the Facility for acceptance, treatment, storage and disposal shall document the waste's chemical properties, physical properties, radiological properties, and its regulatory status. The waste generator shall provide a pre-acceptance sample result in accordance with the following requirements:

a. Waste Documentation

i. Waste Material Profile Sheet

The waste generator shall submit a Waste Material Profile Sheet to CHDT ("Waste Profile"). The waste generator may submit other forms or supporting documents as long as the data and information required in the Waste Profile are fully and completely provided in such alternate documents.

ii. Supplemental NORM Questionnaire

The waste generator shall also submit a Supplemental NORM Questionnaire (Questionnaire) to CHDT. The Questionnaire shall document the radionuclides present, and their specific activity, in the wastes proposed to be delivered to the Facility. The waste generator shall certify, by signature of a responsible official of the waste generator, that there is no byproduct material, source material, manmade radionuclides, or special nuclear material present in the wastes. The Questionnaire shall include a

description of the process(es) that created or generated the wastes. The waste generator shall supply the NRC or Agreement State license number, if applicable. The waste generator shall include sufficient information in the Questionnaire, and provide supporting documents, including analytical results, to support the presence and activity of any radionuclides in the wastes. The waste generator shall document, in the Questionnaire, the characterization method and sampling protocol for the wastes. The Questionnaire is presented in Attachment A. Other forms or documentation may be used as long as the required information is provided.

ii. Lab Analysis Data

The waste generator shall attach to the Questionnaire all analytical data for the wastes which analysis shall be obtained from a National Environmental Laboratory Accreditation Conference ("NELAC") or other accredited laboratory. Such analytical data shall support and confirm the description of radionuclides set forth and described in the Waste Profile and the Questionnaire.

b. Pre-Acceptance Testing

CHDT shall obtain and analyze pre-acceptance samples from and for each new waste or waste stream received from a waste generator. CHDT shall use a NELAC accredited laboratory to analyze, test and determine the species and activity of radionuclides present in such waste or waste stream. Before CHDT may accept the waste, the analytical results must demonstrate that the activity and other limits for radium-226, mass thorium, mass uranium and total activity are under the limits set forth in the Amended CD and this SOP. Generator's Lab Analysis Results from 6.a.ii may be used to fulfill this requirement as long as they meet all facility requirements of 6.b.

Standard analyses shall include: total uranium and total thorium (concentration mass/mass of sample), radium-226 activity (pCi/g), a gamma spectrum (reported in pCi/g with radionuclide identification). Isotopic uranium and isotopic thorium activity (pCi/g) analyses may be used in place of total uranium and total thorium. Lead-210 analysis in pCi/g will be required in wastes where lead-210 is the only parent radionuclide such as waste from natural gas production.

CHDT may use alternate methods of analyses, but only with prior written approval of both the County and the CDPHE, and only if the County and CDHPE agree such alternate analyses will provide data and information sufficient to ensure that the requirements of the Amended CD and this SOP are met.

c. Pre-Acceptance Evaluation

Before any waste or waste stream is approved for acceptance, treatment, storage and disposal at the Facility, the RSO shall ensure that such waste's radiological, physical, and chemical characteristics meet the requirements of the Amended CD and this SOP. CHDT shall use the Waste Profile, the Questionnaire and any other supporting information received from the waste generator, as well as CHDT's pre-acceptance testing and laboratory analyses, to confirm that the waste is acceptable for treatment, storage, and disposal. All waste shipments shall be evaluated before acceptance for the following:

i. Regulatory Information – The RSO shall review regulatory information and requirements to ensure that the Facility has all proper permits, licenses and approvals necessary to accept the waste.

ii. Profiled Isotopes and Activities - The RSO shall review the isotopes and activities listed on the Waste Profile to confirm that the Facility is permitted to accept such wastes under the terms of the Amended CD and this SOP.

iii. Sampling Information - The RSO shall review all sampling information and results to ensure that all sampling has been conducted in accordance with Attachment B at a NELAC or other accredited laboratory that has a sufficient method detection limit or minimum detectable concentration to assess whether the requirements of this SOP have been met.

iv. Laboratory Analysis - The RSO shall review all laboratory analysis results of the waste to ensure that the analyses have been conducted at a NELAC or other accredited laboratory and that such laboratories have sufficient method detection limits or minimum detectable concentrations to assess whether the requirements of this SOP have been met.

v. Capability of the Facility to Manage the Waste - The RSO shall ensure that CHDT and the Facility have the resources, personnel and ability to properly manage the waste.

vi. Waste Management Byproducts - CHDT shall review facility treatment and/or landfill operations to ensure that the management of the waste produces no deleterious byproducts.

vii. Treatment Method - If applicable, CHDT shall determine the prudent and proper treatment method and treatment formula prior to accepting the waste as Regulated Waste.

viii. Safety Requirements - The waste shall be evaluated to confirm that it can be handled at the Facility in accordance with the safety precautions, monitoring, protective equipment and any other safety requirements prescribed in the Facility's Radiation Protection Plan, SOP 15.RPP.01.

ix. Laboratory Analysis Requirements - Representative samples shall be taken from the waste and shall be sent to a NELAC or other accredited radioanalytical laboratory for the following radioanalyses: Gamma Spectrum, Total Uranium Mass, Total Thorium Mass and Total Radium Activity/g. Isotopic Uranium, Isotopic Thorium, and Isotopic Radium analyses (reported in activity/g) may be used in lieu of Total Uranium, Total Thorium, and Total Radium.

d. Documentation of Acceptance

In accordance with the preceding requirements, CHDT shall confirm or deny that the waste is acceptable for treatment, storage, or disposal. If the waste is confirmed to be appropriate for acceptance at the facility, CHDT shall maintain all documents, data, and information that it used to make such determination and include the information and documents, including the Waste Profile and the Questionnaire, in or with the Pretreatment and Disposal Recommendation (PDR) Form. This is presented in Attachment B. If a waste or waste stream has been evaluated in the pre-acceptance process and CHDT confirms it meets the requirements of the Amended

CD and this SOP, such waste stream shall then be approved by CHDT in writing, for acceptance at the Facility. A copy of CHDT's approval, and the supporting documentation, will be kept on file and shall be available for review.

e. Annual Recertification

A waste or waste stream that has been approved for acceptance, treatment, storage, and disposal at the Facility shall maintain such approval for a period of one year from the date of CHDT's approval under subparagraph (d) above. At the one year anniversary of the date of CHDT's approval, the waste stream shall be reevaluated for compliance with this SOP and the Amended CD ("Annual Recertification").

To obtain the Annual Recertification, CHDT and/or the waste generator shall repeat the pre-acceptance requirements and steps described in Sections 6(a) through (d) above. The original radiological analyses shall be repeated. Alternatively a generator may certify by re-signature of the profile and NORM questionnaire that the original characterization is still complete and still applicable and the waste acceptance can continue. The waste generator's certification and the results of the radiological analyses shall be evaluated by CHDT as if the waste or waste stream were being submitted for the first time by the waste generator. If CHDT then re-confirms the waste stream meets the requirements of the Amended CD and this SOP, such waste may be re-approved for acceptance, treatment, storage, and disposal for one year from the date of approval by CHDT of the Annual Recertification. All documentation for any Annual Recertification of a waste or waste stream will be kept on file and will be available for inspection.

7.0 PROFILE DEACTIVATION

If at any time the waste stream is found not to comply with the requirements of the Amended CD and the restrictions of Section 5, Waste Acceptance Criteria, above, the profile will be deactivated.

a. Alternate Means of Compliance

No alternate means of compliance with this SOP may be used, unless CHDT obtains prior written approval from both CDPHE and the County. CDPHE and the County may consider alternate means of compliance on a case-by-case basis, and either or both may require any additional conditions for the approval of any proposed alternate means of compliance they deem appropriate.

b. Record-Keeping; County and CDPHE Access

CHDT shall retain indefinitely all Waste Profiles, Questionnaires, and any and all other supporting documents, information and data, including all records of laboratory analysis, related to the acceptance, treatment, storage and disposal of Regulated Wastes (or the disposal of any approved non-conforming waste) at the Facility. CHDT shall make all records related to the acceptance, treatment, storage and disposal of Regulated Wastes available to the County, the County's Technical Representative, its engineers or other representatives and the CDPHE, its engineers, or other representatives, for inspection and copying, at any time upon reasonable advance notice.

8.0 ON-SITE ACCEPTANCE REQUIREMENTS

a. Generator Preparation of Waste for Transportation to Facility

Each Generator shall prepare any waste for shipment in accordance with Department of Transportation regulations found at Title 49 of the Code of Federal Regulations (CFR) and, where applicable, Part 17 of 6 CCR 1007-1.

b. Generator Certification; Hazardous Waste Manifest

CHDT shall confirm that the Generator independently certifies, on the Waste Profile, that the specific activity (radioactivity per gram) of waste prepared for shipment to the Facility meets the acceptance criteria for Regulated Waste at the Facility. In addition, CHDT shall confirm that a Hazardous Waste Manifest, non-Hazardous Waste Manifest, Bill of Lading and/or NRC Forms 540 and 541, where appropriate, have been completed in accordance with Environmental Protection Agency regulations found at 40 CFR 262.20 and Department of Transportation regulations found at 49 CFR 172.205.

c. CHDT Acceptance Procedures – In General

The waste shall be tested and analyzed to ensure that it matches the Waste Profile description. At such time as wastes are received at the Facility, the radiological properties of the wastes or waste stream shall be verified as consistent with all data, information and documentation associated with the waste shipment and the wastes shall be reviewed by CHDT to ensure compliance with the requirements of the Amended CD and this SOP.

If the waste shipment conforms to and matches the properties determined in the Pre-Acceptance Evaluation (based on the Waste Profile Sheet, the Questionnaire, the results of the required laboratory analyses, and any other supporting information) and CHDT confirms that the waste meets the requirements of the Amended CD and this SOP, such waste may be accepted for treatment, storage and disposal at the Facility.

d. Exposure Rate Survey

All shipments of wastes received at the Facility for acceptance and disposal shall be screened for radiation exposure rate at the outside of the shipment package. Exposure rate meters shall be operated in accordance with License SOP 15.OPS.07, Exposure-Dose Rate Meters.

Expected ranges of exposure rate for waste shipment screening shall be determined by the RSO. A measured exposure rate of a waste shipment exceeding expected ranges shall be evaluated by the RSO to ensure the shipment is in compliance with the requirements of this SOP. If there is a discrepancy, the discrepancy resolution process shall be instituted.

e. Weights

All waste shipments will be weighed on a certified scale.

f. Gamma Isotopic Survey

Each shipment of waste will be surveyed for radionuclide identification using an approved portable gamma spectroscopy unit per SOP 15.OPS.03, Operation of Portable Gamma Spectroscopy Unit. If man-made radionuclides are detected above background, as described in Section 5(c) above, or the observed radionuclide activity concentration or composition exceeds the requirements or limits set forth in the Amended CD and this SOP, the waste shipment shall be rejected and returned to the Generator. The Generator Profile shall be disapproved until the discrepancy is resolved, in accordance with this Section 7, and CHDT shall notify the County and CDPHE of the rejected truckload or shipment.

g. Samples

Waste shipments shall be sampled according to the requirements of Attachment C. Some wastes and waste streams are difficult to sample, for example, large debris-type wastes. These waste types are typically not directly sampled. In such cases, the RSO may conduct a visual inspection of the waste material and take measurements using hand-held instruments as a substitute for direct sampling of the waste. In instances where direct sampling is not reasonably feasible, the RSO shall document the reasons such wastes cannot be sampled directly and provide a description of the results of the visual and hand-held sampling.

h. Documentation Review

All documents accompanying the waste shipment will be reviewed to ensure that the requirements of this SOP are met.

i. On-Site Tracking of Regulated Wastes

CHDT shall maintain data, information and other documentation that conforms to industry standards and prudent practices for on-site tracking of all waste shipments and the disposal location of all wastes. Such information shall be prepared in a form or forms based upon the instructions in the PDR form. These forms will provide instructions for facility workers and shall document and track the location, at all times, and final disposition of each waste shipment.

j. Discrepancy Procedures

If there is a discrepancy (as determined by CHDT's review of the Waste Profile, the Questionnaire, the pre-acceptance sampling, testing and required laboratory analyses and any other supporting documentation) that indicates that the waste or waste stream may not meet the requirements of the Amended CD or the requirements of this SOP, the waste profile will not be approved for acceptance at CHDT unless otherwise approved in writing by CDPHE and the County.

In the event of a discrepancy between the pre-acceptance documentation and the waste shipment, CHDT shall provide to CDPHE and the County the Waste Profile, the Questionnaire, any other supporting documents and all analytical results. The County may, at its sole discretion, choose to participate in the discrepancy resolution process, including the establishment of a final date certain for resolution of the discrepancy. CHDT will notify the County and CDPHE if any discrepancies cannot be resolved.

If the discrepancy can be resolved prior to any agreed-upon deadline and the waste is determined by CHDT, the County, and CDPHE to comply with the Amended CD and this SOP, such waste may be accepted for treatment, storage or disposal at the Facility. If the discrepancy cannot be resolved by the deadline or the waste shipment does not meet the requirements of the Amended CD or this SOP, the waste shipment shall, if not already deposited in a cell, be rejected and returned by CHDT to the waste generator or, at the waste generator's request, to an alternate waste facility. If the waste has been deposited in a disposal cell at the time the discrepancy has been determined or discovered, then the procedures in Section 8.c of the SOP shall apply.

k. Waste Profile Deactivation; Generator Debarment

If at any time, any waste stream is found by CHDT, the County or any other governmental entity not to meet the requirements of the Amended CD or this SOP, the Waste Profile for such waste stream shall be deactivated, and further wastes or waste streams from the offending waste generator shall not be accepted at the Facility by CHDT unless and until (i) CHDT, CDPHE and the County mutually agree to allow the waste generator to resume shipment of further wastes for evaluation and acceptance at the Facility; (ii) CHDT, CDPHE and the County mutually agree on an appropriate revised Random Confirmation Sampling Program, and (iii) the Pre-Acceptance requirements for such further wastes or waste streams have been satisfactorily completed. Such resumption may be conditioned upon an audit of the waste generator's operations and waste handling procedures and may be conditioned on such changes to the waste generator's waste handling methods or other procedures as CHDT, CDPHE and the County agree are necessary to protect the public health and the environment.

9.0 RANDOM CONFIRMATION SAMPLING PROGRAM

Each waste stream and waste shipment containing radioactive materials shall be subject to a random confirmation sampling program ("Confirmation Program"). CHDT shall sample at least one (1) shipment out of every twenty (20) shipments starting with the first shipment received from a Generator. For purposes of this SOP and the Confirmation Program, a "shipment" or "waste shipment" shall mean one truckload of waste.

The confirmation sample shall be a representative sample collected from the shipment (may not always be possible as indicated in Section 8.g).

a. Laboratory Analyses

The off-site laboratory analyses required for random confirmation samples shall be as follows:

- Gamma spectroscopy with in-growth for radium-226
- Isotopic or mass uranium
- Isotopic or mass thorium
- Lead-210, if necessary

b. Comparison of Results

The results of the analyses of the Confirmation Program shall be compared with the results of the Pre-Acceptance sample results and any other samples. The RSO shall determine if the results of the Confirmation Program sampling are consistent with the Waste Profile and any other supporting information, data or documents provided to CHDT by the waste generator. If the results of the Confirmation Program sampling are consistent with the waste generator's data, information and documentation of the waste shipment, and all other requirements of the Amended CD and this SOP are met, the waste may be accepted and disposed at the Facility.

c. Revocation of Acceptance of Waste

If, following acceptance of waste at the Facility, any laboratory analysis or other information is received indicating that the accepted wastes do not conform with the Amended CD or this SOP, CHDT shall notify CDPHE and the County of the non-conformance. CHDT shall prepare and provide to CDPHE and the County an Investigation Plan and proposed Corrective Action Plan (CAP). The Investigation Plan and CAP shall include an evaluation of risk against the Baseline Technical Assessment, the most recent Annual Technical Assessment, and the Facility Lifetime Total Activity established for the Facility. Final disposition of the offending waste shall be subject to CDPHE and County review and approval. If ordered by the County and/or CDPHE, the CAP shall include removal of the offending waste from the Facility. The decision to dispose of the waste in place or to remove the waste shall be made in accordance with the United States Nuclear Regulatory Commission's public dose limit of 100 mrem per year to an individual member of the public. The procedures set forth in Section 7 with respect to Waste Profile deactivation and Generator debarment shall also apply to any Generator whose waste is found non-conforming under this paragraph.

ATTACHMENT A

ENVIRONMENTAL SERVICES, INC.

Supplemental NORM Questionnaire

Clean Harbors Deer Trail Facility

General Information

Waste Name: _____

Profile Number: _____

Generator Name: _____

EPA ID: _____

Site Address: _____

Regulatory Information

Is the Waste Subject to an NRC, State or other Radioactive Materials License?	Yes ☐	No ☐
Does the Waste contain NORM (Naturally Occurring Radioactive Material)?	Yes ☐	No ☐
Does the Waste contain TENORM (Techologically Enhanced NORM)?	Yes ☐	No ☐
Does the Waste contain Source Material?	Yes ☐	No ☐
Does the Waste Contain Byproduct Material?	Yes ☐	No ☐
Does the Waste Contain Man Made or Artificial Radionuclides?	Yes ☐	No ☐
Does the Waste Contain Special Nuclear Material?	Yes ☐	No ☐

Please describe the process which produced the waste: _____

Radiological Information

What is the maximum dose rate at the surface of the waste (microR/hour)? _____

Please list the isotope, average specific activity, and maximum specific activity for each radionuclide present

Isotope	Ave (pCi/g)	Max (pCi/g)	Isotope	Ave (pCi/g)	Max (pCi/g)

Generators Certification

I hereby certify that all information submitted in this and attached documents is correct to the best of my knowledge. I also certify that any samples submitted are representative of the actual waste. I also certify that the Specific Acitivity (radioactivity per gram) of waste prepared for shipment to the facility meets the acceptance criteria for Regulated Waste at the Facility.

Authorized Signature	Name (Print)	Title	Date

Generators Outside the Rocky Mtn. Compact Region (CO, NM, NV) Certification

I hereby certify that the generator is licensed or permitted to, and agrees to, receive back the waste and residues if they cannot be disposed of. (In the case of oil and gas waste collectors/processors, this certification may be signed by the processor/collector.) I agree to provide the Clean Harbors Deer Trail Facility written or e-mail notification at least five days in advance of the initial shipment of waste.

Authorized Signature	Name (Print)	Title	Date

Clean Harbors Deer Trail, LLC
108555 East Highway 36,
Deer Trail, CO 80105
Phone 970-386-2293, Fax 970-386-2262

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ATTACHMENT B

CleanHarbors ENVIRONMENTAL SERVICES, INC.

Pretreatment and Disposal Recommendation

Profile # **Generator**
Waste Name

Profile Review:

Documentation is complete?	Y	N	
The site has the capabilities to manage the waste?	Y	N	
Physical and chemical characteristics reviewed?	Y	N	
Waste is compatible with HDPE landfill liner system?	Y	N	
Waste management byproducts reviewed?	Y	N	
Waste is not prohibited?	Y	N	
LDR status and documentation complete?	Y	N	

Required LDR documentation:
Waste Management Method:
CH Process Final Code Process Type
EPA Waste Codes

EPA Handling Codes:
Incompatability and special handling:

Physical Properties:

Physical State: Color
Density: pH
% Solids: %Aqueous Liquids: % Organic Liquids
Other:

Safety Precautions:

Required PPE:
Monitoring:
Fire Fighting:
Other Comments:

Laboratory and Treatment Instructions

Incoming Lab Analysis
Randon Sample Analysis
Post Treatment Analysis

Handling, Survey, and Decon Instructions

Inbound Survey
Inbound Sampling
Sample Area Survey
Disposal Isntructions
Exit Survey Requirements
Decon Requirements

Approvals:

Operations Date:

RSO Date:

Attachment C

SAMPLING METHODS

1.0 INTRODUCTION

An important consideration in the development of a waste characterization program is the methodologies employed for waste sampling. It is imperative that the sample be as representative of the waste stream as possible, since the reliability of all subsequent analytical and evaluation efforts will be limited by this factor. Procedures and general guidelines for obtaining representative samples of wastes from drums and bulk loads are discussed in the following sections. A Sample Log Book will be used as a tool by samplers to document the waste sampling. The Sample Log Book shall be maintained as part of the Operating Record. Prior to taking a sample, the Waste Profile Sheet and the PDR forms will be reviewed and safety procedures will be implemented.

2.0 DRUM SAMPLING

Drums or other approved waste containers are likely to contain materials that vary in form and consistency, such as liquids, sludges, or dry solids, all generated either separately and/or in mixtures. The sampling methodologies employed will generally depend upon the specific form and type of waste contained in a drum. Sampling must be representative of the material in the drums and account for any layering or stratification that may occur for any wastes having various liquid/liquid or liquid/solid phases. Containers will be sampled in such a manner as to obtain a vertical profile of the material, unless the physical properties prohibit penetration of the sampling devises.

2.1 LIQUID DRUM SAMPLING

Liquids should be sampled using a clean glass or plastic "thief'. A thief is a hollow glass or plastic tube approximately 3/8" internal diameter and greater than a drum in length. After the sample is obtained, replace the bung on the drum and tighten. The use of a dedicated thief for each drum sampled eliminates the need for cleaning and the possibility of cross-contamination and/or incompatible mixing of wastes.

2.2 SLUDGE DRUM SAMPLING

Sludge in drums range in consistency from slurries to near-solid materials. The sampling device employed will be dependent upon the consistency of the sludge material. Loose slurry material will be sampled using a thief. Material that will not enter the thief will need to be sampled by other means. If the sludge contains a large amount of coarse or compacted material, it will be sampled with a core sampler. Semi-solids in open-top drums containing a low concentration of

moisture will be sampled as a solid. Samples of sludge in drums can also be collected using various types of core samplers, such as sampling triers or soil augers. A typical sampling trier is a long tube with an open slot extending nearly the entire length. The tip and edges of the slot are sharp and allow the trier to cut a core of waste material to be sampled when inserted and rotated in the material. Sampling triers usually have a stainless steel tube and a wooden handle. They are usually 24 to 40 inches in length and 1/2 to 1 inch in diameter.

2.3 SOLID DRUM SAMPLING

Solids generally arrive in open-top drums. Waste solids can easily be sampled with a core sampler (i.e. sampling trier or soil auger) through the open top. Sampling trowels can be used in some cases when sampling dry, granular or powdered materials from drums. A sampling trowel (ordinarily zinc-plated) is a small tool with a pointed, scoop-shaped blade having a plastic or wooden handle. The sharp-tipped blade measures approximately 3” X 5”.

3.0 BULK SOLID SAMPLING

Bulk solid wastes generally arrive in dump trucks or roll-off boxes. Dump trucks and roll-off boxes containing solids and sludge will be sampled with trowels, shovels or other sampling devices with extended handles. Specific locations will be sampled by taking surface and subsurface grab samples.

At least one grab sample location per 10 yd^3 of waste is required. The grab samples will be composited in order to provide a representative sample of the shipment.

4.0 LIQUID/SLUDGE TANKER SAMPLING

Each tanker will be sampled via the manhole entrance port on the top of the tankers or through a sampling valve located on the bottom-rear of the tanker. The tanker contents will be sampled using a pond sampler or dipper. If necessary, a weighted bottle or equivalent sampling device will BE UTILIZED.

5.0 DECONTAMINATION OF SAMPLING EQUIPMENT

When practical, disposable sampling equipment will be used and disposed of in the same container from which the sample was taken. All reusable equipment will be cleaned, visually inspected for residues and surveyed for radiation prior to the reuse of such equipment. Equipment that has not been decontaminated will be appropriately labeled and stored.

ATTACHMENT D

ANALYTICAL TEST METHODS AND EVALUATION OF WASTE ACCEPTANCE CRITERIA.

1.0 LAB ANALYSIS

Waste generators will provide laboratory analysis data along with their waste profile. A variety of test methods are available. Preferred methods used will be those listed in Table 1, Acceptable Test Methods. Equivalent test methods may be used as long as they provide the same data quality. Detection limits must be sufficient to determine waste acceptability. CHDT will evaluate the generator's lab analysis. If the data is incomplete or not sufficient to determine acceptance criteria, CHDT will send a sample of the waste to a qualified lab for additional analysis. Both analytical testing and process knowledge may be used to demonstrate that the waste meets the Waste Acceptance Criteria.

Table 1. Acceptable Test Methods

Analytical Tests	Method	Sample Size
Gamma Emitters - Activation and fission products - screen only	EPA 901.1M	500g
Gamma Emitters - Natural Products	EPA 901.1M	500g
Gross alpha/beta (leach) by GFP	EPA 900.0M/ EPA 9310M	100g
Lead-210 by GFP	ASTM-D5811-95M	100g
Radium Tot. Alpha Emitting Isotopes	EPA 903.0M/ EPA 9315M	1L
Radium-226 by Alpha scintillation (Radon emanation)	EPA 903.1M	115g
Radium-226 by GFP (Total Radium Alpha)	EPA 9315	1L
Radium-226, 228 (Bi/Pb-214 ingrow th)	EPA 901.01M	500g
Radium-226, 228 by gamma spec (screening)	EPA 901.0M	500g
Radium-228	EPA 9320	1.5L
Thorium Isotopic Th 228, 230, 232 by alpha spec	ASTM D3972-90M	100g
Thorium Total (ICP)	EPA 6010	4oz
Thorium Total (ICPMS)	EPA 6020	4oz
Uranium Total	ASTM D3972-90M	100g
Uranium Total (ICP)	EPA 6010	4oz
Uranium Total (ICPMS)	EPA 6020	4oz
Uranium Total (Kinetic Phosphoresence Analysis)	ASTM D5174-91M	100g
Uranium isotopic-U-234, 235, 238, by alpha spec	ASTM D3972-90M	100g

2.0 PROCESS KNOWLEDGE

Waste generators must provide detailed process information for each waste stream as part of the pre-acceptance process. They must certify that there are no man-made radionuclides present above background levels, and certify the regulatory status of the waste. They may provide calculations or manufacturer's data to support the waste characterization. CHDT will evaluate this information in conjunction with lab analysis data to make sure the waste meets the acceptance criteria. Process knowledge may be substituted for lab test data, where appropriate, with approval from Adams County and CDPHE.

3.0 EVALUATION OF WASTE ACCEPTANCE CRITERIA.

CHDT must have data on each waste stream that document that the license limits on acceptance of radium-226, mass thorium, mass uranium and total activity are met. CHDT must also be able to ensure the absence of manmade radionuclides above background levels. CHDT must have sufficient knowledge about a waste to protect workers and the public.

a. Identification of Radionuclides and Their Activity

CHDT must have suitable documentation that identifies the radionuclides present and their activity. Uranium and Thorium activities can be determined by isotopic analysis using alpha spectroscopy. Once the isotopic data is known, the activities of the Uranium and Thorium progeny can be determined by inference. In the absence of isotopic data, mass concentration Uranium and mass concentration Thorium can be used to determine identity and activity. Uranium Isotopes in the Uranium, Thorium and Actinium decay series will be presumed to be present in their natural equilibrium concentrations in this case. Gamma spectrum analysis will identify and quantify shorter-lived progeny in the decay series and will also quantify Radium isotopes in the waste. Gamma spectrum analysis can also provide insurance against the presence of manmade radionuclides. Table 2, NORM Radionuclide Determination shows the various methods used for identification of naturally occurring radionuclides and determination of their activities.

Table 2 NORM Radionuclide Determination

Uranium Series					
Nuclide	**T1/2**	**Emmisions**	**Analysis**	**Other Analysis**	**Comments**
U-238	Very Long	Alpha	Alpha spec uranium isotopic	Total Uranium	
Th-234	24.1d	Low energy beta and gamma	Infered by U-238 activity	Total Thorium	Usually in equilibrium
Pa-234m	1.17m	High energy beta and gamma	Gamma spec	Infered by U-238 activity or Total Uranium	Part of gamma spectrum Analysis
Pa-234(0.13%)	6.75hr	Very small percentage			
U-234	long	Alpha	Alpha spec uranium isotopic	Total Uranium	
Th-230	long	Alpha	Alpha spec thorium isotopic	Total Thorium	
Ra-226	1602y	Alpha and low energy gamma	Alpha scintillation	Gamma spec	Use gamma screening unless high (>200pCi/g) is likely
Rn-222	3.823d	Alpha	Infered by Ra-226 activity		
Po-218	3.05m	Alpha	Infered by Ra-226 activity		
Pb-214	26.8m	Beta, Gamma	Gamma spec	Inferred by Ra-226 activity	Part of gamma screen
Bi-214	19.7m	High energy beta and gamma	Gamma spec	Inferred by Ra-226 activity	Part of gamma screen
Po-214	164us	Alpha	Infered by Bi-214 activity	Inferred by Ra-226 activity	
Pb-210	21y	Low energy beta	GFP counting	Inferred by Ra-226 activity	Analyze for Pb-210 if radon has been lost or if Pb-210 w aste
Bi-210	5.01d	High energy beta	Infered by Pb-210 activity		
Po-210	138.4d	Alpha	Infered by Pb-210 activity		
Thorium Series					
Nuclide	**T1/2**	**Emmisions**	**Analysis**	**Other Analysis**	**Comments**
Th-232	very long	Alpha	Alpha spec	Total Thorium	
Ra-228	6.7y	Low energy beta	Infered by Th-232, Ac-228, and Th-228 activity	Ra-228 by GFP	
Ac-228	6.13hr	High energy beta and gamma	Gamma spec	Inferred from Ra-228 activity	Part of gamma screen
Th-228	1.91y	Alpha	Alpha spec	Total Thorium	
Ra-224	3.64d	Alpha	Infered by Th-228 activity		
Rn-220	55s	Alpha	Infered by Th-228 activity		
Po-216	0.15s	Alpha	Infered by Th-228 unless there is loss of radon		
Pb-212	10.64hr	Beta, Gamma	Gamma spec		Part of gamma screen
Bi-212	60.6m	Alpha, beta, gamma	Gamma spec		Part of gamma screen
Po-212 (64%)	304ns	Alpha	Infered by Th-228 unless there is loss of radon		
Tl-208 (36%)	3.1m	High energy beta, gamma	Gamma spec		Part of gamma screen
Actinium Series					
Nuclide	**T1/2**	**Emmisions**	**Analysis**	**Other Analysis**	**Comments**
U-235	long	Alpha, gamma	`	0.7% ot total Uranium	Part of gamma screen
Th-231	25.5hr	Beta, low energy gamma	inferred by U-235	< or = to activity of U-235	
Pa-231	long	Alpha, low energy gamma	inferred by U-235	< or = to activity of U-235	
Ac-227	21.6y	Alpha, low energy gamma	inferred by U-235	< or = to activity of U-235	
Th-227 (98%)	18.2d	Alpha, gamma	inferred by U-235	< or = to activity of U-235	
Ra-223	11.43d	Alpha, gamma	inferred by U-235	< or = to activity of U-235	
Rn-219	4.0s	Alpha, gamma	inferred by U-235	< or = to activity of U-235	
Po-215	1.78ms	Alpha	inferred by U-235	< or = to activity of U-235	
Pb-211	36.1m	Beta, Gamma	inferred by U-235	< or = to activity of U-235	
Bi-211	2.15m	Alpha, gamma	inferred by U-235	< or = to activity of U-235	
Tl-207	4.79m	Beta, Gamma	inferred by U-235	< or = to activity of U-235	
Potassium					
Nuclide	**T1/2**	**Emmisions**	**Analysis**	**Other Analysis**	**Comments**
K-40	Very Long	Beta, Gamma	Gamma Spec	Calculated by % natural abundence from total K	

b. Determination of Total Activity

Acceptable waste must have total activity of less than 2000 pCi/g. Lab Analysis data will be used to determine total activity. Total activity will be calculated by the summation of the activity of the nuclides measured and the activity of nuclides not directly measured but known to be in equilibrium with measured nuclides. Process knowledge may be used as well.

c. Radium-226 Activity

Acceptable waste must have less than 222 pCi/g Radium-226. Radium-226 can be measured by a variety of methods, including gamma spectrum analysis, alpha scintillation, etc.

d. Mass Uranium and Thorium

Mass Uranium and Thorium combined must be less than 0.05%. Determination of this may be made from mass-based uranium and thorium analytical data. It may also be calculated from isotopic uranium and thorium data by using the specific activity of the isotopes. Process knowledge may also be applied.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.WAC.02
WASTE TRACKING

1.0 OBJECTIVE

Define operational procedures for tracking waste through receipt, movement, treatment, and disposal at the Clean Harbors Deer Trail (CHDT) facility.

2.0 SCOPE

This standard operating procedure (SOP) defines the procedures, electronic files, hardcopy forms, and their use in tracking waste at CHDT. It does not cover documentation of laboratory analysis, wastewater treatment plant operations, and radiation surveys, which are covered in other procedures.

3.0 POLICY

All waste received from off site, or generated on site, will have its properties and disposition properly documented in compliance with the RCRA permit and Colorado regulations. All waste storage, movements, treatment, disposal, and shipment off site will be properly documented in compliance with the RCRA permit and Colorado regulations.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 WASTE TRACKING

Clean Harbors utilizes an internet based electronic waste tracking data base to document all facets of waste operations from generation until final disposal. Certain hardcopy forms and logbooks are used to provide additional documentation of waste transport and disposal. A step-by-step description of the waste tracking process is as follows:

5.1 Uniform Manifest

A uniform hazardous waste manifest (shown in Attachment 1) will usually be used by the waste shipper/generator to document the waste shipment and end facility. Alternatively, a nonhazardous waste manifest or a bill of lading may be used to document waste shipments. If required for license transfer purposes, NRC forms 540 and 541 will also be utilized. The utilization of these forms is governed by regulation. After a shipment is received at the facility, and any discrepancies are resolved, the manifest will be signed for

by the facility and a copy will be sent back to the waste generator. Copies of the signed manifest are also scanned into the Clean Harbors waste tracking database and hardcopies are kept on file at CHDT.

5.2 Weight Ticket

Each shipment of waste is weighed at the truck scales at the front of the facility. Gross, tare, and net weight are shown on the weight ticket. Radiation exposure rates determined by the portal monitors are recorded on the weight ticket (Attachment 2). Copies of completed weight tickets are scanned into the Clean Harbors waste tracking database and are kept on file at the facility. Gross, tare and net weights are also entered into the Clean Harbors waste tracking database.

5.3 Gate Log

Information on each incoming waste shipment will be entered in the Clean Harbors waste tracking database. A hardcopy Gate Log of all incoming waste shipments will also be updated on a daily basis and kept on file at CHDT. An example copy of the Gate Log is shown in Attachment 3. Each incoming load is assigned a load number. This load number will be used as the identification number for filing all incoming load documentation.

5.4 Site-Generated Log

Information on each quantity of site-generated waste will be entered into the Clean Harbors waste tracking database. A hardcopy Site-Generated Log will also have this information entered into it and will be kept on file at the facility. An example of this is found in Attachment 4.

5.5 Waste Receiving Report

Information entered into the Clean Harbors internet based waste tracking system (WIN WEB), can be printed out and summarized on a document called a Waste Receiving Report. An example of this is shown in Attachment 5. The Clean Harbors waste tracking system assigns unique numbers to all waste containers.

5.6 Waste Tracking Form/Work Order

A Waste Tracking Form is generated for the shipment. The Waste Tracking Form will be used to track onsite movements or creation of waste (Attachment 6). The waste tracking form provides instructions to CHDT workers for treatment and disposal of waste and provides a format for them to record landfill or treatment locations. .

5.7 Stabilization Recipe

This form provides the information necessary for treatment operations; it contains mixing and reagent addition instruction and safety precautions.

5.8 Bulk Container Inventory

An inventory of bulk containers will be made each operating day (an example inventory form is shown in Attachment 7). The location, identification and description of each bulk container will be entered in the Bulk Container Inventory form printed out each day. Each day's form will be filed.

6.0 FORMS

6.1 Form Format

Tracking forms are subject to frequent revision in order to resolve new and unforeseen circumstances and to improve recordkeeping. Minor changes to the form format may be made by the CHDT RSO, CHDT General Manager, or designee at any time.

ATTACHMENT 1 – UNIFORM MANIFEST

Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number
2. Page 1 of
3. Emergency Response Phone
4. Manifest Tracking Number 002589559 FLE

5. Generator's Name and Mailing Address — Generator's Site Address (if different than mailing address)

Generator's Phone:

6. Transporter 1 Company Name — U.S. EPA ID Number

7. Transporter 2 Company Name — U.S. EPA ID Number

8. Designated Facility Name and Site Address — U.S. EPA ID Number

Facility's Phone:

9a. HM	9b. U.S. DOT Description (Including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
	1.					
	2.					
	3.					
	4.					

14. Special Handling Instructions and Additional Information

15. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name — Signature — Month Day Year

GENERATOR

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

INT'L

17. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name — Signature — Month Day Year

Transporter 2 Printed/Typed Name — Signature — Month Day Year

TRANSPORTER

18. Discrepancy

18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

18b. Alternate Facility (or Generator) — U.S. EPA ID Number

Facility's Phone:

18c. Signature of Alternate Facility (or Generator) — Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

1. 2. 3. 4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a

Printed/Typed Name — Signature — Month Day Year

DESIGNATED FACILITY

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete. DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)

ATTACHMENT 2 – WEIGHT TICKET

Weight Ticket

Clean Harbors Deer Trail, LLC
108555 E. US Highway 36
Deer Trail, CO 80105

Date _____

Drum # _____

Load # _____

Manifest # _____

Sales Ord # _____

Profile # _____

Container # _____

Trailer # _____

Gross _____

Tare _____

Net _____

Driver _____ [ ]on [ ]off Weighed by: _____

Gate Monitor Radioactivity Readings (μR/hr) East _____ West _____

Washouts	Yes	Initials
None	[ ]	_____
Tank Wash	[ ]	_____
Rolloff Wash	[ ]	_____
Vacbox Wash	[ ]	_____
Other Cleanout	[ ]	_____
Wheel Wash	[ ]	_____

Exit Survey	Yes	Initials
DOT Empty	[ ]	_____
Free Release Survey	[ ]	_____

ATTACHMENT 3 – GATE LOG

Load#	Date	State	Doc#	State Man#	CH WO#	Generator	Profile	Actual Weight	Estimated Weight	Date Ret	Manif	Date Copies Faxed	CH Drum#	Container #	Comments

ATTACHMENT 4 – SITE GENERATED LOG

Onsite Load#	Date	Waste Name	Profile	From	To	Volume	Weight	Drum#	Container Type	Container Size	Container #	Comments

ATTACHMENT 5 – EXAMPLE WASTE RECEIVING REPORT

Clean Harbors Environmental Services, Inc.

Waste Receiving Report

Bulk

Plant Received Date: 3/3/2005 12:00:00AM
Work Order #: **D9927737** Load #: **56307**
Receiving Facility: Deer Trail Landfill (DR)
Equipment: UNKNOWN

Generator: [redacted]
Customer: [redacted]
Manifest: [redacted] Cnt: **1**
Generator EPA ID: [redacted] State EPA ID: [redacted]

Line Item	Shipping Name/ US DOT Description	UN/NA Number	Container No. Type	Total Quantity	Unit Wt/Vol	CHI Pre-Code	Profile Number	Pkg Grp	Hazard Class	Hzrd Zone
11A	HAZARDOUS WASTE, LIQUID, N.O.S. (CHROMIUM, LEAD)	NA3082	1 TT	41,000	P	CCS	CH28928B	III	9 MISCELLANEOUS HAZARDOUS MATERIAL	

Profile Constituents (ordered by Max %)	Min	Max		Min	Max		Min	Max
WATER	70.00	80.00	METAL HYDROXIDES	0.00	20.00	LEAD	0.00	7.00
CHROMIUM	0.00	4.00	SELENIUM	0.00	1.50			

** THE PROFILE INDICATES THAT THIS WASTE CONTAINS AN OSHA REGULATED SUBSTANCE,CONTACT HEALTH & SAFETY PRIOR TO HANDING.

Tank Wash:_____ Tank Cleanout:_____ Tank Entry:_____ None:_____ CHI Providing Trans: Y Quoted Tank Wash Price: [redacted]

Waste Codes D002 D007 D008 D010

Least Cost Outlet	Outbound Profile	Outbound Profile Description	Cons (Y/N)
LG	CCS-ARSENIC	HIGH Arsenic contaminated solids- SPECIAL TREATMENT	Y
LG	LAC2	LIQUID ACID CONCENTRATED D002 ONLY	Y
LG	LAC2D	LIQUID ACID CONCENTRATED, D002, D004-11	Y
LG	LAC2DF	LIQUID ACID CONCENTRATED, D002, D004-11, F006-F012, F019	Y
LG	LB2D	ALKALINE LIQUID/SLUDGE D002, D004-11	Y
LG	LB2DF	ALKALINE LIQUID/SLUDGE D002, D004-11, F006-12, F019	Y
LG	lg-ch75714	Milling/Grinding Sludge	Y
LG	LG-CH81342	SODIUM NITRATE LIQUID/ E.C.M.	Y
LG	LM98-0149	343912 INORGANIC WASTEWATER-REG. WATER	Y
LG	LND	NEUTRAL LIQUID/SLUDGE D004-11	Y
LG	LNDF	NEUTRAL LIQUID/SLUDGE D002, D004-11, F006-12, F019	Y
LG	SAD2DF	SOLID ACID D002, 4-11, F006-12, F019	Y
LG	SBND	SOLID BASIC/NEUTRAL D002 & D004-11	Y
LG	SBNDF	SOLID BASIC/NEUTRAL D004-11, F006-12, F019, F035 LOW METALS	Y

Billing Requirements:

Container (Y/N)	Gallons (Y/N)	Special Instructions
	N	

Restrictions:

Restrictions, Other:

Drum No.	Final Code	Qty	Cont. Type	H2O Mix (Y/N)	Ph (Value)	Ign (Y/N)	CN (+/-)	Sulfide (Y/N)	PCB Value	Rad (Y/N)	Oxid (Y/N)	CC Insp	Chlorine (Y/N)	Weight (pounds)	Comments
6543865		40,000	TT												

1 Item(s) printed for **CO05003-D9927737**

Report Printed on 3/8/2005 11:44:01AM waste_mgmt\WS_RCVNG_RPT.rpt Page 1 of 1

ATTACHMENT 6 – WASTE TRACKING FORM

Load #

Load #

Campaign #

From: **To: CELL3**

Container Information

Box Number(s): N/A

No.of Containers: **Total Weight:** **pounds**

Container Type(s): **Container Size:**

Drum Numbers:

Waste Information

Waste Name:

Profile #(s)

Generator(s):

EPA Codes:

Radioactive? NO **State/NRC Licensed Waste?** No

Radionuclides Present NONE

Safety Information

PPE Requirements: Level C **Special Handling:** NONE

Monitoring: N/A **Spill Response:** Contain

Known Hazards: **Cell Exit Req.:**

Fire Fighting: Use Water **Washout Req.:** Wheel Wash

Landfill Grids

Landfill Loads	Tier	Alph	Num	Initials	Time/Date
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Created by: DAN OBRIEN **Date:**

Authorized by: **Date:**

Transfer Tech: **Date:**

ATTACHMENT 7 – EXAMPLE BULK CONTAINER INVENTORY

				Bulk Container Inventory						
7/31/2004				Prepared by: [redacted]						
Type	Size	Container Number	Site # or Campaign #	Arrival Date	Days on Site	Location (A, B, or 10 Day)	Row	Order	Profile #	Comments or Car number
RO	20	UPCU410733	56024	5/21/2004	71	B	7	4	SNDEBRISO-KP-OFF	
RO	20	UPCU411688	56035	5/21/2004	71	B	7	5	SNDEBRISO-KP-OFF	
RO	20	USPC37176	56041	5/28/2004	64	B	7	6	SNDEBRISO-KP-OFF	
RO	20	UP410320	56085	6/26/2004	35	B	6	5	SNDEBRISO-KP	
RO	25	UPCU410377	56088	8/26/2004	-26	B	2	2	CH55486B	
RO	20	USPC30007	56089	6/28/2004	33	B	6	4	SNDEBRISO-KP	
RO	40	MSUU410119	56090	6/29/2004	32	B	6	3	SNDEBRISO-KP	
RO	40	UPCU411224	56092	6/29/2004	32	B	6	2	SNDEBRISO-KP	
RO	20	410714	56094	6/30/2004	31	B	6	1	SNDEBRISO-KP	
RO	25	UPCU410666	56103	7/8/2004	23	A	3	5	SNDEBRISO-KP	
RO	40	UPCU411150	56113	7/13/2004	18	B	1	2	SNDEBRISO-KP	
RO	40	MSUU410200	56114	7/13/2004	18	B	1	3	SNDEBRISO-KP	
RO	40	UPCU411716	56116	7/14/2004	17	B	3	2	SNDEBRISO-KP	
RO	40	UPCU411369	56117	7/14/2004	17	B	3	3	SNDEBRISO-KP	
RO	40	UPCU411089	56119	7/14/2004	17	B	3	1	SNDEBRISO-KP	
RO	20	UP220413	56120	7/14/2004	17	B	1	1	SNDEBRISO-KP	
RO	40	UPCU411312	56121	7/15/2004	16	B	4	2	SNDEBRISO-KP	
RO	40	UPCU419921	56122	7/15/2004	16	B	4	3	SNDEBRISO-KP	
RO	40	UPCU411293	56123	7/15/2004	16	B	5	3	SNDEBRISO-KP	
RO	40	UPCU411247	56124	7/15/2004	16	B	5	4	SNDEBRISO-KP	
RO	20	A413-25	56126	7/16/2004	15	A	3	7	AP309752KP	
RO	20	UPCU410816	56127	7/16/2004	15	B	5	2	SNDEBRISO-KP	
RO	25	UPCU410828	56128	7/16/2004	15	B	4	1	SNDEBRISO-KP	
RO	20	A517-25	56129	7/16/2004	15	A	3	6	AP309752KP	
RO	40	MSUU410258	56132	7/17/2004	14	A	6	10	SNDEBRISO-KP	
RO	20	LMF030003	56133	7/17/2004	14	A	6	11	SNDEBRISO-KP	
RO	20	35270	56134	7/17/2004	14	A	6	8	SNDEBRISO-KP	
RO	40	UPCU419947	56135	7/17/2004	14	A	6	9	SNDEBRISO-KP	
RO	20	UP220394	56136	7/19/2004	12	A	4	8	SNDEBRISO-KP	
RO	40	UPCU419920	56137	7/19/2004	12	A	4	9	SNDEBRISO-KP	
RO	20	LMF037218	56138	7/19/2004	12	A	4	7	SNDEBRISO-KP	
RO	40	MSUU410242	56139	7/20/2004	11	A	4	5	SNDEBRISO-KP	

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.01

LANDFILL OPERATIONS

1.0 OBJECTIVE

To state procedures for disposing of radioactive materials within the Clean Harbors Deer Trail (CHDT) landfill cells.

2.0 SCOPE

This standard operating procedure (SOP) describes procedures for proper operation of the landfill, and procedures for unloading and placement of waste subject to the license.

3.0 POLICY

Landfill operations shall be performed so as to properly maintain the landfill and minimize the release of radioactive material to unrestricted areas.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the *Radiation Protection Plan* (DR 15.RPP.01).

5.0 LANDFILL OPERATIONS

5.1 Unloading Waste in the landfill

All waste in the landfill will be covered after placement per the requirements of the RCRA permit. Trucks delivering waste to the landfill will drive only on haul roads and daily cover material. Radioactive materials placed in the landfill will be covered with non-radioactive materials or daily cover material. Large waste objects will not be subject to daily cover requirements as long as they do not have removable contamination above site limits. Trucks will dump waste in grid areas as directed by the landfill operator. Drivers will stay in their vehicles during dumping operations. Dumping will be conducted by the Clean Harbors operator. Trucks will be inspected after dumping to make sure they are empty. Trucks will then be directed back to the sample station or other areas for inspection and release survey.

5.2 Survey Procedures for Off Site Trucks

The interior surface of off-site bulk conveyances of wastes such as dump trailers or roll-off bins will be surveyed for residual radioactive material in accordance with SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*. If contamination is detected above the site limits, the interior of the truck dump trail or roll-off bin trailer will be swept and/or washed and re-surveyed, until the interior of the truck dump trailer or roll-off bin is determined to meet the release criteria in SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*.

5.3 Waste Placement and Compaction

Wastes will be placed in the landfill in lifts of 2-4 feet high. Waste locations are measured on a 50-foot by 50-foot grid system. The location of each load of waste shall be recorded. Location is determined by a number and letter sequence for north-south, and east-west grids. The grid location and the elevation level of the top of the lift will document the location of each load. Waste shall be compacted in place to meet the standards required by the RCRA permit. Debris-like waste shall be mixed with soil like waste and compacted in place. No debris placement shall be permitted near the liner of the landfill. In order to protect the synthetic liner from possible punctures, a two-foot thick protective soil layer will be placed and maintained on the immediate liner surface. All waste placement and compaction shall be done in compliance with the requirements of the RCRA Operating permit.

5.4 Prevention of Wind Dispersal

Wind dispersal will be prevented by limiting the area of exposed waste at any one time and suitable use of cover. Dumping and placement of waste will be limited to only one or two 50'X50" grid areas at any particular time. Radioactive materials will be covered with non-radioactive materials as soon as practical. Large objects that do not have removable contamination above site limits are not subject to cover requirements. Once a grid area is covered by non-radioactive material, other grid areas may be used for dumping and placement of wastes. Other control measures or means of cover may be used to prevent wind dispersal as needed. If sustained wind speed exceeds 30 miles per hour, truck-unloading operations in the landfill will cease and any exposed areas of radioactive materials will be covered as soon as practical.

5.5 Heavy Equipment

Heavy equipment contaminated by radioactive materials shall be surveyed for contamination and if necessary decontaminated before removal from the landfill. Equipment release surveys (SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*) will be performed following decontamination if needed.

5.6 Site Haul Trucks

Site haul trucks may enter and leave the landfill as needed, provided travel is on haul roads and/or daily cover. Site haul trucks that become contaminated will be surveyed and decontaminated as needed.

5.7 Run-On/ Run-Off Controls

Run-On/Run-Off Controls and procedures are presented in detail in Section VI of the RCRA operating permit.

5.8 Leachate Collection

Requirements for leachate collection are presented in detail in Section VI of the RCRA operating permit

6.0 PERSONAL PROTECTIVE EQUIPMENT

PPE must be worn by CHDT workers in the landfill when radioactive materials are uncovered. Standard personal protective equipment (PPE) for use in the landfill consists of a full face air purifying respirator and combination cartridges, a porous disposable Tyvek suit, plastic liner gloves with cloth or leather over gloves, and boots. Additional discussion of PPE requirements at CHDT is presented in SOP 15.RPP.09, *Personal Protective Equipment,* and the other documents listed in Section 8. Off site truck drivers are not subject to the PPE requirements in the landfill but must stay in their vehicle during dumping operations. PPE is not needed in the landfill after all waste is covered with daily cover.

7.0 REFERENCES

CHDT RCRA Permit, current version

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.02
WASTE TREATMENT

1.0 OBJECTIVE

Define operational procedures for waste treatment operations in the CHDT treatment building.

2.0 SCOPE

This standard operating procedure (SOP) directs procedures for radioactive material storage and treatment operations. It addresses waste unloading, mixing and loading in the treatment building. It does not cover treatment formulas and chemical additives.

3.0 POLICY

Treatment operations will be conducted so as to keep radiation dose to workers and the general public as low as reasonable achievable (ALARA). See facility ALARA goal in the CHDT Radiation Protection Plan ALARA SOP (15.RPP.07).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (15.RPP.01).

5.0 UNLOADING AND TREATMENT OPERATIONS

5.1 Description

The treatment building is constructed over a lined surface impoundment with a leak detection system. It contains nine bulk treatment and storage basins with an aggregate capacity of 2400 cubic yards. The building is equipped with two independent emission control air scrubber systems. Access to the treatment building is restricted to trained CHDT workers, contractors and drivers under supervision. Drivers must stay in the cabs of their trucks while unloading in the treatment building.

5.2 Posting and Maintenance

The Treatment Building is posted “Caution Radioactive Materials”. The Treatment Building will be used for storage and treatment of radioactive materials as needed. The floor of the unloading area in the treatment building will be washed regularly. This will ensure that vehicles will drive only on clean surfaces. The wash water will be directed into the treatment basin, and treated by solidification and land-filled. Exit areas outside the treatment building will be surveyed during routine clean area surveys to ensure that radioactive materials are not being released to unrestricted areas.

5.3 Unloading Operations

CHDT facility personnel will direct waste trucks into the proper entrance of the treatment building. Trucks will back into the unloading area and the waste will be unloaded into the treatment basin. After the truck has been unloaded, the truck will be inspected for the presence of visible amounts of waste. If visible waste is observed, it will be removed via washing, sweeping, etc.

5.4 Exit Procedures for Waste Trucks

Waste trucks leaving the site will be surveyed for contamination in accordance with SOP 15.OPS.13, *Equipment Surveys*. If contamination is detected, trucks will be cleaned and resurveyed until they meet CHDT release criteria.

5.5 Mixing Operations

Mixing operations in the treatment building are conducted using an excavator and various chemical reagent additives. Normally, the waste is placed in the treatment basin, reagents are added, and the waste mixture is mixed until treatment is complete. Samples will be taken if needed to verify proper treatment. All treatment operations must be conducted with the emission control system properly operating to control releases of waste materials.

5.6 On-Site Transfer and Landfill Operations

After waste has been treated in the treatment basin and meets specifications for landfill, the waste will be loaded into site haul trucks using an excavator. Haul trucks will then transport the waste to the landfill for disposal. Waste will be unloaded into the active section of the landfill and the waste will be covered and compacted.

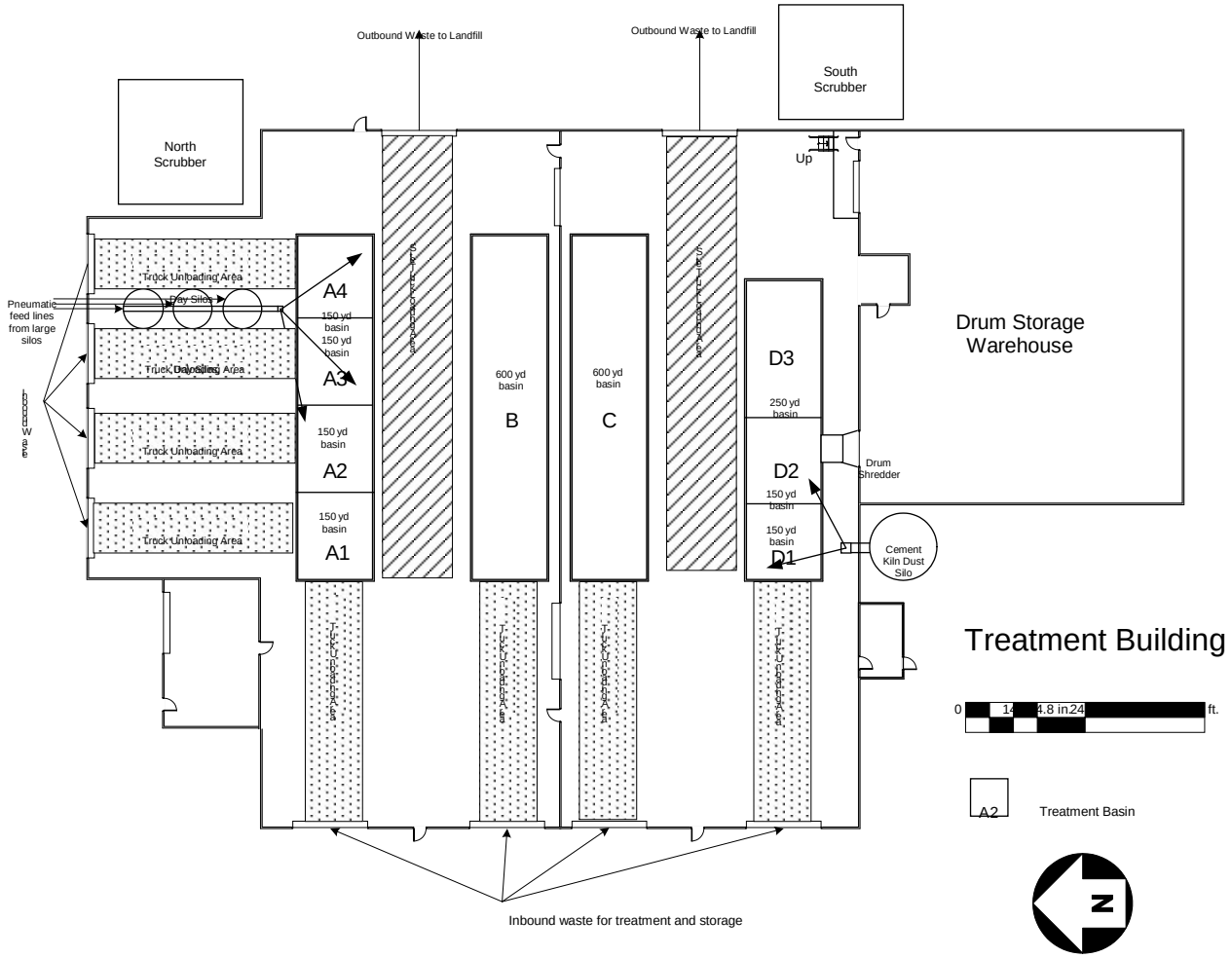
5.7 PPE and Personnel Decontamination

Consistent with 15.RPP.09, *Personal Protective Equipment,* standard PPE for use in the treatment building consists of a full face air purifying respirator and combination cartridges, a porous disposable Tyvek suit, plastic liner gloves with cloth or leather over gloves, and boots. Drivers delivering waste to the treatment building are not required to wear PPE but may not leave the cab of their vehicles until they have exited the treatment building. CHDT trained employees and contractors working with radioactive materials in the treatment building shall doff their PPE and undergo frisk out procedures before doing other work or leaving the immediate area around the building unless they are in a vehicle such as a haul truck. These procedures are delineated in SOP 15.OPS.12, *Personnel Surveys*. Reusable PPE such as boots and respirators may be reused but should be washed off before reuse or stored in the decon area. Other PPE may be used as long as they provide equivalent protection. Contaminated PPE will be disposed of in the landfill.

6.0 STANDARDS AND CRITERIA

Standards and criteria for free release are addressed in SOP's 15.OPS.13 ((Equipment and Vehicle Release Surveys) and 15.OPS.18. (Decontamination of Surfaces and Equipment).

Figure 1. Map of Treatment Building



Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.03

OPERATION OF PORTABLE GAMMA SPECTROSCOPY UNIT

1.0 OBJECTIVE

Define procedures for the operation of portable gamma spectroscopy units to identify radionuclides in waste received at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

2.0 SCOPE

This standard operating procedure (SOP) applies to all activities associated with the use of portable gamma spectroscopy units and associated software.

3.0 POLICY

Qualitative confirmation measurements using the portable gamma spectroscopy system will be performed on all incoming shipments of radioactive materials prior to disposal to confirm the presence of naturally occurring radionuclides. Measurements will also verify that radionuclides from other sources are not present within the disposed materials. Use of the portable gamma spectroscopy units will be limited to those instruments approved by the Colorado Department of Public Health and Environment (CDPHE).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT *Radiation Protection Plan* (15.RPP.01).

5.0 GENERAL SURVEY METHODS

5.1 Instrument Description

Hand Held portable gamma spectroscopy units allow for identification and quantification of gamma energies. The units also have the ability to measure exposure rates. The units contain a digital display which can allow the user to view collected spectra. The detectors are supplied with the appropriate software and can be connected to a computer to allow for printable spectra.

5.2 Operating Procedure

Approved hand held portable gamma spectrometers shall be used by trained CHDT staff to determine the relative contribution of radionuclides in waste received at the CHDT landfill. Unless otherwise directed by the CHDT RSO or designee, the measurements shall not be used to establish personnel dose rates. Specific operating procedures and step-by-step instructions for operation of hand held portable gamma spectrometers are contained in the respective operating instruction manuals supplied by the manufacturers.

Shipments with very low radiation levels may require an increased sample analysis time to properly identify the radioisotopes present. In such cases, the count time can be extended for improved analytical results.

5.3 Downloading and Saving Spectrum Files

Unless otherwise directed by the CHDT RSO or designee, download, print and review data for each spectrum immediately following collection.

6.0 STANDARDS AND CRITERIA

At a minimum, hand held portable gamma spectrometers shall require calibration according to manufacturer's recommendations.

7.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.04

OPERATION OF ALPHA-BETA COUNTER

1.0 OBJECTIVE

To define general and specific methods and procedures for conducting sample analysis for detection of alpha and beta radiation using the Ludlum 3030 alpha-beta tray counter in support of radioactive material disposal operations at the Clean Harbors Deer Trail (CHDT) landfill.

2.0 SCOPE

This SOP covers the operation of the Ludlum 3030 Alpha Beta Counter, quality control of the analysis, and calculation of instrument MDA. Release criteria for removable contamination are defined in SOP 15.OPS.13, Equipment and Vehicle Release Surveys and several additional survey SOPs.

3.0 POLICY

Radiation surveys for removable radioactive material shall be conducted by trained CHDT staff to verify that exposure from radioactive materials to CHDT workers and the public is kept as low as reasonable achievable (ALARA). Surveys will also ensure CHDT compliance with License requirements and State and Federal regulations. Use of the 3030 Alpha Beta counter will be in compliance with this SOP.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan.

5.0 GENERAL METHODS FOR ALPHA-BETA SAMPLE ANALYSIS

5.1 General Discussion

Surface contamination samples shall be collected on two inch diameter filter media and counted with the Ludlum Model 3030 Alpha Beta Scaler using the following procedure:

a. Verify that the Ludlum Model 3030 has power and is ready to count samples

b. Perform the quality control (QC) daily check as described in the instrument manual. With the system in automatic mode, a QC check will be automatically required every 24 hours, and the instrument will be inoperable in the absence of a satisfactory QC check.

- Change the count time dial to 5 minutes, and depress the “QC” button on the unit to start the instrument’s automatic daily QC routine. The first required measurement is alpha, which will require the thorium-230 (^{230}Th) source.

- After satisfactory completion of the ^{230}Th measurement, the display will indicate that a beta source measurement is required. A technicium-99 (^{99}Tc) source should be used for another 5-minute count.
- After satisfactory completion of the ^{99}Tc measurement, a 20-minute background measurement is required.

c. Set the "background subtract" mode to subtract background for alpha and beta radiation.

d. For measurements of smears, the count time dial should be set to 1-minute, or as directed by the CHDT RSO. The measurement will be logged, and should be recorded on the appropriate form.

e. If smear results are elevated, bias from radon progeny may be a factor. Allow 5 to 10 minutes of decay time for the smear and conduct a recount. If the count results remain in excess of the survey limit, notify the individual performing the survey and the CHDT RSO.

f. Determine if the sample is less than the survey limits defined for the specific survey being conducted. Radioactivity limits are described in the appropriate SOPs. Note that the sum of fractions rule is used to determine overall compliance for alpha and beta emitting radionuclides.

g. Using the PC based software, details for each sample count for later reference and analysis may be recorded if necessary.

5.2 Data Download

On a weekly basis, the data logged on each counter must be downloaded. The memory has a limit of 600 measurements, and measurements collected after the memory is full will not be logged. The laboratory desktop computer will be the primary location for downloading data. To download data, attach the serial cable to the back of the 3030 unit, attach it to a USB port on the computer using the serial-to-USB converter, and double-click on the Ludlum 3030 software. Click on the Data Logging tab, and the "Get Samples" button – the data will download from the unit, with a progress bar at the bottom of the window. A numerical count will also appear on the 3030 display. Following complete download, click the "Save Samples" button and save the file in the folder for that instrument with the filename in the following format: "XXXXXX MMDDYY Download" – where XXXXXX is the six-digit serial number and MMDDYY is the date (without spaces, dashes, or slashes). The file will save as a text/Excel spreadsheet.

Double-click on the data file to confirm that it has been completely saved. Once confirmed that the data are complete, click on the "Clear Samples" button in the 3030 software to clear the 3030 memory.

6.0 QUALITY CONTROL AND MDA CALCULATION

6.1 Quality Control

Quality control (QC) measurements will be collected on a daily basis. The 3030 has a built-in feature that requires a QC measurement every 24-hour period. Checks will be performed with plated alpha (^{230}Th) and beta (^{99}Tc) sources that are National Institute of Standards and Technology (NIST)-traceable. The QC tolerances will be set at +/- 15%. If the daily QC check fails, the instrument will not be used and will be taken out of service until the RSO is able to determine a cause.

6.2 Minimum Detectable Concentration

The minimum detectable concentration (MDC) (or minimum detectable activity [MDA]) of the instrument should be known prior to its use to verify that the measurement sensitivity is sufficient for the application. The Ludlum 3030 uses a software routine to calculate the MDC, or it may be calculated manually. The MDC for a static measurement when background and sample count times are the same may be calculated using the following equation from Abelquist 2001:

$$Static\ MDC\left(\frac{dpm}{100\ cm^2}\right)=\frac{3+4.65\sqrt{C_B}}{\varepsilon_S\varepsilon_i\left(\frac{A}{100}\right)T}$$

Where:

C_B = background counts in time T

T = time period over which counts were recorded, in minutes (for one-minute counts, this value is 1)

ε_s = surface efficiency; values default to 1.0 for alpha and beta if no other information is available

ε_i = instrument efficiency; values default to 0.39 for alpha and 0.29 for beta if no other information is available

A = the physical (or "active") probe area in cm^2

The static measurement MDC when background and sample counting times are different may be calculated using the following equation:

$$Static\ MDC\left(\frac{dpm}{100\ cm^2}\right)=\frac{3+3.29\sqrt{R_B T_{S+B}\left(1+\frac{T_{S+B}}{T_B}\right)}}{\varepsilon_S\varepsilon_i\left(\frac{A}{100}\right)T_{S+B}}$$

Where:

R_B = background count rate, cpm

T_B	=	background count time, minutes
T_{S+B}	=	sample count time, minutes
ε_s	=	surface efficiency; values default to 1.0 for alpha and beta if no other information is available
ε_i	=	instrument efficiency; values default to 0.39 for alpha and 0.29 for beta if no other information is available
A	=	the physical (or "active") probe area in cm^2

The equation used by the Ludlum 3030 to calculate the MDC automatically is as follows:

$$MDC(dpm) = \frac{2.71 + CL * \sqrt{R_B \times T_{S+B} \times \left(1 + \frac{T_{S+B}}{T_B}\right)}}{E \times T_{S+B}}$$

Where:

CL	=	Confidence Level; for 95% CL = 3.290
E	=	Overall instrument efficiency

As there is little difference between the results of the two calculations, either equation can be used when manually calculating the MDC.

7.0 REFERENCES

Abelquist, 2001. *Decommissioning Health Physics: A Handbook for MARSSIM Users*, Institute of Physics Publishing, Philadelphia, Pennsylvania.

Ludlum Measurements, Inc., Instruction Manual Model 3030 Alpha Beta Sample Counter Meter, Current Version.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.05

OPERATION OF GATE MONITOR DETECTORS

1.0 OBJECTIVE

Provide a procedure for using the Clean Harbors Deer Trail (CHDT) gate monitor systems to monitor incoming waste shipments and provide a procedure for screening NORM/TENORM waste at the generating site to ensure that it meets CHDT's acceptance criteria.

2.0 SCOPE

This standard operating procedure (SOP) applies to the operation of the Ludlum 3502 gate monitor and the Ludlum 375-20 gate monitor at CHDT or waste generating sites. This SOP may be used for alternate or backup systems at the discretion of the CHDT Radiation Safety Officer (RSO) or designee.

3.0 POLICY

Incoming waste shipments to the CHDT landfill will be monitored for gamma radiation levels by the Ludlum 3502 gate monitor system, the Ludlum 375-20 gate monitor system, or its equivalent. Incoming wastes not classified as radioactive will be subject to a limit of 16 microRoentgens per hour (µR/hr), or another value set by the CHDT RSO. The system will be used to monitor incoming radioactive loads to identify any exposure concerns or noncompliance with Department of Transportation (DOT) regulations. The CHDT RSO will be notified of any incoming shipments greater than 500 µR/hr. The equipment and procedure may also be utilized at waste generating sites to monitor waste shipments. For large projects, waste specific and geometry specific exposure rate limits may be designated by the CHDT RSO.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 GENERAL PROCEDURE

5.1 Instrument Description

The Ludlum 3502 gate monitor system consists of two sodium-iodide (NaI) detectors mounted approximately 6 feet above the incoming scale at CHDT. The detectors are each coupled with an alarming analog exposure rate meter in the scale house. The Ludlum 375-20 gate monitor system consists of two sodium-iodide (NaI) detectors also mounted approximately 6 feet above the incoming scale. The 375-20 utilizes an alarming digital rate meter that provides the average of the measurements of the two detectors.

The 375-20 also contains an internal battery which allows for remote operations in areas without line power. Quality control (QC) measurements consisting of a background check and measurement with a known cesium-137 (^{137}Cs) source will be conducted and recorded every workday. Daily measurements are expected to be within plus or minus 20% of the established background and source measurements. The CHDT RSO or designee must be notified of any deviations outside the expected parameters.

5.2 Routine Operations

Each waste shipment shall pass slowly (at a speed less than 5 miles per hour) between the detectors. During this time, staff within the guard house will monitor the meter displays to identify the maximum reading for each detector. The maximum results will be recorded on the weight ticket. If the shipment is a radioactive shipment, the measurements will also be recorded on a Radiation Survey Report.

6.0 STANDARDS AND CRITERIA

6.1 Quality Control

In addition to the daily QC measurements required by each individual instrument, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

An annual instrument calibration must be performed by a qualified vendor. Copies of the instrument calibration certificates must be maintained for a period of five years. Current calibration certificates should be maintained with the instrument daily QC measurement logs.

6.2 Rejected Wastes

Any waste shipments that are not profiled as radioactive shipments with gate measurements at 16 µR/hr or greater, or NORM/TENORM shipments that are not in compliance with (DOT) regulations, will be subject to the following procedures:

- Step 1 - Record the gate monitor measurements on a Radiation Survey Report along with the hauler's identity and truck number.
- Step 2 – Perform isotopic identification survey using portable gamma spectroscopy units per SOP 15.OPS.03.
- Step 3 – Perform package receipt survey for exposure rate and removable contamination per SOP 15.OPS.21.
- Step 4 - Inform the hauler and the waste generator that the waste load exceeds CHDT policy limits for radioactive materials. Attempt to determine the source of the radioactivity and if possible more accurately profile the waste. If CHDT management believes the waste can meet the CHDT License waste acceptance criteria (WAC), and suitable arrangements are made with the waste generator, the waste may be stored at CHDT without being disposed of until all documentation and analytical requirements are met. If this is not possible, arrangements to reject the shipment back to the waste generator will be made.

- Step 5 - If the shipment must be rejected, contact CDPHE Radiation Management Unit to notify them of the issue and if needed, obtain a special DOT permit to transport the waste back to the generating site.

Radioactive shipments with measured exposure rates greater than 500 uR/hr will be further inspected by the CHDT RSO or designee with handheld instruments to determine if the shipment is in compliance with the CHDT waste acceptance criteria and DOT regulations.

7.0 REFERENCES

49 CFR 173. *Shippers – General Requirements for Shipments and Packagings*. Current Version.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.06
OPERATION OF DIGITAL WASTE MONITOR

1.0 OBJECTIVE

Provide a procedure for using the Clean Harbors Deer Trail (CHDT) digital waste monitor system to monitor incoming waste shipments and provide a procedure for screening NORM/TENORM waste at the generating site to ensure that it meets CHDT's acceptance criteria.

2.0 SCOPE

This standard operating procedure (SOP) applies to the operation of the Ludlum 375-20 gate monitor at CHDT or waste generating sites. This SOP may be used for alternate or backup systems at the discretion of the CHDT Radiation Safety Officer (RSO) or designee.

3.0 POLICY

Incoming waste shipments to the CHDT landfill will be monitored for gamma radiation levels by the Ludlum 3502 gate monitor system, the Ludlum 375-20 gate monitor system, or its equivalent. Incoming wastes not classified as radioactive will be subject to a limit of 16 microRoentgens per hour (µR/hr), or another value set by the CHDT RSO. The system will be used to monitor incoming radioactive loads to identify any exposure concerns or noncompliance with Department of Transportation (DOT) regulations. The CHDT RSO will be notified of any incoming shipments greater than 500 µR/hr. The equipment and procedure may also be utilized at waste generating sites to monitor waste shipments. For large projects, waste specific and geometry specific exposure rate limits may be designated by the CHDT RSO.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 GENERAL PROCEDURE

5.1 Instrument Description

The Ludlum 375-20 Digital Wall Mount Area Monitor consists of two 2" X 2" Sodium Iodide Scintillation Detectors and an instrument box. The detectors are equipped with lead shielding that shields them from most background radiation that is not coming directly from the front. The detectors are connected to the instrument box with cables. The instrument box is equipped with a low radiation alarm (yellow), a high radiation alarm (red), an instrument failure alarm (red), and a low battery alarm (yellow). A green

status light indicates positive operation. The instrument runs on 120 AC current and can be plugged into a convenient outlet. The instrument comes equipped with a built-in battery backup that should last for 48 hours in a non-alarm condition and 12 hours in alarm condition. When the battery is getting low a light will show in the low battery window of the instrument box.

5.2 Routine Operations

Each waste shipment shall pass slowly (at a speed less than 5 miles per hour) between the detectors. During this time, staff within the guard house will monitor the meter displays to identify the maximum reading for each detector. The maximum results will be recorded on the weight ticket. If the shipment is a radioactive shipment, the measurements will also be recorded on a Radiation Survey Report.

6.0 STANDARDS AND CRITERIA

6.1 Quality Control

In addition to the daily QC measurements required by each individual instrument, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

An annual instrument calibration must be performed by a qualified vendor. Copies of the instrument calibration certificates must be maintained for a period of five years. Current calibration certificates should be maintained with the instrument daily QC measurement logs.

6.2 Rejected Wastes

Any waste shipments that are not profiled as radioactive shipments with gate measurements at 16 µR/hr or greater, or NORM/TENORM shipments that are not in compliance with (DOT) regulations, will be subject to the following procedures:

- Step 1 - Record the gate monitor measurements on a Radiation Survey Report along with the hauler's identity and truck number.
- Step 2 – Perform isotopic identification survey using portable gamma spectroscopy units per SOP 15.OPS.03.
- Step 3 – Perform package receipt survey for exposure rate and removable contamination per SOP 15.OPS.21.
- Step 4 - Inform the hauler and the waste generator that the waste load exceeds CHDT policy limits for radioactive materials. Attempt to determine the source of the radioactivity and if possible more accurately profile the waste. If CHDT management believes the waste can meet the CHDT License waste acceptance criteria (WAC), and suitable arrangements are made with the waste generator, the waste may be stored at CHDT without being disposed of until all documentation and analytical requirements are met. If this is not possible, arrangements to reject the shipment back to the waste generator will be made.

- Step 5 - If the shipment must be rejected, contact CDPHE Radiation Management Unit to notify them of the issue and if needed, obtain a special DOT permit to transport the waste back to the generating site.

Radioactive shipments with measured exposure rates greater than 500 uR/hr will be further inspected by the CHDT RSO or designee with handheld instruments to determine if the shipment is in compliance with the CHDT waste acceptance criteria and DOT regulations.

7.0 REFERENCES

49 CFR 173. *Shippers – General Requirements for Shipments and Packagings*. Current Version.

Ludlum Measurements, Inc., 2006. *375-20, 375-30, 375-32 and 375-34 Digital Wall Mount Area Monitors*, July.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.07

OPERATION OF EXPOSURE / DOSE RATE METERS

1.0 OBJECTIVE

To provide instruction for the operation of exposure rate or dose rate survey meters for the measurement of gamma radiation levels for receiving, free release, routine, and health and safety surveys.

2.0 SCOPE

This standard operating procedure (SOPs) applies to the operation of survey meters which may be used to determine ambient gamma radiation levels and to predict worker exposure in facility areas and from packages or vehicles. Examples of such instruments used at CHDT include Ludlum Models 3, 19, 19A, 193-6, etc. These instruments may only be used in low radiation environments. Radiation environments which exceed the capabilities of these instruments are not anticipated.

3.0 POLICY

Instruments will be used in accordance with manufacturer's recommendations, SOPs, and site-specific requirements by trained personnel. The use of an instrument outside of its intended capabilities requires approval by the CHDT Radiation Safety Officer (RSO) or designee. Radiation detection instruments shall not be used in lieu of dosimetry for determining employee occupational dose.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 SURVEY DATA COLLECTION

5.1 Use of Exposure Rate Meters

5.1.1 Instrument Descriptions

All of the exposure rate instruments in use at CHDT are "MicroR" instruments that measure gamma radiation in units of microRoentgens per hour (µR/hr). The front panel controls typically include a rotary switch for selecting the range and instrument shut off, an audio on/off switch, a fast/slow response switch, and push buttons for activating the meter lamp, count reset, and battery test. The meter scale and scale settings may vary depending on the specific instrument.

5.1.2 Typical Instrument Setup and Initial Quality Control

Upon receipt of the instrument through purchase, rental, or receipt from annual calibrations, the following steps should be taken to initially setup the instrument and verify that it is in good working order.

a. Verify that the instrument calibration is current; confirm that serial number on instrument matches that on the calibration certificate.

b. Perform ten (10) initial background quality control (QC) measurements

- Use location away from radioactive sources
- Set response to "S" for slow meter response
- Using the appropriate scale, depress the reset button ("RES") and allow the needle to come to a rest (approximately 20 to 30 seconds). Record the measurement to the nearest tick mark, and repeat for 10 measurements.
- Calculate the average plus and minus 20%. Subsequent background QC measurements must fall within this range. Typical background is between 5 and 20 μR/hr.

c. Perform ten (10) initial source QC measurements

- Use cesium-137 source in a repeatable geometry (i.e., orientation of the source relative to the meter).
- Use same location as background measurements
- Using an appropriate scale, depress the reset button ("RES") and allow the needle to come to a rest (approximately 20 to 30 seconds). Record the measurement to the nearest tick mark, and repeat for 10 measurements.
- Calculate the average plus and minus 20%. Subsequent source QC measurements must fall within this range.

5.1.3 Daily Instrument Quality Control

Each day that the instrument is used, the following QC checks and measurements must be performed and recorded.

a. Check the battery by depressing the "BAT" button, or turn the selctor switch to "BAT".

b. Perform background QC measurement

- Use same location as with initial QC measurements
- Measurement must be within plus or minus 20% of the initial average

c. Perform source QC measurement

- Use same location and source geometry as with initial QC measurements
- Measurement must be within plus or minus 20% of the initial average

If either measurement does not fall within the required tolerances, turn the unit off, turn it back on, and repeat the measurement(s). If the unit fails a second consecutive time, remove the unit from service and notify the CHDT RSO or designee.

5.1.4 Collection of Survey Measurements

Survey measurements may be collected as part of equipment or routine surveys. If the ambient radiation level of an area is being measured, the measurement should be collected at waist-level, or at a height of approximately 1 meter. If a package, container, or vehicle is being measured, the instrument should be placed in contact with the surface, provided that doing so does not present a cross-contamination concern.

When collecting a measurement of an unknown radiation field, use the "fast" response on the instrument and start with the highest scale setting, working downward until the lowest setting the measurement falls within is reached. At that point, switch the response to "slow" and read and record the measurement to the nearest tick mark.

5.1.5 Evaluation of Results

The use of survey data in units of µR/hr is acceptable for use in predicting worker exposures under most circumstances. However, the use of exposure rate meters may not be substituted for required dosimetry.

Measurements of naturally-occurring radioactive materials or of materials shielded by containers may result in an overly conservative estimate of the true radiation levels. The CHDT RSO or designee should be consulted if this appears to be an issue.

6.0 STANDARDS AND CRITERIA

Specific exposure or dose rate limits may be established for the type of survey being performed. The CHDT RSO or designee should be consulted to determine the appropriate limits for any new activity. If the ambient radiation level exceeds 2000 microR/hr (2mR) the CHDT RSO or designee should be notified and work in the area should cease until further direction is received.

An annual instrument calibration must be performed by the instrument manufacturer or other qualified vendor. Copies of the instrument calibration certificates must be maintained for a period of five years. Current calibration certificates should be maintained with the instrument daily QC measurement logs.

7.0 REFERENCES

Ludlum Measurements, Inc., Instruction Manuals, various models

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.08

OPERATION OF ALPHA-BETA SCINTILLATION DETECTORS

1.0 OBJECTIVE

To provide instruction for the operation of dual alpha and beta radiation detectors for the measurement of surface radioactivity for incoming, free release, routine, and health and safety surveys.

2.0 SCOPE

This standard operating procedure (SOP) applies to the operation of radiation survey meters with external scintillation probes to measure alpha and/or beta radiation. These instruments may be used to determine surface alpha or beta radioactivity levels. These instruments may only be used where surface geometry and other environmental conditions permit. The instrument specifically referenced by this SOP is the Ludlum 43-93 alpha-beta scintillation detector with Ludlum 2360 alpha-beta data logger.

3.0 POLICY

Instruments will be used in accordance with manufacturer's recommendations, SOPs, and site-specific requirements by trained personnel. The use of an instrument outside of its intended capabilities requires approval by the CHDT Radiation Safety Officer (RSO) or designee.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP DR 15.RPP.01).

5.0 SURVEY DATA COLLECTION

5.1 Instrument Description

The Ludlum Model 43-93 contains a plastic scintillator in a 100 square centimeter active detector window. The detector has a thin mylar covering along with a protective screen. The 43-93 is used with a 2360 alpha-beta data logger. The front panel controls on the 2360 include a rotary switch for selecting the 4 decade range and instrument shut off, an audio on/off switch, a fast/slow response switch, a toggle switch for the alpha, beta, and dual (alpha+beta) channels, and a rotary switch for scaler counting time, ranging from 0.1 to 60 minutes, with an option for a user-defined time set by the system software on a computer. The scaler count is enabled by a button on the top of the meter handle. The 2360 also has a data logging feature, which can store up to 550 measurements and which may be downloaded to a computer by the RS-232 port at the base of the unit.

5.2 Instrument Setup and Initial Quality Control

Upon receipt of the instrument through purchase or rental, the following steps should be taken to initially setup the instrument and verify that it is in good working order.

a. Verify that the instrument calibration is current; confirm that serial number on instrument matches that on the calibration certificate; confirm high voltage (HV) setting on instrument with calibration

b. Perform ten (10) initial background quality control (QC) measurements

- Use a location away from radioactive sources in a consistent geometry
- Use the 1- or 2-minute scaler count setting, based on requirements determined by the CHDT RSO.
- Depress the scaler count button to initiate the count. Colons (":") will be present in the digital readout during the scaler count. After the count is complete, record the measurement, and repeat for 10 measurements.
- For background, a single count will record the background alpha and beta measurements; record each individually.
- Calculate the average plus and minus 20%. Subsequent background QC measurements must fall within this range. Typical alpha background is between 0 and 2 counts per minute (cpm); beta backgrounds may range from 100 to 300 cpm, depending on location.

c. Perform ten (10) initial source QC measurements

- Use thorium-230 source for alpha measurements and technicium-99 source for beta measurements in a repeatable geometry (i.e., orientation of the source relative to the meter).
- Use same location as background measurements
- Depress the scaler count button to initiate the count. Colons (":") will be present in the digital readout during the scaler count. After the count is complete, record the measurement, and repeat for 10 measurements. Record the alpha measurement when using the thorium-230 source, and the beta measurement when using the technicium-99 source.
- Calculate the average for each radiation plus and minus 20%. Subsequent source QC measurements must fall within this range.

5.2.1 Daily Instrument Quality Control

Each day that the instrument is used, the following QC checks and measurements must be performed and recorded.

a. Check the battery by depressing the "BAT" button

b. Check the HV against the calibrated HV

c. Perform background QC measurement

- Use same location as with initial QC measurements
- Measurement must be within plus or minus 20% of the initial average

d. Perform alpha and beta source QC measurement

- Use same location and source geometry as with initial QC measurements
- Measurement must be within plus or minus 20% of the initial average

If either measurement does not fall within the required tolerances, turn the unit off, turn it back on, and repeat the measurement(s). If the unit fails a second consecutive time, remove the unit from service and notify the CHDT RSO or designee.

5.2.2 Collection of Survey Measurements

Measurements may be collected with the 43-93 either by scanning (using the ratemeter on the 2360) or by direct counting (using the scaler count feature of the 2360). Scanning measurements are typically not effective in detecting alpha radiation due to its short range in air; however, scanning may be performed for beta radiation. When conducting scanning measurements, the audio output of the meter should be audible to the technician so that changes in count rate may be identified without looking away from the surface being surveyed. The mylar window is very thin and fragile, and may be easily torn if it comes into contact with a rough surface. The technician should be familiar with the typical beta count rates expected in the survey environment, which will assist in identifying anomalous count rates. Scanning measurements are collected by moving the detector slowly over the surface, noting any increases in count rate.

Scaler measurements are collected by leaving the probe stationary over a given location, and initiating a scaler count with the meter (typically one minute in length). To allow for consistent measurement geometry, it may be necessary to rest the probe on the surface being measured. However, please note that this action *may result in contamination of the probe* and appropriate precautions should be taken to prevent cross contamination (e.g., the use of removable spacers on the probe, routine wipe and decontamination of probe surfaces, etc). For scaler measurements with the 43-93, record both the alpha and beta measurements.

5.2.3 Evaluation of Results

The 43-93 and 2360 report results in units of cpm. For a meaningful comparison with surface radioactivity limits, the measurement units of cpm will require conversion to decays per minute per 100 square centimeters (dpm/100 cm^2). The following equation will be used to convert the raw measurement in cpm to dpm/100 cm^2:

$$\frac{dpm}{100\,cm^2} = \frac{\frac{C_S}{T_S}}{\varepsilon_T \times (A/100)}$$

Where:

C_S = integrated counts by the instrument

T_S = time period over which the counts were recorded, in minutes

ε_T = total efficiency of the instruments in counts per disintegration; effectively the product of the instrument efficiency (ε_i) and the source efficiency (ε_s)

A = the physical (or "active") probe area in cm^2

Instrument efficiencies may be determined from QC data, from annual instrument calibration certificates, or from the manufacturer's published values. The CHDT RSO or designee will determine the appropriate efficiency to use for a given application. In the absence of application-specific values, standard instrument efficiencies of 0.15 cpm/dpm for alpha radiation and 0.20 cpm/dpm for beta radiation will be used. The measurement may be corrected for background by subtracting an appropriate background value (e.g., representative of the surface or environment) from the raw measurement.

6.0 STANDARDS AND CRITERIA

Specific surface radioactivity limits may be established for the type of survey being performed. The CHDT RSO or designee should be consulted to determine the appropriate limits for any new activity. Release criteria are listed in SOP DR.OPS.13, *Equipment Surveys*, and in other SOPs.

The minimum detectable concentration (MDC) (or minimum detectable activity [MDA]) of the instrument should be known prior to its use to verify that the measurement sensitivity is sufficient for the application. The MDC for a static measurement when background and sample count times are the same may be calculated using the following equation from Abelquist 2001:

$$Static\ MDC\left(\frac{dpm}{100\ cm^2}\right)=\frac{3+4.65\sqrt{C_B}}{\varepsilon_S\varepsilon_i\left(\frac{A}{100}\right)T}$$

Where:

C_B = background counts in time T

T = time period over which counts were recorded, in minutes (for one-minute counts, this value is 1)

ε_s = surface efficiency; values default to 0.25 for alpha and 0.50 for beta if no other information is available

ε_i = instrument efficiency; values default to 0.15 for alpha and 0.20 for beta if no other information is available

A = the physical (or "active") probe area in cm^2

The static measurement MDC when background and sample counting times are different may be calculated using the following equation:

$$Static\ MDC\left(\frac{dpm}{100\ cm^2}\right)=\frac{3+3.29\sqrt{R_B T_{S+B}\left(1+\frac{T_{S+B}}{T_B}\right)}}{\varepsilon_S \varepsilon_i \left(\frac{A}{100}\right) T_{S+B}}$$

Where:

R_B = background count rate, cpm

T_B = background count time, minutes

T_{S+B} = sample count time, minutes

ε_s = surface efficiency; values default to 0.25 for alpha and 0.50 for beta if no other information is available

ε_i = instrument efficiency; values default to 0.15 for alpha and 0.20 for beta if no other information is available

A = the physical (or "active") probe area in cm^2

Measurements for release of equipment or materials should be conducted so that the MDCs reflect sufficient sensitivity for the release criteria. Only results from static measurements may be compared with release criteria; due to higher MDCs, scanning measurements should not be used to determine compliance with release criteria unless project- or task-specific scanning MDCs have been developed by the CHDT RSO.

7.0 REFERENCES

49 CFR 173. *Shippers – General Requirements for Shipments and Packagings*. Current Version.

Abelquist 2001. *Decommissioning Health Physics: A Handbook for MARSSIM Users*, Institute of Physics Publishing, Philadelphia, Pennsylvania.

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Ludlum Measurements, Inc., Instruction Manual Model 43-93 Alpha Beta Scintillation Detector, Current Version.

Ludlum Measurements, Inc., Instruction Manual Model 2360 Alpha Beta Data Logger, Current Version.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.09

OPERATION OF GEIGER MUELLER PANCAKE PROBE

1.0 OBJECTIVE

To provide instruction for the operation of Geiger Mueller (GM) pancake-type probes for the measurement of surface radioactivity levels for receiving, free release, routine, and health and safety surveys.

2.0 SCOPE

This standard operating procedure (SOP) applies to the operation and use of survey meters with GM pancake probes only, such as the Ludlum Model 44-9. These instruments may be used to identify and quantify surface radioactivity levels. These instruments may only be used in low radiation environments. Radiation environments which exceed the capabilities of these instruments are not anticipated.

3.0 POLICY

Instruments will be used in accordance with manufacturer's recommendations, SOPs, and site-specific requirements by trained personnel. The use of an instrument outside of its intended capabilities requires approval by the CHDT Radiation Safety Officer (RSO) or designee.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP DR 15.RPP.01).

5.0 SURVEY DATA COLLECTION

5.1 Instrument Description

The Ludlum Model 44-9 GM pancake probe is a small area (15 square centimeters [cm^2]) probe with an inert gas filled tube. The GM pancake probe may detect alpha, beta, and gamma radiation, but is most efficient in detecting beta and low-energy gamma radiation. Radiation incident upon the tube produces a response in the meter, which may display the results in counts per minute (cpm), microroentgens per hour (µR/hr), or other units. ***The preferred units for this instrument are cpm.***

The GM pancake probe may be used with a number of different meters (e.g., Ludlum Model 3, Ludlum Model 12, and Ludlum Model 177), provided that the meter has been specifically calibrated to do so. Meters may not be interchanged with probes; a calibration must be performed prior to use of a meter with a second probe. The front panel controls on the meter generally include a rotary switch for selecting the 5 decade range and instrument shut off, an audio on/off switch, a fast/slow response switch, and push buttons for activating the meter lamp, count reset, high voltage display and battery test.

5.2 Instrument Setup and Initial Quality Control

Upon receipt of the instrument through purchase or rental, the following steps should be taken to initially setup the instrument and verify that it is in good working order.

a. Verify that the instrument calibration is current; confirm that serial number on instrument matches that on the calibration certificate; confirm high voltage (HV) setting on instrument with calibration

b. Perform ten (10) initial background quality control (QC) measurements

- Use location away from radioactive sources
- Set response to "S" for slow and use
- Using the lowest meter scale, depress the reset button ("RES") and allow the needle to come to a rest (approximately 20 to 30 seconds). Record the measurement to the nearest tick mark, and repeat for 10 measurements.
- Calculate the average plus and minus 20%. Subsequent background QC measurements must fall within this range. Typical background for a GM pancake probe is between 40 and 80 cpm.

c. Perform ten (10) initial source QC measurements

- Use cesium-137 source in a repeatable geometry (i.e., orientation of the source relative to the meter).
- Use same location as background measurements
- Using an appropriate scale, depress the reset button ("RES") and allow the needle to come to a rest (approximately 20 to 30 seconds). Record the measurement to the nearest tick mark, and repeat for 10 measurements.
- Calculate the average plus and minus 20%. Subsequent source QC measurements must fall within this range.

5.2.1 Daily Instrument Quality Control

Each day that the instrument is used, the following QC checks and measurements must be performed and recorded.

a. Check the battery by depressing the "BAT" button

b. Check the HV against the calibrated HV

c. Perform background QC measurement
   - Use same location as with initial QC measurements
   - Measurement must be within plus or minus 20% of the initial average

d. Perform source QC measurement
   - Use same location and source geometry as with initial QC measurements
   - Measurement must be within plus or minus 20% of the initial average

If either measurement does not fall within the required tolerances, turn the unit off, turn it back on, and repeat the measurement(s). If the unit fails a second consecutive time, remove the unit from service and notify the CHDT RSO or designee.

5.2.2 Collection of Survey Measurements

Survey measurements with the GM pancake probe may be collected as part of equipment or routine surveys for surface contamination. The probe should be placed in contact with or as close as possible to the surface being surveyed, keeping in mind that direct contact may present a cross-contamination concern. To perform scanning measurements, the probe should be moved slowly across the surface at a consistent distance. The technician should use the instrument's audio response to initially identify potential contamination. If the count rate is heard to increase, the probe should be returned to the affected area and held over for a longer time period to determine if the readings are consistent. The range of observed count rates should be noted and recorded on the appropriate survey form, along with the instrument's make and model, serial numbers, and calibration due date.

5.2.3 Evaluation of Results

In most circumstances, measurements collected with a GM pancake probe will be qualitatively evaluated with background. As a result, the technician must have a thorough understanding of the background associated with the instrument and the audio response. When evaluating GM pancake probe data qualitatively, a measurement greater than 1.5 or 2 times background is typically indicative of contamination. The specific criteria will be determined by the CHDT RSO or designee.

In the event that a quantitative evaluation of survey data is required, the following calculation is required to convert the instrument response in units of cpm to the standard units of surface radioactivity of decays per minute per 100 cm^2.

$$Net\ Activity\left(\frac{dpm}{100cm^2}\right)=\frac{Measurement-Background\ (cpm)}{Efficiency\left(\frac{cpm}{dpm}\right)\times\left(\frac{\mathrm{Pr}obe\ Area\ cm^2}{100\ cm^2}\right)}$$

For a standard GM pancake probe, the general efficiency may be estimated to be 15% (0.15 cpm/dpm) and the probe area is 15 cm^2.

6.0 STANDARDS AND CRITERIA

Specific surface contamination limits may be established for the type of survey being performed. The CHDT RSO or designee should be consulted to determine the appropriate limits for any new activity.

An annual instrument calibration must be performed by the instrument manufacturer or other qualified vendor. Copies of the instrument calibration certificates must be maintained for a period of five years. Current calibration certificates should be maintained with the instrument daily QC measurement logs.

7.0 REFERENCES

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Ludlum Measurements, Inc., Instruction Manual Model 44-9 Geiger Mueller Pancake Probe, Current Version.

Ludlum Measurements, Inc., Instruction Manual Model 3 Survey Meter, Current Version.

Ludlum Measurements, Inc., Instruction Manual Model 12 Rate Meter, Current Version.

Ludlum Measurements, Inc., Instruction Manual Model 177 Rate Meter, Current Version.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.10
OPERATION OF GAMMA SCINTILLATION DETECTORS

1.0 OBJECTIVE

To provide instruction for the operation of gamma scintillation detectors for the measurement of gamma radiation levels for environmental characterization, remediation support, and contamination monitoring surveys.

2.0 SCOPE

This standard operating procedure (SOP) applies to the operation of gamma scintillation detectors using external probes with sodium iodide (NaI) crystals or plastic scintillators. These instruments may be used to determine ambient gamma radiation levels and/or worker exposure in facility areas and from packages or vehicles.

3.0 POLICY

Instruments will be used in accordance with manufacturer's recommendations, SOPs, and site-specific requirements by trained personnel. The use of an instrument outside of its intended capabilities requires approval by the CHDT Radiation Safety Officer (RSO) or designee.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP DR 15.RPP.01).

5.0 SURVEY DATA COLLECTION

5.1 Instrument Description

Gamma scintillation detectors are a group of instruments that utilize an external gamma scintillation crystal with a ratemeter or scaler detector. NaI crystals that are present within the detectors may range in size from 1-inch by 1-inch (1x1) to 3-inches by 3-inches (3x3). Thinner NaI crystals or plastic scintillators may also be used to preferentially detect lower-energy gamma radiation and x-rays. The CHDT RSO or designee should be consulted for the appropriate crystal size for the specific application.

The meters typically used with gamma detectors provide measurements in units of counts per minute (cpm), although some meters may be calibrated to provide measurements in units of exposure (such as microRoentgens per hour [μR/hr]). Gamma detectors may be used with a global positional system (GPS) device to allow for data logging and subsequent mapping of surface gamma radiation levels.

5.2 Instrument Setup and Initial Quality Control

Upon receipt of the instrument through purchase or rental, the following steps should be taken to initially setup the instrument and verify that it is in good working order.

a. Verify that the instrument calibration is current; confirm that serial number on instrument matches that on the calibration certificate; confirm high voltage (HV) setting on instrument with calibration

b. Perform ten (10) initial background quality control (QC) measurements
   - Use location away from radioactive sources
   - Depress the scaler count button to collect a one-minute count. Record the measurement, and repeat for 10 measurements.
   - Calculate the average plus and minus 20%. Subsequent background QC measurements must fall within this range.

c. Perform ten (10) initial source QC measurements
   - Use cesium-137 source in a repeatable geometry (i.e., orientation of the source relative to the meter). Other gamma radiation sources may also be applicable depending on the specific instrument used.
   - Use same location as background measurements
   - Depress the scaler count button to collect a one-minute count. Record the measurement, and repeat for 10 measurements.
   - Calculate the average plus and minus 20%. Subsequent source QC measurements must fall within this range.

d. If the meter used with the instrument does not perform scaler measurements (i.e., only has ratemeter function), consult SOPs 15.OPS.07, *Operation of Exposure Rate/ Dose Rate Meter*, and 15.OPS.09, *Operation of GM Pancake Probe*, for instruction on conducting QC measurements on a ratemeter instrument.

5.2.1 Daily Instrument Quality Control

Each day that the instrument is used, the following QC checks and measurements must be performed and recorded.

a. Check the battery by depressing the “BAT” button

b. Check the HV against the calibrated HV

c. Perform background QC measurement
   - Use same location as with initial QC measurements
   - Measurement must be within plus or minus 20% of the initial average

d. Perform source QC measurement
   - Use same location and source geometry as with initial QC measurements

- Measurement must be within plus or minus 20% of the initial average

If either measurement does not fall within the required tolerances, turn the unit off, turn it back on, and repeat the measurement(s). If the unit fails a second consecutive time, remove the unit from service and notify the CHDT RSO or designee.

5.2.2 Collection of Survey Measurements

While scaler measurements can be collected with a gamma scintillator, it is primarily a scnning tool. Survey measurements with a gamma scintillator may be collected in exterior locations as part of a gamma walkover survey (GWS) or as part of a contamination survey. Scanning measurements collected during a GWS rely on the technician's monitoring of the audio output of the meter to identify elevated areas. Data logging by a GPS system is used to log individual measurements and locations, and can be used to determine scanning speeds. When scanning, the technician should keep the detector approximately 6 inches from the ground surface, moving the detector in a "Z"-pattern while walking forward. If the survey goal is to identify contamination, any locations with increases in count rates should be re-surveyed at a slower pace in order to pinpoint the source location.

5.2.3 Evaluation of Results

Logged scanning measurements can be evaluated for outliers by generating contour maps and or performing statistics on the data. Calculation of the Z-score (i.e., number of standard deviations from the mean) of each measurement in the data set can identify statistical anomalies. In addition, a time series plot of the logged data versus collection time may also identify anomalies and or fluctuations in naturally-occurring background.

The scanning data may also be evaluated against the observed ambient background in the area. In addition, it may be possible to correlate the instrument response to concentrations of radionuclides in soil using the Microshield modeling software and procedures developed in NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* (NRC 1998). The CHDT RSO should be consulted on project- or task-specific data evaluation requirements.

6.0 STANDARDS AND CRITERIA

Specific evaluation criteria may be established for the type of survey being performed. The CHDT RSO or designee should be consulted to determine the appropriate limits for any new activity.

7.0 REFERENCES

Detector-specific instrument operation manuals

NRC 1998. *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG-1507, June.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.11
ROUTINE CONTAMINATION SURVEYS

1.0 OBJECTIVE

To define general and specific methods and procedures for conducting routine surveys for radioactive contamination at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

2.0 SCOPE

This standard operating procedure (SOP) addresses the performance of routine contamination surveys to determine and document ambient radiation and contamination levels in locations around and within the CHDT landfill and to evaluate if controls are necessary when performing routine maintenance or other tasks that could encounter radioactive materials. This standard operating procedure (SOP) does not apply to special or emergency situations.

3.0 POLICY

Contamination surveys will be conducted or performed in areas potentially impacted by radioactive materials on a routine basis to identify contamination issues and verify that worker exposure is maintained as low as reasonably achievable (ALARA). In addition, routine contamination surveys that demonstrate an absence of contamination will serve to demonstrate the effectiveness of contamination control methods and will be used as a baseline of surface radioactivity levels if a contamination event is suspected.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (DR.RPP.01).

5.0 GENERAL SURVEY METHODS

Direct surveys may be conducted using a Ludlum Model 44-9 Geiger Mueller (GM) “pancake”-type probe with Ludlum Model 3 survey meter (or equivalent) for surface beta-gamma measurements; a Ludlum 43-93 alpha-beta scintillation detector with Ludlum 2360 survey meter (or equivalent) for surface alpha-beta measurements; a Ludlum Model 19 (or equivalent) for ambient exposure rate measurements; a Ludlum Model 193-6 Survey Wand (or equivalent) for large area gamma scanning measurements; or any other radiation measuring instrument appropriate for the task. Equipment surveys will be supported by smear sample analyses for removable radioactivity using the Ludlum 3030 alpha-beta sample counter (or equivalent).

5.1 Pre-Survey Instrument Check List

Prior to use of any field instrument, the operation of the probe and survey meter used shall be checked using the following general procedure. Specific direction is provided in the SOP for each individual instrument.

a. Check Batteries

- Turn the switch to "BAT" or flip the "BAT" switch to "ON."
- The needle on the meter face should move to a position within or beyond the indicated area on the meter scale.
- Replace batteries if needed before use.

b. Check Count Rate Meter Speaker

- Turn the audio switch, if present, to ON.
- Set the Fast-Slow toggle switch to the F position (for fast response).
- Set the count rate meter scale to X1.
- The rate meter should "chirp" or "click."
- If the speaker does not function, the survey meter can be used, but the survey technician will need to check the meter reading or display frequently.

c. Background Check

- Conduct background check during daily quality control (QC) measurements.
- On most instruments, the background count rate is observed when the survey meter scale is set to the lowest scale setting – X0.1 or X1.
- Prior to conducting surveys, verify background at that location.
- Most surveys rely upon the technician to identify contamination above background. Therefore, *the survey technician must have a strong understanding of what background is for the instrument being used*.
- Do not use the meter if it does not register a background reading.

d. Source Check

- Conduct source check during daily QC measurements.
- Use the same source in the same geometry for all QC measurements.
- The technician should be familiar with the detector response to a source.
- Do not use the instrument if the QC falls out of requirements.

5.2 Routine Contamination Surveys

Routine contamination surveys will be performed to verify the absence of contamination in high-traffic portions of the site, areas where eating, drinking, or washing may occur, or other areas that may be susceptible to cross contamination. Routine surveys shall be recorded in ink on appropriate survey forms, which shall document the following:

- Time and date of the survey
- Technician(s) performing the survey
- Instrument(s) used, with serial number, calibration due date
- Measurement locations, with pictures or drawings as necessary
- Background and efficiency information for the instruments, as appropriate
- Raw measurements, including measurement type and count time (if necessary)

Where necessary, surveys may be documented in a field logbook in the absence of a survey form. Pictures or drawings of equipment, vehicles, or frequently surveyed items may be electronically inserted into the survey form to facilitate documentation. For frequent routine surveys, specific survey forms may be developed by the CHDT RSO or designee to facilitate data collection.

5.3 Routine Survey Frequency

The frequency of routine surveys will be dependent on the frequency of radioactive material receipt at the CHDT landfill. Surveys will be conducted according to the frequencies listed in Table 1. A minimum of five locations (subject to each of the measurements indicated) will be required for each area in Table 1.

Table 1. Frequency of Routine Contamination Surveys

Area	Minimum Survey Frequency	Survey Type
Disposal cell, before and after installation of daily cover	Daily during radioactive materials emplacement	Exposure rate (Ludlum 193-6 or Model 19) or gamma
Cell truckwash	Daily during radioactive materials emplacement	Exposure rate or gamma; removable alpha/beta
Cell sample shack	Weekly during receipt of radioactive materials; otherwise monthly	Exposure rate or gamma; fixed alpha/beta; removable alpha/beta

Area	Minimum Survey Frequency	Survey Type
Sample station	Weekly during receipt of radioactive materials; otherwise monthly	Exposure rate or gamma; fixed alpha/beta; removable alpha/beta
Laboratory area	Weekly during receipt of radioactive materials; otherwise monthly	Exposure rate or gamma; fixed alpha/beta; removable alpha/beta
Men's locker room	Weekly during receipt of radioactive materials; otherwise monthly	Exposure rate or gamma; fixed alpha/beta; removable alpha/beta
Operations building lunch room	Weekly during receipt of radioactive materials; otherwise monthly	Exposure rate or gamma; fixed alpha/beta; removable alpha/beta

Other areas or buildings may be subject to contamination surveys on an as-needed basis or randomly, based on radioactive materials handling activities. The CHDT RSO or designee will determine if additional areas require routine surveys.

5.4 Exposure Rate Measurements

Exposure or dose rate measurements should be operated according to SOP 15.OPS.07, *Operation of Exposure Rate/ Dose Rate Meters*. Ambient exposure rate measurements using the Model 19 or similar instrument during routine contamination surveys should be collected at waist level to provide a measurement of the external trunk dose to a worker. Exposure rate measurements collected with the 193-6 should be collected at a distance of 6 inches or less from the ground surface.

5.5 Measurements for Fixed Contamination

Measurements for fixed contamination can be directly collected by scaler or scanning measurements with field instruments. Scaler measurements are collected by leaving the probe stationary over a given location, and initiating a scaler count with the meter (typically one minute in length). To allow for consistent measurement geometry, it may be necessary to rest the probe on the surface being measured. However, please note that this action *may result in contamination of the probe* and appropriate precautions should be taken to prevent cross contamination (e.g., the use of removable spacers on the probe, routine wipe and decontamination of probe surfaces, etc).

Scanning measurements are collected by slowly moving the probe over a given surface. The instrument's audio response and meter reading are monitored to identify any anomalies. Typically scanning measurements are performed to increase survey coverage over an area. The probe is held approximately 1 centimeter from the surface being surveyed and is moved at a rate of approximately 2 inches per second. If the count rate audibly increases, or if the alarm sounds, pause for 5 to 10 seconds over the area to provide for adequate time for instrument response. Scanning measurements may be recorded as a range of measurements for a given surface or area, and are generally evaluated to identify any outliers above background.

5.6 Measurements for Removable Contamination

Measurements for removable contamination are measured indirectly by the collection of smear or wipe samples. Smears are collected with a 47-millimeter smear filter. Using evenly applied pressure, the smear should be collected with an S-shape over approximately 100 square centimeters. The smear may then be removed from the paper folder, adhered to an aluminum planchet and counted in the alpha-beta sample counter.

If directed by the CHDT RSO or designee, large-area smears may be collected on a larger surface area using masselin or other absorbent cloth. The large area smear may then be checked using a field instrument for any radioactivity above background. A large area smear should be considered to be a qualitative measurement only.

6.0 STANDARDS AND CRITERIA

6.1 Data Conversion

For comparison with the measurement criteria listed in Section 6.2, surface measurements in counts per minute (cpm) must be converted to units of decays per minute per 100 square centimeters (dpm/100cm^2). Procedures for data conversion are provided in SOPs 15.OPS.08, *Operation of Alpha-Beta Scintillation Detector,* and 15.OPS.09, *Operation of GM Pancake Probe*.

6.2 Surface Contamination Levels

Fixed radioactivity measured by direct measurements and removable activity measured by smear samples will be evaluated against the values listed in Table 1, from ANSI/HPS N13.12-1999 (ANSI/HPS 1999). In the absence of radionuclide data to establish the appropriate screening group, the most conservative screening levels will be used.

Table 1 – Surface Contamination Limits for Free Release Surveys

Radionuclide Group	Surface Screening Levels (Bq/cm^2)	Surface Screening Levels ($dpm/100cm^2$)[a]	Removable Contamination Limits ($dpm/100cm^2$)
Group 1 Radium and Thorium: ^{210}Po, ^{210}Pb, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and associated decay chains[b]	0.1	600	60 alpha
Group 2 Uranium: ^{234}U, ^{235}U, ^{238}U, natural uranium[c], and associated decay chains	1	6,000	600 alpha
Group 3 General Beta-Gamma Emitters: ^{24}Na, ^{36}Cl, ^{59}Fe, ^{109}Cd, ^{131}I, ^{129}I, ^{144}Ce, ^{198}Au, ^{241}Pu, and others	10	60,000	600 beta
Group 4 Other Beta-Gamma Emitters: ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{45}Ca, ^{51}Cr, ^{55}Fe, ^{63}Ni, ^{89}Sr, ^{99}Tc, ^{111}In, ^{125}I, ^{147}Pm, and others	100	600,000	600 beta

(a) Rounded to one significant figure.
(b) For decay chains, the screening levels represent the total activity (i.e. the activity of the parent plus the activity of all progeny) present.
(c) Where the Natural Uranium activity equals 48.9% from ^{238}U, plus 48.9% from ^{234}U, plus 2.25% from ^{235}U.

6.3 Exposure Rate Limits

For areas with no known radioactive source, exposure rates are expected to be at background levels. If above-background levels are observed, the CHDT RSO should be notified.

For release of the disposal cell following daily cover, the exposure rates should be no greater than 1.5X the average background measurement.

Other exposure rate limits may apply depending on the situation or activity. The CHDT RSO may establish additional limits as necessary to provide additional worker protection.

6.4 Quality Control

In addition to the daily QC measurements required by each individual instrument SOP, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

7.0 REFERENCES

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.12
PERSONNEL CONTAMINATION SURVEYS

1.0 OBJECTIVE

To define general and specific methods and procedures for personnel contamination surveys at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

2.0 SCOPE

This standard operating procedure (SOP) applies to the release of personnel following decontamination activities, from radioactive materials handling areas, and after an emergency response event.

3.0 POLICY

Personnel surveys are required when personnel contamination is suspected to prevent further contamination of personnel, equipment, and/or facilities. In addition, personnel surveys are required to verify and document that worker exposures are maintained as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan SOP 15.RPP.01.

5.0 GENERAL SURVEY METHODS

Direct surveys of personnel ("frisks") may be conducted using a Geiger Mueller (GM) "pancake"-type probe (or equivalent) for beta-gamma measurements; or an alpha-beta scintillation detector (or equivalent) for alpha-beta measurements. Other instruments that measure ambient, rather than surface, radioactivity, such as a Ludlum Model 19 (or equivalent) for ambient exposure rate measurements, or a Ludlum Model 193-6 Survey Wand (or equivalent) for large area gamma scanning measurements, are not appropriate for conducting personnel contamination surveys.

5.1 Pre-Survey Instrument Check List

Prior to use of any field instrument, the operation of the probe and survey meter used shall be checked using the following general procedure.

a. Check Batteries
   - Turn the switch to "BAT" or flip the "BAT" switch to "ON."
   - The needle on the meter face should move to a position within or beyond the indicated area on the meter scale.
   - Replace batteries if needed before use.

b. Check Count Rate Meter Speaker
   - Turn the audio switch, if present, to ON.
   - Set the Fast-Slow toggle switch to the F position (for fast response).
   - Set the count rate meter scale to X1.
   - The rate meter should "chirp" or "click."
   - If the speaker does not function, the survey meter can be used, but the surveyor will need to check the meter reading or display frequently.

c. Background Check
   - Conduct background check during daily quality control (QC) measurements.
   - On most instruments, the background count rate is observed when the survey meter scale is set to the lowest scale setting – X0.1 or X1.
   - Prior to conducting surveys, verify background at that location.
   - Most surveys rely upon the technician to identify contamination above background. Therefore, *the survey technician must have a strong understanding of what background is for the instrument being used*.
   - Do not use the meter if it does not register a background reading.

d. Source Check
   - Conduct source check during daily QC measurements.
   - Use the same source in the same geometry for all QC measurements.
   - The technician should be familiar with the detector response to a source.
   - Do not use the instrument if the QC falls out of requirements.

5.2 General Personnel Surveys

Where possible, CHDT personnel should conduct the survey measurements themselves. Activities that may require a second or support technician will be identified in advance. The general scanning or frisk procedure is as follows:

a. Prior to initiating the activity, verify that the instrument is turned on, the audio response is audible, and the probe is face up so that the hands may be scanned without touching the instrument.

b. After completion of the activity, start the frisk by scanning the fronts and backs of hands without touching the instrument. After the hands have been determined to be free of contamination, the instrument may be picked up to conduct the remainder of the frisk.

c. Hold the probe 1 cm from the body surface being surveyed and move the probe slowly over the surface, approximately 2 inches per second.

d. If the count rate increases, pause for 5 to 10 seconds over the area to provide for adequate time for instrument response.

e. If consistent count rates in excess of background are detected, decontamination according to SOP 15.OPS.19 shall be followed prior to re-surveying.

f. The remaining survey order will be from head to foot, *prior to the removal of personal protective equipment (PPE),* as follows:

- Head – pause at the mouth and nose for five seconds; conduct thorough scan of respirator cartridges and faceshield, if present
- Neck
- Arms
- Chest and abdomen
- Back, hips, and seat of pants
- Legs – pause at the knees and cuffs for five seconds
- Tops of shoes or shoe coverings
- Bottom of shoes or shoe coverings
- Personal items – hats, gloves, notebooks, equipment, etc.

g. If measurements on PPE are at background levels, the PPE may be removed under the constraints of the hazardous materials handling requirements (i.e., without regard to radioactivity)

h. If measurements that exceed background are found on personnel, contact the CHDT RSO. Decontamination of personnel will be performed according to SOP 15.OPS.19, *Decontamination of Personnel*. Decontamination surveys shall be recorded in ink on appropriate survey forms, which shall document the following:

- Time and date of the survey
- Technician(s) performing the survey
- Instrument(s) used, with serial number, calibration due date
- Measurement locations, with pictures or drawings as necessary
- Background and efficiency information for the instruments, as appropriate
- Raw measurements, including measurement type and count time (if necessary)

Where necessary, surveys may be documented in a field logbook in the absence of a survey form. Pictures or drawings of the affected personnel may be electronically inserted into the survey form to facilitate documentation.

5.3 Additional Personnel Surveys

In some cases, additional measurement sensitivity may be required. An integrated scanning count may be collected using the 43-93 alpha/beta probe and 2360 scaler/data logger. The collected measurement is essentially a timed scan, where the scaler count is initiated and the detector is slowly moved at a consistent distance over a selected portion of the body (e.g., the feet). The total number of counts over a set time, such as one or two minutes, may be used for compliance with surface activity limits. The total counting time, which is greater than what is done with a typical scan, allows for a lower calculated minimum detectable concentration (MDC). MDC calculations for the 43-93 are described in SOP 15.OPS.08, *Operation of Alpha-Beta Scintillation Detector*.

6.0 STANDARDS AND CRITERIA

6.1 Indistinguishable from Background

Personnel contamination surveys will be performed with the criterion of no contamination present, or no radioactivity above background. Therefore, the technician must have a clear understanding of the appropriate background levels for the instrument being used and for the location of the survey.

6.2 Data Conversion

For comparison with the measurement criteria listed in Section 6.3, surface measurements in counts per minute (cpm) must be converted to units of decays per minute per 100 square centimeters (dpm/100cm^2). Procedures for data conversion are provided in SOPs 15.OPS.08, *Operation of Alpha-Beta Scintillation Detector,* and 15.OPS.09, *Operation of GM Pancake Probe*.

6.3 Surface Contamination Limits

Fixed and removable activity that may be present on PPE will be evaluated against the values listed in Table 1, from ANSI/HPS N13.12-1999 (ANSI/HPS 1999). In the absence of radionuclide data to establish the appropriate screening group, the most conservative screening levels will be used. PPE may also be assumed to be contaminated and properly disposed of if desired.

Table 1 – Surface Contamination Limits for Free Release Surveys

Radionuclide Group	Surface Screening Levels (Bq/cm^2)	Surface Screening Levels ($dpm/100cm^2$)[(a)]	Removable Contamination Limits ($dpm/100cm^2$)
Group 1 Radium and Thorium: ^{210}Po, ^{210}Pb, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and associated decay chains[(b)]	0.1	600	60 alpha
Group 2 Uranium: ^{234}U, ^{235}U, ^{238}U, natural uranium[(c)], and associated decay chains	1	6,000	600 alpha
Group 3 General Beta-Gamma Emitters: ^{24}Na, ^{36}Cl, ^{59}Fe, ^{109}Cd, ^{131}I, ^{129}I, ^{144}Ce, ^{198}Au, ^{241}Pu, and others	10	60,000	600 beta
Group 4 Other Beta-Gamma Emitters: ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{45}Ca, ^{51}Cr, ^{55}Fe, ^{63}Ni, ^{89}Sr, ^{99}Tc, ^{111}In, ^{125}I, ^{147}Pm, and others	100	600,000	600 beta

(a) Rounded to one significant figure.
(b) For decay chains, the screening levels represent the total activity (i.e. the activity of the parent plus the activity of all progeny) present.
(c) Where the Natural Uranium activity equals 48.9% from ^{238}U, plus 48.9% from ^{234}U, plus 2.25% from ^{235}U.

6.4 Quality Control

In addition to the daily QC measurements required for each individual instrument, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

7.0 REFERENCES

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.13
EQUIPMENT AND VEHICLE RELEASE SURVEYS

1.0 OBJECTIVE

To define general and specific methods and procedures for conducting radiation surveys for release of equipment from restricted areas at the Clean Harbors Deer Trail (CHDT) landfill or other job sites, or following decontamination.

2.0 SCOPE

This standard operating procedure (SOP) applies to the release of equipment or vehicles following their use in restricted areas at the CHDT facility, or following decontamination.

3.0 POLICY

Radiological contamination surveys will be performed on all equipment leaving restricted areas to verify surface contamination levels meet appropriate release limits. In addition, contamination surveys will be performed following the decontamination of equipment to document the effectiveness of decontamination prior to unrestricted release.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (15.RPP.01).

5.0 GENERAL SURVEY METHODS

Direct surveys of equipment may be conducted using a Ludlum Model 44-9 Geiger Mueller (GM) “pancake”-type probe with Ludlum Model 12 survey meter (or equivalent) for surface beta-gamma measurements; a Ludlum 43-93 alpha-beta scintillation detector with Ludlum 2360 survey meter (or equivalent) for surface alpha-beta measurements; a Ludlum Model 19 (or equivalent) for ambient exposure rate measurements; a Ludlum Model 193-6 Survey Wand (or equivalent) for large area gamma scanning measurements; or any other radiation measuring instrument appropriate for the task. Equipment surveys will be supported by smear sample analyses for removable radioactivity using the Ludlum 3030 alpha-beta sample counter (or equivalent).

5.1 Pre-Survey Instrument Check List

Prior to use of any field instrument, the operation of the probe and survey meter used shall be checked using the general guidelines provided in SOP’s 15.OPS.07, 15.OPS.08, 15.OPS.09, and 15.OPS.10 depending on the type of instruments to be used. .

5.2 Equipment and Vehicle Release Surveys

Release surveys will be performed to free-release equipment, containers and vehicles exiting restricted areas of the site or when leaving the facility. Where possible, surveys will be conducted in dedicated areas. Equipment and vehicle surveys shall be recorded in ink on appropriate survey forms, which shall document the following:

- Time and date of the survey
- Technician(s) performing the survey
- Instrument(s) used, with serial number, calibration due date
- Measurement locations, with pictures or drawings as necessary
- Background and efficiency information for the instruments, as appropriate
- Raw measurements, including measurement type and count time (if necessary)

Where necessary, surveys may be documented in a field logbook in the absence of a survey form. Pictures or drawings of equipment, vehicles, or frequently surveyed items may be electronically inserted into the survey form to facilitate documentation.

For free release surveys of vehicles containers, and equipment, a minimum of five locations will be measured for fixed and/or removable contamination. The CHDT RSO or designee will determine additional survey requirements as necessary. Measurements for fixed contamination will be collected prior to the collection of smear samples. Specific measurement locations are to be determined at the discretion of the survey technician; however, measurements should be biased toward the most likely areas of contamination to provide conservative survey results. These areas may include the tires or treads; undercarriage of the vehicle; within the cab of the vehicle; within equipment buckets; or on other surfaces potentially contacted by contaminated material.

5.3 Class 7 Empty Package Survey Procedures

Class 7 waste conveyances and waste containers may be returned to the waste generator without undergoing complete free release procedures if they are shipped as Class 7 Empty Packages.

Requirements for these shipments are governed by the US DOT regulations of 49CFR 173.428. Trained CHDT employees will ensure that Class 7 empty packages will not leave the facility unless these requirements are met. The following procedures will be used to ensure compliance.

5.3.1 Class 7 Empty Packages must be subject to an exclusive use agreement. The CHDT RSO or designee will ensure that proper instructions are on file and carried with the shipping papers.

5.3.2 The package will be marked as appropriate (UN2908). This will be verified at the time the shipment leaves the facility.

5.3.3 An “Empty” Label will be affixed to the packaging; all other labels must be removed, obliterated, or covered. This will be verified at the time the shipment leaves the facility.

5.3.4 Surveys of radiation levels of the external surface of the package will be done to ensure that radiation levels are less than or equal to 0.5mR/hr. Radiation levels will be documented on the survey report.

5.3.5 The external surface of the container will be surveyed for removable contamination to ensure that it is less than or equal to 220 dpm/cm^2. Internal surface of the package will be surveyed to ensure that it is less than 22,000dpm/cm^2. Surface contamination will be documented on the survey report.

5.3.6 The packaging must be in unimpaired condition and securely closed to prevent the leakage of radioactive material under normal conditions. This will be verified by inspection.

5.3.7 Training – CHDT employees will be properly trained in the requirements of shipping excepted packaging empty containers.

5.4 Measurements for Fixed Contamination

Measurements for fixed contamination can be directly collected by scaler or scanning measurements with field instruments. Scaler measurements are collected by leaving the probe stationary over a given location, and initiating a scaler count with the meter (typically one minute in length). To allow for consistent measurement geometry, it may be necessary to rest the probe on the surface being measured. However, please note that this action *may result in contamination of the probe* and appropriate precautions should be taken to prevent cross contamination (e.g., the use of removable spacers on the probe, routine wipe and decontamination of probe surfaces, etc).

Scanning measurements are collected by slowly moving the probe over a given surface. The instrument's audio response and meter reading are monitored to identify any anomalies. Typically scanning measurements are performed to increase survey coverage over an area. The probe is held approximately 1 centimeter from the surface being surveyed and is moved at a rate of approximately 2 inches per second. If the count rate audibly increases, or if the alarm sounds, pause for 5 to 10 seconds over the area to provide for adequate time for instrument response. Scanning measurements may be recorded as a range of measurements for a given surface or area, and are generally evaluated to identify any outliers above background.

5.5 Measurements for Removable Contamination

Measurements for removable contamination are measured indirectly by the collection of smear or wipe samples. Smears are collected with a 47-millimeter smear filter. Using evenly applied pressure, the smear should be collected with an S-shape over approximately 100 square centimeters. The smear may then be removed from the paper folder, adhered to an aluminum planchet and counted in the alpha-beta sample counter.

If directed by the CHDT RSO or designee, large-area smears may be collected on a larger surface area using masselin or other absorbent cloth. The large area smear may then be checked using a field instrument for any radioactivity above background. A large area smear should be considered to be a qualitative measurement only.

6.0 STANDARDS AND CRITERIA

6.1 Data Conversion

For comparison with the measurement criteria listed in Sections 6.2 and 6.3, surface measurements in counts per minute (cpm) must be converted to units of decays per minute per 100 square centimeters (dpm/100cm^2). Procedures for data conversion are provided in SOPs 15.OPS.08, *Operation of Alpha-Beta Scintillation Detector,* and 15.OPS.09, *Operation of GM Pancake Probe*. The Ludlum 3030 used at CHDT provides measurements in units of dpm.

6.2 Surface Contamination Levels

Fixed radioactivity measured by direct measurements and removable activity measured by smear samples will be evaluated against the values listed in Table 1, from ANSI/HPS N13.12-1999 (ANSI/HPS 1999). In the absence of radionuclide data to establish the appropriate screening group, the most conservative screening levels will be used.

Table 1 – Surface Contamination Limits for Free Release Surveys

Radionuclide Group	Surface Screening Levels (Bq/cm^2)	Surface Screening Levels (dpm/100cm^2)[(a)]	Removable Contamination Limits (dpm/100cm^2)
Group 1 Radium and Thorium: ^{210}Po, ^{210}Pb, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and associated decay chains[(b)]	0.1	600	60 alpha
Group 2 Uranium: ^{234}U, ^{235}U, ^{238}U, natural uranium[(c)], and associated decay chains	1	6,000	600 alpha
Group 3 General Beta-Gamma Emitters: ^{24}Na, ^{36}Cl, ^{59}Fe, ^{109}Cd, ^{131}I, ^{129}I, ^{144}Ce, ^{198}Au, ^{241}Pu, and others	10	60,000	600 beta
Group 4 Other Beta-Gamma Emitters: ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{45}Ca, ^{51}Cr, ^{55}Fe, ^{63}Ni, ^{89}Sr, ^{99}Tc, ^{111}In, ^{125}I, ^{147}Pm, and others	100	600,000	600 beta

(a) Rounded to one significant figure.
(b) For decay chains, the screening levels represent the total activity (i.e. the activity of the parent plus the activity of all progeny) present.
(c) Where the Natural Uranium activity equals 48.9% from ^{238}U, plus 48.9% from ^{234}U, plus 2.25% from ^{235}U.

6.3 Transportation – Non-Fixed Contamination

Contamination control limits for non-fixed (i.e., removable) surface contamination are established by the Department of Transportation (DOT) in 49 CFR 173.443. Additional requirements for empty packaging are established in 49 CFR 173.428. These limits are summarized in Table 2.

Table 2 – DOT Non-Fixed Surface Contamination Limits

Radionuclide Group	Maximum Permissible Limit (Bq/cm^2)	Maximum Permissible Limit (dpm/cm^2)[(a)]	Maximum Permissible Limit ($dpm/100\ cm^2$)[(a)]	Maximum Permissible Internal Limit for Empty Packaging ($dpm/100\ cm^2$)[(a)]
1. Beta and gamma emitters and low-toxicity alpha emitters	4	220	22,000	220,000
2. All other alpha-emitting radionuclides	0.4	22	2200	22,000

(a) Averaged over 300 cm^2.

In addition, there are exposure rate limits associated with different types of shipments. Task-specific direction will be provided by the CHDT RSO or designee regarding these limits.

6.4 Quality Control

In addition to the daily QC measurements required for each individual instrument, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

7.0 REFERENCES

49 CFR 173. *Shippers – General Requirements for Shipments and Packagings*. Current Version.

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.14
SPILL SURVEYS

1.0 OBJECTIVE

To define general and specific methods and procedures for conducting radiation surveys at locations of spills of radioactive materials at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

2.0 SCOPE

This standard operating procedure (SOP) applies to radiological surveys of areas where spills of radioactive materials have occurred. Both initial response surveys (to characterize the extent of the spill) and post-cleanup survey (to verify that cleanup criteria are met) are addressed.

3.0 POLICY

Inadvertent or unplanned releases of radioactive materials in the form of spills can present both real and perceived contamination concerns. Spills of radioactive materials will be managed to prevent the spread of radioactive contamination and keep worker and public exposures as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (15.RPP.01).

5.0 GENERAL SURVEY METHODS

Direct surveys of areas with spills may be conducted using a Ludlum Model 44-9 Geiger Mueller (GM) “pancake”-type probe with Ludlum Model 3 survey meter (or equivalent) for surface beta-gamma measurements; a Ludlum 43-93 alpha-beta scintillation detector with Ludlum 2360 survey meter (or equivalent) for surface alpha-beta measurements; a Ludlum Model 19 (or equivalent) for ambient exposure rate measurements; a Ludlum Model 193-6 Survey Wand (or equivalent) for large area gamma scanning measurements; a Ludlum 44-2 gamma scintillation detector (or equivalent) for ambient gamma scanning measurements; or any other radiation measuring instrument appropriate for the task. Spill surveys may be supported by smear sample analyses for removable radioactivity using the Ludlum 3030 alpha-beta sample counter (or equivalent).

5.1 Pre-Survey Instrument Check List

Prior to use of any field instrument, the operation of the probe and survey meter used shall be checked using the following general procedure. Specific direction for quality control measurements is provided in the SOP for each individual instrument.

a. Check Batteries

- Turn the switch to "BAT" or flip the "BAT" switch to "ON."
- The needle on the meter face should move to a position within or beyond the indicated area on the meter scale.
- Replace batteries if needed before use.

b. Check Count Rate Meter Speaker

- Turn the audio switch, if present, to ON.
- Set the Fast-Slow toggle switch to the F position (for fast response).
- Set the count rate meter scale to X1.
- The rate meter should "chirp" or "click."
- If the speaker does not function, the survey meter can be used, but the surveyor will need to check the meter reading or display frequently.

c. Background Check

- Conduct background check during daily quality control (QC) measurements.
- On most instruments, the background count rate is observed when the survey meter scale is set to the lowest scale setting – X0.1 or X1.
- Prior to conducting surveys, verify background at that location.
- Most surveys rely upon the technician to identify contamination above background. Therefore, the survey technician must have a strong understanding of what background is for the instrument being used.
- Do not use the meter if it does not register a background reading.

d. Source Check

- Conduct source check during daily QC measurements.
- Use the same source in the same geometry for all QC measurements.
- The technician should be familiar with the detector response to a source.
- Do not use the instrument if the QC falls out of requirements.

5.2 Initial Response Surveys

Before any initial response surveys are performed, the following actions should be taken when a spill occurs:

a. If the spill is liquid, immediately stop the flow of liquid using towels, absorbent materials, or other means

b. Isolate the area using tape, rope, signs, or other means to warn others and prevent access

c. Notify the CHDT RSO, facility general manager, and/or plant foreman

After the above steps are performed, initial response surveys will be performed to determine the extent and radioactivity levels of the spill to aid in cleanup planning. Survey data shall be recorded in ink on appropriate survey forms, which shall document the following:

a. Time and date of the survey

b. Technician(s) performing the survey

c. Instrument(s) used, with serial number, calibration due date

d. Measurement locations, with pictures or drawings as necessary

e. Background and efficiency information for the instruments, as appropriate

f. Raw measurements, including measurement type and count time (if necessary)

Where necessary, surveys may be documented in a field logbook in the absence of a survey form. Pictures, photographs, or drawings of impacted equipment or areas may be used to facilitate documentation.

Static measurements for fixed contamination, smear samples for removable contamination, exposure rate measurements, and scanning measurements should be collected to adequately characterize the area. As spills may vary in size and type, no specific number of measurements is prescribed; rather the CHDT RSO should be consulted as to the appropriate level of effort to provide sufficient data.

Generally, areas that require cleanup following a spill are those with above-background surface radioactivity levels. Maintaining contamination controls to an indistinguishable from background standard will ensure that exposures are ALARA. In limited cases following a spill, dose-based release criteria (Section 6.3) may be applicable.

5.3 Decontamination Support and Verification Surveys

Radiological surveys should be conducted to support decontamination efforts (performed per SOP 15.OPS.18, Decontamination of Surfaces and Equipment) to verify successful removal or cleanup of contamination. Following decontamination to background levels (or other criteria, as directed by the CHDT RSO), a final verification survey should be performed and appropriately documented on a survey form or in a field logbook.

If necessary, the CHDT RSO will use the data from spill surveys to evaluate worker or public dose during the response actions.

6.0 STANDARDS AND CRITERIA

6.1 Indistinguishable from Background

The majority of personnel contamination surveys will be performed with the criterion of no contamination present, or no radioactivity above background. Therefore, the technician must have a clear understanding of the appropriate background levels for the instrument being used and for the location of the survey.

6.2 Data Conversion

For comparison with the measurement criteria listed in Section 6.3, surface measurements in counts per minute (cpm) must be converted to units of decays per minute per 100 square centimeters (dpm/100cm^2). Procedures for data conversion are provided in SOPs 15.OPS.08, *Operation of Alpha-Beta Scintillation Detector,* and 15.OPS.09, *Operation of GM Pancake Probe*. The Ludlum 3030 used at CHDT provides measurements in units of dpm.

6.3 Surface Contamination Levels

Removable activity measured by smear samples will be evaluated against the values listed in Table 1, from ANSI/HPS N13.12-1999 (ANSI/HPS 1999). In the absence of radionuclide data to establish the appropriate screening group, the most conservative screening levels will be used.

Table 1 – Surface Contamination Limits for Free Release Surveys

Radionuclide Group	Surface Screening Levels (Bq/cm^2)	Surface Screening Levels (dpm/100cm^2)[(a)]	Removable Contamination Limits (dpm/100cm^2)
Group 1 Radium and Thorium: ^{210}Po, ^{210}Pb, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and associated decay chains[(b)]	0.1	600	60 alpha
Group 2 Uranium: ^{234}U, ^{235}U, ^{238}U, natural uranium[(c)], and associated decay chains	1	6,000	600 alpha
Group 3 General Beta-Gamma Emitters: ^{24}Na, ^{36}Cl, ^{59}Fe, ^{109}Cd, ^{131}I, ^{129}I, ^{144}Ce, ^{198}Au, ^{241}Pu, and others	10	60,000	600 beta
Group 4 Other Beta-Gamma Emitters: ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{45}Ca, ^{51}Cr, ^{55}Fe, ^{63}Ni, ^{89}Sr, ^{99}Tc, ^{111}In, ^{125}I, ^{147}Pm, and others	100	600,000	600 beta

(a) Rounded to one significant figure.

(b) For decay chains, the screening levels represent the total activity (i.e. the activity of the parent plus the activity of all progeny) present.
(c) Where the Natural Uranium activity equals 48.9% from ^{238}U, plus 48.9% from ^{234}U, plus 2.25% from ^{235}U.

6.4 Quality Control

In addition to the daily QC measurements required by each individual instrument SOP, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

7.0 REFERENCES

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.15
AIR MONITORING FOR RADIOACTIVE MATERIALS

1.0 OBJECTIVE

To define the methods and requirements for conducting air particulate and radon monitoring at the Clean Harbors Deer Trail (CHDT) facility or other job sites

2.0 SCOPE

This standard operating procedure (SOP) applies to the performance of general area and breathing zone air monitoring for airborne radioactive materials, and to radon monitoring during normal operations at the CHDT facility.

3.0 POLICY

Air monitoring will be performed to assess potential environmental impacts from site operations, to verify the effectiveness of engineered contamination control or containment systems, and to evaluate worker and public exposures from site operations. All worker and public exposures will be maintained as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 AIR MONITORING PROCEDURES

5.1 General Area Air Monitoring

5.1.1 Monitoring Locations and Equipment

Meteorological study has determined the prevailing wind speeds and directions at CHDT. Continuous particulate air monitoring will be performed at three general locations at the facility. Location A is the north or downwind background air sampling station, located at some distance to the northeast of the current active disposal cell. Location B is the south or upwind background air sampling station, located south of the current active disposal cell. Locations C and D are side by side locations adjacent to the north rim of the current active disposal cell. The current airborne sampling systems consist of a Hi-Q model VS23-1023CV ¾ HP oil-less rotary vane pump, flow rate rotometer and calibration knob, elapsed timer, 47 mm diameter filter holder with 3/8 inch quick disconnect, stainless steel gooseneck to set sample point approximately 59 inches above ground, rain and wind shield, outdoor instrument weather house.

Flow rates on the air samplers are recorded from the rotometer. Flow rates are checked against the data shown by a Hi-Q Air Flow Calibrator (AFC) Complete-6. The AFC measures the true flow rate in actual and in standard temperature and pressure (STP) units. Flow calibration will be performed a minimum of once per month, per Section 5.1.5. Upgrades or changes to the sampling equipment will be made by the CHDT RSO as needed in consultation with CDPHE.

5.1.2 Sample Collection

Air sample pumps will be run during daylight hours during sample collection periods. Samples will be collected from each location after a time period designated by the RSO that adequately samples air during representative work activity and allows sufficient sample loading to analyze. The pumps will be inspected a minimum of weekly during the sample collection to verify that the pumps are in working order. The date and time of the pump inspection and pump flow rate will be recorded in the air monitoring logbook or attached example form (Attachment 1) to document the inspection.

When filters are collected, appropriate precautions will be taken to minimize the potential for cross-contamination of samples and equipment. Nitrile or latex gloves will be worn when handling the filters and pumps. The final flow rate, elapsed time, and filter collection date and time will be recorded in a dedicated log book or on the example form included as Attachment 2.

5.1.3 Off-Site Sample Analysis

Filters will then be sent to an offsite analytical laboratory for the following analyses:

- Gross Alpha/Beta with a desired detection limit of 2 pCi/g of sample
- Radium-226 by wet chemistry method E903.0 or equivalent, with a desired detection limit of 0.1 pCi/g.
- Isotopic thorium (Th-232, Th-230, Th-228) with a detection limit of 1 pCi/g of sample
- Isotopic uranium (U-238, U-235, U-234) with a detection limit of 1 pCi/g of sample

If multiple filters are collected from a single location over a month, the filters will be composited for offsite analysis.

5.1.4 Pump Calibration and Maintenance

Flow rates on the Hi-Q sampling pumps will be checked once a month during the filter change out, using the AFC-Complete-6. During calibration, the following procedure will be followed:

- Unplug the air monitor and remove the sample holder containing the used filter. Connect the hose to the AFC and the air inlet.
- Prior to starting the flow, turn on the AFC and turn the knob to allow it to zero itself with no flow
- Plug in the pump and start the airflow
- Record the following information:

- Date/time
- Flow measured by the rotometer on the pump (CFM)
- Flow measured by AFC (CFM) for both STP and actual settings
- Stop the flow and disconnect the calibrator

As necessary, the pump rotometer may be adjusted to match the AFC measurement for STP. Alternatively, values recorded from the AFC unit may be used to calculate the correct flow rate on the pump.

Maintenance will be performed as necessary on the pumps. Rebuild kits will be kept on hand at the facility. Pump maintenance will be documented in the air monitoring log book.

5.2 Breathing Zone Air Monitoring

5.2.1 Monitoring Procedures and Equipment

Breathing zone monitoring will be performed as directed by the CHDT RSO or designee to determine exposures of specific personnel to airborne radioactivity in the current active landfill, in the treatment building and at other work-zone locations as designated by the RSO. Monitoring will be performed with portable lapel air samplers and 37 mm filters with cartridges placed near the breathing zone of the air monitoring subject. The samplers may also be placed in specific areas, or in cabs of equipment, in order to obtain a longer sample. Other types of air sampling equipment may be used such as semi-portable hi flow or low flow sampling stations, and or direct reading air samplers.

5.2.2 Sample Collection

Samples will be collected over a period of time determined by the RSO that adequately represents work activities and that collects sufficient sample for analysis. At a minimum, the following information will be collected in the air monitoring logbook or form:

- Sampled individual/activity/area
- Start date/time, and starting flow rate (including units)
- Stop date/time, and ending flow rate (including units)
- Total sampling time
- Calibration information, including pre- and post- sampling flow rate check, if performed.

When filters are collected, appropriate precautions will be taken to minimize the potential for cross-contamination of samples and equipment. Nitrile or latex gloves will be worn when handling the filters and pumps.

5.2.3 On-Site Sample Analysis

Air filters may be counted on-site using the 3030 counter, and converted to an activity concentration in µCi/ml using the following equation from Section 5.1.3:

$$C = \frac{M}{EF_{lpm}\left(1000\frac{ml}{l}\right)T_S\left(2.22\times10^6\frac{dpm}{\mu Ci}\right)}$$

Where M is the 3030 measurement in dpm. The airflow rate also requires conversion from the standard lapel sampler units of liters per minute (lpm) to milliliters, as shown in the equation.

5.2.4 Off-Site Sample Analysis

Personal air samples will be sent off-site for radiochemical analysis when determined to be required by the CHDT RSO or designee. If off-site analytical is required one or more of the following analyses may be performed:

- Gross Alpha/Beta with a desired detection limit of 2 pCi/g of sample
- Radium-226 by wet chemistry method E903.0 or equivalent, with a desired detection limit of 0.1 pCi/g.
- Isotopic thorium (Th-232, Th-230, Th-228) with a detection limit of 1 pCi/g of sample
- Isotopic uranium (U-238, U-235, U-234) with a detection limit of 1 pCi/g of sample

5.2.5 Pump Calibration and Maintenance

Pump calibration and maintenance will be performed in accordance with manufacturer's recommendations and the user's manual for the equipment. Where possible, the air sampler will be calibrated on-site, but calibration by a rental vendor is acceptable. In addition, battery life will be extended by following the user manual recommendations for charging.

5.3 Radon Monitoring

5.3.1 Monitoring Equipment

Radon monitoring will be performed at the CHDT facility using Landauer Radtrak alpha-track radon monitors. The Radtrak is a passive radon gas monitor that records the alpha tracks from radon gas decay. The tracks are counted and correlated with a known air concentration of radon, which is averaged over the sampling time.

5.3.2 Deployment Procedure

The radon monitors will be deployed at the following locations:

1	Active Landfill Cell
2	Active Landfill Cell

3	Perimeter Fence Background
4	Perimeter Fence (Background)
5	Perimeter Fence (Background)
6	Perimeter Fence (Background)

The Radtrak detectors will be positioned upside down inside the plastic cup. The serial numbers of the outgoing and incoming detectors will be recorded, as will the deployment date and time. Detectors will be changed out at the start of each quarter, or as close as possible – January 1, April 1, July 1, and October 1. When removed, the foil stickers provided by Landauer will be placed over the openings on the detector face.

5.3.3 Off-Site Analysis

Detectors will be sent to Landauer for analysis. The manufacturer's report of analysis will be sent to CHDT for review. The report will include the detector number/location, exposure in picocuries per liter (pCi/l)-days, and the average radon concentration in pCi/l.

6.0 STANDARDS AND CRITERIA

6.1 Ambient Air Sampling

Analytical results from the ambient air samples will be used to estimate the committed effective dose equivalent (CEDE) for site workers, per 15.RPP.05, *Estimation of Inhalation Dose.*

6.2 Breathing Zone Air Sampling

Results from breathing zone air sampling will be compared with the derived air concentration (DAC) or air effluent limits from 10 CFR 20 to determine potential worker exposure and dose.

6.3 Radon Sampling

The quarterly analytical report of measured radon concentrations will be evaluated by the CHDT RSO. Background radon levels will be statistically evaluated in order to determine average and peak natural radon levels. Radon effluent levels in the open landfill cell(s) will be compared with background levels in order to evaluate the effectiveness of the interim cover and to ensure that worker protection is adequate. If excessive levels are encountered, the landfill operations will be reviewed and modified, as appropriate, to limit radon effluents. Radon effluent levels in the treatment building will be evaluated to ensure that worker protection is adequate.

7.0 REFERENCES

10 CFR 20. *Standards for Protection Against Radiation*. Current Version.

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

NRC 1993. *Air Sampling in the Workplace.* NUREG-1400. September.

Ludlum Measurements, Inc., Instruction Manual Model 3030 Alpha Beta Sample Counter Meter, Current Version.

8.0 ATTACHMENTS

Attachment 1 Air Monitor Weekly Inspection Checklist

Attachment 2 Monthly Air Monitor Filter Collection Form

Clean Harbors Deer Trail LLC

Approved by:		
	General Manager	Radiation Safety Officer

Groundwater Sampling Standard Operating Procedure 15.Env.2

1.0 **Objective:** To establish groundwater sampling and analysis procedures that will provide quality data for evaluation of waste treatment and disposal unit integrity and environmental quality. The plan is consistent with and will run concurrently with the groundwater-monitoring program defined in the State RCRA Permit.

2.0 **Scope:** This procedure applies to all environmental monitoring samples collected from the groundwater monitoring wells and the secure cell leachate collection system, leak detection system and permanent sumps as well as the leak detection system in the treatment building.

3.0 **Policy:** All Deer Trail activities that could result in discharges of regulated waste to groundwater or effluents are subject to the groundwater-monitoring program.

4.0 **Responsibilities:** Responsibilities of the Deer Trail Radiation Safety Officer (RSO), the facility Compliance Manager, other management and staff are defined in the Deer Trail Radiation Safety Plan.

5.0 Groundwater Sampling Procedures

5.1 Container Preparation

5.1.1 The containers will be constructed of a material compatible and non-reactive with the expected sample aliquots. Consult Section 6.0, Table 4.0, Recommended Sample Handling, Preservation, and Instrumentation, to determine the number, type and volume of containers needed. Metal lids should not be utilized. Plastic lids with polyethylene or Teflon liners are acceptable in most cases.

5.1.2 Individual aliquot containers are not required for each determination or test. If two or more tests require the same container and preservation, and a container of sufficient size is available, the sample aliquots may be combined.

5.1.3 Generally the analytical laboratory will supply the sample containers. The laboratory will clean the containers before shipment to the Facility in accordance with the laboratory's quality assurance program. The Laboratory will provide documentation certifying the containers to be analyte-free. Alternatively, the laboratory may provide sample containers that have been purchased from a vendor, provided the vendor can provide documentation certifying the containers to be analyte-free. If the Laboratory and/or vendor do not supply sample containers the containers shall be cleaned in accordance with Section 5.6.

5.1.4 If the sample locations and tests are known prior to collection, the container labels may be partially completed and the chemical preservatives added to the containers (where applicable) before sampling.

5.1.5 The Laboratory will generally supply sample shuttle kits (each) consisting of an insulated cooler, pre-cleaned containers, labels, seals, and Chain-of-Custody, field log, and shipping forms. The sampling crew will supply refrigerant at the time of sampling.

5.2 Well Inspection

The monitoring wells shall be inspected prior to each groundwater-sampling event. During the well inspection, water levels will be measured to determine which wells contain water and which wells are dry. The depth to water, if any, and total well depth shall be measured during the inspection. These data will be recorded on the form provided in Section 7.0. Personnel will also note well conditions, as appropriate, on this form.

5.3 Well Evacuation

Prior to purging the well in preparation for sampling, the groundwater personnel will perform the following tasks:

- Measure depth to water and total well depth.

The procedures to perform these tasks are described in Section 5.4.

6 CCR 1007-3 264.97 (a)(2) requires that groundwater samples must represent the quality of water passing the point of compliance to ensure that the water sampled is not stagnant and therefore representative of the surrounding groundwater conditions. To meet this requirement, the following protocol shall be followed for purging or evacuating wells:

5.3.1 Rapidly recovering wells are defined as those wells, which recover at least 90% of one well volume in less than 12 hours.

- Rapidly recovering wells shall have approximately three well volumes removed prior to sampling.
- Sampling of these wells shall be completed within 24 hours from the time that the last well volume is purged.

5.3.2 Low yield or slowly recovering wells are those wells, which take longer than 12 hours but less than 48 hours to recover at least 90% of one well volume of water. Sampling of low yield wells will be following the Ground water Sampling Procedure for Low Stress (Low Flow) Purging and Sampling Procedure contained in Section 8.0.

- Low yield wells shall be totally evacuated (to the extent practicable) only one time prior to sampling.
- Sampling of these wells shall be completed within 48 hours of the well evacuation.

5.3.3 Dry wells are defined as a well, which contains no water. These wells shall not be sampled.

5.3.4 During each sampling event each previously dry well shall have been checked during the well inspection procedure to determine if water is present in the well. If water is present it shall be purged as described above.

5.3.5 During the first sampling event all inspection and detection monitoring wells shall be classified as a rapidly recovering, low yield or no-yield well.

The first sampling event classifications and measurement of well recovery data shall be recorded on the form in Section 7.0. The form presents a protocol for classifying the wells relative to recovery. The results of this well recovery classification shall be included in the Monitoring Report.

During the second sampling event each well will be evacuated and sampled in accordance with the procedures applicable to that well's recovery classification, which was determined in the first sampling event. Well evacuation procedures and data for those quarterly events will be recorded on the form presented in Section 7.0.

5.3.6 In order to prevent well contamination, one of the following well purging procedures will be utilized:

5.3.7 A dedicated bailer, constructed of the same material as the well casing, Teflon, or stainless steel, attached to the reel with a single strand of stainless steel wire or a monofilament line, shall be used. If necessary, the reel will be mounted on a tripod and set directly above the well opening. The bailer and cable should only contact the internal well casing. The reel's monofilament line will be wiped with a clean towel moistened with de-ionized water as the bailer line is retrieved. As the last bailer-full is pulled, the cable will be wiped away from the well casing opening with a freshly prepared reagent grade methanol/D.I. water saturated cloth. Care must be exercised not to permit excessive methanol/water to drop into the well, possibly resulting in contamination of the well. Well water will be evacuated from the uppermost part of the water column to assure that fresh water moves upward from the screen.

5.3.8 A dedicated system composed of either an electrically powered submersible pump, a gas operated positive displacement (bladder or piston) pump, or a gas lift purge pump may be used. The pump intake will be located approximately a foot above the bottom of the screened area to minimize the potential for electrically powered submersible pumps to burnout upon total evacuation. Electrically powered submersible pumps will not be operated when the water level in the well drops below the pump intake.

5.3.9 If non-dedicated equipment is used in well purging, that equipment will be cleaned before evacuating each well. The equipment shall be cleaned and stored per the procedures outline in Section 5.6. (Note: All groundwater wells at the Deer Trail Facility, except the dry wells, utilize dedicated purging and sampling equipment.)

5.3.10 All dedicated bailers will be inspected at the time of well purging for cleanliness and functionality.

5.3.11 All dedicated equipment temporarily removed from its well for repair (i.e. Maintenance Building or Off-site) shall be decontaminated as described in Section 5.6. Equipment blank samples shall be taken on all dedicated equipment that has been temporarily removed from the well for repairs in Maintenance Building or Off-site and after it has been decontaminated.

5.3.12 All purge water shall be collected in a calibrated container to determine evacuation rate and volume. Well water not used for sampling will be transferred to a central collection point (portable collection tanks), and evaluated for proper wastewater management.

5.4 Field Records (Evacuation)

A separate evacuation field log for each well shall be maintained to record all pertinent information regarding the evacuation and sampling of monitor wells. Sample forms are presented in Section 7.0. The form will be utilized during the first sampling event for classifying wells according to their recovery characteristics. The form in Section 7.0 will be utilized for all other sampling events. This recorded information is necessary to maintain well sampling data and becomes part of the analytical report. The sample collector shall sign and date each page of the field log (see Section 7.0). The following data shall be determined and recorded upon the evacuation of each well:

- Sample collector's name, date and time that evacuation was initiated and completed.
- Site and Location
- Event and Year
- Well Identification - i.e., monitor well number, code or name.
- Well Depth - Measure from a marked reference point at the top of the casing to the bottom of the well to the nearest 0.01 foot with a clean weighted measuring tape or a calibrated water level indicator. The tape or water level indicator shall be wiped with a clean cloth saturated with reagent grade methanol and de-ionized water following each measurement of well depth. Wells with dedicated pumps will be re-developed at a minimum once a year during the second quarter, or at any time should excessive silting occur. Well depth will be measured after re-development and recorded on the sampling log.
- Water Level Depth - Measure from the marked reference point at the top of the well casing to the water surface to the nearest 0.01-foot with a calibrated water level indicator. The water level indicator shall be calibrated and any correction factors noted on the meter, and the factor, if any, will be applied to the water level depth measurements. Each well shall have a marked measurement reference point at the top of the casing from which its water level is taken. An elevation/location reference point shall be established in relation to mean sea level by a licensed surveyor for each well, the marker is typically located on the concrete well pad. The reference point shall be established in relation to mean sea level and the survey shall also note the well location coordinates.
- Measure and record well casing inside diameter to the nearest 0.1 inch.
- Record total gallons evacuated - Well yield

- Record water level (in feet) following evacuation.
- Record method of evacuation - type of bailer, pump, etc.
- Comments - Any deviation from standard sampling procedures, unusual conditions, damage or problems encountered at each well should be recorded completely, clearly and concisely.

5.5 Sampling the Monitor Wells

After the wells have been evacuated, the containers and sampling equipment shall be prepared and the initial log data entered. Those wells that meet the recovery criteria specified in Section 5.3 shall be sampled as follows:

5.5.1 Re-measure the water level depth to the nearest 0.01-foot and record on the field sampling log (Section 7.0).

5.5.2 All non-dedicated equipment used to sample the well (e.g., bailer, funnel, etc.) must be cleaned and stored per the procedures outlined in Section 5.6.

5.5.3 During the normal course of sampling equipment blanks will not be taken from wells utilizing dedicated sampling equipment. If the dedicated equipment is removed from the well for any reason other than the normal course of sampling or well purging, then the equipment will be decontaminated and an equipment blank will be collected from the final rinse of the decontamination process which was performed in accordance with Section 5.6.

5.5.4 If the well is equipped with a dedicated submersible pump, it will be used to sample the well. Wells shall be sampled within the time periods specified in Section 5.3.

5.5.5 Wells not equipped with a pump system will be sampled utilizing a bailer. The bailers will be constructed of stainless steel, Teflon or of the same material as the well casing, attached to a reel with a clean single strand stainless steel wire or a monofilament line. The reel will be mounted on a tripod if necessary and set directly above the well opening. Except as specified in Section 5.3.7 the first bailer-full collected shall be used to rinse the bailer and managed as described in paragraph 5.3.12. If the well has recharged sufficiently to collect all samples required. If the well contains insufficient water to generate the necessary aliquots, then the first bailer-full may be used to collect the sample, rather than discarding it as rinse water. Samples will be transferred, with as little agitation as possible, from the bailer to the sample containers and immediately preserved according to the specific test requirements. Upon withdrawing the last bailer-full, the cable will be wiped away from the well casing opening with a fresh clean cloth saturated with deionized water and reagent grade methanol. Care must be taken not to allow any excess methanol/water mixture to enter the well.

5.5.6 All samples collected for transport to the Laboratory shall be chemically preserved (if applicable). See Section 6.0, Table 4.0, for specific requirements.

5.5.7 The following determinations will be made in the field at the time of sampling and recorded on the field logs:

- pH
- Specific Conductance
- Temperature
- Redox Potential
- Calibration checks
- Turbidity

Field monitoring instruments including pH, specific conductance, and turbidity meters, shall be calibrated each day of sample collection prior to sampling. In addition, the calibration of these instruments shall be verified using certified standards prior to the sampling of each well. All calibration verifications will be recorded in the designated logbook.

5.5.8 Sample Shipment - Samples will be shipped in sealed insulated shipping containers, ice chests or coolers supplied by the analytical laboratory conducting the analyses. Shipment and receipt of samples must be coordinated with the laboratory to minimize time in transit. To insure arrival at the laboratory in good condition, the samples will be sent in sturdy insulated ice chests (coolers). An air courier or equivalent overnight courier service will be utilized, if necessary.

5.5.9 One well field duplicate will be obtained for 20 wells (batch) in each scheduled sampling event. Duplicated sampling of wells will be determined by the random sampling method discussed in Appendix 8 of this plan. Only those wells that have traditionally produced a sufficient volume of water to fill a complete Background Parameters (Groundwater Protection Program Table 2.0) or Detection Monitoring (Groundwater Protection Program Table 3.0) bottle set will be included as potential duplicate well candidates. Duplicate sample aliquots (except for volatile analysis samples) will be collected in quarter-bottle increments to ensure inter-sample homogeneity.

5.6 Decontamination of Non-Dedicated Evacuation and Sampling Equipment and Non-Laboratory Supplied Sampling Equipment

The cleanliness of the containers, evacuating and sampling equipment is most important.

5.6.1 Bottles and lids to contain samples must be hand washed with a liquid hand dishwashing detergent, rinsed in hot tap water, rinsed with chemically pure or reagent grade nitric acid, rinsed at least four times with tap water and four times with distilled or deionized water and allowed to air dry.

5.6.2 Glass bottles used to collect samples for analysis shall be washed with a liquid hand dishwashing detergent, rinsed with hot tap water, rinsed with reagent grade methanol, finished with D.I. water (at least six rinses), and kiln baked at 300° C. Caps and teflon liners, shall be prepared in the same manner, except without the kiln bake. When the bottles are cool and the caps and liners are completely dry, cap the bottles and store them in a clean and dry environment.

5.6.3 All non-dedicated equipment used to bail or sample a well must be cleaned in the same manner prescribed for cleaning the bottles and lids for conventional analysis described in A. above, and stored in a clean and dry environment. Clean bailers must be wrapped in new aluminum foil with the bright side out, or high-grade paper for storage.

5.7 Field Records (Sampling)

5.7.1 It is most important to maintain an accurate and thorough field log in case one is required to recall particular detailed information concerning the evacuation and sampling of a monitor well. As mentioned earlier, these logs become part of the analytical report. In addition to the information recorded during the purging process, the following information will be also be recorded on the field log at the time of sampling:

- Sample collector's name, date and time of sampling.
- Water Level Depth - Measure from the reference point at the top of casing to the water surface to the nearest 0.01-foot with a calibrated water level indicator.
- Reason for sampling - e.g., semi-annual sampling, special problem
- Initiator requesting the well sampling.
- Sample identification number for each set of samples taken from a single sample source.
- Sample pH, specific conductance, temperature, turbidity, Redox Potential and calibration documentation.
- Method of sample collection - type of bailer, pump, etc.
- Sample characteristics such as color, odor, sediment, surface oil, etc.
- Sample volume, containers, and preservatives.
- Test to be performed on each sample (if known).
- The weather conditions at the time of sampling.
- Sample sequence number - Order in which well was sampled with respect to other wells onsite. If more than one sampler or sampling team are participating in the sampling event, each sampler or team shall record the sequence or order in which each well was sampled with respect to the other wells they have sampled.
- Any additional field observations, comments or recommendations - e.g., split sampling (with whom), re-sampling, equipment failures, condition of the well, etc.
- Sample Custody Statement - If the samples are transferred to the receiving laboratory by the collector and are in his or her possession at all times, a statement to this effect shall be noted.

5.7.2 The samples must be sealed to protect their value. If the sample shuttle kit (cooler) does not employ a tamper proof seal, the collector is to date, sign and identify each sample on a seal and attach it to each sample container and lid. A waterproof adhesive seal and pen must be used.

5.7.3 Prepare a sample label for each sample container employing a waterproof pen and adhesive label. The following is to be indicated on the label -

- Collector's name, date and time of sampling.
- Sample source.
- Sample identification number.
- Sample preservatives.
- Test(s) to be performed on the sample, if known.

5.8 Chain-of-Custody

Chain-of-Custody records will be used to insure the integrity of the sampling event and the analyses.

5.8.1 The sample collector will complete a Chain-of-Custody record (Section 7.0 or equivalent) for all monitoring well samples.

5.8.2 The sample collector will retain a copy of the Chain-of-Custody record, and forward the original with the sample to the laboratory performing the analyses.

5.8.3 Upon receipt of the samples, the laboratory manager or representative will complete the Chain-of-Custody record, make a copy for his or her files, and return the original with the analytical data.

5.9 Instructions to the Laboratory

The results of the analysis of the blanks should not be used to correct the ground water data. If contaminants are found in the blanks, the source of the contamination must be identified and corrective action, including re-sampling, must be initiated. Other quality control samples (e.g., standards, spikes, performance evaluation samples) must be prepared and analyzed as part of the laboratory operation.

5.10 Laboratory Requirements

The laboratory shall have the capabilities to analyze for most monitor well parameters. Some samples submitted to the laboratory for analysis may be subcontracted to another independent commercial laboratory. Any samples submitted to the Lab must be properly preserved, accompanied with completed Chain-of-Custody records. If an independent, subcontracted laboratory is utilized, the procedures recommended for sample preservation will be followed, Chain-of-Custody records, and a completed Sample Analysis Request form will accompany the samples.

5.10.1 Laboratory: Laboratory QA/QC plan applicable to the Groundwater Analysis performed by CHDT will be in accordance with the facilities approved QA/QC plan and standard operating procedures. These standard operating procedures will include, but are not limited to, the following:

- The use of Standard Reference Materials, intra-laboratory samples, laboratory blanks, duplicate and spike samples for calibration and matrix interference identification.
- Statistical procedures and accuracy control charts to monitor and document laboratory performance and define analysis acceptance criteria.
- Programs for instrument calibration and maintenance control.
- Sample receipt and documentation.

5.10.2 Outside Laboratory – CHDT will submit to the Department a QA/QC plan or verification of independent laboratory certification for each outside laboratory contracted to perform groundwater analysis. The outside laboratories QA/QC plan and/or certification shall meet or exceed those required of CHDT by the Colorado Department of Public Health.

5.11 Analytical Parameters

The analytical parameters to be analyzed for in groundwater samples collected at the facility are given in Section 6.0 - Tables 2.0 and 3.0. Listed are each parameter, their respective analytical methods and levels of Reporting Detection Limits and if they are background or detection monitoring parameters, or both. The parameters pH, specific conductance and turbidity will be determined in the field.

6.0 Tables

6.1 Table 1.0 – Frequency of Data Collection and Evaluation
6.2 Table 2.0 – Background Monitoring Parameters
6.3 Table 3.0 – Detection Monitoring Parameters
6.4 Table 4.0 – Sample Handling, preservation, and Instrumentation

7.0 Forms

7.1 Monitoring Well Field Log – Sampling
7.2 Monitoring Well Field Log – Evacuation and Recovery Classification (1st event)
7.3 Monitoring Well Field Log – Evacuation and Recovery Classification (2nd event)
7.4 Sample Chain –of – Custody

8.0 Groundwater Sampling Procedure for Low Stress (Low Flow) Purging and Sampling Procedure, U.S. EPA Region II, March 16, 1998

TABLE - 1.0
Frequency of Data Collection and Evaluation

Monitoring Location	Monitoring Program	Data Collection Frequency		Data Evaluation Frequency		
		Hydraulic Measurements	Sampling and Lab Analysis (if appropriate)	Descriptive Statistics	Comparative Statistics	Trend Analyses
Closed Secure Cell LCS	Secure Cell Performance Monitoring	Weekly	Quarterly	NA	NA	NA
Active Secure Cell LCS	Secure Cell Performance Monitoring	Weekly	Quarterly	NA	NA	NA
Secure Cell LDS	Secure Cell Performance Monitoring	Weekly	Quarterly	NA	NA	NA
Secure Cell Permanent Sump	Secure Cell Performance Monitoring	Weekly	Quarterly	NA	NA	NA
Treatment Building LDS	Surface Impoundment Performance Monitoring	Weekly	Quarterly	NA	NA	NA
Level 3 Wells	Inspection Monitoring	Quarterly	Quarterly	Semiannually	Semiannually	Semiannually
Level 4A Wells	Detection Monitoring	Quarterly	Quarterly	Semiannually	Semiannually	Semiannually
Level 4 Wells	Detection Monitoring	Quarterly	Quarterly	Semiannually	Semiannually	Semiannually
Level 5 Wells	Detection Monitoring	Quarterly	Quarterly	Semiannually	Semiannually	Semiannually
Level 6 Wells	Inspection Monitoring	Quarterly	Quarterly	Semiannually	Semiannually	Semiannually

TABLE 2.0
Background Monitoring Parameters

ANALYTE	Instrumentation [1]	GW Reporting Limit (pCi/L)	CDPHE Groundwater Standard (pCi/L)
RADIOACTIVITY			
Gross Alpha	A, B, or G	3.0	15 (excludes U and Rn)
Gross Beta	A or G	4.0	50 (pCi/L) (screening level)
Lead-210	E	3.0	
Thorium-228	H	1.0	
Thorium-230 and 232	H	1.0	60
Uranium-234	H	1.0	30 (ug/l) (Total)
Uranium-235	H	1.0	See above
Uranium-238	H	1.0	See above
Radium-226 and 228	A, B, D, or G	1.0	5.0
H-3 (Tritium)	E	500	20,000
C-14	E	20	
K-40	C	250	
Co-60	C	30	
Cs-137	C	20	80 (as Cs-134)
Sr-90	A or G	3.0	8.0
Pu-238	E or H	0.1	
Pu-239	E or H	0.1	0.15 (Pu-239 and Pu240)
Pu-241	E or H	5.0	
Am-241	H	0.1	0.15

[1] A = Low background proportional system; B = Alpha and beta scintillation system; C = Gamma spectrometer [Ge(Hp) or Ge(Li)]; D = Scintillation cell system; E = Liquid scintillation system; F = Fluorometer; G = Low background alpha and beta counting system other than gas-flow proportional; H=Alpha spectrometry system.

TABLES 3.0
Detection Monitoring Parameters

ANALYTE	Instrumentation [1]	GW Reporting Limit	CDPHE Groundwater Standard
RADIOACTIVITY			
Gross Alpha	A, B, or G	3.0 (pCi/L)	15 (pCi/L) (excludes U and Rn)
Gross Beta	A or G	4.0 (pCi/L)	50 (pCi/L) (screening level)
Uranium-Total	F	1.0 (ug/l)	30 (ug/l) (Total)
Radium-226 and 228	A, B, D, or G	1.0 (pCi/L)	5.0 (pCi/L) (combined)

[1] A = Low background proportional system; B = Alpha and beta scintillation system; C = Gamma spectrometer [Ge(Hp) or Ge(Li)]; D = Scintillation cell system; E = Liquid scintillation system; F = Fluorometer; G = Low background alpha and beta counting system other than gas-flow proportional; H=Alpha spectrometry system.

Table 4.0
Sample Handling, Preservation, and Instrumentation

Parameter	Preservative [1]	Container [2]	Maximum Holding Time[3]	Instrumentation[4]
Gross Alpha	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A, B, or G
Gross beta	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Strontium-89	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Strontium-90	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Radium-226	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A, B, D or G
Radium-228	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A or G
Cesium-134	Conc. HCl to pH <2[5]	P or G	90 Days	A, C or G
Iodine-131	None	P or G	8 Days	A, C or G
Tritium	None	G	90 Days	E
Uranium	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	A, B, F, H
Photon emitters	Conc. HCl or HNO_3 to pH <2[5]	P or G	90 Days	C

[1] It is recommended that the preservative be added to the sample at the time of collection unless suspended solids activity is to be measured. If the sample has to be shipped to a laboratory or storage area unpreserved, acidification of the sample (in its original container) may be delayed for a period not to exceed 5 days. A minimum of 16 hours must elapse between acidification and analysis.

[2] P = Plastic, hard or soft; G = Glass, hard or soft.

[3] Holding time is defined as the period from time of sampling to time of analysis. In all cases, samples should be analyzed as soon after collection as possible. Exceptions will require approval by CDPHE.

[4] A = Low background proportional system; B = Alpha and beta scintillation system; C = Gamma spectrometer [Ge(Hp) or Ge(Li)]; D = Scintillation cell system; E = Liquid scintillation system; F = Fluorometer; G = Low background alpha and beta counting system other than gas-flow proportional; H=Alpha spectrometry system.

[5] If HCl is used to acidify samples, which are to be, analyzed for gross alpha or gross beta activities, the acid salts must be converted to nitrate salts before transfer of the samples to planchets.

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970.386.2293
Fax 970.386.2262

September 11, 2006

Mr. Steve Tarlton
Unit leader
Radiation Management Unit
Hazardous Waste and Waste Management Unit
Colorado Dept. of Public Health and Environment
4300 Cherry Drive South
Denver, CO 80246-1530

Re: Groundwater Sampling Standard Operating Procedure 15 Env. 2

Dear Mr. Tarlton:

Please find enclosed Revision 1 of the above referenced document. This revision was made to incorporate those modifications noted in the Departments letter dated August 24, 2006.

Should you have any questions please contact me at 970-386-2293.

Sincerely,

Michael Webb
Senior Facility Compliance Manager

Enclosure

cc: Jennifer Opila, CDPHE
Tanell Roberts, CDPHE

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.17

VOLUMETRIC AND MATERIAL SAMPLING

1.0 OBJECTIVE

To provide instruction in techniques for collecting volumetric or material samples from radioactive materials.

2.0 SCOPE

This standard operating procedure (SOP) establishes the requirements for performance, documentation, and review of radiological sampling activities for bulk samples. The collection of samples is used to quantify radioactivity that may be present to comply with Clean Harbors Deer Trail (CHDT) waste acceptance criteria.

3.0 POLICY

Random confirmation sampling will be performed on incoming wastes to comply with CHDT waste acceptance criteria. CHDT personnel will take appropriate precautions to maintain exposures to radioactive materials as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 PROCEDURE

5.1 Personal Protective Equipment

Latex or nitrile gloves shall be worn (and changed when contaminated or torn) when taking samples where radiological contamination is present or suspected. A pair of cotton gloves may be worn under the latex or nitrile gloves. Additional personal protective equipment (PPE) may be required based on the specific requirements of the sampling location (e.g., within the cell, treatment building, etc).

Soil samples and PPE used during sample collection are potentially contaminated materials and should be handled and disposed of as such. The potential contamination may be associated with radiological, chemical, and/or biological contaminants dependent on the source location.

5.2 Sampling Equipment

Sampling equipment used shall be sufficient to collect a representative sample from the materials under investigation. Dedicated or disposable sampling equipment should be used to minimize decontamination requirements. Absorbent wipes or cloths should be available to clean spills and minimize cross contamination concerns. Typical sampling materials include scoops and telescoping poles, but specialized sampling equipment like drum samplers may also be used. Prior to the initiation of a long-term waste stream that will require multiple random confirmation samples, the sampling requirements should be reviewed, and sufficient sample containers for the duration of the project should be obtained.

Following sample collection, the jar or container should be placed into a clean 1 gallon Ziploc bag to contain any potential contamination present on the outside of the container.

5.3 Sample Identification

The sample should be labeled with the CHDT sequential sample number, load number (if applicable), drum number, and profile number. The sample collection date and time should also be printed legibly on the sample label.

5.4 Sample Volume

Typically the minimum sample volume for radiological analyses is 500 milliliters, but additional sample is almost always appropriate. The sample should be representative of the load or shipment being sampled.

5.5 Sample Screening

The sample should be screened with hand-held instrumentation and/or be subject to smear samples to determine if contamination is present on the outside surfaces of the sample containers.

6.0 STANDARDS AND CRITERIA

None.

7.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.18

DECONTAMINATION OF SURFACES AND EQUIPMENT

1.0 OBJECTIVE

Provide instruction in techniques for removing radioactive contamination from surfaces or equipment following routine use and spills.

2.0 SCOPE

This standard operating procedure (SOP) applies to decontamination of surfaces and equipment following routine use and spills and is intended to be used in conjunction with other CHDT and Clean Harbors procedures.

3.0 POLICY

Decontamination of surfaces and equipment is required to prevent the spread of radioactive contamination, and to maintain worker and public exposures as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 PROCEDURE

5.1 Decontamination Following Spills

Decontamination following spills should be supported and verified by radiological surveys conducted per SOP 15.OPS.14, *Spill Surveys*.

5.1.1 Liquid Spills

A liquid spill must be addressed immediately to stop the flow of liquid. Towels, absorbent material (such as Speedi-Dry), or dams should be used to contain the liquid. Using appropriate personal protective equipment (PPE), mop and dry the liquid, placing the spent material into an appropriate container. If necessary, the liquid may be vacuumed using equipment appropriate to do so.

If the spilled liquid has penetrated into soils or other surfaces, additional removals may be required to remediate the area. Specific requirements for more involved decontamination or remediation efforts will be developed on a case-by-case basis by the CHDT RSO.

5.1.2 Solid Spills

Depending on the size of the spill, material may be cleaned using manual means (e.g., shovels, brushes, brooms, etc.) or mechanically (e.g., vacuums or heavy equipment). If the solid material is fine and may become airborne, dust suppression techniques should be used. Small spills of solid material may be cleaned using masselin cloths, or duct tape or other sticky material. Collected decon materials should be placed into appropriate containers for subsequent transport and disposal.

5.2 Equipment Decontamination

Equipment includes backhoe, trucks, and front loader, machine tools, hand tools, and any reusable device. The following steps should be followed when decontaminating equipment:

a. Remove visible dirt or other visible contamination from the equipment using washing, sweeping, wiping or other cleaning methods.

b. Survey the equipment for radioactive contamination, per SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*. If contamination limits are met, equipment may be released.

c. If contamination limits are not met, continue cleaning operations. After cleaning, re- survey the equipment for radioactive contamination, per SOP 15.OPS.13, Equipment and Vehicle Release Surveys. If contamination limits are met, equipment may be released. If contamination limits are not met, continue cleaning followed by surveying until limits are met. If limits cannot be met, consult the RSO. Equipment may be properly disposed of if decontamination is not feasible.

d. Appropriate PPE and dosimetry must be worn during decontamination operations.

e. All waste produced from decontamination must be disposed of properly.

f. All decontamination surveys will be recorded on a radiation survey report.

g. Areas where decontamination operations have taken place must be surveyed after use as appropriate.

6.0 STANDARDS AND CRITERIA

Specific criteria for radiological surveys that support decontamination activities are listed in SOPs 15.OPS.13, *Equipment and Vehicle Release Surveys*, and 15.OPS.14, *Spill Surveys.*

7.0 REFERENCES

Additional discussion of decontamination techniques beyond the scope of this SOP may be found in the following reference:

U.S DOE 1994. *Decommissioning Handbook*. DOE/EM-0142P. U.S. Department of Energy, Office of Environmental Restoration. April.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.19
DECONTAMINATION OF PERSONNEL

1.0 OBJECTIVE

To provide instruction on specific actions to be taken upon detection of personnel contamination.

2.0 SCOPE

This standard operating procedure (SOP) applies to all workers at the Clean Harbors Deer Trail (CHDT) facility that may potentially be contaminated by radioactive materials. As noted in SOP 15.RPP.06, *Emergency Response*, life-threatening injuries in an emergency situation may supersede contamination concerns, as dictated by the CHDT Radiation Safety Officer (RSO) or designee.

3.0 POLICY

Radiation exposures for CHDT and other personnel will be maintained as low as reasonably achievable (ALARA). Decontamination will be performed on personnel who become contaminated with radioactive materials. Emergency medical care should be administered immediately for injuries affected by radioactive materials. Medical treatment of injuries shall take precedence over potential radioactive contamination concerns. This SOP is intended to comply with the current version of Clean Harbors procedure HS 0.00021.T25-10HS, *Decontamination Standards.*

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (DR 15.RPP.01).

5.0 DECONTAMINATION TECHNIQUES

If contamination is a potential issue, appropriate personal protective equipment (PPE) should be worn.

5.1 General Decontamination of Personal or Protective Clothing

Contamination may be removed from personnel clothing by patting the affected area with sticky tape (e.g., duct tape), followed by a resurvey to determine if additional decontamination is necessary. If contamination can not be reduced to background levels below the applicable levels and ALARA, the clothing will be removed from service (either entirely or with the affected portion cut out) for disposal as radioactive material.

5.2 General Decontamination of Skin

If personnel require skin decontamination, they shall be decontaminated by the following methods. *Situations that require more than removal with adhesive or soap and water are rare and are unlikely to be encountered by CHDT or other Clean Harbors personnel.*

a. Personnel skin contamination above 1.5X background must be reported to the CHDT RSO or designee. The CHDT RSO will determine if a skin dose assessment must be performed.

b. Survey the affected area and record the types and initial levels of contamination. If possible, remove particles of contamination with tape and save the particles for evaluation as necessary.

c. Attempt localized washing with warm water and soap ensuring the contamination is not spread to uncontaminated parts of the body.

d. Resurvey the affected area to determine if the contamination has been reduced to background levels and ALARA.

e. If contamination persists, decontamination attempts and resurveys may be repeated multiple times but should stop if these methods are ineffective or skin irritation occurs.

f. If the area can not be decontaminated sufficiently with soap and water, the area may be covered (e.g. with plastic or by wearing latex gloves) to allow contamination to be removed through perspiration. Notify the CHDT RSO or designee if contamination cannot be removed.

5.3 Decontamination in Situations Requiring Medical Treatment

As noted above, the response to life-threatening emergency situations must take precedence over any potential radioactive contamination concerns that may be encountered by CHDT or other Clean Harbors personnel. Personnel decontamination in situations where medical treatment is required should proceed according to the following:

a. Emergency medical care should be administered immediately for injuries affected by radioactive materials.

b. Medical treatment of injuries shall take precedence over radiological considerations.

c. The CHDT RSO or designee will provide medical personnel with any necessary radiological support in regards to contamination control and monitoring of the patient and medical staff.

d. The treatment of radioactively-contaminated injuries should include the following:

- Treatment of contaminated wounds by medically qualified individuals,
- Monitoring of wounds, bandages, and medical instruments and equipment for contamination, and
- Radionuclide identification

e. Contaminated wounds of any kind will be decontaminated under the supervision of the CHDT RSO or designee. Severe wounds will be decontaminated under the supervision of medical personnel.

f. Depending on the levels of contamination encountered, an internal dosimetry evaluation and/or bioassay may be required.

6.0 RECORDKEEPING

Records of contamination events must be maintained in the employee's occupational exposures file. Information regarding a contamination event may be recorded in a field logbook or on a form – an example is provided in Attachment A. Following decontamination, a report should be prepared and submitted to the CHDT RSO or designee. At a minimum, the information provided in this report will consist of the following:

a. Employee name, date, time, radiation work permit number (if appropriate), project name and number, and technician/supervisor,

b. When contamination occurred, description of the cause, where happened/what specific task,

c. A comments/additional information section,

d. How contamination could have been prevented /corrective actions,

e. A drawing of a human figure (front and back views) to document the location of contamination,

f. Survey data – instrument information, pre-decontamination, after each decontamination attempt, radionuclide/form, decontamination method(s), bioassay results (if applicable), and

g. Surveyor and CHDT RSO or designee signatures with signature dates

The information requested in this report must be provided as completely and accurately as possible for evaluation of subsequent actions, personnel dose, and for required documentation.

7.0 REFERENCES

Clean Harbors Environmental Services. HS 1.11, *Decontamination Guidelines*, Current Version.

ATTACHMENT A – PERSONNEL CONTAMINATION FORM
(Page 1 of 2)

Contaminated Individual's Name:	Date:	Time:	RWP/Task #:
Project Name/Number:	Approx. surface area of contamination (cm^2):		Technician/Supervisor:

Approximate length of time that individual remained contaminated, including decontamination attempts:	**Type of Contamination:** ☐ Localized ☐ Discrete Particle ☐ Distributed

PPE Level	☐ Level D	☐ Level C	☐ Level B	☐ Level A	☐ Other (describe below)
Description of PPE:					

Probable Reason for Contamination:

☐ Poor Work Practices ☐ Inadequate HP Controls ☐ Inadequate PPE

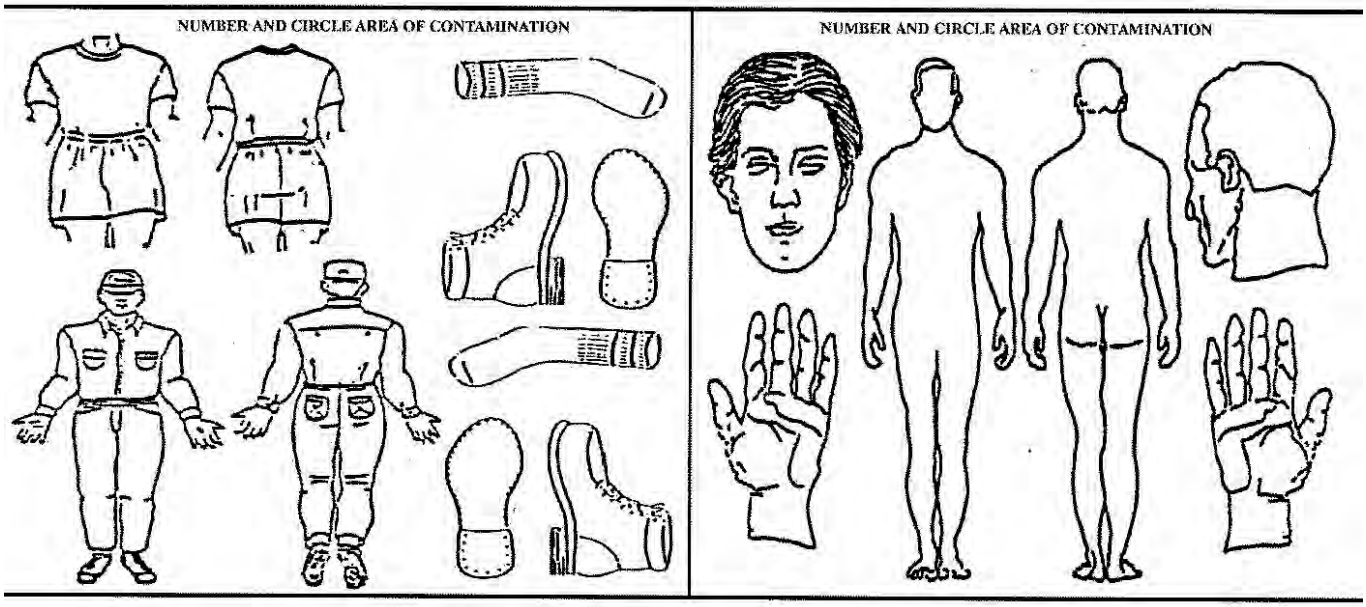
☐ PPE Failure ☐ Contaminated PPE ☐ Perspiration Through PPE

☐ Planned Contamination ☐ Accidental Contamination ☐ Spread From Adjacent Work Area

Comments:
Action Taken:

ATTACHMENT A – PERSONNEL CONTAMINATION FORM
(Page 2 of 2)

☐ CLOTHING CONTAMINATION ☐ SKIN CONTAMINATION



If a discrete particle is on clothing, provide survey through clothing, if possible.

Initial Measurement		1st Decon		2nd Decon		3rd Decon	
Location (note above)	**cpm**	**Method**	**cpm**	**Method**	**cpm**	**Method**	**cpm**

Instrument Type:	Serial No.	Calibration Due Date	Efficiency	Background (cpm)

Disposition of Clothing:

Surveyed by: _____
Print Sign Date

Reviewed by: _____
Print Sign Date

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.20

HANDLING OF LIQUIDS CONTAINING RADIOACTIVE MATERIAL

1.0 OBJECTIVE

Define procedures for handling and disposal of liquids containing radioactive material.

2.0 SCOPE

This standard operating procedure (SOP) applies to the handling of liquids containing radioactive material for treatment and disposal at the Clean Harbors Deer Trail (CHDT) facility.

3.0 POLICY

Liquids containing radioactive material will be handled in a manner to minimize the potential for spills, and maintain worker and public exposures as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (15.RPP.01).

5.0 PROCEDURES

5.1 Waste Receipt

Liquid wastes will typically be shipped in drums, totes, tankers, or vacuum boxes. Drums and totes will typically arrive on-site in covered semi-trailers, while tankers and vacuum boxes will be self-contained. All wastes will be received in accordance with SOP 15.WAC.02, *Waste Tracking*.

5.2 Treatment of Liquids

Treatment operations will be conducted according to the provisions of SOP 15.OPS.02, *Waste Treatment*. Liquid wastes are turned into solids suitable for landfill by the addition of Pozzolanic reagents such as cement kiln dust, Portland cement, lime, lime kiln dust, and fly ash. Pozzolanic reagents function not just by absorption but also by chemically combining with free water in the waste to form a stable solid. Specific treatment formulas will be dependent upon the specific components of the waste stream and will be created on a case-by-case basis and documented as part of the approved waste profile. Liquids with radioactive material will be solidified in treatment basins in the Treatment Building as needed.

5.3 Tanker and Vacuum Box Unloading Operations

Facility personnel will direct the transporter to the unloading area. The truck will back into the unloading area directly up to the edge of the basin. The truck will dump the waste directly into the treatment basin. Trucks will be rinsed using water with the rinsate directed into the treatment basin. Waste trucks leaving the facility will be surveyed for contamination per SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*. If radioactive material is detected above site survey limits, the truck will be decontaminated by washing with water, and the rinsate will be directed into the treatment basin. The truck will then be re-surveyed as needed.

5.4 Small Container Processing Operations

Drums will normally be unloaded using a drum-tipping machine. This machine has arms that grab the drum by the side. Drums will have the lids removed or the bungs opened. They will then be picked up by the drum tipper, turned upside down, and dumped into the treatment basin. Tote tanks will normally be unloaded using the bottom outlet and the liquid waste will be drained into the treatment basin. Alternatively, drums and totes may be processed through the drum shredder with shredded residue directed into a treatment basin where they can be processed with other waste. Shredding drums and totes reduces the empty containers to small pieces that can be processed with the rest of the waste. Empty containers will normally be crushed and disposed of in the landfill, filled with absorbent and disposed of in the landfill, or decontaminated for other uses if they are returnable containers per SOP 15.OPS.18, *Decontamination of Surfaces and Equipment*. Crushing of containers will preferentially take place in the landfill, in the treatment basins, and on the floor of the treatment building in that order.

5.5 Mixing Operations

Mixing operations in the treatment building are conducted using a backhoe and chemical reagent additives, typically cement kiln dust or other Pozzolanic reagents. Waste is placed in the treatment basin, reagents are added, and the waste mixture is mixed until treatment (solidification) is complete. The treatment building is a totally enclosed building with two emission control systems consisting of a bag house and a wet scrubber. All treatment operations must be conducted with the emission control system properly operating to control releases of waste materials. Treatment and hauling the treated waste to the landfill will be conducted according to the provisions of SOP 15.OPS.02 *Waste Treatment.*

5.6 Release of Liquid Containers

A radiological release survey per 15.OPS.13, *Equipment and Vehicle Release Surveys*, will be performed prior to return of the waste container. (This procedure is usually only performed on large tankers and vacuum trucks. Smaller containers that are not released for return will be disposed in the active CHDT disposal cell.) The release process will be performed by an evaluation of the radiological conditions of accessible areas. Smear and direct surveys of the inlet, outlet, cleanouts, and other access points will be performed. Remote survey equipment such as extendable Geiger Mueller (GM) probes and smear collection devices will be used as needed. If the results of the surveys of the accessible areas indicate radioactivity levels consistent with facility release limits, no further survey is required. If contamination is detected, further surveys of the equipment will be directed by the RSO. Decontamination methods include, but are not limited to, entry into the tanker to perform physical decontamination and

release and/or performing an interior rinse or wash. All rinsate will be directed into a treatment basin, solidified and land-filled.

6.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.OPS.21
PACKAGE RECEIPT SURVEYS

1.0 OBJECTIVE

To define general and specific methods and procedures for conducting radiation surveys for receipt of packages containing radioactive material in compliance with Colorado Regulations.

2.0 SCOPE

This standard operating procedure (SOP) applies to the receipt of bulk and containerized shipments of waste known to contain radioactive materials and receipt of waste samples known to contain radioactive materials. Most waste samples containing radioactive materials sent to CHDT are exempt quantity non-DOT labeled shipments. Similarly, most waste shipments containing radioactive materials acceptable to DR under the License are either non-DOT regulated, limited quantity, or LSA-1 shipments not requiring labels. While most of these shipments would appear not to require package receipt surveys under Colorado Regulations (RH Part 4.32), Licensees must "Monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are crushed, wet, or damaged". (RH 4.32.2.3). In the interest of complying with this part, CHDT will conduct receipt surveys on all packages and waste shipments known to contain radioactive materials.

3.0 POLICY

CHDT will conduct receipt surveys on all packages and waste shipments known to contain radioactive materials in accordance with the provisions of this SOP and Colorado Regulations. All packages known to contain radioactive materials will be monitored for radioactive contamination, radiation levels, and package integrity.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (15.RPP.01).

5.0 GENERAL SURVEY METHODS

Direct surveys of packages may be conducted using a Ludlum Model 44-9 Geiger Mueller (GM) "pancake"-type probe with Ludlum Model 12 survey meter (or equivalent) for surface beta-gamma measurements; a Ludlum 43-93 alpha-beta scintillation detector with Ludlum 2360 survey meter (or equivalent) for surface alpha-beta measurements; a Ludlum Model 19 (or equivalent) for ambient exposure rate measurements; or any other

radiation measuring instrument appropriate for the task. Package surveys will be supported by smear sample analyses for removable radioactivity using the Ludlum 3030 alpha-beta sample counter (or equivalent).

5.1 Pre-Survey Instrument Check List

Prior to use of any field instrument, the operation of the probe and survey meter used shall be checked in accordance with SOP's 15.OPS.7 and 15.OPS.08 and 15.OPS.09.

5.2 Package Receipt Surveys

Receipt surveys will be performed on incoming packages and waste shipments known to contain radioactive materials. Where possible, surveys will be conducted in dedicated areas. Survey results shall be recorded in ink on appropriate survey forms, which shall document the following:

- Time and date of the survey
- Technician(s) performing the survey
- Instrument(s) used, with serial number, calibration due date
- Measurement locations, with pictures or drawings as necessary
- Background and efficiency information for the instruments, as appropriate
- Raw measurements, including measurement type and count time (if necessary)

Where necessary, surveys may be documented in a field logbook in the absence of a survey form. Pictures or drawings of equipment, vehicles, or frequently surveyed items may be electronically inserted into the survey form to facilitate documentation.

A minimum of four locations will be measured for removable contamination. The CHDT RSO or designee will determine additional survey requirements as necessary. Specific measurement locations are to be determined at the discretion of the survey technician; however, measurements should be biased toward the most likely areas of contamination to provide conservative survey results.

5.3 Package Integrity Inspection

A visual inspection of the package or container holding radioactive materials will include checking for damage such as signs of crushing, wet spots or evidence of leakage. If any damage is found, the CHDT RSO or designee will be notified immediately, and the package will be segregated from other packages until the extent of damage has been determined. Any damage will be noted on the inspection form. The CHDT RSO or designee will determine what actions need to be taken and any notifications that need to be made to the carrier and regulatory agencies.

5.4 Measurements of Radiation Levels

Radiation levels will normally be measured according to the procedures in SOP 15.OPS.07, Operation of Exposure Rate/ Dose Rate Meters. Radiation levels will be measured on at least two sides of the package.

5.5 Measurements of Removable Contamination

Measurements for removable contamination will normally be performed according to the procedures in SOP 15.OPS.04 Operation of Alpha Beta Counter. Measurements for removable contamination are measured indirectly by the collection of smear or wipe samples. Smears are collected with a 47-millimeter smear filter. Using evenly applied pressure, the smear should be collected with an S-shape over approximately 100 square centimeters. The smear may then be removed from the paper folder, adhered to an aluminum planchet and counted in the alpha-beta sample counter.

6.0 STANDARDS AND CRITERIA

6.1 Data Conversion

For comparison with the measurement criteria listed in Sections 6.2 and 6.3, surface measurements in counts per minute (cpm) must be converted to units of decays per minute per 100 square centimeters (dpm/100cm2). Procedures for data conversion are provided in SOPs 15.OPS.08, Operation of Alpha-Beta Scintillation Detector, and 15.OPS.09, Operation of GM Pancake Probe. The Ludlum 3030 used at CHDT provides measurements in units of dpm.

6.2 Package Receipt Non-Fixed Contamination Levels

Contamination control limits for non-fixed (i.e., removable) surface contamination are established by the Department of Transportation (DOT) in 49 CFR 173.443. These limits are summarized in Table 1.

Table 1 – DOT Non-Fixed Surface Contamination Limits

Radionuclide Group	Maximum Permissible Limit (Bq/cm^2)[a,b]	Maximum Permissible Limit (dpm/cm^2)[a,b]	Maximum Permissible Limit ($dpm/100\ cm^2$)[a,b]
1. Beta and gamma emitters and low-toxicity alpha emitters	0.4	24.0	2,400
2. All other alpha-emitting radionuclides	0.04	2.4	240

(a) Averaged over 300 cm^2
(b) Divided by 10 to account for default efficiency required by 49 CFR 173.443(a)(1)(i)

In addition, there are exposure rate limits associated with different types of shipments. Task-specific direction will be provided by the CHDT RSO or designee regarding these limits.

6.3 Quality Control

In addition to the daily QC measurements required for each individual instrument, survey forms must be reviewed and approved by the CHDT RSO or designee. The frequency of review and approval will be dictated by the frequency of the surveys.

7.0 REFERENCES

49 CFR 173. Shippers – General Requirements for Shipments and Packagings. Current Version.

CO 6 CCR 1007-1 Part 4.32. Procedures for Receiving and Opening Packages.

RADIATION PROTECTION PLAN
FOR
CLEAN HARBORS DEER TRAIL, LLC

15.RPP.01 Revision 3
December 31, 2014

Clean Harbors Environmental Services

108555 East Highway 36

Deer Trail, CO 80105-9611

APPROVALS

By signature below, the undersigned attest that the Radiation Protection Plan (RPP) documented herein meets or exceeds all applicable regulatory requirements for radiological activities at the Clean Harbors Deer Trail (CHDT), LLC RCRA Subtitle C landfill. The RPP is designed to protect employees, the public, and the environment from the potentially harmful effects of exposure to ionizing radiation from radioactive materials disposed in accordance with the limits of License 1102-01. CHDT is committed to meeting all applicable State and Federal regulatory requirements and to keeping worker and public doses from radioactive materials as low as reasonably achievable (ALARA). The license activity addressed by this Plan is the disposal of limited quantities of naturally-occurring radionuclides under 6 CCR 1007-1, Part 14. Because of the site location, the engineered design of the disposal cells, and the low concentrations of radionuclides in the materials to be disposed under the license, the relevant performance objectives will be met.

As part of this Radiation Protection Plan, the Company provides:

- Personnel instruction in radiation safety, as given by safety staff and field supervisors,
- Relevant manuals, installation and test instructions, and Standard Operating Procedures (SOPs) for equipment and activities at the Deer Trail landfill,
- Radiation safety seminars,
- A personnel monitoring system, as required (thermoluminescent dosimeters [TLDs]),
- Gate monitors, radiation monitors, air sampling, and radiation survey meters when required, and
- This Radiation Protection Plan

This RPP has been approved by CHDT corporate staff and CHDT Radiation Safety Officer (RSO).

Approved by:

_____

Phil Retallick - Senior Vice President, Regulatory Affairs

_____

John H (Jack) Kehoe, MS - Facility General Manager

_____

Clyde Christman, RRPT - Radiation Safety Officer

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REFERENCED STANDARD OPERATING PROCEDURES

SOP Number	Title
15.RPP	**Radiation Protection Program**
15.RPP.01	Radiation Protection Plan
15.RPP.02	Radiation Safety Training
15.RPP.03	Worker Protection Records
15.RPP.04	Individual and Area Dosimetry
15.RPP.05	Estimating Inhalation Doses
15.RPP.06	Emergency Response
15.RPP.07	ALARA
15.RPP.08	Radiation Work Permits
15.RPP.09	Personal Protective Equipment
15.RPP.10	Determination of Prior Occupational Dose
15.WAC	**Waste Acceptance and Analysis**
15.WAC.01	Radioactive Materials Acceptance
15.WAC.02	Waste Tracking
15.WAC.03	Survey of Radium Scale Waste[a.]
15.OPS	**Facility and Field Operations**
15.OPS.01	Landfill Operations
15.OPS.02	Waste Treatment Activities
15.OPS.03	Operation of Portable Gamma Spectroscopy Unit
15.OPS.04	Operation of Alpha-Beta Smear Counter
15.OPS.05	Operation of Gate Monitor Detectors
15.OPS.06	Operation of Digital Waste Monitor
15.OPS.07	Operation of Exposure Rate/ Dose Rate Meters
15.OPS.08	Operation of Alpha-Beta Scintillation Detector
15.OPS.09	Operation of GM Pancake Probe
15.OPS.10	Operation of Gamma Scintillation Detectors
15.OPS.11	Routine Contamination Surveys
15.OPS.12	Personnel Contamination Surveys
15.OPS.13	Equipment and Vehicle Release Surveys
15.OPS.14	Spill Surveys

SOP Number	Title
15.OPS.15	Air Monitoring for Radioactive Materials
15.OPS.16	Groundwater Monitoring[a.]
15.OPS.17	Volumetric and Material Sampling
15.OPS.18	Decontamination of Surfaces and Equipment
15.OPS.19	Decontamination of Personnel
15.OPS.20	Handling of Liquids
15.OPS.21	Package Receipt Surveys

[a.] Previously submitted, awaiting comments.

1.0 PURPOSE AND SCOPE

The purpose of this Radiation Protection Plan is to establish all necessary precautions, procedures, and plans to be observed when working directly with radioactive materials during treatment and disposal operations. This plan, supporting policies, and standard operating procedures (SOPs) comprise the Clean Harbors Deer Trail (CHDT) Radiation Protection Program (RPP), and all procedures set forth shall be strictly adhered to, by each and every designated employee, site visitor, or outside contractor who works with and around radioactive materials. It is the responsibility of the CHDT Radiation Safety Officer (RSO) to ensure that all employees, visitors, or outside contractors understand and will comply with the procedures and conditions defined in the RPP.

The procedures and policies in the RPP apply primarily to operations at the CHDT facility. Some of the SOPs are more general in nature and may be used at other Clean Harbors facilities or job sites as directed by the CHDT RSO or other Clean Harbors health and safety personnel.

2.0 ORGANIZATION AND RESPONSIBILITIES

The responsibilities for maintaining radiation safety at the CHDT facility are assigned to the following individuals:

1. CHDT Facility General Manager
2. CHDT RSO
3. CHDT Environmental Compliance Manager
4. CHDT Lab Supervisor
5. CHDT Plant Foreman
6. CHDT Employees

The duties and responsibilities of these individuals are described below.

2.1 Facility General Manager

The Deer Trail General Manager is responsible for overall site operations. He shall ensure that supervisory and operating staff are trained in the procedures and understand them. He shall ensure that the staff have adequate resources to implement the SOPs. He shall ensure that proper procedures are followed. He has the authority to cease operations in the landfill if it becomes evident that the procedures are not being followed or do not achieve their goals. Note that these operations are consistent with those required for RCRA landfill operations, as tailored for the presence of radioactive materials.

2.2 Radiation Safety Officer (RSO)

The CHDT RSO is responsible for directing the CHDT Radiation Protection Program. The RSO is responsible for all aspects of radiation safety and for monitoring compliance with the radiation protection SOPs. He is responsible for: 1) developing the radiation safety SOPs and ensuring that the procedures are adequate to achieve their goals, 2) conducting or supervising the conduct of radiological surveys and monitoring, and 3) keeping appropriate records. He is responsible for implementing the procedures and

modifying or updating the procedures, if needed. He has the authority to cease operations in the landfill if it becomes evident that the radiation protection procedures are not being followed or do not achieve their radiological safety goals. Specifically, the Deer Trail RSO shall:

1. Direct the operations of the staff regarding radiation safety;
2. Be empowered to impose conditions of work, restrictions on work, and termination of work involving regulated waste as necessary to protect personnel, the public, or the environment or to ensure regulatory compliance;
3. Review the Radiation Protection Program at least annually;
4. Serve as the CHDT's point of contact with state and federal regulatory agencies on all matters related to radiation safety;
5. Maintain a personnel dosimetry program, including evaluation of the need for issuance of dosimetry, maintain a contract for commercial dosimetry services, maintain dose records, and provide reports to individuals consistent with Colorado Regulations 6 CCR 1007-1, § 4.56 (Reports of Individual Monitoring);
6. Maintain radiation protection records including approved procedures, amendments, revisions and renewals consistent with Colorado Regulations 6 CCR 1007-1, § 4.40, 4.41, 4.42, 4.44, 4.47, and 4.50;
7. Provide radiation safety training for Company personnel;
8. Provide information and consultation on matters related to radiation safety.

2.3 Environmental Manager

The Environmental Manager shall report issues of environmental radiological noncompliance or other radiological issues to the RSO and the General Manager. (The General Manager is currently filling the position of the Environmental Manager at the time of this application.)

2.4 Lab Supervisor

The Lab Supervisor will supervise all laboratory activities including waste acceptance sampling and analysis. The Lab Supervisor is also responsible for ensuring and documenting quality control in the waste receiving process and all laboratory operations.

2.5 Plant Foreman

The plant foreman shall supervise the operating staff and make sure that proper radiation safety procedures are followed. He shall report any radiological noncompliance to the RSO and General Manager. He shall communicate problems in following the radiation procedures to the RSO and General Manager. He shall request resources to fully implement the SOPs, if needed, from the General Manager. He shall make sure that the operating staff are trained and understand the procedures. He shall suggest modification to the procedures, if needed.

2.6 Deer Trail Employees

Each CHDT employee who works with radioactive materials as outlined in this plan shall take responsibility for his or her own protection and for reporting any condition, which, in the individual's opinion, constitutes unsafe or improper working conditions. Each individual is responsible for:

1. Maintaining their own exposures to radioactive materials ALARA;
2. Following procedures and accepted safe work practices so as not to endanger him or her, the public, or the environment;
3. Reporting any unsafe working conditions, violations of the rules prescribed in this document, or violations of the applicable regulations of the state to their supervisor and/or to the CHDT RSO and;
4. Employees who may serve as visitor escorts shall point out any hazardous area that a visitor may be entering and shall ensure that all Company radiation safety rules and precautions are observed.

3.0 CONTROL AND LIMITATION OF RADIATION EXPOSURES

State and federal regulations establish a system of radiation dose justification, limitation and optimization. Individual doses are limited to ensure that immediate, deterministic effects (such as radiation burns, or skin erythema) are avoided and that total lifetime risks of chronic or stochastic effects (such as cancer and hereditary effects) do not exceed overall health risks for those persons working in safe industries. However, regulations also require that licensees further minimize radiation doses to individuals and to groups of individuals to the extent practical, which is known as the ALARA philosophy.

3.1 Radiation Dose Limits

For exposure to radioactive materials, CHDT workers shall be considered as occupational radiation workers, subject to a total effective dose equivalent (TEDE) of 5,000 millirem per year (mrem/yr) per 6 CCR 1007-1, § 4.6 in the Colorado regulations for radiation control. However, CHDT intends to maintain radiation exposures to its workers at levels ALARA, with a goal of 25 mrem/yr TEDE or less. Employee doses, both internal and external, shall be evaluated by the RSO on a quarterly basis. If it is determined from worker dosimetry results that selected worker doses could exceed 25 mrem/yr, the RSO shall conduct an evaluation of the potential for other occupational exposures for these workers to ensure that maximum individual doses shall not exceed 5,000 mrem/yr.

3.2 Planned Special Exposures

The provisions of 6 CCR 1007-1, § 4.11 allow licensees to authorize an adult worker to receive doses in addition to and accounted for separately from the doses received under normal conditions. These provisions relate to the occupational dose limits of 5,000 mR/yr plus ALARA. However, because of the limited concentrations of radioactive materials to be treated and disposed under the license, it is highly unlikely that exposure situations will arise that could require imposition of these provisions. When special conditions are encountered that may result in significant worker exposures, exposure rates, contamination levels, and potential exposure conditions shall be determined,

documented, and discussed in advance of performing the activity using SOP 15.RPP.08, *Radiation Work Permits*. The CHDT RSO shall evaluate the survey data and evaluate which controls will be required for a specific task. The CHDT RSO will gather and maintain information regarding Prior Occupational Dose in accordance with the requirements of SOP 15.RPP.10, and institute administrative controls regarding planned special exposures for individuals if needed.

3.3 Protection of the Embryo/Fetus

The provisions of 6 CCR 1007-1, § 4.13 require licensees to ensure that the dose equivalent to an embryo/fetus during the entire pregnancy, due to the occupational exposure of a declared pregnant woman, does not exceed 500 mrem, with monitoring requirements imposed under § 4.18 for those that could be exposed in excess of 100 mrem. Declared pregnant worker exposures shall be tracked and reported under the CHDT SOPs, evaluated by the CHDT RSO, and information about protection of the embryo/fetus shall be included in the CHDT training, as outlined in SOP 15.RPP.02, *Radiation Safety Training*.

3.4 Posting

Because of the anticipated low dose rates (average dose rates of less than 0.1 mrem/hr), there should be no need for posting radiation areas because of dose rates. However, posting shall be required where radioactive materials are treated or disposed. This shall include areas within the lab, treatment building, and the landfill disposal cells.

3.5 Routes of Exposure

Exposures to radioactive materials may be received from radiation fields that are external to the body (external exposure), from radioactive materials that are inside the body (internal exposure following inhalation), or both. Inhalation of dust particles is the primary potential route of internal exposure.

3.6 Respiratory Protection

Exposure of workers to airborne radioactive materials shall be controlled through the use of full-face respirators that filter airborne particulate materials. These masks are required under the RCRA Permit as part of the CHDT Health and Safety Plan for in-cell disposal operations, waste sampling operations, and all operations in the treatment building. These masks are NIOSH-approved for particulates under the 42 CFR 84 P100 classification and are 99.7% efficient in removing particles of 0.3 microns or greater in diameter. As described in 6 CCR 1007-1, § 4, Appendix A, these respirators have a respiratory protection factor of 50. An evaluation was conducted per the guidance in 6 CCR 1007-1, § 4.24.2.1 to determine the adequacy of this mandatory respiratory protection equipment. For this evaluation, natural uranium, with a specific activity of 2,000 pCi/g was assumed with the most restrictive DAC (i.e., Class Y material, with a value of 2E-11 µCi/mL in air). For dusty outdoors operations, air concentrations range from about 100 to 500 $\mu g/m^3$ (NUREG/CR-5512; Kennedy and Strenge 1992). Assuming a conservative, long-term air concentration of 500 $\mu g/m^3$, the estimated activity concentration is air is 1E-12 µCi/mL. This concentration is about 5% of the DAC, which supports the conclusion that the respiratory protection would not be needed

for protecting CHDT workers from airborne particulate radioactive material. However, since this equipment is mandatory under the RCRA Permit, further assurance is provided that worker inhalation exposures will be quite low. Procedures for estimating airborne concentrations are provided in SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*. The procedure for estimating worker inhalation doses is provided in SOP 15.RPP.05, *Estimating Inhalation Doses*. Procedures for recording those doses, on a quarterly and annual basis, are detailed in SOP 15.RPP.04, *Individual and Area Dosimetry*.

3.7 Determination of Internal Exposure

Per 6 CCR 1007-1, § 4.9, estimates of internal exposure shall be made using the measured airborne concentrations at appropriate work locations to perform an assessment of the committed effective dose equivalent (CEDE). Procedures for estimating airborne concentrations are provided in SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*. These airborne concentration estimates shall be used as described in SOP 15.RPP.05, *Estimating Inhalation Doses* and worker inhalation doses recorded on an annual basis, as described in SOP 15.RPP.04, *Individual and Area Dosimetry*. Because of the relatively low concentrations of radioactive materials to be disposed, and because of the use of mandatory respiratory protection under the RCRA Permit, no bioassays will be conducted.

3.8 Means of Exposure Control

Common external exposure controls include the use of time, distance, and shielding to minimize radiation doses. These concepts are thoroughly presented in CHDT radiation safety training courses but should also be continually reinforced by field personnel through daily or weekly radiation safety briefings. Common control measures to reduce inhalation exposures include the use of protective equipment and engineering controls. Personal protective equipment (PPE) required under the RCRA Permit, including disposable coveralls, gloves, and boot covers, provide protection against skin contamination. Required protective equipment used in these operations is detailed in SOP 15.RPP.09, *Personal Protective Equipment,* the CHDT Facility Health and Safety Plan, and other corporate procedures. Engineering controls utilized to control exposure include dust control measures in the landfill cell and the air filtration system in the treatment building.

3.9 Minors

Minor visitors to the facility shall be escorted within the site and shall not be allowed in restricted areas. Minors are not employed at the CHDT facility.

3.10 Waste Tracking

All waste that is received, treated, and disposed at the CHDT facility is tracked through operational procedures, largely developed for the RCRA permit. These procedures are provided in SOP 15.WAC.02, *Waste Tracking*, which defines the procedures, electronic files, hardcopy forms and their use in tracking waste at CHDT.

4.0 RADIATION DOSIMETRY

The purpose of the radiation dosimetry program is to measure radiation dose equivalent received by Deer Trail employees during the handling and disposal of regulated waste. The results serve to verify and document compliance with the applicable dose limits (see Section 3) and to identify problems and monitor the effectiveness of radiation safety controls. Radiation doses may be received in two ways: 1) from radioactive materials that are external to the body (external dose) or 2) from radioactive materials that are inside the body (internal dose). These doses shall be monitored when required by regulation and as described below:

4.1 External Radiation Dosimetry

Radiation dosimeters shall be issued by the CHDT RSO and worn by individual workers, visitors, and outside contractors who have been appropriately trained and who may routinely come into contact with or are in the proximity of, radioactive materials, consistent with 15.RPP.04, *Individual and Area Dosimetry*.

4.2 Internal Radiation Dose Assessment

Consistent with the 6 CCR 1007-1, § 4.9 (Determination of Internal Exposure), for purposes of assessing internal radiation doses from the inhalation of airborne radioactive materials, suitable and timely measurements of the concentrations of airborne materials in workplace air shall be made and recorded. Airborne concentrations shall be determined consistent with SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*. These airborne concentrations, in combination with estimates of the duration of exposure and the impact of respiratory controls (as appropriate), with assumptions about the physical and chemical nature of the airborne regulated waste, shall be used to assess internal dose to workers from inhalation, in accordance with SOP 15.RPP.05, *Estimating Inhalation Doses*.

5.0 RECORDS

All records of exposure, internal and external, are legal and personal documents and shall be controlled to preclude release of personnel information. All radiation protection records including individual worker records, approved procedures, amendments, revisions and renewals shall be maintained consistent with the Colorado Regulations 6 CCR 1007-1, § 4.40, 4.41, 4.42, 4.44, 4.47, and 4.50.

6.0 RADIATION SURVEYS AND INSTRUMENTATION

Radiation surveys are used to identify and quantify radiation hazards, verify contamination control, and to support the documentation of regulatory compliance. The CHDT RSO and all field personnel must work together to ensure safety in the workplace and to protect both the public and the environment from the harmful effects of radiation.

6.1 Types of Surveys

Several types of radiation surveys shall be performed supporting specific operations at CHDT. In summary, these include:

1. Waste Receipt – surveys shall be conducted to verify that incoming radioactive materials will meet the CHDT waste acceptance criteria and do not present an exposure or contamination concern. The surveys shall include:
   a. Screening at the facility gate for gamma radiation per SOP 15.OPS.05, *Operation of Gate Monitor Detectors*.
   b. Qualitative gamma spectroscopy screening, per SOP 15.OPS.03, *Operation of Portable Gamma Spectroscopy Unit*.
   c. Removable contamination surveys, per SOP 15.WAC.01, *Waste Acceptance*, and 15.OPS.04, *Operation of Alpha-Beta Smear Counter*.
2. Contamination surveys for different areas at the facility, per SOP 15.OPS.11, *Routine Contamination Surveys*.
3. Personnel contamination surveys using SOP 15.OPS.12, *Personnel Contamination Surveys*.
4. Spill response surveys using SOP 15.OPS.14, *Spill Surveys*.
5. Equipment contamination surveys using SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*.

Surveys may be conducted with portable, stationary, or laboratory survey equipment. Individual SOPs for the use of each type of instrument are to be referenced prior to their use.

6.2 Requirements on Maintaining Radiation Detection Instrumentation

The CHDT RSO shall ensure that the facility maintains radiation detection equipment that is appropriate for detecting the types of radiation emitted by radioactive materials received for disposal. All radiation detection instruments shall be calibrated, as appropriate for the use of the instrument, or after repair of the instrument, to the manufacturer's specifications. Battery replacement is not cause for performing a calibration.

On each day of use, a quality control check using a check source of known radioactivity will be performed for each instrument. In addition, a background measurement will be collected. These measurements will be compared against established operating parameters to verify that the instrument is operating appropriately and consistently.

7.0 TRAINING

All CHDT employees, visitors, and outside contractors who work with or near regulated waste are required to complete radiation safety training, as described in SOP 15.RPP.02, *Radiation Safety Training*. The depth of the training shall be commensurate with the level of hazard to which the individual is exposed. All training shall be documented. No individual shall be allowed to work unsupervised until that person completes appropriate radiation safety training.

7.1 Basic Radiation Safety Training

All individuals who work with radioactive materials are required to satisfactorily complete appropriate radiation safety training course offered by or at the direction of the CHDT RSO and/or demonstrate competence on that subject matter by scoring at least 70% on a test administered or directed by the CHDT RSO. CHDT RSO-provided refresher training shall be conducted at least once each year for all individuals who work with radioactive materials. All training shall be documented and maintained on file by the CHDT RSO. Training documentation shall include content of the training (outline, course description, etc.); instructor name; date and duration of training; and the printed name and signature of trainee(s). Copies of individual employee training records are available from the CHDT RSO. Visitors who work with radioactive materials shall be required to complete training similar to that of employees. Visitors who will not be working with radioactive materials but who will enter restricted areas shall be required to be escorted at all times and undergo basic training commensurate with their potential exposure.

7.2 Hazard Communication Program

The CHDT facility has a hazard communication program as part of the Facility Health and Safety Plan maintained under the RCRA Permit. The hazard communication program utilizes waste profiles, MSDS's, labels and formal training to inform employees of any hazards of the waste materials with which they will be working. The hazard communication program shall be utilized to convey information on the specific hazards of regulated waste handled at the facility.

8.0 INCIDENTS AND EMERGENCIES

General procedures for dealing with emergency situations such as spills or accidents are detailed in the CHDT RCRA Permit Attachment 4, "Contingency Plan." The Contingency Plan contains procedures for spill cleanup, notification of authorities, and other responses. It also provides a description of the equipment and staff available to deal with such situations. In addition, SOP 15.RPP.06, *Emergency Response,* provides additional direction on emergency response activities after an incident involving radioactive materials. In the event of a radiological incident, such as a spill or other emergency, the CHDT RSO shall be notified immediately. In instances where there is doubt about whether such notification is necessary, contact should be made to allow the CHDT RSO to assess the situation and initiate the appropriate response. If appropriate, the measures described in SOP 15.RPP.06 and the Contingency Plan shall be implemented. Radiation surveys following spills of regulated waste shall be conducted according to SOP 15.OPS.14, *Spill Surveys*.

What Constitutes an Incident or Emergency?

1. Loss, theft, or misuse of any radioactive material.
2. High or potentially high radiation exposure to an individual or to a member of the public; for example greater than 10 mrem to any offsite member of the public from an incident.

3. Intake or potential intake of radioactive materials by inhalation, ingestion, or injection through skin or wound.
4. Deceptive or potentially deceptive exposure of a dosimeter.
5. Personnel contamination that cannot be completely removed after three washes with only soap and water.
6. Any personnel injuries that may involve radioactive contamination or radiation exposure.

9.0 RECORD KEEPING

Record-keeping requirements vary and are maintained along with actual records by the Deer Trail RSO consistent with Colorado Regulations 6 CCR 1007-1, § 4.40, 4.41, 4.42, 4.44, 4.47, and 4.50. Record keeping requirements are provided in SOP 15.RPP.03, *Worker Radiation Protection Records*.

9.1 General Record-Keeping Requirements

1. The CHDT RSO shall maintain the following records in a clear, concise, and orderly format. Retention periods are included in parentheses.
   a. Radiation surveys, as required (3 years)
      i. Radiation field surveys for areas in proximity to regulated waste for disposal,
      ii. Ambient radiation field surveys in unaffected areas, and
      iii. Contamination surveys for release of trucks and equipment.
   b. Survey instrument calibrations, as required by the manufacturer (3 years)
   c. Personnel records (1 year post termination of employment)
      i. Worker/user lists,
      ii. Training records.
   d. Individual monitoring results, for routine, planned special exposures, accidents, and emergency conditions as provided by the CHDT Standard Operating Procedure on Individual and Area Dosimetry (duration of license)
   e. Records of waste disposal as required by regulation
   f. Annual ALARA program audits (duration of license)
   g. Incident investigation reports (duration of license)
   h. Declarations of pregnancy (duration of license)
   i. Environmental monitoring data and reports (duration of license)
   j. Operating and emergency procedures (current)
   k. Procedure manuals from CHDT RSO (current)

2. In addition to maintaining all records in step 1, the Deer Trail RSO shall maintain the following records, which are available for review during normal office hours.
   a. Copies of current state regulations relating to regulated waste,
   b. Inspection reports and copies of all "Notices of Violation" issued by state regulatory agencies and the Deer Trail responses to those Notices,
   c. Current version of all policy manuals and standard operating procedure manuals,
   d. Dosimetry records, and
   e. Survey instrument calibrations records.

9.2 Information Required on Specific Records

1. Radiation surveys
   a. Records shall be in units of dpm, Ci, µCi, mR/h, mrem/h, etc., as appropriate. Units of "cpm" or "counts" are not acceptable for quantitative survey records,
   b. Records shall clearly indicate the areas surveyed,
   c. Records shall indicate the person performing the survey and date of survey, and
   d. Records shall uniquely identify the survey instrument used, i.e., serial number, or other unique description.
2. Training records are specified in Section 6.

9.3 Audits

The CHDT RSO or designee will conduct periodic informal audits of the CHDT RPP throughout the year. A formal audit of the program will be conducted annually to coincide with the ALARA audit performed for the Annual Report. The audit will identify any items of concern, any equipment needs, or any other issue impacting the program.

10.0 GLOSSARY OF TERMS

"Absorbed dose" means the energy imparted by ionizing radiation per unit mass of irradiated material. The unit of absorbed dose is the Rad.

"Activity" means the rate of disintegration or transformation or decay of radioactive material. The units of activity are "disintegrations per second (or minute)" (dps or dpm) and curie (Ci).

1 Ci = 37,000,000,000 dps (3.7E10 dps)

1 Ci = 2,220,000,000,000 dpm (2.22E12 dpm)

"Agreement State" means a state that has executed an agreement with the U.S. Nuclear Regulatory Commission transferring to the state the responsibility for regulating uses of certain radioactive materials within its borders. Colorado is an agreement state.

"Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, particles, mists, vapors, or gases.

"As low as reasonably achievable (ALARA)" means making every reasonable effort to maintain exposures to radiation as far below regulatory dose limits as is practical, consistent with the purpose for which the licensed or registered activity is undertaken, taking into account the state of technology, the economics of improvements in relation to benefits to public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of ionizing radiation and licensed sources of radiation in the public interest.

"Background radiation" means radiation from cosmic sources; non-technologically enhanced naturally occurring radioactive material, including radon, except as a decay product of source or special nuclear material, and including global fallout as it exists in the environment from the testing of nuclear explosive devices. "Background radiation" does not include sources of radiation from radioactive materials regulated by the State of Colorado.

"Committed dose equivalent (HT, 50 or CDE)" means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

"Committed effective dose equivalent (HE,50 or CEDE)" means the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues.

"Curie (Ci)" means a unit of measurement of activity. One curie (Ci) is that quantity of radioactive material that decays at the rate of 3.7E10 disintegrations per second (dps). Commonly used sub-multiples of the curie are the millicurie, the microcurie, the nanocurie, and the picocurie.

"Dose" is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, total organ dose equivalent, or total effective dose equivalent.

"Dose equivalent (HT)" means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are rem or mrem.

"Dosimeter" means devices designed to be worn by a single individual for the assessment of dose equivalent. Examples of individual monitoring devices are film badges, thermoluminescent dosimeters (TLDs), and pocket ionization chambers.

"Effective dose equivalent (HE)" means the sum of the products of the dose equivalent to each organ or tissue (HT) and the weighting factor (WT) applicable to each of the body organs or tissues that are irradiated.

"Exposure rate" means the exposure per unit of time, typically milliRoentgens per hour (mR/h) or microRoentgens per hour (µR/h).

"External dose" means that portion of the dose equivalent received from any source of radiation outside the body.

"Internal dose" means that portion of the dose equivalent received from radioactive material taken into the body.

"Ionizing radiation" means any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter. Ionizing radiation includes gamma rays and x rays, alpha and beta particles, high-speed electrons, neutrons, and other nuclear particles.

"Lost or missing source of radiation" means a source of radiation whose location is unknown. This definition includes licensed material that has been shipped but has not reached its planned destination and whose location cannot be readily traced in the transportation system, and sources that may be detected and recovered by the Deer Trail gate monitors.

"Natural radioactivity" means radioactivity of naturally occurring nuclides whose location and chemical and physical form have not been altered by man.

"Quality factor (Q)" means the modifying factor that is used to derive dose equivalent from absorbed dose, per the table below:

Radiation	Quality Factor
Beta	1
Gamma	1
X-ray	1
Alpha	20
Neutron	Varies from 3 to 10

"Rad" means the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs per gram.

"Radiation" means one or more of the following:

(1) gamma and x-rays, alpha and beta particles, and other atomic or nuclear particles or rays; or

(2) stimulated emission of radiation from any electronic device to such energy density levels as to reasonably cause bodily harm.

"Radiation Safety Officer (RSO)" is an individual, designated by the Company, who has the required training, knowledge authority and responsibility to apply appropriate radiation protection rules, standards, and practices.

"Rem" means the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor.

"Roentgen (R)" means the special unit of exposure. One roentgen (R) equals 2.58E-4 coulombs/kilogram of air.

"Sealed source" means radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions that are likely to be encountered in normal use and handling.

"Survey" means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, and/or presence of sources of radiation. When appropriate, such evaluation includes, but is not limited to, tests, physical examination of location of materials and equipment, and measurements of levels of radiation or concentration of radioactive material present.

"Technologically Enhanced Naturally Occurring Radioactive Material (or TENORM)" means naturally occurring radioactive material whose radionuclide concentrations are increased by, or as a result of, past or present human practices. "TENORM" does not include:

(a) Background radiation or the natural radioactivity of rocks or soils;

(b) "Byproduct material" or "source material," as defined by Colorado statute or rule; or

(c) Enriched or depleted uranium as defined by Colorado or federal statute or rule

"Total effective dose equivalent (TEDE)" means the sum of the deep dose equivalent (DDE) for external exposures and the committed effective dose equivalent for internal exposures.

TEDE = DDE + CEDE

"Whole body" means, for purposes of external exposure, head, trunk (including male gonads), arms above the elbow, and legs above the knees.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.02
RADIATION SAFETY TRAINING

1.0 OBJECTIVE

To define general and specific radiation safety training requirements for employees at the Clean Harbors Deer Trail (CHDT) facility or other temporary job sites to ensure that workers can safely work with radioactive materials.

2.0 SCOPE

This standard operating procedure (SOP) applies to all workers who may be exposed to radioactive materials brought onsite. Additional radiation safety training beyond the scope of this procedure may be prescribed by the CHDT Radiation Safety Officer (RSO) as necessary.

3.0 POLICY

All workers who may potentially be exposed to radioactive materials at the CHDT landfill or other job sites shall attend a General Employee Radiation Protection Training course and refresher training each year, and demonstrate competence by scoring at least 70% on a test administered or directed by the CHDT RSO or designee.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 RADIATION SAFETY TRAINING PROCEDURE

5.1 Criteria for Determining Radiation Safety Training Requirements

Training requirements are based on job descriptions and types of areas that workers are required to access to perform their assigned duties. Training may be adjusted to be commensurate with the individual's job category, assigned duties, and previous training and experience. All CHDT workers who may be exposed to radioactive materials as part of their routine employment shall be part of the General Employee Radiation Protection Training program. The following factors shall be considered to determine the appropriate level of knowledge and training for individual CHDT workers:

- The individual's job assignment (i.e., activities in or near the weight station, waste sampling and analysis operations, waste treatment facility when radioactive materials could be present, and disposal cell operations),

- The nature of the radiation hazards that could be present (dependent on waste form, type of treatment if any, and disposal configuration), and
- The type and complexity of any protective actions that the individual might be expected to execute (i.e., the need to limit the duration of an activity, provide temporary shielding, or observe special procedures for some types of radioactive materials). Note that workers in the CHDT landfill are required to wear personal protective equipment (PPE) and respiratory protection under the Resource Conservation and Recovery Act (RCRA) Permit.

5.2 Training Requirements for Radiation Workers

General employees whose job assignments indicate the potential for exposure to radioactive materials shall receive the General Employee Radiation Protection Training prior to conducting those assignments. The CHDT RSO is responsible for ensuring that all workers receive the appropriate training before conducting their assigned duties.

5.3 Training for Site Visitors or Contractors

Visitors or contractors who work with radioactive materials at the CHDT landfill or who enter areas restricted because of the presence of radioactive materials shall complete a radiation safety briefing and shall be escorted by trained CHDT staff.

5.4 Evaluating the Adequacy of Current Training for Individual Workers

The CHDT RSO shall:

- Ensure that all new hires who will work with radioactive materials receive the General Employee Radiation Protection Training followed by annual refresher courses.
- Periodically check the training records and determine current levels of Radiation Protection Training for individual workers and their training expiration dates to ensure that workers are adequately trained.
- Compare the individual's current training to the required training, especially in cases where workers change job assignments.
- Ensure that special periodic retraining occurs in the event of changes to CHDT policies, procedures, and practices that affect radioactive material disposal.

5.5 Training Records

Records certifying completion of each part of the required training shall be maintained as part of the CHDT records retention program and within each individual worker's employment file, as required by SOP 15.RPP.03, *Worker Radiation Protection Records*.

6.0 TRAINING SYLLABUS

Radiation safety training for CHDT workers will be commensurate with their responsibilities. Training course and quiz content are revised annually to reflect areas of improvement identified through observation and evaluation conducted by the RSO. The CHDT General Employee Radiation Protection Training program shall cover radiation safety basics, and is required for all workers performing activities with radioactive materials. Additional training in site operations, SOPs, and the application and use of radiation survey instruments comprise the remainder of the program that may be required based on the job responsibilities of the employee.

7.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.03
WORKER RADIATION PROTECTION RECORDS

1.0 OBJECTIVE

To define general and specific worker radiation protection records that shall be generated and maintained for Clean Harbors Deer Trail (CHDT) employees who may be exposed to radiation and radioactivity from site activities.

2.0 SCOPE

This standard operating procedure (SOP) applies to all worker radiation protection records generated for workers at the CHDT facility. These records include, but are not limited to, the following:

- Sign-in sheets for training sessions
- On-the-job training records
- Annual dosimetry records and dose calculations
- Historical individual dose records
- Personnel decontamination forms
- Memoranda to file regarding worker exposure

3.0 POLICY

All records of exposure, internal and external, are legal and personal and shall be controlled to preclude release of personnel information to non-authorized personnel. All radiation protection records including individual worker records, approved procedures, amendments, revisions and renewals shall be maintained consistent with the Colorado Regulations 6 CCR 1007-1, § 4.40, 4.41, 4.42, 4.44, 4.47, and 4.50. Individual forms are subject to change as needed. Records retention requirements will remain unchanged.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

Approved by:		
	General Manager	Radiation Safety Officer

5.0 WORKER RADIATION PROTECTION RECORDS PROCEDURE

5.1 Requirements

Record keeping requirements are defined in the RPP, including identified retention periods. The CHDT RSO shall maintain records in a clear, concise, and orderly format. Retention periods are included in parentheses.

5.2 Training

The CHDT RSO shall ensure that all staff radiation protection training records are dispositioned, controlled, and maintained as described in this procedure:

- Upon completion of the training roster form, it shall be checked for completeness, accuracy, and legibility before disposition:
- Ensure the form has been signed and dated,
- Ensure that changes to the document are legible, with a simple line through deletions, and clearly printed inserts. All deletions and insertions shall include the initials of the individual making the changes.
- Training forms shall be filed as part of the CHDT Administrative filing system and shall include:
- Course title, name of instructor, and date(s) of training,
- Course completion rosters,
- Test scores for each class member, and
- Documentation of any waivers, exceptions, or extensions.

5.3 Individual and Area Dosimetry Results

The Deer Trail RSO shall ensure that all individual worker and area dosimetry results obtained using SOP 15.RPP.04, *Individual and Area Dosimetry*, are recorded and filed in the Deer Trail Administrative filing system:

- Individual dosimetry results shall be filed in each worker's personnel file
- Area dosimetry results shall be filed in a separate administrative file so that trending analyses over time can be performed.

5.4 Individual Radiation Doses

The Deer Trail RSO shall ensure that all individual worker quarterly and annual radiation doses obtained using the SOP 15.RPP.04, *Individual and Area Dosimetry*, and SOP 15.RPP.05, *Estimating Inhalation Doses*, are recorded on the appropriate forms and filed in the CHDT Administrative filing system. Individual radiation dose results shall be filed in each worker's personnel file.

Approved by:		
	General Manager	Radiation Safety Officer

6.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.RPP.04

INDIVIDUAL AND AREA DOSIMETRY

1.0 OBJECTIVE

To describe the procedures for conducting individual and area dosimetry for worker and environmental exposures associated with the Clean Harbors Deer Trail (CHDT) landfill.

2.0 SCOPE

This standard operating procedure (SOP) applies to CHDT workers who may be exposed to radioactive materials and for identified areas within and in the immediate area around the CHDT landfill.

3.0 POLICY

Individual and area monitoring shall be performed to verify that radiation doses to CHDT workers and members of the public are maintained as low as reasonably achievable (ALARA), with an ALARA total effective dose equivalent (TEDE) goal of 25 millirem per year (mrem/yr). All full-time CHDT staff that have undergone the radiation safety training are considered to be radiation workers and are subject to the occupational dose limit of 5,000 mrem/yr per 10 CFR 20.1201.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 INDIVIDUAL DOSIMETRY PROGRAM

5.1 Dosimeter Issue

Personnel with the potential to receive > 100 millirem/yr. or working in the proximity of radioactive materials, shall be issued and wear an individual dosimeter. Additional personnel may also be issued dosimeters at the discretion of the CHDT RSO or designee. Dosimeters are issued to only one person and shall not be shared. The individual dosimeters shall be worn at the location on the body likely to receive the highest dose, consistent with manufacturer specifications, which is typically on the chest area or between the waist and the neck, underneath the outside layer of PPE, if worn. Lost or damaged dosimeters shall be reported to the CHDT RSO as soon as possible. Persons who have lost or damaged their dosimeters shall be required to provide documentation of work activities and radiation exposures as necessary for the CHDT RSO to assess doses. Individual dosimeters shall be issued only to personnel formally instructed in their use, and those dosimeters shall be worn only by those to whom the dosimeters were issued.

In addition, dosimeters shall not be:

a. Removed from the CHDT facility;

b. Deceptively exposed;

- Employees shall notify the Deer Trail RSO immediately upon learning of possible deceptive exposures of dosimeters.
- Intentional deceptive exposures of dosimeters are forbidden and may result in reprimands or termination of employment.

c. Stored near radiation sources;

d. Exposed to high heat, chemical or physical insults, or washed in a washing machine; or,

e. Worn during or after medical administration of radioactive materials (thyroid ablation therapy, cardiac stress tests, diagnostic nuclear medicine tests, etc.) until approved by the CHDT RSO.

5.2 Changes in Worker Job Status

If a worker's job status changes, the CHDT RSO shall:

a. Remove the employee from the individual dosimeter program if the employee has terminated employment or if the employee's job has changed such that the worker is no longer in the proximity of radioactive materials.

b. Add an employee to the individual dosimeter program if the employee's job has changed such that the worker will now be working in the proximity of radioactive materials.

5.3 Non-occupational Radiation Doses

a. Dosimeter users:

- Are responsible for ensuring that dosimeters are not exposed to non-occupational sources of radiation (e.g., medical or security x-ray devices, therapeutic medical sources, or radiation from medical radionuclides injected into the body).
- Shall notify the CHDT RSO prior to receiving medical injections of radionuclides.
- Shall notify the CHDT RSO if their dosimeter is exposed to non-occupational radiation sources.

b. The CHDT RSO shall:

- Determine a course of action that shall prevent exposure of an individual dosimeter and problems with personnel surveys for employees who report receiving medical injections of radionuclides.

- Will investigate the cause of the exposure from non-occupational sources and determine the corrections that are necessary for recording the employee's radiation dose.

5.4 Quarterly Dosimeter Exchange

Personnel dosimeter badges will be exchanged quarterly. Employees shall return used dosimeters to the CHDT RSO promptly after receiving replacement dosimeters at the beginning of a new wear period. The CHDT RSO shall:

a. Be responsible for establishing a program for dosimeter exchange, processing (consistent with the manufacturer's specifications), and recording and reporting of the results.

b. Ensure dosimeters are exchanged on a quarterly basis, unless the CHDT RSO or his designee determines a change in exchange frequency is warranted to ensure radiation doses to workers and the public are maintained ALARA.

c. Verify that all dosimeters are exchanged and either note that dosimeters are in good condition or note the damage if they are not.

d. Note the actual date of dosimeter exchange.

e. Verify that all dosimeter results are recorded.

f. Modify the annual doses to include potential inhalation doses, as estimated using the CHDT 15.RPP.05, Estimating Inhalation Doses.

g. Develop and report all dose results to the employees on an annual basis.

h. Serve as the CHDT point of contact for individual dosimetry issues.

i. Ensure that individual worker doses are recorded, by quarter and annually using the form in Attachment 1 (or equivalent), and maintained in their personnel file.

j. Ensure that the doses to declared pregnant workers are tracked on the dosimetry forms in Attachments 1 and 2 (or equivalent) and maintained at levels not to exceed 500 mrem during the pregnancy, plus ALARA.

k. Ensure that a corporate record of worker doses, by quarter and annually, including doses to declared pregnant workers, is developed using the form in Attachment 2 (or equivalent) consistent with the CHDT records management procedures.

5.5 Data Evaluation

The RSO shall review all dosimetry records on a quarterly and annual basis and shall:

a. Perform a dosimetry investigation if a worker's dosimeter cannot be read, is lost, has an anomalous result, or equals or exceeds an administrative control level of 25 millirem in any quarter.

b. Evaluate the work duties for individual workers whose annual radiation dose equals or exceeds 100 millirem/yr to reduce their exposure to radioactive materials.

c. Monitor annual worker radiation doses against the ALARA goal and take appropriate measures, such as modifying job assignments or specific work procedures, when this goal is challenged.

5.6 Record Requests

Any person who was issued and wore a dosimeter may request a copy of his or her dosimetry records at any time. These records are maintained by and are available from the CHDT RSO upon written request. All contact with the dosimetry service provider is to be made through the CHDT RSO.

5.7 Employment Termination Dose Report

After termination of employment, a dose report (termination report) shall be provided to anyone who was issued and wore a dosimeter. This report shall be provided using the latest copy of Attachment 1 (or equivalent) found in the employee's personnel file, updated to show doses through the date of employment termination.

6.0 AREA DOSIMETRY PROGRAM

6.1 Program Requirements

Dose rates shall be measured on a fequency determined by the CHDT RSO, using special-issue dosimeters in locations:

a. Where workers are routinely in the proximity of bulk radioactive materials, such as the weight station and disposal cell,

b. Where it is unlikely that radioactive materials would be present such as the change room, lunch room, and maintenance areas, and

c. Remote from radioactive materials that will record the ambient background.

6.2 Responsibilities

The CHDT RSO shall:

a. Determine the number and location of the area dosimeters in and around the CHDT landfill and provide a facility map indicating the location of each area dosimeter.

b. Ensure that each identified location has at least one area dosimeter.

c. Maintain a map of the location of each dosimeter.

d. Ensure that area dosimeters are placed 1 to 1.5 meters (40 to 60 inches) above the ground or floor level.

e. Provide protection for area dosimeters against heat, moisture, and direct sunlight.

f. Exchange the dosimeters on a basis as determined by the CHDT RSO.

g. Maintain records for each area dosimeter location.

h. Note any special conditions including tampering, damage, or loss of dosimeter, in the records.

i. Investigate any missing or damaged dosimeters.

j. Resolve anomalous data, and track and trend data for routine annual and other special reports, as required.

k. Serve as the point of contact for area dosimetry issues. Ensure that a corporate record of area radiation doses is developed using the form provided as Attachment 4 (or equivalent) and maintained consistent with SOP 15.RPP.03, *Worker Protection Records*.

7.0 REFERENCES

10 CFR 20.1201. *Occupational Dose Limits for Adults.* Current Version.

ATTACHMENT 1 – EXAMPLE ANNUAL INDIVIDUAL DOSIMETRY RECORD

Clean Harbors Deer Trail LLC
ANNUAL INDIVIDUAL DOSIMETRY RECORD

Individual _____ Payroll No. _____ Year _____

Was this individual a declared pregnant worker during the calendar year? ☐ Yes ☐ No

Exchange Dates for Calendar Year _____ (a)	From/To:	From/To:	From/To:	From/To:	
Individual/ (Dosimeter No.)	1st Quarter Dose Rate (millirem)	2nd Quarter Dose Rate (millirem)	3rd Quarter Dose Rate (millirem)	4th Quarter Dose Rate (millirem)	Annual Total Dose Rate (millirem)
Exchange Dates for Calendar Year _____ (a)	From/To:	From/To:	From/To:	From/To:	
Individual/ (Dosimeter No.)	1st Quarter Dose Rate (millirem)	2nd Quarter Dose Rate (millirem)	3rd Quarter Dose Rate (millirem)	4th Quarter Dose Rate (millirem)	Annual Total Dose Rate (millirem)

(a) Enter year of employment and provide exact dates for those employees whose deployment and exchange dates differ from the company standard.

Comments: (add additional pages, if necessary)

For declared pregnant workers, note the duration of the pregnancy relative to the recorded quarters.

Annual Log Completed By:	Annual Log Reviewed By:
Name (Print) _____	Name (Print) _____
Signature _____	Signature _____

ATTACHMENT 2 – EXAMPLE ANNUAL WORKER DOSIMETRY LOG

Clean Harbors Deer Trail LLC
ANNUAL WORKER DOSIMETRY LOG

Exchange Dates[(a)]	From/To:	From/To:	From/To:	From/To:	
Individual Name/ (Dosimeter No.)	1st Quarter Dose Rate (millirem)	2nd Quarter Dose Rate (millirem)	3rd Quarter Dose Rate (millirem)	4th Quarter Dose Rate (millirem)	Annual Total Dose Rate (millirem)

Declared Pregnant Workers					
Individual Name/ (Dosimeter No.)	1st Quarter Dose Rate (millirem)	2nd Quarter Dose Rate (millirem)	3rd Quarter Dose Rate (millirem)	4th Quarter Dose Rate (millirem)	Annual Total Dose Rate (millirem)

(a) Provide exact dates for those employees whose deployment and exchange dates differ from the company standard.

Comments: (add additional pages, if necessary)

Annual Log Completed By:	Annual Log Reviewed By:
Name (Print) _____	Name (Print) _____
Signature _____	Signature _____

ATTACHMENT 3 – EXAMPLE OCCUPATIONAL EXPOSURE RECORD REPORT FORM

OCCUPATIONAL EXPOSURE RECORD FOR A MONITORING PERIOD

1. NAME (LAST, FIRST, MIDDLE INITIAL)	2. IDENTIFICATION NUMBER	3. ID TYPE	4. SEX ☐ MALE ☐ FEMALE	5. DATE OF BIRTH (MM/DD/YY)

6. MONITORING PERIOD	7. LICENSEE OR REGISTRANT NAME	8. LICENSE OR REGISTRATION NUMBER(S)	9A.	9B.
	Clean Harbors Environmental Services (Deer Trail RCRA Subtitle C Landfill)		☐ RECORD ☐ ESTIMATE	☐ ROUTINE ☐ PSE

INTAKES

10A. RADIONUCLIDE	10B. CLASS	10C. MODE	10D. INTAKE IN µCi

DOSES in mrem

DEEP DOSE EQUIVALENT (DDE)	11.
EYE DOSE EQUIVALENT TO THE LENS OF THE EYE (LDE)	12.
SHALLOW DOSE EQUIVALENT (SDE, WB)	13.
SHALLOW DOSE EQUIVALENT, MAX EXTREMITY (SDE, ME)	14.
COMMITTED EFFECTIVE DOSE EQUIVALENT (CEDE)	15.
COMMITTED DOSE EQUIVALENT MAXIMALLY EXPOSED ORGAN	16.
(BLOCKS 11+15) (TEDE)	17.
MAX ORGAN *(BLOCKS 11+15) (TODE)*	18.
19. COMMENTS	

20. SIGNATURE – LICENSEE OR REGISTRANT	21. DATE PREPARED

INSTRUCTIONS FOR COMPLETION OF THE OCCUPATIONAL EXPOSURE RECORD

All doses should be stated in mrem.

1. Type or print the full name of the monitored individual in the order of last name (including "Jr.," "Sr.," "III," etc), first name, middle initial (if appropriate).

2. Enter individual's identification number, including punctuation. This number should be the 9-digit social security number if at all possible. If the individual has no social security number, enter the number from another official identification such as a passport or work permit.

3. Enter the code for the type of identification used as shown below:

CODE	ID TYPE
SSN	U.S. Social Security Number
PPN	Passport Number
CSE	Canadian Social Insurance Number
WPN	Work Permit Number
IND	INDEX Identification Number
OTH	Other

4. Check the box that denotes the sex of the individual being monitored.

5. Enter the date of birth of the individual being monitored in the format MM/DD/YY.

6. Enter the monitoring period for which this report is filed. The format should be MM/DD/YY – MM/DD/YY.

7. Enter the name of the licensee or registrant (already entered).

8. Enter the Department license or registration number.

9A. Place an "X" in Record or Estimate. Choose "Record" if the dose data listed represent a final determination of the dose received to the best of the licensee's or registrant's knowledge. Choose "Estimate" only if the listed dose data are preliminary and will be superseded by a final determination resulting in a subsequent report. An example of such an instance would be dose data based on self-reading dosimeter results and the licensee intends to assign the record dose on the basis of TLD results that were not yet available.

9B. Place an "X" in either Routine or PSE. Choose "Routine" if the data represent the results of monitoring for routine exposures. Choose "PSE" if the listed dose data represents the results of monitoring of planned special exposures received during the monitoring period. If more than one PSE was received in a signle year, the licensee or registrant should sum them and report the total of all PSEs.

FOR ITEMS 10D – 18, ENTER SPECIAL UNITS OF mrem

10A. Enter the symbol for each radionuclide that resulted in an internal exposure recorded for the individual using the format "Xx-###x," for instance, Cs-137 or Tc-99m.

10B. Enter the lung clearance class as listed in Appendix B to Part D (D, W, Y, V, or O for other) for all intakes by inhalation.

10C. Enter the mode of intake. For inhalation, enter "H." For absorption through the skin, enter "B." For oral ingestion, enter "G." For injection, enter "J."

10D. Enter the intake of each radionuclide in µCi.

11. Enter the Deep Dose Equivalent ((DDE) to the whole body.

12. Enter the Eye Dose Equivalent (LDE) recorded for the lens of the eye.

13. Enter the Shallow Dose Equivalent recorded for the skin of the whole body (SDE, WB).

14. Enter the Shallow Dose Equivalent recorded for the skin of the extremity receiving the maximum dose (SDE, ME).

15. Enter the Committed Effective Dose Equivalent (CEDE) or "NR" for "Not Required" or "NC" for "Not Calculated."

16. Enter the Committed Dose Equivalent (CDE) recorded for the maximally exposed organ or "NR" for "Not Required" or "NC" for "Not Calculated."

17. Enter the total effective dose equivalent (TEDE). The TEDE is the sum of items 11 and 15.

18. Enter the total organ dose equivalent (TODE) for the maximally exposed organ. The TODE is the sum of items 11 and 16.

19. Signature of the person designated to represent the licensee or registrant.

20. Enter the date this form was prepared.

21. COMMENTS.

In the space provided, enter additional information that might be needed to determine compliance with limits. An example might be to enter the note that the SDE, ME was the result of exposure from a discrete hot particle. Another possibility would be to indicate that an overexposure report has been sent to the Department in reference to the exposure report.

ATTACHMENT 4 – EXAMPLE QUARTERLY AND ANNUAL AREA DOSIMETRY LOG

Clean Harbors Deer Trail LLC QUARTERLY AND ANNUAL NORM/TENORM AREA DOSIMETRY LOG					
Exchange Dates:	From/To:	From/To:	From/To:	From/To:	
Location	1st Quarter Dose Rate (millirem)	2nd Quarter Dose Rate (millirem)	3rd Quarter Dose Rate (millirem)	4th Quarter Dose Rate (millirem)	Annual Total Dose Rate (millirem)
Comments: (add additional pages, if necessary)					

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.05
ESTIMATION OF INHALATION DOSE

1.0 OBJECTIVE

To define specific methods and procedures for estimating the inhalation dose for workers at the Clean Harbors Deer Trail (CHDT) landfill or other job sites from inhalation of airborne radioactive material.

2.0 SCOPE

This standard operating procedure (SOP) addresses the calculation of radionuclide intakes and committed effective dose equivalent (CEDE) for CHDT or other applicable workers and members of the general public.

3.0 POLICY

Estimates of inhalation dose to CHDT landfill workers shall be conducted to verify that annual CEDE are below annual occupational limits per 10 CFR 20.1201 and maintained as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 GENERAL PROCEDURE

5.1 Calculation of Radionuclide Intake

Corrected workplace airborne concentrations from radioactive materials shall be established, on a quarterly basis, from the airborne monitoring program, consistent with SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*. Breathing zone air monitoring shall be conducted in the landfill and in the treatment building during radioactive materials disposal operations. Breathing zone monitoring will be conducted at frequencies and for time periods specified by the RSO. Radon monitoring shall be conducted in the landfill and treatment building on a continuous basis. Monthly, quarterly or other data, in units of picocuries (pCi) per cubic meter of air, shall be specific to work location and shall be corrected for background ambient concentrations.

For workers who are potentially exposed to airborne radioactive materials, internal exposure estimates are determined using radionuclide air concentrations, respirator protection factors, and occupancy factors appropriate for the workgroup.

The analytical results in picocuries (pCi) are converted to an air concentration as follows:

$$Concentration\left(\frac{\mu Ci}{ml}\right) = \frac{\mathrm{Re}\,sult(pCi)}{\left(10^6\,\frac{pCi}{\mu Ci}\right)\times T(hr)\times\left(60\,\frac{\min}{hr}\right)\times F\left(\frac{cubic\ feet}{\min}\right)\times\left(28316.846592\,\frac{ml}{cubic\ feet}\right)}$$

where

T = sample collection time

F = average flow rate over the sample collection time

Once the estimated radionuclide mixtures and corrected airborne contamination levels are established, individual worker intake by inhalation can be estimated. The intake from inhalation of a radionuclide *i* is estimated using the following equation:

$$I_i = T \times Breathing\ Rate \times C_{a,i}$$

where: I_i = intake of radionuclide *i* by inhalation, pCi,

T = the duration of inhalation, hours,

Ventilation Rate = amount of air inhaled per time, cubic meters per hour, and

$C_{a,i}$ = concentration of radionuclide *i* in air, pCi per cubic meter (following a conversion from units of µCi/ml).

Based on information provided by the International Commission on Radiation Protection (ICRP) in Publication 66, the adult male ventilation rate during light exercise is 1.5 cubic meters per hour (ICRP 1993).

5.2 Calculation of Inhalation Dose

CEDEs to workers shall be calculation using the following equation:

$$H_{E,50} = \Sigma_i\, \Sigma\, W_T\, H_{T,50,i}$$

where: $H_{E,50}$ = the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the CEDE to each of these organs or tissues,

W_T = weighting factors for each specific body tissue or organ, and

$H_{T,50,i}$ = CEDE for radionuclide *i* (millirem).

The CEDE for radionuclide *i* ($H_{T,50,i}$) is found by multiplying the intake of each radionuclide (I_i) by the unit intake committed dose conversion factor for each radionuclide and tissue or organ ($DCF_{T,i}$) as shown in the following equation:

$$H_{T,50,i} = I_i \times DCF_{T,i}$$

To streamline the process, and for consistency with the doses recorded by the external dosimetry program, unit intake effective dose coefficients by radionuclide *i* (i.e., $DCF_{E,i} = \Sigma T\ DCF_{T,i}$, where T is for each tissue or organ) tabulated by the U.S. Environmental Protection Agency (EPA) shall be used. Modifying the above equations to account for the use of unit inhalation intake effective dose coefficients is shown in the following equation.

$$H_{E,50} = (T_w \times Breathing\ Rate)\ \Sigma_i\ (C_{a,i} \times DCF_{E,i})$$

The unit inhalation intake effective dose coefficients, taken from Federal Guidance Report No. 11 (Eckerman et al. 1988) are provided in Attachment 1 for the radionuclides of concern. These values are the most conservative (highest) across all solubility classes considered by the EPA.

6.0 RESPIRATORY PROTECTION:

The CHDT RCRA permit requires the use of respiratory protection for all activities when workers are in close proximity to the waste. These activities include sampling, treatment (when required), and in-cell disposal. Full-face air-purifying respirators are used by CHDT workers for these activities. Consistent with 6 CCR-1007-1, § 4.24 and Part 4 - Appendix A, a respiratory protection factor of 50 shall be applied to all appropriate work when the use of respirators is mandatory.

7.0 INHALATION DOSE WORKSHEET

An example worksheet for calculating inhalation CEDEs is provided in Attachment 2. The sum of the inhalation doses for each quarter is used to produce the annual inhalation dose estimate for each worker. This value is then added to the annual external dose for each worker to produce the estimated annual total CEDE. Similar calculations may be performed in a spreadsheet or using other means.

8.0 REFERENCES

10 CFR 20.1201. *Occupational Dose Limits for Adults.* Current Version.

Eckerman, K. F., A. B. Wolbarst, and A. C. B. Richardson. 1988. Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion. Federal Guidance Report No. 11, EPA-520/1-88-020, U.S. Environmental Protection Agency, Washington, D.C.

International Commission on Radiation Protection (ICRP). 1993. Human Respiratory Tract Model for Radiological Protection. ICRP Publication 66, Annals of the ICRP, Vol. 23, Nos. 1-3.

ATTACHMENT 1 – UNIT INTAKE COMMITTED EFFECTIVE DOSE EQUIVALENT COEFFICIENTS

Radionuclides	$DCF_{E,i}$ [(a)] (seiverts/becquerel inhaled)	$DCF_{E,i}$ [(b)] (millirem/picocurie inhaled)
Uranium Series		
^{238}U	3.20E-05	1.18E-01
^{234}Th	9.47E-09	3.50E-05
^{234}U	3.58E-05	1.32E-01
^{230}Th	8.80E-05	3.26E-01
^{226}Ra	2.32E-06	8.58E-03
^{214}Pb	2.11E-09	7.81E-06
^{214}Bi	1.78E-09	6.59E-06
^{210}Pb	3.67E-06	1.36E-02
^{210}Bi	5.29E-08	1.96E-04
^{210}Po	2.54E-06	9.40E-03
Actinium Series		
^{235}U	3.32E-05	1.23E-01
^{231}Th	2.37E-10	8.77E-07
^{231}Pa	3.47E-04	1.28E+00
^{227}Ac	4.65E-04	1.72E+00
^{227}Th	4.37E-06	1.62E-02
^{223}Ra	2.12E-06	7.84E-03
^{211}Pb	2.35E-09	8.70E-06
Thorium Series		
^{232}Th	4.43E-04	1.64E+00
^{228}Ra	1.29E-06	4.77E-03
^{228}Ac	8.33E-08	3.08E-04
^{228}Th	9.23E-05	3.42E-01
^{224}Ra	8.53E-07	3.16E-03
^{212}Pb	4.56E-08	1.69E-04
^{212}Bi	5.83E-09	2.16E-05

(a) Based on data from Federal Guidance Report No. 11 (Eckerman et al. 1988).

(b) Converted from units of sievert per becquerel to units of millirem/picocurie by multiplying by a conversion factor of 3,700.

ATTACHMENT 2 – EXAMPLE DEER TRAIL WORKER QUARTERLY INHALATION WORKSHEET

Employee Name: _____ Payroll Number: _____ Reporting Period: _____ Date: _____

Estimated inhalation exposure duration for this worker during the reporting period	500 hours per Quarter	Respiratory protection used?	(Y/N)		
Inhalation Dose Calculations:	**Column 1**	**Column 2**	**Column 3**	**Column 4**	**Column 5**
	Identified Radionuclides[1]	**Estimated Airborne Concentration by Radionuclide[2] (picocuries/cubic meter)**	**Estimated Intake by Radionuclide[3] (picocuries)**	**Unit Intake Inhalation Dose Conversion Factors[4] (millirem/picocurie)**	**Estimated CEDE[5] (millirem)**
				Total:	

Prepared by: _____ (Signature) Reviewed by: _____ (Signature)

[1] List the radionuclides reported by the analytical laboratory for the air sample with the highest reported activity to which this worker was exposed.
[2] Enter the corrected airborne concentration for this quarter, by radionuclide, from data collected per SOP 15.OPS.15, *Air Monitoring for Radioactive Materials*
[3] Multiply the entries in **Column 2** by a ventilation rate of 1.5 cubic meters per hour, and by 500 hours (per quarter).
[4] Insert the unit intake inhalation dose conversion factors from Attachment 1 in units of mrem/pCi inhaled.
[5] Multiply the entries in **Column 3** by the entries in **Column 4**, and divide by 50 if this worker used respiratory protection during the exposure. Total the entries in this column at the bottom of the column.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.06
EMERGENCY RESPONSE

1.0 OBJECTIVE

To define specific requirements for employees at the Clean Harbors Deer Trail (CHDT) facility or other temporary job sites in addressing emergency situations involving radioactive materials.

2.0 SCOPE

This standard operating procedure (SOP) applies to emergency situations involving radioactive materials at the CHDT facility or other job sites.

3.0 POLICY

This SOP should be used along with the Deer Trail Emergency Response Plan (April 2005) and the facility's RCRA Contingency Plan for emergency response training and planning purposes. Clean Harbors personnel will take appropriate steps to protect worker and public health during an emergency situation involving radioactive materials. No employee will perform emergency rescue or aid beyond the training and ability of that employee. All worker exposures will be maintained as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 GENERAL PROCEDURES

5.1 Communications

Communications during or after an emergency event are essential for appropriate response and documentation. In the event of a spill, injury, or other event at the CHDT facility, the CHDT RSO (or designee), the facility general manager, and/or site foreman must be notified as soon as it safe to do so. Additional notifications within the Clean Harbors organization will be made as required according to Corporate procedures.

For other job sites, the appropriate emergency contacts must be established at the start of the project, with contact information available to all site personnel. Notifications must be made to the emergency contacts as soon as it is safe to do so.

5.2 Spill Response

All equipment used to handle a radiological spill response shall be surveyed in accordance with SOP 15.OPS.13, *Equipment and Vehicle Release Surveys*. All personnel exiting the spill response area shall perform an exit survey in accordance with the SOP 15.OPS.12, *Personnel Surveys*. All equipment and spill response items that are expended or cannot be decontaminated shall be disposed in the active CHDT disposal cell.

Surveys to verify successful cleanup should be performed per SOP 15.OPS.14, *Spill Surveys.* All information pertaining to the spill, cleanup, and survey activities will be collected and filed to document the event. If necessary, the CHDT RSO will prepare a worker or public exposure assessment if the spill resulted in potential dose.

5.2.1 Spills of Solid Materials

Spills are the most likely form of emergency to occur with the bulk radioactive materials being disposed at CHDT. While not life-threatening, they may result in real or perceived contamination concerns if not addressed appropriately from the outset. For spills of bulk solids, the area should be cordoned off with tape, cones, or other means to prevent unauthorized access. If the spill occurs on a public road, additional precautions must be taken to work safely around traffic. The spilled material should be cleaned as quickly as possible using appropriate means. Worker exposures should be mitigated through the techniques of time, distance, and shielding, as appropriate.

5.2.2 Spills of Liquids

Liquid spills will be addressed utilizing the **SWIM** technique. The SWIM technique follows the following steps.

- **S**top the spill – for small spills, use absorbent pads, for larger spills, absorbent booms or the use of a solidifying agent such as polymers or cement kiln dust may be necessary.
- **W**arn others in the area and notify supervision – used in conjunction with the first step.
- **I**solate the area – use ropes, flagging tape, or other means to warn any approaching personnel
- **M**inimize exposure – avoid contact with liquids. Minimize the number of personnel who enter the spill area.

The primary goal of a liquid spill response is to contain the liquid and prevent the liquid from traveling off-site or contaminating the environment. To accomplish this goal, multiple methods may be employed. Methods include, but are not limited to, the following:

- Trenches may be created to divert liquid from traveling off-site
- Dikes or berms may be created to contain liquids from traveling away from the point of the spill
- Pumps may be used to pump liquids into containment

- Absorbent pads, berms, or solidifying agents may be used to absorb or retain the liquids in place

Any collected absorbent materials or recovered liquid should be placed into appropriate containers for transport and disposal. Liquid spills that result in contamination of soils or other porous surfaces may require additional remediation activities after the emergency situation (i.e., the immediate spread of contamination) is addressed which are beyond the scope of this SOP. A remediation plan to prescribe the remediation activities, cleanup levels, and confirmation surveys or sampling activities may be required.

5.3 Injuries

Emergencies involving injuries to workers or members of the general public in areas where radioactive materials exist may present challenges in working with emergency medical personnel if the perceived contamination level is high. Radioactivity levels in materials handled by CHDT are low, and the potential exposure during the treatment of an injury is also low. Unlike hazardous materials handled at CHDT, under no circumstances will a radioactive environment that is immediately hazardous to human health be present at CHDT. Unless specifically directed otherwise by the CHDT RSO prior to an activity involving radioactive materials, the treatment of life-threatening injuries should supersede any radioactive contamination concerns. The CHDT RSO will routinely work with local emergency medical personnel to address their questions and concerns.

When life-threatening injuries are addressed and stabilized, or in situations where injuries are not life threatening, workers may be assessed for contamination according to SOP 15.OPS.12, *Personnel Surveys*, and if necessary decontaminated according to SOP 15.OPS.19, *Decontamination of Personnel*.

6.0 DOCUMENTATION

All information regarding the emergency, including worker statements, photographs, survey documentation, and other pertinent information, must be collected and filed.

7.0 REFERENCES

Clean Harbors Deer Trail Emergency Response Plan, April 2005.

Clean Harbors RCRA Contingency Plan, Current Version.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.RPP.07

ALARA

1.0 OBJECTIVE

To define specific requirements for conducting As Low As Reasonably Achievable (ALARA) program reviews, briefings, and audits.

2.0 SCOPE

This standard operating procedure (SOP) applies to all operations at the CHDT landfill involving radioactive materials.

3.0 POLICY

All occupational doses received by CHDT workers will be maintained ALARA. The CHDT ALARA program will be reviewed periodically to identify any potential shortcomings or areas of improvement.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 REVIEWS AND BRIEFINGS

ALARA reviews by the CHDT RSO and follow-up briefings with CHDT staff are required when:

- An individual worker's annual dose exceeds or is anticipated to exceed 100 millirem
- Exposure rates exceed 2 milliRoentgens per hour (mR/hr)
- Removable contamination levels exceed 10X the values listed in SOP 15.OPS.13, *Equipment Surveys,* and others.
- Any other potential worker exposure event is anticipated

The ALARA review will be conducted by the CHDT RSO and will identify any specific contamination control procedures, exposure control procedures, or other task-specific requirements. A radiation work permit (RWP) will be created per SOP 15.RPP.08, *Radiation Work Permits*, if required. Following the review, the CHDT RSO will hold a pre-task briefing with affected staff members to present the potential exposure concerns, information in the RWP, and other details regarding the task. A post-task briefing will also be held to present any collected data and to describe any lessons learned. Documentation regarding the review and briefings will be collected in a memorandum to file for later reference.

6.0 ALARA PROGRAM AUDITS

At a minimum, the CHDT RSO will conduct a quarterly review of CHDT worker external and internal exposures to identify any ALARA concerns. An audit of the ALARA program will be performed and documented as part of the CHDT Annual Report. Any ALARA reviews and briefings conducted in the calendar year will be identified and discussed in the Annual Report.

7.0 REFERENCES

None.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.08
RADIATION WORK PERMITS

1.0 OBJECTIVE

To define the circumstances in which a Radiation Work Permit (RWP) is required and address the requirements for planning, issuing, modifying, and terminating RWPs at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

2.0 SCOPE

This standard operating procedure (SOP) shall be used at the discretion of the CHDT Radiation Safety Officer (RSO) or designee to initiate job- or task-specific requirements to mitigate potential worker exposures. Examples of where an RWP may apply include areas with high airborne radioactivity or areas with radioactive material that presents a high or unique contamination concern. High Airborne Radioactivity as referenced in this SOP applies only to levels defined as an Airborne Radioactivity Area, 6 CCR 1007-1, Rules and Regulations Pertaining to Radiation Control, Part 1, Section 1.2, Definitions:

"Airborne radioactivity area" means a room, enclosure, or area in which airborne radioactive materials exist in concentrations:

(1) In excess of the derived air concentrations (DACs) specified in Appendix 4B, Table 4B1, or

(2) To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC hours"

In the absence or real time air monitoring, the airborne radioactivity concentration can be estimated using re-suspension factors and removable contamination levels.

3.0 POLICY

RWPs will be used where necessary to maintain worker exposures as low as reasonably achievable (ALARA) by presenting job- or task-specific information regarding airborne radioactivity concentrations or contamination levels.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01).

5.0 GENERAL PROCEDURE

5.1 Initiation and Briefing

Upon identification of a high airborne radioactivity hazard or other significant radiation hazard, the CHDT RSO will initiate a RWP using the RWP form included as Attachment 1 as a starting point. If necessary, the form may be modified or additional sheets may be added as necessary to provide additional information to workers.

The RWP form will be prepared by the CHDT RSO and reviewed by the CHDT general manager (or designee). Both the CHDT RSO and general manager will sign the RWP after any comments have been resolved.

The CHDT RSO or designee will provide a briefing to affected workers prior to the start of activities to be performed under the RWP. All workers working under the RWP will be required to sign the Briefing Sign-In form (Attachment 2) before any work is performed.

5.2 Work Activities

The RWP will be posted in a visible area for affected workers to periodically review over the course of activities. The CHDT RSO will monitor activities and if necessary revise the RWP. If revisions are performed, an additional briefing will be performed and Briefing Sign-In form generated.

5.3 Termination

Upon completion of activities performed under the RWP, the CHDT RSO may terminate the RWP. Originals of all associated information collected during the RWP activities, including survey and monitoring data, field notes, briefing sheets, and other materials, will be filed and maintained to document the RWP.

6.0 REFERENCES

6 CCR 1007-1, Rules and Regulations Pertaining to Radiation Control

Radiation Work Permit (RWP)

RWP Number: 15.RPP.08, Rev.2, Attachment 1

Work Description: ☐ General ☐ Specific

Work Location

Est. Start Date/Time

Requested By

Request Date

Hazardous Conditions

Radionuclides Present	Radiation Levels	Other (Safety, etc.)

Surveys

Type	Number	Date	By

REQUIRED PERSONNEL PROTECTIVE CLOTHING AND EQUIPMENT

Head/Eyes		Feet/Legs		Body	
Hard Hat	☐	Safety Work Shoes	☐	Cotton Coveralls	☐
Safety Glasses	☐	Disposable Boot Covers	☐	Tyvek Coveralls	☐
Monogoggles	☐	Tyvek Booties	☐	Polypropylene	☐
Face Shield	☐	Rubber Boot Covers	☐	Water Proof Coveralls	☐
Other (Specify):	☐	Other (Specify)	☐	Other (Specify)	☐
Respiratory		**Hands**		**Miscellaneous**	
Full-face (Negative Pressure)*	☐	Cotton Liners (optional)	☐	Tape Gloves & Boots to Coveralls	☐
Powered Air Purifying*	☐	Latex Gloves	☐	Safety Belt With Lanyard	☐
* Specify Cartridge or Canister Type Below		Rubber Gloves	☐	Hearing Protection	☐
Other (Specify):	☐	Leather Work Gloves	☐	Face Shield	☐
		Cotton Work Glove	☐	Other (Specify):	☐

Special Instructions and Requirements

Dosimetry	Indiv.	Group
TLD Badge		
Extremity TLD		
Other (Specify):		
Lapel Air Sampler		
IH Monitoring	**Indiv.**	**Group**

Expiration Date/Time

Approvals	Date	Termination	Date
CHDT HP/RSO		CHDT HP/RSO	
Site S & H Officer		Reason:	

ATTACHMENT 2

RWP BRIEFING SIGN-IN SHEET

RWP Number: _____

Briefing Conducted by: _____

Date/Time: _____

Attendees:

By signing this sheet, I attest that I have reviewed and understand the contents of the RWP listed above, and will comply with its requirements.

Employee ID	Printed Name	Signature

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.RPP.09
PERSONAL PROTECTIVE EQUIPMENT

1.0 OBJECTIVE

To define the requirements for and usage of personal protective equipment (PPE) while working in radioactively contaminated environments.

2.0 SCOPE

This standard operating procedure (SOP) applies to all workers who may be exposed to potential contamination from radioactive materials at the Clean Harbors Deer Trail (CHDT) landfill or other job sites.

3.0 POLICY

All workers who may potentially be exposed to radioactive contamination at CHDT or other job sites will take appropriate precautions to minimize exposure and the spread of contamination. The requirements of this SOP are intended to be consistent with other applicable Clean Harbors procedures, including the most current version of the *US Landfill Division PPE Hazard Assessment Summary*.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), CHDT management, and other Clean Harbors staff are defined in the *Radiation Protection Plan* (SOP 15.RPP.01).

5.0 GENERAL PPE REQUIREMENTS

5.1 PPE Selection

Protective clothing will be selected to provide an appropriate barrier between personnel clothing/ skin and radioactive contamination that may exist. The level of PPE selected is based on the level of risk or potential exposure.

Minimum PPE requirements for handling radioactive materials with the potential for dispersal (e.g, non-sealed sources) include protective gloves and eyewear. Operations in the CHDT landfill or treatment facility will be conducted with tyvek coveralls, gloves, boots, and respiratory protection. CHDT personnel may upgrade PPE requirements if desired. Downgrade of PPE requirements for radiological operations at the CHDT landfill may be prescribed by the CHDT RSO or designee.

5.2 PPE Usage

Work activities will be planned and, if appropriate, practiced prior to donning PPE to minimize the amount of time spent in PPE. Contaminated areas will be delineated and support areas will be established at the contaminated area boundary to allow for personnel contamination surveys and PPE donning/doffing support upon exit.

Site-specific PPE requirements at temporary job sites will be defined and documented in job hazard analyses or site safety and health plans.

5.3 Respiratory Protection

Respiratory protection requirements for radiological operations at the CHDT landfill are defined in the most current version of *US Landfill Division PPE Hazard Assessment Summary* and other procedures. In addition, respiratory protection will be required when airborne contamination levels exceed 10-percent of the Derived Air Concentration (DAC) for radioactive materials, as listed in 10 CFR 20, Appendix B, Table 1, Column 3. Appropriate air sampling will be performed at CHDT or temporary job sites to establish airborne contamination levels and potential worker exposures when new activities are performed or when determined by the CHDT RSO or designee.

Respirator selection, fit testing, and usage will be consistent with the most current version of the *Respiratory Protection Guidelines* and other general Clean Harbors procedures.

6.0 REFERENCES

10 CFR 20. *Standards for Protection Against Radiation.* Current Version.

Clean Harbors Environmental Services. *Personal Protective Equipment Guidelines,* Current Version.

Clean Harbors Environmental Services. *Respiratory Protection Guidelines,* Current Version.

Clean Harbors Environmental Services. *US Landfill Division PPE Hazard Assessment Summary,* Current Version.

STANDARD OPERATING PROCEDURE

15.RPP.10

DETERMINATION OF PRIOR OCCUPATIONAL DOSE

1.0 OBJECTIVE

Collect prior occupational dose information which could be needed in the event of a planned special exposure, and to comply with Colorado Regulations. Details of Planned Special Exposures are to be found in SOP 15.RPP.08 Radiation Work Permits.

2.0 SCOPE

This standard operating procedure (SOP) governs the collection and maintenance of prior occupational dose information which is required by the Colorado Regulations. It governs how the information will be collected and how prior dose will be estimated in the event that more accurate information is unavailable.

3.0 POLICY

The RSO will collect and maintain Prior Occupational Dose Information in compliance with Colorado Regulations. Prior Dose Information will be collected for all employees and temporary employees that may reasonably be expected to receive an occupational dose beyond that permitted to the general public.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, CHDT management, and other Clean Harbors staff are defined in the Radiation Protection Plan (SOP 15.RPP.01). The CHDT RSO shall be responsible for collecting and maintaining prior occupational dose information.

5.0 GENERAL PROCEDURE

5.1 Current and Prior Years

For each individual who is likely to receive, in a year, an occupational dose requiring monitoring pursuant to 4.18, the licensee or registrant shall determine the occupational radiation dose received during the current year; and attempt to obtain the records of lifetime cumulative occupational radiation dose.

5.2 Planned Special Exposures

Prior to permitting an individual to participate in a planned special exposure, the licensee or registrant shall determine: the internal and external doses from all previous planned special exposures; and all doses in excess of the limits, including doses received during accidents and emergencies, received during the lifetime of the individual; and all lifetime cumulative occupational radiation dose.

5.3 Written Statement

The RSO may accept, as a record of the occupational dose that the individual received during the current year, a written signed statement from the individual, or from the individual's most recent employer for work involving radiation exposure, that discloses the nature and the amount of any occupational dose that the individual received during the current year.

5.4 Documented Cumulative Exposure History

The RSO may accept, as the record of lifetime cumulative radiation dose, an up-to-date Department Form R-16, Cumulative Occupational Exposure History, or equivalent, signed by the individual and countersigned by an appropriate official of the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant.

5.5 Request Records From Employer

The RSO may obtain reports of the individual's dose equivalent from the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant, by telephone, telegram, facsimile, or letter. The licensee or registrant shall request a written verification of the dose data if the authenticity of the transmitted report cannot be established.

5.6 Department Form R-16

The RSO shall record the exposure history, on Department Form R-16, or other clear and legible record, of all the information required on that form. The form or record shall show each period in which the individual received occupational exposure to radiation or radioactive material and shall be signed by the individual who received the exposure. For each period for which the licensee or registrant obtains reports, the licensee or registrant shall use the dose shown in the report in preparing Department Form R-16 or equivalent. For any period in which the licensee or registrant does not obtain a report, the licensee or registrant shall place a notation on Department Form R-16 or equivalent indicating the periods of time for which data are not available.

5.7 Assumed Dose Limit

If the RSO is unable to obtain a complete record of an individual's current and previously accumulated occupational dose, the licensee or registrant shall assume that for the current year, the allowable dose limit for the individual is reduced by 12.5 mSv (1.25 rem) for each quarter for which records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure. The individual will not be available for planned special exposures during the current year.

5.8 Record Retention

Records of Form R-16 or equivalent will be retained per SOP 15.RPP.03.

6.0 REFERENCES

6 CCR 1007-1

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.WAC.01
RADIOACTIVE MATERIALS ACCEPTANCE

1.0 OBJECTIVE; DEFINITIONS; REFERENCES TO REGULATIONS

Define the requirements for screening or otherwise determining that shipments of radioactive materials proposed for acceptance, treatment, storage, and disposal at the Clean Harbors Deer Trail ("CHDT") Facility ("Facility") comply with the definition of Regulated Wastes set forth in the Amended and Restated Certificate of Designation issued by the Adams County Board of County Commissioners on November 14, 2012 ("Amended CD"). In the event of any conflict between the requirements of this standard operating procedure ("SOP") and the requirements of the Amended CD, the requirements of the Amended CD shall govern. Terms used herein shall have the meanings ascribed to them in the Amended CD. Reference herein to the Colorado Code of Regulations ("CCR") or the Code of Federal Regulations ("CFR") shall be deemed to mean such regulations as they existed as of September 1, 2011, and no later date.

2.0 SCOPE OF SOP

This SOP applies to the Regulated Wastes allowed for acceptance, treatment, storage, and disposal at the Facility under the Amended CD and the State of Colorado Radioactive Materials License 1102-01 at the Facility, which include radionuclides associated with naturally-occurring radioactive materials ("NORM"), technologically-enhanced NORM ("TENORM"), and radium processing wastes.

3.0 POLICY

Wastes will be evaluated for acceptability at the Facility according to the procedures in this SOP.

4.0 RESPONSIBILITIES OF CHDT

Responsibilities of the CHDT Radiation Safety Officer ("RSO"), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01). CHDT's RSO, management and staff are responsible for, and shall follow, all requirements of this SOP; such responsibilities include, without limitation, notifying Adams County (the "County") and the Colorado Department of Public Health and Environment ("CDPHE") of the receipt at the Facility of any waste that does not conform to the terms of the Amended CD regarding Regulated Wastes prior to the acceptance of any such non-conforming waste for storage, treatment or disposal at the Facility.

5.0 WASTE ACCEPTANCE CRITERIA

The physical properties of wastes that can be accepted for treatment, storage, or disposal at the Facility are defined in the Colorado Hazardous Waste Act Permit No. CO-05-12-21-01 ("Permit") and the Amended CD. The radiological component, if any, of waste that can be accepted for treatment, storage, or disposal at the Facility is regulated by the Amended CD, License 1102-01, and this SOP. Any received radioactive materials must meet the following additional acceptance criteria:

a. Acceptable Radionuclides

Acceptable radionuclides are limited to naturally-occurring radionuclides only, including the radionuclides in the decay series for uranium-238 (U-238), uranium-235 (U-235), thorium-232 (Th-232), and potassium-40 (K-40). No man-made radionuclides shall be accepted, stored, or disposed at the Facility, except for expected background levels resulting from radioactive fallout.

b. Activity Limits

The total activity per gram of all radioactive materials (including all decay progeny) shall not exceed 2,000 pCi/g, and the radium-226 (Ra-226) activity per gram shall not exceed 222 pCi/g. Potassium-40 (K-40) below background levels of 40 pCi/g will not be used in calculating total activity of waste streams nor the Facility Lifetime Total Activity. Uranium and thorium shall not be accepted, treated, nor disposed at the Facility at source material levels as defined per 6 CCR 1007-1, Part 1.2.

The activity limits for the CHDT facility for specific radionuclides are set forth in Table 1 as follows: Table 1. Summary of Accepted Activity Levels

Radionuclide	Limit (pCi/g)
Natural Uranium (48.83% U-238, 48.83% U-234, 2.34% U-235)	340[ab]
Natural Uranium expressed as U-238 concentration	165[ab]
Natural Uranium expressed as a mass percentage	0.05%[ab]

Radionuclide	Limit (pCi/g)
Natural or Processed Thorium (Th-232 (50%) and Th-228 (50%))	110[ab]
Natural Thorium expressed as Th-232 concentration	55[ab]
Natural Thorium expressed as a mass percentage	0.05%[ab]
Ra-226	222[b]
Pb-210	666[b]

Notes to Table 1:

a – Concentration limits are expressed as a sum of fractions for uranium and thorium as calculated in the following equation:

$$\frac{Conc_{Uranium}}{Limit_{Uranium}} + \frac{Conc_{Thorium}}{Limit_{Thorium}} \leq 1$$

The result of the calculation must be less than unity (1) for the waste to be acceptable at CHDT.

b – In secular equilibrium with shorter lived progeny.

If the waste does not exceed the limits presented in Table 1 for individual radionuclides, the radionuclides listed in Table 1 are to be summed to determine compliance with the 2000 pCi/g overall limit for acceptance at CHDT. A shipment of wastes may have isolated areas of activity exceeding the limit, but the mean concentration of the shipment based on radioanalytical sample results shall not exceed the limits presented in Table 1. Concentration limits are based on an "as received" (wet weight) basis.

c. Lower Limits of Radioactive Material Subject to the License

Wastes that have measured activity concentrations at or below the levels providing for unrestricted disposal in the Interim Policy and Guidance Pending Rulemaking for Control and Disposition of Technologically Enhanced Naturally Occurring Regulated Wastes in Colorado, shall not be subject to this SOP nor will such wastes require tracking toward the Facility Lifetime Total Activity Limit. Such wastes shall be subject to the Waste Acceptance Criteria and procedures for Hazardous Waste set forth

in the Amended CD and the Permit. For such wastes to be non-Regulated Wastes, Ra-226 shall be less than 4.4 pCi/g (with a background concentration of 1.4 pCi/g included), Ra-228 shall be less than 4.3 pCi/g (with a background concentration of 1.3 pCi/g included), natural Uranium shall be less than 32.4 pCi/g (with a background concentration of 2.4 pCi/g included), and natural Thorium shall be less than 5.4 pCi/g (with a background concentration of 1.3 pCi/g included). These activity concentrations include background concentrations of the respective radionuclides. If any of the aforementioned activity concentration limits are exceeded, the waste shall be immediately subject to this SOP as Regulated Wastes.

d. Acceptable Physical Form

The physical form of Regulated Waste shall be limited to soils, sludge(s), process residues, resins, filters, debris, liquids and contaminated media that are compatible with the design and operational criteria required by 6 CCR 1007-1, Part 14.

6.0 PRE-ACCEPTANCE REQUIREMENTS

Any waste generator proposing to send waste to the Facility for acceptance, treatment, storage and disposal shall document the waste's chemical properties, physical properties, radiological properties, and its regulatory status. The waste generator shall provide a pre-acceptance sample result in accordance with the following requirements:

a. Waste Documentation

i. Waste Material Profile Sheet

The waste generator shall submit a Waste Material Profile Sheet to CHDT ("Waste Profile"). The waste generator may submit other forms or supporting documents as long as the data and information required in the Waste Profile are fully and completely provided in such alternate documents.

ii. Supplemental NORM Questionnaire

The waste generator shall also submit a Supplemental NORM Questionnaire (Questionnaire) to CHDT. The Questionnaire shall document the radionuclides present, and their specific activity, in the wastes proposed to be delivered to the Facility. The waste generator shall certify, by signature of a responsible official of the waste generator, that there is no byproduct material, source material, manmade radionuclides, or special nuclear material present in the wastes. The Questionnaire shall include a

description of the process(es) that created or generated the wastes. The waste generator shall supply the NRC or Agreement State license number, if applicable. The waste generator shall include sufficient information in the Questionnaire, and provide supporting documents, including analytical results, to support the presence and activity of any radionuclides in the wastes. The waste generator shall document, in the Questionnaire, the characterization method and sampling protocol for the wastes. The Questionnaire is presented in Attachment A. Other forms or documentation may be used as long as the required information is provided.

ii. Lab Analysis Data

The waste generator shall attach to the Questionnaire all analytical data for the wastes which analysis shall be obtained from a National Environmental Laboratory Accreditation Conference ("NELAC") or other accredited laboratory. Such analytical data shall support and confirm the description of radionuclides set forth and described in the Waste Profile and the Questionnaire.

b. Pre-Acceptance Testing

CHDT shall obtain and analyze pre-acceptance samples from and for each new waste or waste stream received from a waste generator. CHDT shall use a NELAC accredited laboratory to analyze, test and determine the species and activity of radionuclides present in such waste or waste stream. Before CHDT may accept the waste, the analytical results must demonstrate that the activity and other limits for radium-226, mass thorium, mass uranium and total activity are under the limits set forth in the Amended CD and this SOP. Generator's Lab Analysis Results from 6.a.ii may be used to fulfill this requirement as long as they meet all facility requirements of 6.b.

Standard analyses shall include: total uranium and total thorium (concentration mass/mass of sample), radium-226 activity (pCi/g), a gamma spectrum (reported in pCi/g with radionuclide identification). Isotopic uranium and isotopic thorium activity (pCi/g) analyses may be used in place of total uranium and total thorium. Lead-210 analysis in pCi/g will be required in wastes where lead-210 is the only parent radionuclide such as waste from natural gas production.

CHDT may use alternate methods of analyses, but only with prior written approval of both the County and the CDPHE, and only if the County and CDHPE agree such alternate analyses will provide data and information sufficient to ensure that the requirements of the Amended CD and this SOP are met.

c. Pre-Acceptance Evaluation

Before any waste or waste stream is approved for acceptance, treatment, storage and disposal at the Facility, the RSO shall ensure that such waste's radiological, physical, and chemical characteristics meet the requirements of the Amended CD and this SOP. CHDT shall use the Waste Profile, the Questionnaire and any other supporting information received from the waste generator, as well as CHDT's pre-acceptance testing and laboratory analyses, to confirm that the waste is acceptable for treatment, storage, and disposal. All waste shipments shall be evaluated before acceptance for the following:

i. Regulatory Information – The RSO shall review regulatory information and requirements to ensure that the Facility has all proper permits, licenses and approvals necessary to accept the waste.

ii. Profiled Isotopes and Activities - The RSO shall review the isotopes and activities listed on the Waste Profile to confirm that the Facility is permitted to accept such wastes under the terms of the Amended CD and this SOP.

iii. Sampling Information - The RSO shall review all sampling information and results to ensure that all sampling has been conducted in accordance with Attachment B at a NELAC or other accredited laboratory that has a sufficient method detection limit or minimum detectable concentration to assess whether the requirements of this SOP have been met.

iv. Laboratory Analysis - The RSO shall review all laboratory analysis results of the waste to ensure that the analyses have been conducted at a NELAC or other accredited laboratory and that such laboratories have sufficient method detection limits or minimum detectable concentrations to assess whether the requirements of this SOP have been met.

v. Capability of the Facility to Manage the Waste - The RSO shall ensure that CHDT and the Facility have the resources, personnel and ability to properly manage the waste.

vi. Waste Management Byproducts - CHDT shall review facility treatment and/or landfill operations to ensure that the management of the waste produces no deleterious byproducts.

vii. Treatment Method - If applicable, CHDT shall determine the prudent and proper treatment method and treatment formula prior to accepting the waste as Regulated Waste.

viii. Safety Requirements - The waste shall be evaluated to confirm that it can be handled at the Facility in accordance with the safety precautions, monitoring, protective equipment and any other safety requirements prescribed in the Facility's Radiation Protection Plan, SOP 15.RPP.01.

ix. Laboratory Analysis Requirements - Representative samples shall be taken from the waste and shall be sent to a NELAC or other accredited radioanalytical laboratory for the following radioanalyses: Gamma Spectrum, Total Uranium Mass, Total Thorium Mass and Total Radium Activity/g. Isotopic Uranium, Isotopic Thorium, and Isotopic Radium analyses (reported in activity/g) may be used in lieu of Total Uranium, Total Thorium, and Total Radium.

d. Documentation of Acceptance

In accordance with the preceding requirements, CHDT shall confirm or deny that the waste is acceptable for treatment, storage, or disposal. If the waste is confirmed to be appropriate for acceptance at the facility, CHDT shall maintain all documents, data, and information that it used to make such determination and include the information and documents, including the Waste Profile and the Questionnaire, in or with the Pretreatment and Disposal Recommendation (PDR) Form. This is presented in Attachment B. If a waste or waste stream has been evaluated in the pre-acceptance process and CHDT confirms it meets the requirements of the Amended

CD and this SOP, such waste stream shall then be approved by CHDT in writing, for acceptance at the Facility. A copy of CHDT's approval, and the supporting documentation, will be kept on file and shall be available for review.

e. Annual Recertification

A waste or waste stream that has been approved for acceptance, treatment, storage, and disposal at the Facility shall maintain such approval for a period of one year from the date of CHDT's approval under subparagraph (d) above. At the one year anniversary of the date of CHDT's approval, the waste stream shall be reevaluated for compliance with this SOP and the Amended CD ("Annual Recertification").

To obtain the Annual Recertification, CHDT and/or the waste generator shall repeat the pre-acceptance requirements and steps described in Sections 6(a) through (d) above. The original radiological analyses shall be repeated. Alternatively a generator may certify by re-signature of the profile and NORM questionnaire that the original characterization is still complete and still applicable and the waste acceptance can continue. The waste generator's certification and the results of the radiological analyses shall be evaluated by CHDT as if the waste or waste stream were being submitted for the first time by the waste generator. If CHDT then re-confirms the waste stream meets the requirements of the Amended CD and this SOP, such waste may be re-approved for acceptance, treatment, storage, and disposal for one year from the date of approval by CHDT of the Annual Recertification. All documentation for any Annual Recertification of a waste or waste stream will be kept on file and will be available for inspection.

7.0 PROFILE DEACTIVATION

If at any time the waste stream is found not to comply with the requirements of the Amended CD and the restrictions of Section 5, Waste Acceptance Criteria, above, the profile will be deactivated.

a. Alternate Means of Compliance

No alternate means of compliance with this SOP may be used, unless CHDT obtains prior written approval from both CDPHE and the County. CDPHE and the County may consider alternate means of compliance on a case-by-case basis, and either or both may require any additional conditions for the approval of any proposed alternate means of compliance they deem appropriate.

b. Record-Keeping; County and CDPHE Access

CHDT shall retain indefinitely all Waste Profiles, Questionnaires, and any and all other supporting documents, information and data, including all records of laboratory analysis, related to the acceptance, treatment, storage and disposal of Regulated Wastes (or the disposal of any approved non-conforming waste) at the Facility. CHDT shall make all records related to the acceptance, treatment, storage and disposal of Regulated Wastes available to the County, the County's Technical Representative, its engineers or other representatives and the CDPHE, its engineers, or other representatives, for inspection and copying, at any time upon reasonable advance notice.

8.0 ON-SITE ACCEPTANCE REQUIREMENTS

a. Generator Preparation of Waste for Transportation to Facility

Each Generator shall prepare any waste for shipment in accordance with Department of Transportation regulations found at Title 49 of the Code of Federal Regulations (CFR) and, where applicable, Part 17 of 6 CCR 1007-1.

b. Generator Certification; Hazardous Waste Manifest

CHDT shall confirm that the Generator independently certifies, on the Waste Profile, that the specific activity (radioactivity per gram) of waste prepared for shipment to the Facility meets the acceptance criteria for Regulated Waste at the Facility. In addition, CHDT shall confirm that a Hazardous Waste Manifest, non-Hazardous Waste Manifest, Bill of Lading and/or NRC Forms 540 and 541, where appropriate, have been completed in accordance with Environmental Protection Agency regulations found at 40 CFR 262.20 and Department of Transportation regulations found at 49 CFR 172.205.

c. CHDT Acceptance Procedures – In General

The waste shall be tested and analyzed to ensure that it matches the Waste Profile description. At such time as wastes are received at the Facility, the radiological properties of the wastes or waste stream shall be verified as consistent with all data, information and documentation associated with the waste shipment and the wastes shall be reviewed by CHDT to ensure compliance with the requirements of the Amended CD and this SOP.

If the waste shipment conforms to and matches the properties determined in the Pre-Acceptance Evaluation (based on the Waste Profile Sheet, the Questionnaire, the results of the required laboratory analyses, and any other supporting information) and CHDT confirms that the waste meets the requirements of the Amended CD and this SOP, such waste may be accepted for treatment, storage and disposal at the Facility.

d. Exposure Rate Survey

All shipments of wastes received at the Facility for acceptance and disposal shall be screened for radiation exposure rate at the outside of the shipment package. Exposure rate meters shall be operated in accordance with License SOP 15.OPS.07, Exposure-Dose Rate Meters.

Expected ranges of exposure rate for waste shipment screening shall be determined by the RSO. A measured exposure rate of a waste shipment exceeding expected ranges shall be evaluated by the RSO to ensure the shipment is in compliance with the requirements of this SOP. If there is a discrepancy, the discrepancy resolution process shall be instituted.

e. Weights

All waste shipments will be weighed on a certified scale.

f. Gamma Isotopic Survey

Each shipment of waste will be surveyed for radionuclide identification using an approved portable gamma spectroscopy unit per SOP 15.OPS.03, Operation of Portable Gamma Spectroscopy Unit. If man-made radionuclides are detected above background, as described in Section 5(c) above, or the observed radionuclide activity concentration or composition exceeds the requirements or limits set forth in the Amended CD and this SOP, the waste shipment shall be rejected and returned to the Generator. The Generator Profile shall be disapproved until the discrepancy is resolved, in accordance with this Section 7, and CHDT shall notify the County and CDPHE of the rejected truckload or shipment.

g. Samples

Waste shipments shall be sampled according to the requirements of Attachment C. Some wastes and waste streams are difficult to sample, for example, large debris-type wastes. These waste types are typically not directly sampled. In such cases, the RSO may conduct a visual inspection of the waste material and take measurements using hand-held instruments as a substitute for direct sampling of the waste. In instances where direct sampling is not reasonably feasible, the RSO shall document the reasons such wastes cannot be sampled directly and provide a description of the results of the visual and hand-held sampling.

h. Documentation Review

All documents accompanying the waste shipment will be reviewed to ensure that the requirements of this SOP are met.

i. On-Site Tracking of Regulated Wastes

CHDT shall maintain data, information and other documentation that conforms to industry standards and prudent practices for on-site tracking of all waste shipments and the disposal location of all wastes. Such information shall be prepared in a form or forms based upon the instructions in the PDR form. These forms will provide instructions for facility workers and shall document and track the location, at all times, and final disposition of each waste shipment.

j. Discrepancy Procedures

If there is a discrepancy (as determined by CHDT's review of the Waste Profile, the Questionnaire, the pre-acceptance sampling, testing and required laboratory analyses and any other supporting documentation) that indicates that the waste or waste stream may not meet the requirements of the Amended CD or the requirements of this SOP, the waste profile will not be approved for acceptance at CHDT unless otherwise approved in writing by CDPHE and the County.

In the event of a discrepancy between the pre-acceptance documentation and the waste shipment, CHDT shall provide to CDPHE and the County the Waste Profile, the Questionnaire, any other supporting documents and all analytical results. The County may, at its sole discretion, choose to participate in the discrepancy resolution process, including the establishment of a final date certain for resolution of the discrepancy. CHDT will notify the County and CDPHE if any discrepancies cannot be resolved.

If the discrepancy can be resolved prior to any agreed-upon deadline and the waste is determined by CHDT, the County, and CDPHE to comply with the Amended CD and this SOP, such waste may be accepted for treatment, storage or disposal at the Facility. If the discrepancy cannot be resolved by the deadline or the waste shipment does not meet the requirements of the Amended CD or this SOP, the waste shipment shall, if not already deposited in a cell, be rejected and returned by CHDT to the waste generator or, at the waste generator's request, to an alternate waste facility. If the waste has been deposited in a disposal cell at the time the discrepancy has been determined or discovered, then the procedures in Section 8.c of the SOP shall apply.

k. Waste Profile Deactivation; Generator Debarment

If at any time, any waste stream is found by CHDT, the County or any other governmental entity not to meet the requirements of the Amended CD or this SOP, the Waste Profile for such waste stream shall be deactivated, and further wastes or waste streams from the offending waste generator shall not be accepted at the Facility by CHDT unless and until (i) CHDT, CDPHE and the County mutually agree to allow the waste generator to resume shipment of further wastes for evaluation and acceptance at the Facility; (ii) CHDT, CDPHE and the County mutually agree on an appropriate revised Random Confirmation Sampling Program, and (iii) the Pre-Acceptance requirements for such further wastes or waste streams have been satisfactorily completed. Such resumption may be conditioned upon an audit of the waste generator's operations and waste handling procedures and may be conditioned on such changes to the waste generator's waste handling methods or other procedures as CHDT, CDPHE and the County agree are necessary to protect the public health and the environment.

9.0 RANDOM CONFIRMATION SAMPLING PROGRAM

Each waste stream and waste shipment containing radioactive materials shall be subject to a random confirmation sampling program ("Confirmation Program"). CHDT shall sample at least one (1) shipment out of every twenty (20) shipments starting with the first shipment received from a Generator. For purposes of this SOP and the Confirmation Program, a "shipment" or "waste shipment" shall mean one truckload of waste.

The confirmation sample shall be a representative sample collected from the shipment (may not always be possible as indicated in Section 8.g).

a. Laboratory Analyses

The off-site laboratory analyses required for random confirmation samples shall be as follows:

- Gamma spectroscopy with in-growth for radium-226
- Isotopic or mass uranium
- Isotopic or mass thorium
- Lead-210, if necessary

b. Comparison of Results

The results of the analyses of the Confirmation Program shall be compared with the results of the Pre-Acceptance sample results and any other samples. The RSO shall determine if the results of the Confirmation Program sampling are consistent with the Waste Profile and any other supporting information, data or documents provided to CHDT by the waste generator. If the results of the Confirmation Program sampling are consistent with the waste generator's data, information and documentation of the waste shipment, and all other requirements of the Amended CD and this SOP are met, the waste may be accepted and disposed at the Facility.

c. Revocation of Acceptance of Waste

If, following acceptance of waste at the Facility, any laboratory analysis or other information is received indicating that the accepted wastes do not conform with the Amended CD or this SOP, CHDT shall notify CDPHE and the County of the non-conformance. CHDT shall prepare and provide to CDPHE and the County an Investigation Plan and proposed Corrective Action Plan (CAP). The Investigation Plan and CAP shall include an evaluation of risk against the Baseline Technical Assessment, the most recent Annual Technical Assessment, and the Facility Lifetime Total Activity established for the Facility. Final disposition of the offending waste shall be subject to CDPHE and County review and approval. If ordered by the County and/or CDPHE, the CAP shall include removal of the offending waste from the Facility. The decision to dispose of the waste in place or to remove the waste shall be made in accordance with the United States Nuclear Regulatory Commission's public dose limit of 100 mrem per year to an individual member of the public. The procedures set forth in Section 7 with respect to Waste Profile deactivation and Generator debarment shall also apply to any Generator whose waste is found non-conforming under this paragraph.

ATTACHMENT A

ENVIRONMENTAL SERVICES, INC.

Supplemental NORM Questionnaire

Clean Harbors Deer Trail Facility

General Information

Waste Name: _____

Profile Number: _____

Generator Name: _____

EPA ID: _____

Site Address: _____

Regulatory Information

Is the Waste Subject to an NRC, State or other Radioactive Materials License?	Yes ☐	No ☐
Does the Waste contain NORM (Naturally Occurring Radioactive Material)?	Yes ☐	No ☐
Does the Waste contain TENORM (Techologically Enhanced NORM)?	Yes ☐	No ☐
Does the Waste contain Source Material?	Yes ☐	No ☐
Does the Waste Contain Byproduct Material?	Yes ☐	No ☐
Does the Waste Contain Man Made or Artificial Radionuclides?	Yes ☐	No ☐
Does the Waste Contain Special Nuclear Material?	Yes ☐	No ☐

Please describe the process which produced the waste: _____

Radiological Information

What is the maximum dose rate at the surface of the waste (microR/hour)? _____

Please list the isotope, average specific activity, and maximum specific activity for each radionuclide present

Isotope	Ave (pCi/g)	Max (pCi/g)	Isotope	Ave (pCi/g)	Max (pCi/g)

Generators Certification

I hereby certify that all information submitted in this and attached documents is correct to the best of my knowledge. I also certify that any samples submitted are representative of the actual waste. I also certify that the Specific Acitivity (radioactivity per gram) of waste prepared for shipment to the facility meets the acceptance criteria for Regulated Waste at the Facility.

Authorized Signature	Name (Print)	Title	Date

Generators Outside the Rocky Mtn. Compact Region (CO, NM, NV) Certification

I hereby certify that the generator is licensed or permitted to, and agrees to, receive back the waste and residues if they cannot be disposed of. (In the case of oil and gas waste collectors/processors, this certification may be signed by the processor/collector.) I agree to provide the Clean Harbors Deer Trail Facility written or e-mail notification at least five days in advance of the initial shipment of waste.

Authorized Signature	Name (Print)	Title	Date

Clean Harbors Deer Trail, LLC
108555 East Highway 36,
Deer Trail, CO 80105
Phone 970-386-2293, Fax 970-386-2262

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ATTACHMENT B

CleanHarbors ENVIRONMENTAL SERVICES, INC.

Pretreatment and Disposal Recommendation

Profile # **Generator**
Waste Name

Profile Review:

Documentation is complete?	Y	N	
The site has the capabilities to manage the waste?	Y	N	
Physical and chemical characteristics reviewed?	Y	N	
Waste is compatible with HDPE landfill liner system?	Y	N	
Waste management byproducts reviewed?	Y	N	
Waste is not prohibited?	Y	N	
LDR status and documentation complete?	Y	N	

Required LDR documentation:
Waste Management Method:
CH Process Final Code Process Type
EPA Waste Codes

EPA Handling Codes:
Incompatability and special handling:

Physical Properties:

Physical State: Color
Density: pH
% Solids: %Aqueous Liquids: % Organic Liquids
Other:

Safety Precautions:

Required PPE:
Monitoring:
Fire Fighting:
Other Comments:

Laboratory and Treatment Instructions

Incoming Lab Analysis
Randon Sample Analysis
Post Treatment Analysis

Handling, Survey, and Decon Instructions

Inbound Survey
Inbound Sampling
Sample Area Survey
Disposal Isntructions
Exit Survey Requirements
Decon Requirements

Approvals:

Operations Date:

RSO Date:

Attachment C

SAMPLING METHODS

1.0 INTRODUCTION

An important consideration in the development of a waste characterization program is the methodologies employed for waste sampling. It is imperative that the sample be as representative of the waste stream as possible, since the reliability of all subsequent analytical and evaluation efforts will be limited by this factor. Procedures and general guidelines for obtaining representative samples of wastes from drums and bulk loads are discussed in the following sections. A Sample Log Book will be used as a tool by samplers to document the waste sampling. The Sample Log Book shall be maintained as part of the Operating Record. Prior to taking a sample, the Waste Profile Sheet and the PDR forms will be reviewed and safety procedures will be implemented.

2.0 DRUM SAMPLING

Drums or other approved waste containers are likely to contain materials that vary in form and consistency, such as liquids, sludges, or dry solids, all generated either separately and/or in mixtures. The sampling methodologies employed will generally depend upon the specific form and type of waste contained in a drum. Sampling must be representative of the material in the drums and account for any layering or stratification that may occur for any wastes having various liquid/liquid or liquid/solid phases. Containers will be sampled in such a manner as to obtain a vertical profile of the material, unless the physical properties prohibit penetration of the sampling devises.

2.1 LIQUID DRUM SAMPLING

Liquids should be sampled using a clean glass or plastic "thief'. A thief is a hollow glass or plastic tube approximately 3/8" internal diameter and greater than a drum in length. After the sample is obtained, replace the bung on the drum and tighten. The use of a dedicated thief for each drum sampled eliminates the need for cleaning and the possibility of cross-contamination and/or incompatible mixing of wastes.

2.2 SLUDGE DRUM SAMPLING

Sludge in drums range in consistency from slurries to near-solid materials. The sampling device employed will be dependent upon the consistency of the sludge material. Loose slurry material will be sampled using a thief. Material that will not enter the thief will need to be sampled by other means. If the sludge contains a large amount of coarse or compacted material, it will be sampled with a core sampler. Semi-solids in open-top drums containing a low concentration of

moisture will be sampled as a solid. Samples of sludge in drums can also be collected using various types of core samplers, such as sampling triers or soil augers. A typical sampling trier is a long tube with an open slot extending nearly the entire length. The tip and edges of the slot are sharp and allow the trier to cut a core of waste material to be sampled when inserted and rotated in the material. Sampling triers usually have a stainless steel tube and a wooden handle. They are usually 24 to 40 inches in length and 1/2 to 1 inch in diameter.

2.3 SOLID DRUM SAMPLING

Solids generally arrive in open-top drums. Waste solids can easily be sampled with a core sampler (i.e. sampling trier or soil auger) through the open top. Sampling trowels can be used in some cases when sampling dry, granular or powdered materials from drums. A sampling trowel (ordinarily zinc-plated) is a small tool with a pointed, scoop-shaped blade having a plastic or wooden handle. The sharp-tipped blade measures approximately 3” X 5”.

3.0 BULK SOLID SAMPLING

Bulk solid wastes generally arrive in dump trucks or roll-off boxes. Dump trucks and roll-off boxes containing solids and sludge will be sampled with trowels, shovels or other sampling devices with extended handles. Specific locations will be sampled by taking surface and subsurface grab samples.

At least one grab sample location per 10 yd^3 of waste is required. The grab samples will be composited in order to provide a representative sample of the shipment.

4.0 LIQUID/SLUDGE TANKER SAMPLING

Each tanker will be sampled via the manhole entrance port on the top of the tankers or through a sampling valve located on the bottom-rear of the tanker. The tanker contents will be sampled using a pond sampler or dipper. If necessary, a weighted bottle or equivalent sampling device will BE UTILIZED.

5.0 DECONTAMINATION OF SAMPLING EQUIPMENT

When practical, disposable sampling equipment will be used and disposed of in the same container from which the sample was taken. All reusable equipment will be cleaned, visually inspected for residues and surveyed for radiation prior to the reuse of such equipment. Equipment that has not been decontaminated will be appropriately labeled and stored.

ATTACHMENT D

ANALYTICAL TEST METHODS AND EVALUATION OF WASTE ACCEPTANCE CRITERIA.

1.0 LAB ANALYSIS

Waste generators will provide laboratory analysis data along with their waste profile. A variety of test methods are available. Preferred methods used will be those listed in Table 1, Acceptable Test Methods. Equivalent test methods may be used as long as they provide the same data quality. Detection limits must be sufficient to determine waste acceptability. CHDT will evaluate the generator's lab analysis. If the data is incomplete or not sufficient to determine acceptance criteria, CHDT will send a sample of the waste to a qualified lab for additional analysis. Both analytical testing and process knowledge may be used to demonstrate that the waste meets the Waste Acceptance Criteria.

Table 1. Acceptable Test Methods

Analytical Tests	Method	Sample Size
Gamma Emitters - Activation and fission products - screen only	EPA 901.1M	500g
Gamma Emitters - Natural Products	EPA 901.1M	500g
Gross alpha/beta (leach) by GFP	EPA 900.0M/ EPA 9310M	100g
Lead-210 by GFP	ASTM-D5811-95M	100g
Radium Tot. Alpha Emitting Isotopes	EPA 903.0M/ EPA 9315M	1L
Radium-226 by Alpha scintillation (Radon emanation)	EPA 903.1M	115g
Radium-226 by GFP (Total Radium Alpha)	EPA 9315	1L
Radium-226, 228 (Bi/Pb-214 ingrow th)	EPA 901.01M	500g
Radium-226, 228 by gamma spec (screening)	EPA 901.0M	500g
Radium-228	EPA 9320	1.5L
Thorium Isotopic Th 228, 230, 232 by alpha spec	ASTM D3972-90M	100g
Thorium Total (ICP)	EPA 6010	4oz
Thorium Total (ICPMS)	EPA 6020	4oz
Uranium Total	ASTM D3972-90M	100g
Uranium Total (ICP)	EPA 6010	4oz
Uranium Total (ICPMS)	EPA 6020	4oz
Uranium Total (Kinetic Phosphoresence Analysis)	ASTM D5174-91M	100g
Uranium isotopic-U-234, 235, 238, by alpha spec	ASTM D3972-90M	100g

2.0 PROCESS KNOWLEDGE

Waste generators must provide detailed process information for each waste stream as part of the pre-acceptance process. They must certify that there are no man-made radionuclides present above background levels, and certify the regulatory status of the waste. They may provide calculations or manufacturer's data to support the waste characterization. CHDT will evaluate this information in conjunction with lab analysis data to make sure the waste meets the acceptance criteria. Process knowledge may be substituted for lab test data, where appropriate, with approval from Adams County and CDPHE.

3.0 EVALUATION OF WASTE ACCEPTANCE CRITERIA.

CHDT must have data on each waste stream that document that the license limits on acceptance of radium-226, mass thorium, mass uranium and total activity are met. CHDT must also be able to ensure the absence of manmade radionuclides above background levels. CHDT must have sufficient knowledge about a waste to protect workers and the public.

a. Identification of Radionuclides and Their Activity

CHDT must have suitable documentation that identifies the radionuclides present and their activity. Uranium and Thorium activities can be determined by isotopic analysis using alpha spectroscopy. Once the isotopic data is known, the activities of the Uranium and Thorium progeny can be determined by inference. In the absence of isotopic data, mass concentration Uranium and mass concentration Thorium can be used to determine identity and activity. Uranium Isotopes in the Uranium, Thorium and Actinium decay series will be presumed to be present in their natural equilibrium concentrations in this case. Gamma spectrum analysis will identify and quantify shorter-lived progeny in the decay series and will also quantify Radium isotopes in the waste. Gamma spectrum analysis can also provide insurance against the presence of manmade radionuclides. Table 2, NORM Radionuclide Determination shows the various methods used for identification of naturally occurring radionuclides and determination of their activities.

Table 2 NORM Radionuclide Determination

Uranium Series					
Nuclide	**T1/2**	**Emmisions**	**Analysis**	**Other Analysis**	**Comments**
U-238	Very Long	Alpha	Alpha spec uranium isotopic	Total Uranium	
Th-234	24.1d	Low energy beta and gamma	Infered by U-238 activity	Total Thorium	Usually in equilibrium
Pa-234m	1.17m	High energy beta and gamma	Gamma spec	Infered by U-238 activity or Total Uranium	Part of gamma spectrum Analysis
Pa-234(0.13%)	6.75hr	Very small percentage			
U-234	long	Alpha	Alpha spec uranium isotopic	Total Uranium	
Th-230	long	Alpha	Alpha spec thorium isotopic	Total Thorium	
Ra-226	1602y	Alpha and low energy gamma	Alpha scintillation	Gamma spec	Use gamma screening unless high (>200pCi/g) is likely
Rn-222	3.823d	Alpha	Infered by Ra-226 activity		
Po-218	3.05m	Alpha	Infered by Ra-226 activity		
Pb-214	26.8m	Beta, Gamma	Gamma spec	Inferred by Ra-226 activity	Part of gamma screen
Bi-214	19.7m	High energy beta and gamma	Gamma spec	Inferred by Ra-226 activity	Part of gamma screen
Po-214	164us	Alpha	Infered by Bi-214 activity	Inferred by Ra-226 activity	
Pb-210	21y	Low energy beta	GFP counting	Inferred by Ra-226 activity	Analyze for Pb-210 if radon has been lost or if Pb-210 w aste
Bi-210	5.01d	High energy beta	Infered by Pb-210 activity		
Po-210	138.4d	Alpha	Infered by Pb-210 activity		
Thorium Series					
Nuclide	**T1/2**	**Emmisions**	**Analysis**	**Other Analysis**	**Comments**
Th-232	very long	Alpha	Alpha spec	Total Thorium	
Ra-228	6.7y	Low energy beta	Infered by Th-232, Ac-228, and Th-228 activity	Ra-228 by GFP	
Ac-228	6.13hr	High energy beta and gamma	Gamma spec	Inferred from Ra-228 activity	Part of gamma screen
Th-228	1.91y	Alpha	Alpha spec	Total Thorium	
Ra-224	3.64d	Alpha	Infered by Th-228 activity		
Rn-220	55s	Alpha	Infered by Th-228 activity		
Po-216	0.15s	Alpha	Infered by Th-228 unless there is loss of radon		
Pb-212	10.64hr	Beta, Gamma	Gamma spec		Part of gamma screen
Bi-212	60.6m	Alpha, beta, gamma	Gamma spec		Part of gamma screen
Po-212 (64%)	304ns	Alpha	Infered by Th-228 unless there is loss of radon		
Tl-208 (36%)	3.1m	High energy beta, gamma	Gamma spec		Part of gamma screen
Actinium Series					
Nuclide	**T1/2**	**Emmisions**	**Analysis**	**Other Analysis**	**Comments**
U-235	long	Alpha, gamma	`	0.7% ot total Uranium	Part of gamma screen
Th-231	25.5hr	Beta, low energy gamma	inferred by U-235	< or = to activity of U-235	
Pa-231	long	Alpha, low energy gamma	inferred by U-235	< or = to activity of U-235	
Ac-227	21.6y	Alpha, low energy gamma	inferred by U-235	< or = to activity of U-235	
Th-227 (98%)	18.2d	Alpha, gamma	inferred by U-235	< or = to activity of U-235	
Ra-223	11.43d	Alpha, gamma	inferred by U-235	< or = to activity of U-235	
Rn-219	4.0s	Alpha, gamma	inferred by U-235	< or = to activity of U-235	
Po-215	1.78ms	Alpha	inferred by U-235	< or = to activity of U-235	
Pb-211	36.1m	Beta, Gamma	inferred by U-235	< or = to activity of U-235	
Bi-211	2.15m	Alpha, gamma	inferred by U-235	< or = to activity of U-235	
Tl-207	4.79m	Beta, Gamma	inferred by U-235	< or = to activity of U-235	
Potassium					
Nuclide	**T1/2**	**Emmisions**	**Analysis**	**Other Analysis**	**Comments**
K-40	Very Long	Beta, Gamma	Gamma Spec	Calculated by % natural abundence from total K	

b. Determination of Total Activity

Acceptable waste must have total activity of less than 2000 pCi/g. Lab Analysis data will be used to determine total activity. Total activity will be calculated by the summation of the activity of the nuclides measured and the activity of nuclides not directly measured but known to be in equilibrium with measured nuclides. Process knowledge may be used as well.

c. Radium-226 Activity

Acceptable waste must have less than 222 pCi/g Radium-226. Radium-226 can be measured by a variety of methods, including gamma spectrum analysis, alpha scintillation, etc.

d. Mass Uranium and Thorium

Mass Uranium and Thorium combined must be less than 0.05%. Determination of this may be made from mass-based uranium and thorium analytical data. It may also be calculated from isotopic uranium and thorium data by using the specific activity of the isotopes. Process knowledge may also be applied.

Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE
15.WAC.02
WASTE TRACKING

1.0 OBJECTIVE

Define operational procedures for tracking waste through receipt, movement, treatment, and disposal at the Clean Harbors Deer Trail (CHDT) facility.

2.0 SCOPE

This standard operating procedure (SOP) defines the procedures, electronic files, hardcopy forms, and their use in tracking waste at CHDT. It does not cover documentation of laboratory analysis, wastewater treatment plant operations, and radiation surveys, which are covered in other procedures.

3.0 POLICY

All waste received from off site, or generated on site, will have its properties and disposition properly documented in compliance with the RCRA permit and Colorado regulations. All waste storage, movements, treatment, disposal, and shipment off site will be properly documented in compliance with the RCRA permit and Colorado regulations.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 WASTE TRACKING

Clean Harbors utilizes an internet based electronic waste tracking data base to document all facets of waste operations from generation until final disposal. Certain hardcopy forms and logbooks are used to provide additional documentation of waste transport and disposal. A step-by-step description of the waste tracking process is as follows:

5.1 Uniform Manifest

A uniform hazardous waste manifest (shown in Attachment 1) will usually be used by the waste shipper/generator to document the waste shipment and end facility. Alternatively, a nonhazardous waste manifest or a bill of lading may be used to document waste shipments. If required for license transfer purposes, NRC forms 540 and 541 will also be utilized. The utilization of these forms is governed by regulation. After a shipment is received at the facility, and any discrepancies are resolved, the manifest will be signed for

by the facility and a copy will be sent back to the waste generator. Copies of the signed manifest are also scanned into the Clean Harbors waste tracking database and hardcopies are kept on file at CHDT.

5.2 Weight Ticket

Each shipment of waste is weighed at the truck scales at the front of the facility. Gross, tare, and net weight are shown on the weight ticket. Radiation exposure rates determined by the portal monitors are recorded on the weight ticket (Attachment 2). Copies of completed weight tickets are scanned into the Clean Harbors waste tracking database and are kept on file at the facility. Gross, tare and net weights are also entered into the Clean Harbors waste tracking database.

5.3 Gate Log

Information on each incoming waste shipment will be entered in the Clean Harbors waste tracking database. A hardcopy Gate Log of all incoming waste shipments will also be updated on a daily basis and kept on file at CHDT. An example copy of the Gate Log is shown in Attachment 3. Each incoming load is assigned a load number. This load number will be used as the identification number for filing all incoming load documentation.

5.4 Site-Generated Log

Information on each quantity of site-generated waste will be entered into the Clean Harbors waste tracking database. A hardcopy Site-Generated Log will also have this information entered into it and will be kept on file at the facility. An example of this is found in Attachment 4.

5.5 Waste Receiving Report

Information entered into the Clean Harbors internet based waste tracking system (WIN WEB), can be printed out and summarized on a document called a Waste Receiving Report. An example of this is shown in Attachment 5. The Clean Harbors waste tracking system assigns unique numbers to all waste containers.

5.6 Waste Tracking Form/Work Order

A Waste Tracking Form is generated for the shipment. The Waste Tracking Form will be used to track onsite movements or creation of waste (Attachment 6). The waste tracking form provides instructions to CHDT workers for treatment and disposal of waste and provides a format for them to record landfill or treatment locations. .

5.7 Stabilization Recipe

This form provides the information necessary for treatment operations; it contains mixing and reagent addition instruction and safety precautions.

5.8 Bulk Container Inventory

An inventory of bulk containers will be made each operating day (an example inventory form is shown in Attachment 7). The location, identification and description of each bulk container will be entered in the Bulk Container Inventory form printed out each day. Each day's form will be filed.

6.0 FORMS

6.1 Form Format

Tracking forms are subject to frequent revision in order to resolve new and unforeseen circumstances and to improve recordkeeping. Minor changes to the form format may be made by the CHDT RSO, CHDT General Manager, or designee at any time.

ATTACHMENT 1 – UNIFORM MANIFEST

Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number
2. Page 1 of
3. Emergency Response Phone
4. Manifest Tracking Number 002589559 FLE

5. Generator's Name and Mailing Address — Generator's Site Address (if different than mailing address)

Generator's Phone:

6. Transporter 1 Company Name — U.S. EPA ID Number

7. Transporter 2 Company Name — U.S. EPA ID Number

8. Designated Facility Name and Site Address — U.S. EPA ID Number

Facility's Phone:

9a. HM	9b. U.S. DOT Description (Including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
	1.					
	2.					
	3.					
	4.					

14. Special Handling Instructions and Additional Information

15. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name — Signature — Month Day Year

GENERATOR

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

INT'L

17. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name — Signature — Month Day Year

Transporter 2 Printed/Typed Name — Signature — Month Day Year

TRANSPORTER

18. Discrepancy

18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

18b. Alternate Facility (or Generator) — U.S. EPA ID Number

Facility's Phone:

18c. Signature of Alternate Facility (or Generator) — Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

1. 2. 3. 4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a

Printed/Typed Name — Signature — Month Day Year

DESIGNATED FACILITY

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete. DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)

ATTACHMENT 2 – WEIGHT TICKET

Weight Ticket

Clean Harbors Deer Trail, LLC
108555 E. US Highway 36
Deer Trail, CO 80105

Date _____

Drum # _____

Load # _____

Manifest # _____

Sales Ord # _____

Profile # _____

Container # _____

Trailer # _____

Gross _____

Tare _____

Net _____

Driver _____ [ ]on [ ]off Weighed by: _____

Gate Monitor Radioactivity Readings (μR/hr) East _____ West _____

Washouts	Yes	Initials
None	[ ]	_____
Tank Wash	[ ]	_____
Rolloff Wash	[ ]	_____
Vacbox Wash	[ ]	_____
Other Cleanout	[ ]	_____
Wheel Wash	[ ]	_____

Exit Survey	Yes	Initials
DOT Empty	[ ]	_____
Free Release Survey	[ ]	_____

ATTACHMENT 3 – GATE LOG

Load#	Date	State	Doc#	State Man#	CH WO#	Generator	Profile	Actual Weight	Estimated Weight	Date Ret	Manif	Date Copies Faxed	CH Drum#	Container #	Comments

ATTACHMENT 4 – SITE GENERATED LOG

Onsite Load#	Date	Waste Name	Profile	From	To	Volume	Weight	Drum#	Container Type	Container Size	Container #	Comments

ATTACHMENT 5 – EXAMPLE WASTE RECEIVING REPORT

Clean Harbors Environmental Services, Inc.

Waste Receiving Report

Bulk

Plant Received Date: 3/3/2005 12:00:00AM
Work Order #: **D9927737** Load #: **56307**
Receiving Facility: Deer Trail Landfill (DR)
Equipment: UNKNOWN

Generator: [redacted]
Customer: [redacted]
Manifest: [redacted] Cnt: **1**
Generator EPA ID: [redacted] State EPA ID: [redacted]

Line Item	Shipping Name/ US DOT Description	UN/NA Number	Container No. Type	Total Quantity	Unit Wt/Vol	CHI Pre-Code	Profile Number	Pkg Grp	Hazard Class	Hzrd Zone
11A	HAZARDOUS WASTE, LIQUID, N.O.S. (CHROMIUM, LEAD)	NA3082	1 TT	41,000	P	CCS	CH28928B	III	9 MISCELLANEOUS HAZARDOUS MATERIAL	

Profile Constituents (ordered by Max %)	Min	Max		Min	Max		Min	Max
WATER	70.00	80.00	METAL HYDROXIDES	0.00	20.00	LEAD	0.00	7.00
CHROMIUM	0.00	4.00	SELENIUM	0.00	1.50			

** THE PROFILE INDICATES THAT THIS WASTE CONTAINS AN OSHA REGULATED SUBSTANCE,CONTACT HEALTH & SAFETY PRIOR TO HANDING.

Tank Wash:_____ Tank Cleanout:_____ Tank Entry:_____ None:_____ CHI Providing Trans: Y Quoted Tank Wash Price: [redacted]

Waste Codes D002 D007 D008 D010

Least Cost Outlet	Outbound Profile	Outbound Profile Description	Cons (Y/N)
LG	CCS-ARSENIC	HIGH Arsenic contaminated solids- SPECIAL TREATMENT	Y
LG	LAC2	LIQUID ACID CONCENTRATED D002 ONLY	Y
LG	LAC2D	LIQUID ACID CONCENTRATED, D002, D004-11	Y
LG	LAC2DF	LIQUID ACID CONCENTRATED, D002, D004-11, F006-F012, F019	Y
LG	LB2D	ALKALINE LIQUID/SLUDGE D002, D004-11	Y
LG	LB2DF	ALKALINE LIQUID/SLUDGE D002, D004-11, F006-12, F019	Y
LG	lg-ch75714	Milling/Grinding Sludge	Y
LG	LG-CH81342	SODIUM NITRATE LIQUID/ E.C.M.	Y
LG	LM98-0149	343912 INORGANIC WASTEWATER-REG. WATER	Y
LG	LND	NEUTRAL LIQUID/SLUDGE D004-11	Y
LG	LNDF	NEUTRAL LIQUID/SLUDGE D002, D004-11, F006-12, F019	Y
LG	SAD2DF	SOLID ACID D002, 4-11, F006-12, F019	Y
LG	SBND	SOLID BASIC/NEUTRAL D002 & D004-11	Y
LG	SBNDF	SOLID BASIC/NEUTRAL D004-11, F006-12, F019, F035 LOW METALS	Y

Billing Requirements:

Container (Y/N)	Gallons (Y/N)	Special Instructions
	N	

Restrictions:

Restrictions, Other:

Drum No.	Final Code	Qty	Cont. Type	H2O Mix (Y/N)	Ph (Value)	Ign (Y/N)	CN (+/-)	Sulfide (Y/N)	PCB Value	Rad (Y/N)	Oxid (Y/N)	CC Insp	Chlorine (Y/N)	Weight (pounds)	Comments
6543865		40,000	TT												

1 Item(s) printed for **CO05003-D9927737**

Report Printed on 3/8/2005 11:44:01AM waste_mgmt\WS_RCVNG_RPT.rpt Page 1 of 1

ATTACHMENT 6 – WASTE TRACKING FORM

Load #

Load #

Campaign #

From: **To: CELL3**

Container Information

Box Number(s): N/A

No.of Containers: **Total Weight:** **pounds**

Container Type(s): **Container Size:**

Drum Numbers:

Waste Information

Waste Name:

Profile #(s)

Generator(s):

EPA Codes:

Radioactive? NO **State/NRC Licensed Waste?** No

Radionuclides Present NONE

Safety Information

PPE Requirements: Level C **Special Handling:** NONE

Monitoring: N/A **Spill Response:** Contain

Known Hazards: **Cell Exit Req.:**

Fire Fighting: Use Water **Washout Req.:** Wheel Wash

Landfill Grids

Landfill Loads	Tier	Alph	Num	Initials	Time/Date
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Created by: DAN OBRIEN **Date:**

Authorized by: **Date:**

Transfer Tech: **Date:**

ATTACHMENT 7 – EXAMPLE BULK CONTAINER INVENTORY

				Bulk Container Inventory						
7/31/2004				Prepared by: [redacted]						
Type	Size	Container Number	Site # or Campaign #	Arrival Date	Days on Site	Location (A, B, or 10 Day)	Row	Order	Profile #	Comments or Car number
RO	20	UPCU410733	56024	5/21/2004	71	B	7	4	SNDEBRISO-KP-OFF	
RO	20	UPCU411688	56035	5/21/2004	71	B	7	5	SNDEBRISO-KP-OFF	
RO	20	USPC37176	56041	5/28/2004	64	B	7	6	SNDEBRISO-KP-OFF	
RO	20	UP410320	56085	6/26/2004	35	B	6	5	SNDEBRISO-KP	
RO	25	UPCU410377	56088	8/26/2004	-26	B	2	2	CH55486B	
RO	20	USPC30007	56089	6/28/2004	33	B	6	4	SNDEBRISO-KP	
RO	40	MSUU410119	56090	6/29/2004	32	B	6	3	SNDEBRISO-KP	
RO	40	UPCU411224	56092	6/29/2004	32	B	6	2	SNDEBRISO-KP	
RO	20	410714	56094	6/30/2004	31	B	6	1	SNDEBRISO-KP	
RO	25	UPCU410666	56103	7/8/2004	23	A	3	5	SNDEBRISO-KP	
RO	40	UPCU411150	56113	7/13/2004	18	B	1	2	SNDEBRISO-KP	
RO	40	MSUU410200	56114	7/13/2004	18	B	1	3	SNDEBRISO-KP	
RO	40	UPCU411716	56116	7/14/2004	17	B	3	2	SNDEBRISO-KP	
RO	40	UPCU411369	56117	7/14/2004	17	B	3	3	SNDEBRISO-KP	
RO	40	UPCU411089	56119	7/14/2004	17	B	3	1	SNDEBRISO-KP	
RO	20	UP220413	56120	7/14/2004	17	B	1	1	SNDEBRISO-KP	
RO	40	UPCU411312	56121	7/15/2004	16	B	4	2	SNDEBRISO-KP	
RO	40	UPCU419921	56122	7/15/2004	16	B	4	3	SNDEBRISO-KP	
RO	40	UPCU411293	56123	7/15/2004	16	B	5	3	SNDEBRISO-KP	
RO	40	UPCU411247	56124	7/15/2004	16	B	5	4	SNDEBRISO-KP	
RO	20	A413-25	56126	7/16/2004	15	A	3	7	AP309752KP	
RO	20	UPCU410816	56127	7/16/2004	15	B	5	2	SNDEBRISO-KP	
RO	25	UPCU410828	56128	7/16/2004	15	B	4	1	SNDEBRISO-KP	
RO	20	A517-25	56129	7/16/2004	15	A	3	6	AP309752KP	
RO	40	MSUU410258	56132	7/17/2004	14	A	6	10	SNDEBRISO-KP	
RO	20	LMF030003	56133	7/17/2004	14	A	6	11	SNDEBRISO-KP	
RO	20	35270	56134	7/17/2004	14	A	6	8	SNDEBRISO-KP	
RO	40	UPCU419947	56135	7/17/2004	14	A	6	9	SNDEBRISO-KP	
RO	20	UP220394	56136	7/19/2004	12	A	4	8	SNDEBRISO-KP	
RO	40	UPCU419920	56137	7/19/2004	12	A	4	9	SNDEBRISO-KP	
RO	20	LMF037218	56138	7/19/2004	12	A	4	7	SNDEBRISO-KP	
RO	40	MSUU410242	56139	7/20/2004	11	A	4	5	SNDEBRISO-KP	