STATE OF COLORADO

Bill Owens, Governor
Douglas H. Benevento, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

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Colorado Department
of Public Health
and Environment

September 22, 2005

Attention: David B. Nielsen, Director of Landfill Compliance
Clean Harbors Deer Trail, LLC
2500 West Lokern Road
PO Box 787
Buttonwillow, CA 93206

Re: Request for License-Financial Assurance and Standard Operating Procedures

This letter is a follow-up to our meeting on September 9, 2005 and a request for additional documentation to resolve issues and deficiencies identified with your January 31, 2005 license application to operate a low-level waste disposal facility in Colorado. Please provide appropriate documentation to resolve each of the following items.

Decommissioning Warranty

Condition 45 of the draft Radioactive Materials License requires Clean Harbors establish a Department-approved financial warranty for decommissioning that meets the requirements of RH 3.9.5. Clean Harbors has proposed to establish an external sinking fund for this warranty as described in RH 3.9.5 (4). Please submit documentation of the proposed sinking fund for decommissioning, which includes the following:

1. In consideration of your proposal to have a partial sinking fund for decommissioning, the Department maintains the requirements specified in condition 45 of the draft license. The value of sinking fund must be sufficient to ensure decommissioning of the facility in accordance with the requirements in RH 3.9.5 (4) and 3.9.5.5. The Department expects that a full fund be established within twenty (20) years from the issuance of the license.
2. The sinking fund must be coupled with a surety method or insurance. This surety method or insurance must include the following provisions:
    a. The policy or bond must specifically include coverage for decommissioning pursuant to the Radioactive Materials License, the Colorado Radiation Control Act and the Colorado Rules and Regulations Pertaining to Radiation Control.
    b. The surety or insurance company shall become liable on the obligation upon a written notification by the Department in accordance with the provisions of CRS 25-11-111.
    c. The licensee shall provide to the Department written notification at least ninety (90) days prior to cancellation, termination, or revocation of the warranty. However, no such termination shall become effective until the surety or insurance company receives written authorization for termination of the bond or insurance from the department.
    d. The surety or insurance company shall provide to the Department written notification at least ninety (90) days prior to cancellation, termination, or revocation of the warranty.

3. The Department prefers the external sinking fund for decommissioning be established in an account with the State Treasury.

Long-Term Care Warranty

Condition 45 of the draft Radioactive Materials License requires Clean Harbors establish a Department-approved financial warranty for long-term care that meets the requirements of RH 3.9.5.10. Clean Harbors has proposed to establish an external sinking fund for this warranty as described in RH 3.9.5 (4). Please submit documentation of the proposed sinking fund for long-term care, which includes the following:

4. As required by 3.9.5.10, the value of sinking fund shall be enough that with an assumed six percent annual real interest rate, the annual interest earnings will be sufficient to cover the annual costs of site surveillance by the Department, including reasonable administrative costs incurred by the Department, in perpetuity, subsequent to the termination of the license. The Department expects that a full fund be established within twenty (20) years from the issuance of the license.
5. The sinking fund must be coupled with a surety method or insurance. The surety or insurance must include the provisions listed above in Item 2.
6. The Department prefers the external sinking fund for long-term care be established in an account with the State Treasury.

SOP on Radiation Protection Records

7. The list of Record Keeping requirements found in Section 8.0 of the Radiation Protection Plan and in the SOP on Worker Radiation Protection Records does not include Records of Individual Monitoring Results and Records of Waste Disposal as required by RH 4.46 and RH 4.48.

SOP on Individual and Area Dosimetry

8. Section 5.4 –Reference is made to the Deer Trail Standard Operating Procedure on Records Management. A procedure under this title is not included in the latest set of SOPs.
9. Section 6.1- Should read “dose rates shall be measured quarterly or more frequently, as determined by the Deer Trail RSO…” These measurements should not be conducted less frequently than quarterly.

SOP on Airborne Monitoring

10. The current Air Monitoring Plan does not include monitoring to demonstrate that the interim cover of the disposal cell will meet effluent limits for radon. Please submit a plan for determining background radon levels around the disposal cell and periodic sampling and analysis for radon effluent concentrations at an appropriate number of locations around the disposal cell.
11. In your letter dated July 7, 2005, your response to the Department’s comment 11 states that radionuclide instrumentation will be selected and designed to comply with the requirements of EPA 40 CFR 50 Appendix B. What instrumentation will be designed and used? Please provide a detailed description of the manufacturer, model and configurations that will be used.
12. Section 5.1- There is an inconsistency between the sample collection frequency (every two weeks) and the sample evaluation frequency (weekly). Weekly collection and analysis of the filters is appropriate.
13. Section 5.3- How will background levels for air samples be determined? Actions based on mean plus two standard deviations are preferable to action based on twice background.
14. Offsite analysis of sample filters should be performed monthly rather than quarterly to verify that air concentration limits do not exceed effluent limits.
15. Section 5.4- The detection limits proposed should be in the form of activity per cubic meter of air sampled.

16. Full quality assurance and quality control results should be included in the records.

SOP on Gate Monitoring System

17. The procedure for the gate monitoring system permits the RSO a great deal of discretion to adjust the alarm set point for the gate monitor. This discretion is not supported by calculations, procedures, and criteria to be used by the RSO in making these adjustments.

    The use of a gate alarm is one of three means proposed by CHDT to ensure that material received at the facility for disposal are within the authorizations granted by the license. The alarm set point for monitoring of trucks of waste should be determined, approved by the Department, and enforced judiciously by CHDT.

    The alarm set point should be determined to represent the highest possible exposure based on the authorizations in the license, taking into consideration such factors as shielding from the sides of the truck, geometry, and the efficiency of the monitoring system for the isotopes in question. In addition a small contingency factor of 5-10% higher than model results could be incorporated into the alarm set point to account for situational variances between the real world and computer modeling. Once the alarm set point is determined, it should remain the same for all trucks of regulated waste. If a truck exceeds this alarm set point it should be rejected until further testing can be performed on the load to ensure that it doesn't exceed the authorized limits.

    If based on operational data, the facility can support modification to the alarm set point, the value of the set point can be changed following a review by the Department.

Routine Radiation Surveys

18. Section 5.4- Please clarify what work areas are to be surveyed for contamination. Areas where there is the potential for contamination to spread to clean areas should be surveyed.
19. Section 5.4 – How often are the work area contamination surveys performed?
20. Sections 5.4 and 5.6 – How long will the filter paper samples be counted?
21. Sections 5.4 and 5.6 – How close to the probe of the portable survey instrument will the filter sample be held? How will you ensure that the same distance is used for every sample?

SOP on Equipment Surveys

22. Section 5.2 states that trucks will be decontaminated in a designated area on the haul road. How will you prevent the haul road from becoming contaminated during decontamination of a truck? If the haul road becomes contaminated how will you prevent other vehicles that travel on the haul road from becoming contaminated?

SOP on Surveys Following Spills

23. There is an inconsistency between Section 5.0 and 5.4 regarding the use of the Ludlum 193-6 Survey Wand for surveys following spills.

SOP on Regulated Waste Landfill Operations

24. There were multiple items in this SOP that were inconsistent with the operating conditions required by the Colorado Hazardous Waste Act (CHWA) Permit. The following items in this SOP need to be adjusted to be consistent with the CHWA permit:
    a. Section 6.4 states that waste will be placed in lifts up to 6 feet thick. However, two feet thick is pushing the limits of the equipment;
    b. Section 6.4 states that size reduction of debris waste will done using compactor. However, the permit does not allow treatment in the landfill;
    c. Section 6.4 states that sand will be used as a protective cover on side slopes. However, sideslopes are not a drainage layer;
    d. Section 6.5 states that cover material will be placed over the waste at the end of each landfill-operating day. However, the permit requires placement of cover material at end of each shift;
    e. Section 6.5 states that you will cease operations and cover within 2 hours when sustained wind is 35 mph. However, the permit requires ceasing operations and immediately covering waste whenever wind is 35mph; and
    f. Section 6.5 states that waste and haul road may be wetted with water for dust suppression. However, the permit and Colorado Hazardous Waste Regulations prohibit liquids of any sort to be placed in landfill.

SOP on Treatment Operations

25. Section 6.4- Samples of the treated waste must be taken to verify proper treatment

Please contact Jennifer Opila at (303) 692-3403 if you have any questions regarding this letter.

Sincerely,

Steve Tarlton, Unit Leader
Radiation Management Unit
Hazardous Materials and Waste Management Division

CleanHarbors®
ENVIRONMENTAL SERVICES, INC.

Clean Harbors Deer Trail, LLC
108555 East Highway 36
Deer Trail, CO 80105
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OCT 26 2005

Jen's copy

October 25, 2005

Mr. Steve Tarlton, Unit Leader
Radiation Management Unit
Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246-1530

RE: Response to Request for License-Financial Assurance and Standard Operating Procedures Letter Dated September 22, 2005, Docket Number 5873

Dear Mr. Tarlton:

We received your letter dated September 24, 2005, which requested additional information on financial assurance and standard operating procedures associated with the Clean Harbors Deer Trail LLC, *Radioactive Materials License Application*, dated January 2005. Enclosed is Clean Harbor's response.

If you have any questions, please feel free to me at (661) 762-6200.

Sincerely,

David B. Nielsen, PE, REA
Director of Landfill Compliance
Clean Harbors Environmental Services, Inc.

DBN:dbn

Enclosures: Response to Comments;

RESPONSE TO COMMENTS ON CLEAN HARBORS DEER TRAIL, LLC, RADIOACTIVE MATERIALS LICENSE APPLICATION, DOCKET NUMBER 5873

Colorado Department of Public Health and Environment
Request for Information September 22, 2005

CDPHE Comment 1 – Decommissioning Warranty

Condition 45 of the draft Radioactive Materials License requires Clean Harbors establish a Department-approved financial warranty for decommissioning that meets the requirements of RH 3.9.5. Clean Harbors has proposed to establish an external sinking fund for this warranty as described in RH 3.9.5 (4). Please submit documentation of the proposed sinking fund for decommissioning, which includes the following:

1. **In consideration of your proposal to have a partial sinking fund for decommissioning, the Department maintains the requirements specified in condition 45 of the draft license. The value of sinking fund must be sufficient to ensure decommissioning of the facility in accordance with the requirements in RH 3.9.5 (4) and 3.9.5.5. The Department expects that a full fund be established within twenty (20) years from the issuance of the license.**

Clean Harbors Response: Clean Harbors is currently pursuing two different alternatives related to the decommissioning warranty: (1) a surety bond for all decommissioning costs in accordance with RH 3.9.5, and consistent with 25-11-110(6)(b)(I); or (2) a sinking fund for all decommissioning costs which will be full funded within 20 years after license issuance and which will meet the requirements of RH 3.9.5. Clean Harbors is currently finalizing discussions with sureties regarding both of these proposed financial assurance mechanisms, and, in the near future, will know which one of these two alternatives will be available to it. More detail on these two proposed approaches will be included in Clean Harbors' comments on the draft radioactive materials license, which will be submitted to the Department on or before October 26, 2005.

2. **The sinking fund must be coupled with a surety method or insurance. This surety method or insurance must include the following provisions:**
   a. **The policy or bond must specifically include coverage for decommissioning pursuant to the Radioactive Materials License, the Colorado Radiation Control Act and the Colorado Rules and Regulations Pertaining to Radiation Control.**

   Clean Harbors Response: If Clean Harbors' chosen decommissioning warranty method is the establishment of a sinking fund, it will be coupled with insurance which expressly includes coverage for decommissioning pursuant to applicable Colorado Radiation Control rules and regulations. If this method is chosen, Clean Harbors will propose specific language for the certificate of insurance..

   b. **The surety or insurance company shall become liable on the obligation upon a written notification by the Department in accordance with the provisions of CRS 25-11-111.**

   Clean Harbors Response: Any insurance that is coupled with a sinking fund will become liable on the obligation upon written notification by the Department in accordance with C.R.S. 25-11-111.

c. **The licensee shall provide to the Department written notification at least ninety (90) days prior to cancellation, termination, or revocation of the warranty. However, no such termination shall become effective until the surety or insurance company receives written authorization for termination of the bond or insurance from the department.**

Clean Harbors Response: Clean Harbors will provide the Department written notification at least 90 days prior to cancellation, termination, or revocation of the warranty. No such termination shall become effective until the insurance company receives written authorization for termination of the insurance from the Department.

d. **The surety or insurance company shall provide to the Department written notification at least ninety (90) days prior to cancellation, termination, or revocation of the warranty.**

Clean Harbors Response: If Clean Harbors opts to establish a sinking fund, the insurance agreement will provide that the insurance company will provide to the Department written notification a least ninety (90) days prior to cancellation, termination, or revocation of the warranty.

3. **The Department prefers the external sinking fund for decommissioning be established in an account with the State Treasury.**

Clean Harbors Response: If an external sinking fund is established, it will be fully funded either in an account with the State Treasury, or an alternative approved by the Department.

Long-Term Care Warranty

Condition 45 of the draft Radioactive Materials License requires Clean Harbors establish a Department-approved financial warranty for long-term care that meets the requirements of RH 3.9.5.10. Clean Harbors has proposed to establish an external sinking fund for this warranty as described in RH 3.9.5 (4). Please submit documentation of the proposed sinking fund for long-term care, which includes the following:

4. **As required by 3.9.5.10, the value of sinking fund shall be enough that with an assumed six percent annual real interest rate, the annual interest earnings will be sufficient to cover the annual costs of site surveillance by the Department, including reasonable administrative costs incurred by the Department, in perpetuity, subsequent to the termination of the license. The Department expects that a full fund be established within twenty (20) years from the issuance of the license.**

Clean Harbors Response: Clean Harbors is currently pursuing two different alternatives related to the long-term care warranty: (1) a surety bond for all decommissioning costs in accordance with RH 3.9.5, and consistent with 25-11-110(6)(b)(I); or (2) a sinking fund for all decommissioning costs which will be established within 20 years after license issuance and which will meet the requirements of RH 3.9.5. Clean Harbors is currently finalizing discussions with sureties regarding both of these proposed financial assurance mechanisms, and, in the near future, will know which one of these two alternatives will be available to it. More detail on these two proposed approaches will be included in Clean Harbors' comments on the draft radioactive materials license, which will be submitted to the Department on or before October 26, 2005.

5. **The sinking fund must be coupled with a surety method or insurance. The surety or insurance must include the provisions listed above in Item 2.**

Clean Harbors Response: If Clean Harbors' chosen long-term care warranty method is the establishment of a sinking fund, it will be coupled with insurance which expressly includes coverage for long-term care pursuant to applicable Colorado Radiation Control rules and regulations. Such insurance will include the provisions listed above in Item 2 as responded to by Clean Harbors, above.

6. **The Department prefers the external sinking fund for long-term care be established in an account with the State Treasury.**

Clean Harbors Response: If an external sinking fund is established, it will be established either in an account with the State Treasury, or an alternative approved by the Department.

SOP on Radiation Protection Records

7. **The list of Record Keeping requirements found in Section 8.0 of the Radiation Protection Plan and in the SOP on Worker Radiation Protection Records does not include Records of Individual Monitoring Results and Records of Waste Disposal as required by RH 4.46 and RH 4.48.**

Clean Harbors Response: The RPP, Section 8, has been modified consistent with RH 4.46 and RH 4.48 on Records of Individual Monitoring Results and Records of Waste Disposal. The revised text is as follows:

"c. Personnel records (1 year post termination of employment)
   i. Worker/user lists,
   ii. Training records, and
   iii. Individual monitoring results, for routine, planned special exposures, accidents, and emergency conditions using the occupational exposure record form provided in Attachment 3 of the CHDT *Standard Operating Procedure on Individual and Area Dosimetry*.
d. Records of waste disposal as required by regulation"

The SOP on Worker Radiation Protection Records has been modified as follows:

"c. Personnel records (1 year post termination of employment)
   i. Worker/user lists,
   ii. Training records (as described in 5.2 below), and
   iii. Individual monitoring results, for routine, planned special exposures, accidents, and emergency conditions using the occupational exposure record form provided in Attachment 3 of the CHDT *Standard Operating Procedure on Individual and Area Dosimetry*.
d. Records of waste disposal as required by regulation"

Updated and signed copies of the RPP and the SOP on Worker Radiation Protection Records are provided in Attachment A.

SOP on Individual and Area Dosimetry

8. **Section 5.4 –Reference is made to the Deer Trail Standard Operating Procedure on Records Management. A procedure under this title is not included in the latest set of SOPs.**

Clean Harbors Response: The SOP on Records Management was not submitted as part of the license application since it is an existing internal Deer Trail procedure affecting overall RCRA operations. In this light, the SOP has been modified as follows:

- "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 consistent with the Deer Trail records management procedures.

- Ensure that individual doses are reported to the Department using the form in Attachment 3 consistent with the Deer Trail records management procedures."

9. **Section 6.1- Should read "dose rates shall be measured quarterly or more frequently, as determined by the Deer Trail RSO…" These measurements should not be conducted less frequently than quarterly.**

Clean Harbors Response: This editorial change has been made.

An updated and signed copy of the SOP on Individual and Area Dosimetry is provided in Attachment A.

SOP on Airborne Monitoring

10. **The current Air Monitoring Plan does not include monitoring to demonstrate that the interim cover of the disposal cell will meet effluent limits for radon. Please submit a plan for determining background radon levels around the disposal cell and periodic sampling and analysis for radon effluent concentrations at an appropriate number of locations around the disposal cell.**

Clean Harbors Response: The SOP on Airborne Monitoring has been revised to include a new section 5.5 describing the radon monitoring procedure and section 7 describing the evaluation of radon results. The modifications are as follows:

"5.5 <u>RADON MONITORING PROCEDURE</u>: Monitoring will be conducted in the following manner:

- Monitoring of radon concentrations shall be conducted using passive alpha track radon detectors.
- *CHDT will utilize the Landauer Alpha Track Rad-Trak Outdoor Air Detector item # 3409 type DRNF, or equivalent.*
- The manufacturers procedure for use of these detectors shall be followed.
- Background Radon Detectors shall be placed in each location where a particulate air sampler is located.
- Landfill Cell Radon Detectors shall be placed on all four sides of each open landfill cell at the perimeter of the cell.
- Each detectors shall be used for a period of ninety (90) days,

- At the end of each ninety-day period, the detectors shall be sent to the manufacturer for analysis.
- The manufacturers report of analysis will be sent to CHDT for review. The report will include the detector number/location, exposure in pCi/L days, and the average radon concentration in pCi/L."

"7.0 EVALUATION OF RADON RESULTS: The quarterly analytical report of measured radon concentrations will be evaluated by the Deer Trail RSO. Background radon levels will be statistically evaluated in order to determine average and peak natural radon levels. Radon effluent levels at the edge of the open landfill cell(s) will be compared with background levels in order to evaluate the effectiveness of the interim cover. If excessive levels are encountered, the landfill operations will be reviewed and modified, as appropriate, to limit radon effluents."

An updated and signed SOP on Airborne Monitoring is provided in Attachment A.

11. In your letter dated July 7, 2005, your response to the Department's comment 11 states that radionuclide instrumentation will be selected and designed to comply with the requirements of EPA 40 CFR 50 Appendix B. What instrumentation will be designed and used? Please provide a detailed description of the manufacturer, model and configurations that will be used.

Clean Harbors Response: The ambient air sampling stations and meteorological instrumentation are being designed and constructed by HI-Q, Environmental Products Company located in San Diego, California and ENSR, International located in Fort Collins, Colorado. HI-Q will provide an Operations and Maintenance Manual including a list of recommended spare parts with the delivery of the sampling systems.

The TSPR samples provided by HI-Q will consist of a model VS23-1023CV ¾ HP oil less rotary vane pump, flow rate controller, elapsed timer, 47mm diameter filter holder with 3/8 inch quick disconnect, stainless steel gooseneck to set sample point at approximately 59 inches above ground, rain and wind shield, outdoor instrument weather house. Each sampling station operates continuously when the wind is from the direction ≥ 180 degrees and ≤ 270 degrees and will be controlled by a R.M. Young Wind Monitor AG. The data will be recorded on a Campbell Scientific data logger (CR205 at two stations and a CR10X at one station). The sampler located in the treatment building is not dependent on wind direction. Filters will be model LB-5211in a 47mm diameter. Quarterly flow calibration will be done with a Model AFC-Complete-6 NIST traceable digital air flow calibrator. See Attachment B for manufactures data.

The meteorological tower will be 30 feet high and will be equipped with a R.M. Young Wind Monitor A, Viasala Temperature / Relative Humidity probe model HMP45C, Radiation Shield Model UT12VA, SERTA Barometric Pressure Probe Model CS100 (or equivalent) and a Met One heated Precipitation gauge Model 385-L. Data from the two outlying wind monitors will be sent to the primary meteorological station using a Campbell Scientific 900 mhz RF transmitter. All meteorological data will then be transmitted to the Deer Trail facility operations building using a model RF 400 900 mhz transmitter. Meteorological data will be processed using Campbell Scientific Loggernet software. See Attachment B for manufactures data.

12. **Section 5.1- There is an inconsistency between the sample collection frequency (every two weeks) and the sample evaluation frequency (weekly). Weekly collection and analysis of the filters is appropriate.**

Clean Harbors Response: The bullet list in Section 5.1 has been modified as follows:

- "Sample filters will be collected approximately every week and analyzed using the onsite Alpha Beta sample counter.
- Monthly composites of the sample filters will be sent to a laboratory for analysis."

13. **Section 5.3- How will background levels for air samples be determined? Actions based on mean plus two standard deviations are preferable to action based on twice background.**

Clean Harbors Response: As described in the revised Air Monitoring Plan, separate locations will be established for collection of background levels. These locations will be at upwind locations that are unaffected by landfill operations. The text has been revised to indicate that actions will be taken if the levels reach background plus two standard deviations. Section 5.3 of the SOP has been revised as follows:

"Upon removal of the air filter, a preliminary, qualitative assessment shall be conducted using the Ludlum Model 3 survey meter with a Ludlum 44-9 Pancake G-M probe to determine gross contamination levels. Background samples shall be taken at upwind locations that are unaffected by landfill operations. If background levels of radon or thoron progeny interfere, prompt field assessments may not be possible. In this situation, the sample will be allowed to decay for one week before the preliminary assessment is conducted. If the preliminary assessment indicates radioactive contamination levels in excess of background plus two standard deviations, the Deer Trail RSO shall evaluate the need for additional dust suppression activities."

14. **Offsite analysis of sample filters should be performed monthly rather than quarterly to verify that air concentration limits do not exceed effluent limits.**

Clean Harbors Response: The text has been revised to indicate that monthly composite samples will be sent for offsite analysis.

15. **Section 5.4- The detection limits proposed should be in the form of activity per cubic meter of air sampled.**

Clean Harbors Response: The units shown in Section 5.4 are simply the units provided by the analytical laboratory. A new bullet has been added to this section indicating that the laboratory results will be converted to units of µCi/mL, and the subsequent forms in Attachments 1 and 2 of the SOP have also been modified. Clean Harbors proposes to modify the reporting units of this procedure to be µCi/mL, instead of pCi/m^3 for consistency with the units found in the Colorado Regulations for air emissions.

16. **Full quality assurance and quality control results should be included in the records.**

Clean Harbors Response: The test has been modified to indicate that the laboratory quality assurance/quality control results will be included in the record. The last paragraph of Section 5.4 has been modified as follows:

"The results of these analyses shall be recorded using the form in Attachment 2. The information shall include: Specific monitor location, model number or identifier for the monitor, name of analytical laboratory, instrument sensitivity, collection efficiency, flow rate, filter medium, correction factors applied, exchange dates and times, monitoring duration, analytical results, background activity, net activity, and total net activity, as well as net activity and estimated error, by radionuclide. The completed form in Attachment 2, and all laboratory quality control/quality assurance results, will be maintained as records by the RSO as described in Section 7.0 of this procedure."

An updated and signed copy of the SOP on Airborne Monitoring is provided in Attachment A.

SOP on Gate Monitoring System

17. **The procedure for the gate monitoring system permits the RSO a great deal of discretion to adjust the alarm set point for the gate monitor. This discretion is not supported by calculations, procedures, and criteria to be used by the RSO in making these adjustments.**

    The use of a gate alarm is one of three means proposed by CHDT to ensure that material received at the facility for disposal are within the authorizations granted by the license. The alarm set point for monitoring of trucks of waste should be determined, approved by the Department, and enforced judiciously by CHDT.

    The alarm set point should be determined to represent the highest possible exposure based on the authorizations in the license, taking into consideration such factors as shielding from the sides of the truck, geometry, and the efficiency of the monitoring system for the isotopes in question. In addition a small contingency factor of 5-10% higher than model results could be incorporated into the alarm set point to account for situational variances between the real world and computer modeling. Once the alarm set point is determined, it should remain the same for all trucks of regulated waste. If a truck exceeds this alarm set point it should be rejected until further testing can be performed on the load to ensure that it doesn't exceed the authorized limits.

    If based on operational data, the facility can support modification to the alarm set point, the value of the set point can be changed following a review by the Department.

    Clean Harbors Response: In response to this comment, the text in Section 5.4 of the SOP has been modified to indicate that the initial set point for the alarm will be used for all regulated waste based on computer modeling. The RSO, through operational experience, can determine an alternative set point, depending on measurements and laboratory analyses for both long-term clients and episodic wastes; however, the revised alarm set point will only be adopted after review and approval by the Department. This should remove the original flexibility and help assure proper operation of the gate monitor for evaluating waste acceptance. The revised text is as follows:

    "5.4 Determination of the Alarm Set Point: Because of the variability of waste loads both in content and geometry, the Deer Trail RSO shall evaluate and confirm, or propose modification to the alarm set point used. The evaluation shall consist of recording the gate monitor response, comparing the concentrations shown on the shipping manifest, considering external dose rates measured with the Ludlum Model 19 MicroR meter or supplied by the generator, and/or obtaining waste samples for analysis. The alarm set point will then be confirmed or the proposed modification will be documented by the

Deer Trail RSO, as appropriate, using the manifest information and the evaluation form provided in Attachment 2. The revised alarm set point will only be adopted after review and approval by the Department."

An updated and signed copy of the SOP on Use of the Gate Monitor is provided in Attachment A.

Routine Radiation Surveys

18. Section 5.4- Please clarify what work areas are to be surveyed for contamination. Areas where there is the potential for contamination to spread to clean areas should be surveyed.

Clean Harbors Response: The text has been revised to indicate that the work areas include the treatment building, equipment in the decontamination areas, surfaces in the onsite laboratory, and adjacent areas where contamination may have spread during normal operations. The revised text for Section 5.4 is provided as part of the response to comment 19, below.

19. Section 5.4 – How often are the work area contamination surveys performed?

Clean Harbors Response: The text of Section 5.4 has been revised to indicate that work area surveys are to be conducted at the end of each workday when regulated waste has been received. The revised text is as follows:

"5.4 Ambient Work Area Contamination Levels: Ambient work area contamination level surveys shall be performed daily when regulated waste is received and recorded on the CHDT survey form, shown in Attachment 1. For solid surfaces in the landfill or treatment building, combined fixed (or bulk) and removable surface contamination (when appropriate) shall be surveyed using the Ludlum Model 3 survey meter with a Ludlum Model 44-9 Pancake G-M probe for localized (hot spot) measurements (by holding the probe about 1 cm from the surface for a static count), and the Ludlum Model 193-6 Survey Wand for large area scanning measurements (by holding the probe within two inches of the surface with a scanning rate of about 4 inches per second). The survey limits shall be the detection of radiation levels above 1.5 times background to account for the normal variability in background readings. Removable contamination shall be measured at representative locations using a two-inch diameter filter paper to wipe the surface. The filter paper shall be applied to the surface with moderate pressure, and shall wipe about 100 cm^2 (about four inches by four inches) of surface area. The filter paper shall then be held within 1 cm of the count rate meter probe for one minute to determine the presence of elevated levels of removable contamination. As shown in the survey form in Attachment 1, the measured counts per minute (cpm) shall be converted to disintegrations per minute (dpm), using a dpm/cpm conversion factor. Based on the manufacturer's specifications, for mixtures of natural uranium including radium, a conversion factor is about 5, or as modified by the Deer Trail RSO, shall be used. The gross and net (background corrected) results for both combined (fixed plus removable) and removable surface contamination shall be recorded in dpm per 100 cm^2 above background as the routine ambient work area radiation survey readings on the CHDT survey form, shown in Attachment 1. Locations where removable contamination is present shall be noted and those samples shall be sent to the laboratory for measurement using the Ludlum Model 3030 Alpha Beta Sample Counter. These samples will be counted for five minutes to determine the presence of removable surface contamination. As a contamination control measure, any areas demonstrating contamination levels above background shall be decontaminated by sweeping the surface and collecting the material,

or using soap and water, and paper towels. Any waste generated during decontamination shall be disposed in the landfill."

20. Sections 5.4 and 5.6 – How long will the filter paper samples be counted?

Clean Harbors Response: Both sections have been revised to indicate a one-minute count in the field, and a five-minute count in the laboratory. The revised text for Section 5.4 is shown in response to comment 19 above. Section 5.6 has been revised as follows:

"5.6 Ambient Clean Area Contamination Levels: Contamination level surveys shall be conducted on a monthly basis in areas of the facility defined as clean in the CHDT *Standard Operating Procedure on Landfill Operations.* Combined fixed and removable surface contamination (when appropriate) shall be surveyed using the Ludlum Model 3 survey meter with a Ludlum Model 44-9 Pancake G-M probe for localized measurements (by holding the probe about 1 cm from the surface for a static count), and the Ludlum Model 193-6 Survey Wand for large area scanning measurements (by holding the probe within two inches of the surface with a scanning rate of about 4 inches per second). These areas shall include the change room, lunchroom, administrative offices, haul roads weight station and other areas that are identified as part of the Area Dosimetry program (see the CHDT *Standard Operating Procedure on Individual and Area Dosimetry*). The survey limits shall be the detection of radiation levels above 1.5 times background to account for the normal variability in background. As shown in the survey form in Attachment 2, the measured counts per minute (cpm) shall be converted to disintegrations per minute (dpm), using a dpm/cpm conversion factor. Based on the manufacturer's specifications, for mixtures of natural uranium including radium, a conversion factor is about 5, or as modified by the Deer Trail RSO, shall be used. Total or bulk contamination shall be measured directly at the surface of the contamination with the count rate meter held at close proximity to the surface, without direct contact with the probe. A slow scanning speed, of about 2 inches per second, shall be used for such direct measurements, and locations where readings are above background shall be noted. Removable contamination shall be detected and measured by using a two-inch diameter filter paper to wipe the surface. The filter paper shall be applied to the surface with moderate pressure, and shall wipe about 100 cm^2 of surface area (about 4 inches by 4 inches). The filter paper shall then be held in close proximity of the count rate meter probe for one minute to determine the presence of elevated levels of removable contamination. Locations where removable contamination is present shall be noted and those samples shall be sent to the laboratory for measurement using the Ludlum Model 3030 Alpha Beta Sample Counter. These samples will be counted for five minutes to determine the presence of removable surface contamination. Any areas demonstrating contamination levels above background in the clean areas of the facility shall be decontaminated by sweeping the surface or using soap and water, and paper towels. Any waste generated during decontamination shall be disposed in the landfill. The gross and net (background corrected) results for both combined (fixed plus removable) and removable surface contamination shall be recorded in dpm per 100 cm^2 on the monthly radiation survey log shown in Attachment 2 and maintained in a log book controlled by the Deer Trail Radiation Safety Officer (RSO). An annual review of the survey data shall be conducted by the RSO."

21. Sections 5.4 and 5.6 – How close to the probe of the portable survey instrument will the filter sample be held? How will you ensure that the same distance is used for every sample?

Clean Harbors Response: The text has been revised stating that for field measurements, the filter will be held within 1 cm of the probe. The alpha beta counter will have a fixed geometry. The revised text for Section 5.4 is shown in response to comment 19 above, and the revised text for Section 5.6 is shown in response to comment 20 above.

An updated and signed copy of the SOP on Routine Radiation Surveys is provided in Attachment A.

SOP on Equipment Surveys

22. Section 5.2 states that trucks will be decontaminated in a designated area on the haul road. How will you prevent the haul road from becoming contaminated during decontamination of a truck? If the haul road becomes contaminated how will you prevent other vehicles that travel on the haul road from becoming contaminated?

Clean Harbors Response: The text has been revised to indicate that the surveys will be conducted in a designated survey and decontamination area outside the operating landfill cell, on the haul road in close proximity to the cell entrance. The decontamination area and section of the haul road between the cell and the decon area will be kept free of contamination through the use of radiation surveys of the road surface and decon area surface. This should prevent cross contamination caused by vehicular traffic. The revised text is as follows:

"5.2 <u>EQUIPMENT AND TRUCK SURVEYS</u>: Equipment surveys shall be conducted for equipment leaving the areas designated in the CHDT *Standard Operating Procedure on Landfill Operations.* These surveys shall be performed for trucks or containers leaving the disposal cells, and earthmoving equipment used to emplace and cover the waste. The surveys shall be conducted in a designated survey and decontamination area located outside of the operating landfill cell, and adjacent to the haul road. …"

An updated and signed copy of the SOP on Equipment Surveys is provided in Attachment A.

SOP on Surveys Following Spills

23. There is an inconsistency between Section 5.0 and 5.4 regarding the use of the Ludlum 193-6 Survey Wand for surveys following spills.

Clean Harbors Response: The procedure has been modified to allow use of the Ludlum 193-6 Survey Wand for large areas. The revised text is as follows:

"5.0 <u>GENERAL SURVEY METHODS</u>: Radiation surveys following spills of regulated waste shall be conducted using a Ludlum Model 3 Portable Survey Meter, and a Ludlum Model 193-6 Survey Wand for large area scanning, supported by CHDT laboratory sample analyses using the Ludlum 3030 Alpha Beta Sample Counter, as described below.

5.1 <u>Count Rate Meter Instrument Check List</u>: Prior to use of the Ludlum Model 3 Survey Meter or the Ludlum Model 193-6 Survey Wand, the operation of the meter and the probe used shall be checked using the following procedure:"

An updated and signed copy of the SOP on Surveys Following Spills is provided in Attachment A.

SOP on Regulated Waste Landfill Operations

24. **There were multiple items in this SOP that were inconsistent with the operating conditions required by the Colorado Hazardous Waste Act (CHWA) Permit. The following items in this SOP need to be adjusted to be consistent with the CHWA permit:**
    a. **Section 6.4 states that waste will be placed in lifts up to 6 feet thick. However, two feet thick is pushing the limits of the equipment;**

Clean Harbors Response: Lifts will be 2-4 feet thick. The SOP will be changed to reflect this.

    b. **Section 6.4 states that size reduction of debris waste will done using compactor. However, the permit does not allow treatment in the landfill;**

Clean Harbors Response: This sentence will be removed from the SOP.

    c. **Section 6.4 states that sand will be used as a protective cover on side slopes. However, sideslopes are not a drainage layer;**

Clean Harbors Response: Soil will be used as a protective cover. The SOP will be changed to reflect this.

    d. **Section 6.5 states that cover material will be placed over the waste at the end of each landfill-operating day. However, the permit requires placement of cover material at end of each shift;**

Clean Harbors Response: Cover will be placed at the end of each shift. The SOP will be changed to reflect this.

    e. **Section 6.5 states that you will cease operations and cover within 2 hours when sustained wind is 35 mph. However, the permit requires ceasing operations and immediately covering waste whenever wind is 35mph; and**

Clean Harbors Response: Waste will be covered immediately whenever wind is 35 mph. The SOP will be changed to reflect this.

    f. **Section 6.5 states that waste and haul road may be wetted with water for dust suppression. However, the permit and Colorado Hazardous Waste Regulations prohibit liquids of any sort to be placed in landfill.**

Clean Harbors Response: Clean Harbors has requested in our comments on the RCRA Hazardous Waste Facility Permit to allow for the use of Non-Hazardous Liquids (NHLs). Clean Harbors believes the use of NHLs is the best material to use to protect human health and the environment from the spread of wind blown radionuclides. As such, Clean Harbor's requests that the CDPHE keep the option available for the use of NHLs for dust suppression in the landfills in the Radioactive Materials License should the Hazardous Waste Management program staff grant our request.

SOP on Treatment Operations

25. **Section 6.4- Samples of the treated waste must be taken to verify proper treatment**

Clean Harbors Response: Samples of the treated waste will be taken to verify proper treatment. This section will be removed from the SOP. A revised version of this SOP is presented as an attachment to this letter.

ATTACHMENT A

Radiation Protection Program (RPP)

And

Standard Operating Procedures (SOPs)

ATTACHMENT A

Radiation Protection Program (RPP)

And

Standard Operating Procedures (SOPs)

INFORMATION ONLY

INTRODUCTION/APPROVAL

The Radiation Protection Program at the Clean Harbors Deer Trail, LLC RCRA Subtitle C landfill is designed to protect employees, as well as the public and the environment from the potentially harmful effects of exposure to ionizing radiation from regulated waste disposed in accordance with its license limits. Clean Harbors is committed to meeting all applicable regulatory requirements imposed by the State of Colorado and the U.S. government and to keeping doses from regulated waste As Low As Reasonably Achievable (ALARA) - social, technological and economic factors taken into account. The license activity addressed by this Plan is the disposal of limited concentrations of regulated waste 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 regulated waste to be disposed under the license, the relevant performance objectives will be met.

As part of Clean Harbor's Radiation Protection Program, 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 [TLD]),
- Gate monitors, radiation monitors, air sampling, and radiation survey meters when required, and
- This Radiation Protection Plan

This Plan has been approved by the Clean Harbors Deer Trail, LLC corporate staff and Deer Trail Landfill Radiation Safety Officer (RSO).

Approved by:

Senior Vice President Compliance and Regulatory Affairs

Radiation Safety Officer

Date: October 4, 2005

Effective Date: Date License is Issued

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REFERENCED STANDARD OPERATING PROCEDURES

Standard Operating Procedure on Worker Radiation Protection Records
Standard Operating Procedure on Individual and Area Dosimetry
Standard Operating Procedure on Airborne Monitoring for Regulated Waste
Standard Operating Procedure on Estimating Inhalation Doses
Standard Operating Procedure on Radiation Protection Training
Standard Operating Procedure on Use of the Gate Monitoring System
Standard Operating Procedure on Routine Radiation Surveys
Standard Operating Procedure on Personnel Surveys
Standard Operating Procedure on Equipment Surveys
Standard Operating Procedure on Surveys Following Spills
Standard Operating Procedure on Gamma Spectra Analysis
Standard Operating Procedure on Use of the Alpha Beta Sample Counter
Standard Operating Procedure on Regulated Waste Landfill Operations
Standard Operating Procedure on Treatment Operations
Standard Operating Procedure on Waste Tracking

Standard Operating Procedures (SOPs) referenced in this Plan require approval by the Colorado Department of Public Health and Environment (CDPHE) prior to use or change.

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 regulated waste during treatment and disposal operations. This plan and supporting policies and standard operating procedures shall be read, and all procedures set forth strictly adhered to, by each and every designated employee, site visitor, or outside contractor who works with and around ionizing radiation from regulated waste at Deer Trail. It is the responsibility of the Clean Harbors Deer Trail (CHDT) Radiation Safety Officer (RSO) to ensure that all employees, visitors, or outside contractors have read, understand and will comply with the procedures and conditions defined in this Radiation Protection Plan. No Deer Trail employee shall be allowed to work unsupervised with regulated waste until they complete appropriate radiation safety training (Section 6). The RSO shall maintain a file containing signature sheets acknowledging that the appropriate radiation safety training has been given to any and all new employees within 10 days of employment.

For exposure to regulated waste, CHDT workers shall be considered as occupational radiation workers. However, CHDT intends to maintain radiation exposures to its workers at levels as low as reasonably achievable (ALARA) but in no case exceeding 100 mrem/y, with a goal of 25 mrem/y or less. Employee doses, both internal and external, shall be evaluated by the RSO on a quarterly basis and workers shall be re-assigned to different duties if their quarterly radiation doses equal or exceed 5 mrem in any two consecutive quarters. If it is determined from worker dosimetry results that selected worker doses could exceed 25 mrem/y, the RSO shall conduct an evaluation of the potential for other man-made exposures for these workers to ensure that maximum individual doses from man-made sources shall not exceed 100 mrem/y. This assessment shall consider real individuals working at Deer Trail. As described in this plan, because of the low dose rates and administrative levels, selected provisions of 6 CCR 1007-1, Part 4, such as protection of an embryo/fetus during the entire pregnancy are implicitly covered.

As stated in the Deer Trail license application, CHDT requested a license to accept, treat, and dispose regulated waste at concentrations that are less than 2,000 pCi/g. An upper activity concentration limit of ^{226}Ra of 400 pCi/g was provided to ensure that external dose rates for workers would be maintained ALARA. CHDT proposes to accept only "regulated material" defined as to include: a) NORM/ TENORM radionuclides in solid waste; b) NORM/TENORM radionuclides in material licensed by CDPHE (including natural levels that meet the definition of source material); c) NORM/TENORM radionuclides mixed with RCRA hazardous wastes; and d) radium processing wastes. No other forms of radioactive waste, including man-made radionuclides in medical, research, U.S. Department of Energy, or commercial nuclear power radioactive waste, shall be accepted.

If the upper activity limits are applied as a peak value for purposes of setting the gate monitor alarms, it is recognized that the average concentrations received shall be less (likely about 10% of the peak concentration), and therefore the average doses to workers will be also be less (likely about 10 mrem/y or less), consistent with ALARA. The activity concentration limit, through modeling analysis, is initially equated to a gate monitor alarm set point of 100 μR/h above background. Given that background is about 16 μR/h, the alarm set point is 116 μR/h. This alarm set point is about seven times the background level. The Deer Trail RSO shall periodically (at least annually) evaluate, confirm, or modify this alarm set point, as described in the CHDT *Standard Operating Procedure on Use of the Gate Monitoring System.*

2.0 ORGANIZATION AND RESPONSIBILITIES

The responsibilities for maintaining radiation safety at the Deer Trail landfill are assigned to:

1) The Deer Trail General Manager, 2) the Deer Trail RSO, 3) the Deer Trail Environmental Manager, 4) the Deer Trail Plant Foreman, and 5) Deer Trail employees. The duties and responsibilities of these individuals are described below.

The 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. Basic regulated waste disposal operations at Deer Trail are discussed in the CHDT *Standard Operating Procedure on Regulated Waste Landfill Operations.* Note that these operations are consistent with those required for RCRA landfill operations, as tailored for the presence of regulated waste.

Radiation Safety Officer (RSO)

The Deer Trail RSO is charged by Clean Harbors Deer Trail, LLC to direct the Facility 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 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.

Environmental Manager

The Environmental Manager shall report issues of environmental radiological noncompliance or other radiological issues to the RSO and the General Manager.

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.

Deer Trail Employees

Each Clean Harbors Deer Trail, LLC employee who works with regulated waste 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 radiation from regulated waste 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 Deer Trail 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 deterministic effects (such as radiation burns, or skin *erythema*) are avoided and that total lifetime risks of 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 optimize radiation doses to individuals and to groups of individuals to the extent practical, social, economic and technological factors taken into account. This concept or philosophy is given the special name ALARA, which is an acronym for As Low As is Reasonably Achievable.

Radiation Dose Limits For exposure to regulated waste, Deer Trail workers shall be considered as radiation workers: however, it will be CHDT's policy to maintain worker doses at levels as low as reasonably achievable (ALARA) but in no case exceeding 100 mrem/y, with a goal of 25 mrem/y or less. As outlined in the CHDT *Standard Operating Procedure on Individual and Area Dosimetry, e*mployee doses, both internal and external, shall be evaluated on a quarterly basis and workers shall be re-assigned to different duties if their quarterly radiation doses equal or exceed 5 mrem in any two consecutive quarters. If it is determined from worker dosimetry results that selected worker doses could exceed 25 mrem/y, an assessment shall be conducted of the potential for other man-made exposures for those workers to ensure that maximum individual doses from man-made sources shall not exceed 100 mrem/y. This assessment shall consider real workers at Deer Trail.

Planned Special Exposures The provisions of 6 CCR 1007-1, § 4.11 require licensees to authorize an adult worker to receive doses in addition to and accounted for separately from the doses received under the limits under specified conditions. These provisions relate to the occupational dose limits of 5 rem/y plus ALARA. However, because of the limited concentrations of regulated waste 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, such as routine maintenance of equipment potentially contaminated with regulated waste, exposure rates, contamination levels, and potential exposure conditions shall be determined in advance of performing the activity using the CHDT *Standard Operating Procedure on Routine Radiation Surveys* The Deer Trail RSO shall evaluate the survey data and evaluate which controls will be required for a specific task. For example, the regulated waste concentrations and dose rates associated with leachate from the disposal cells shall be determined

and appropriate controls developed prior to leachate processing. The goal will be to maintain dose rates during leachate processing to less than 100 μR/h and maintain worker exposures ALARA.

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. Because the site will be operating under an annual limit of 100 mrem plus ALARA, with a goal of 25 mrem/y or less, this requirement is implicitly met. However, declared pregnant worker exposures shall be tracked and reported under the CHDT SOPs, evaluated by the Deer Trail RSO, and information about protection of the embryo/fetus shall be included in the CHDT training, as outlined in the CHDT *Standard Operating Procedure on Radiation Protection Training.*

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 licensed material is treated or disposed. This shall include areas within the treatment building, and the landfill cells, as discussed in the CHDT *Standard Operating Procedure on Regulated Waste Landfill Operations.*

Routes of Exposure Exposures from regulated waste may be received from radiation fields that are external to the body (external exposure) or from radioactive materials that are inside the body (internal exposure following inhalation) or both. Inhalation of dust particles is one of the primary routes of internal exposure.

Respiratory Protection Exposure of workers to airborne regulated waste shall be protected through the use of full-face masks that filter airborne particulate materials. These masks are required under the RCRA Permit as part of the Deer Trail 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 masks have a particulate 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 Deer Trail 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 the CHDT *Standard Operating Procedure on Airborne Monitoring for Regulated Waste.* To ensure that worker doses are low, procedures for estimating worker inhalation doses are provided in the CHDT *Standard Operating Procedure on Estimating Inhalation Doses.* Procedures for recording those doses, on a quarterly and annual basis, are provided in the CHDT *Standard Operating Procedure on Individual and Area Dosimetry.*

Determination of Internal Exposure As described in 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. Procedures for airborne monitoring are provided in the CHDT *Standard Operating Procedure on Airborne Monitoring for Regulated Waste.* These airborne concentration estimates shall be used as described in the CHDT *Standard Operating Procedure on Estimating Inhalation Doses* and worker inhalation doses recorded on a quarterly and annual basis, as described in the CHDT *Standard Operating Procedure on Individual and Area*

Dosimetry. Because of the relatively low concentrations of regulated waste to be disposed, and because of the use of mandatory respiratory protection under the RCRA Permit, no bioassays will be conducted.

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 Deer Trail 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 the Deer Trail Facility Health and Safety Plan. Engineering controls utilized to control exposure include dust control measures in the landfill cell, and the air filtration system in the treatment building.

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 Clean Harbors Deer Trail Facility.

Waste Tracking. All waste that is received, treated, and disposed at the Deer Trail landfill is tracked through operational procedures, largely developed for the RCRA permit. These procedures are provided in the CHDT *Standard Operating Procedure on 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 of the body (internal dose). These doses shall be monitored when required by regulation and as described below:

External Radiation Dosimetry

Radiation dosimeters shall be issued by the Deer Trail RSO and worn by individual workers, visitors, and outside contractors who have been appropriately trained and who may routinely come into contact or are in the proximity of regulated waste being disposed, consistent with the Deer Trail *Standard Operating Procedure on Individual and Area Dosimetry.*

Internal Radiation Dose Assessment

Consistent with the Colorado Regulations 6 CCR 1007-1, § 4.9 (Determination of Internal Exposure), for purposes of assessing internal radiation doses from the inhalation of airborne regulated waste, suitable and timely measurements of the concentrations of airborne materials in workplace air shall be made and recorded. Airborne concentrations shall be estimated consistent with the CHDT *Standard Operating Procedure on Airborne Monitoring for Regulated Waste.* 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 the CHDT *Standard Operating Procedure on Estimating Inhalation Doses.*

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.

5.0 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 Deer Trail 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.

Types of Surveys

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

1. Waste Receipt – surveys shall be conducted to verify that regulated waste will meet the Deer Trail waste acceptance criteria. The surveys shall include:
   a. Gate Monitor Screening: Each shipment shall pass a gate monitor system as described in the CHDT *Standard Operating Procedure on Use of the Gate Monitoring System.*
   b. Gamma Dose Rate Assessment described in the CHDT *Standard Operating Procedure on Radiation Surveys..*
   c. Gamma Spectra Analysis as described in the CHDT *Standard Operating Procedure on Gamma Spectra Analysis.*
2. Area Surveys using the CHDT *Standard Operating Procedure on Routine Radiation Surveys.*
3. Personnel Surveys using the CHDT *Standard Operating Procedure on Personnel Surveys.*
4. Spill Response Surveys using the CHDT *Standard Operating Procedure on Surveys Following Spills.*
5. Equipment Surveys using the CHDT *Standard Operating Procedure on Equipment Surveys.*

Surveys may be conducted with portable, stationary, or laboratory survey equipment, as described in the Standard Operating Procedures. These surveys may be supported through the use of a portable gamma spectra analysis instrument for isotope identification, as described in the CHDT *Standard Operating Procedure on Gamma Spectra Analysis*, smear analysis, as described in the CHDT *Standard Operating Procedure on Use of the Alpha Beta Sample Counter*, or by sending samples offsite for laboratory analysis.

Requirements on Maintaining Radiation Detection Instrumentation

1. The Deer Trail RSO shall ensure that the facility maintain radiation detection equipment that is appropriate for detecting the types of radiations emitted by the regulated waste received for disposal.
2. Portable and stationary radiation detectors, and the gate monitor shall be calibrated or response checked, as appropriate for the use of the instrument, at least annually or after repair of the instrument, to the manufacturer's specifications. Battery replacement is not

cause for performing a calibration. The Deer Trail RSO shall perform such routine response checks at the request of any Deer Trail employee.

6.0 TRAINING

All Deer Trail employees, visitors, and outside contractors who work with or near regulated waste are required to complete radiation safety training, as described in the CHDT *Standard Operating Procedure on Radiation Protection 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.

Basic Radiation Safety Training

All individuals who work with regulated waste are required to satisfactorily complete appropriate radiation safety training course offered by or at the direction of the Deer Trail RSO and/or demonstrate competence on that subject matter by scoring at least 70% on a test administered or directed by the Deer Trail RSO. Deer Trail RSO-provided refresher training shall be conducted at least once each year for all individuals who work with regulated waste. All training shall be documented and maintained on file by the Deer Trail RSO. Training documentation shall include: Content of the training (outline, course description, etc.), Instructor name, Date and duration of training, Printed name of trainee(s), and Signature or initials of trainee(s). Copies of individual employee training records are available from the Deer Trail RSO. Visitors who work with regulated waste shall be required to complete training similar to that of employees. Visitors who will not be working with regulated waste but who will enter restricted areas shall be required to be escorted at all times and undergo basic training commensurate with the level of exposure they will undergo.

Hazard Communication Program

The Clean Harbors Deer Trail 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.

7.0 INCIDENTS AND EMERGENCIES

General procedures for dealing with emergency situations such as spills or accidents are detailed in the Deer Trail 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 the event of a radiological incident, such as a spill of regulated waste, or other emergency potentially involving regulated waste, the Deer Trail RSO shall be notified immediately. In instances where there is doubt about whether such notification is necessary, contact should be made to allow the Deer Trail RSO to assess the situation and initiate the appropriate response. If appropriate, the measures described in the Contingency Plan shall be implemented. Radiation surveys following spills of regulated waste shall be conducted consistent with the guidance provided in CHDT *Standard Operating Procedure on Surveys Following Spills*.

What Constitutes an Incident or Emergency?

1. Loss, theft, or misuse of any regulated waste.
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 two washes with only soap and water.
6. Any personnel injuries that may involve radioactive contamination or radiation exposure.

8.0 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. Records keeping requirements are provided in the CHDT *Standard Operating Procedure on Worker Radiation Protection Records.*

General Record-Keeping Requirements

1. The Deer Trail 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, and
      iii. Individual monitoring results, for routine, planned special exposures, accidents, and emergency conditions using the occupational exposure record form provided in Attachment 3 of the CHDT *Standard Operating Procedure on Individual and Area Dosimetry.*
   d. Records of waste disposal as required by regulation
   e. Annual ALARA program audits (duration of license)
   f. Incident investigation reports (duration of license)
   g. Declarations of pregnancy (3 years)
   h. Environmental monitoring data and reports (duration of license)
   i. Operating and emergency procedures (current)
   j. Procedure manuals from Deer Trail RSO (current)

2. In addition to maintaining duplicates of 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.

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 uniquely identify the source of the radiation,
c. Records shall clearly indicate the areas surveyed,
d. Records shall indicate the person performing the survey and date of survey, and
e. Records shall uniquely identify the survey instrument used, i.e., serial number, or other unique description.

2. Training records are specified in Section 6.

9.0 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 (3.7×10^{10} dps)
1 Ci = 2,220,000,000,000 dpm (2.22×10^{12} 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 is 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 ($H_{T,50}$ 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 ($H_{E,50}$ 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 ($H_{E,50} = \Sigma W_T, H_{T,50}$).

"Curie (Ci)" means a unit of measurement of activity. One curie (Ci) is that quantity of radioactive material that decays at the rate of 3.7×10^{10} disintegrations per second (dps). Commonly used sub-multiples of the curie are the millicurie and the microcurie. One millicurie (mCi) = 1×10^{-3} curie = 3.7×10^{7} dps. One microcurie (μCi) = 1×10^{-6} curie = 3.7×10^{4} dps. One nanocurie (nCi) = 1×10^{-9} curie = 3.7×10^{1} dps. One picocurie (pCi) = 1×10^{-12} curie = 3.7×10^{-2} dps.

"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 (H_T)" 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 (H_E)" means the sum of the products of the dose equivalent to each organ or tissue (H_T) and the weighting factor (W_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \Sigma W_T H_T$).

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

Radiation	Quality Factor
beta	1
gamma	1
x-ray	1
alpha	20
neutron	varies from 3 - 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 of, and authority and responsibility to apply appropriate radiation protection rules standards, and practices.

"Regulated Waste" means waste that includes: a) NORM/ TENORM radionuclides in solid waste; b) NORM/TENORM radionuclides in material licensed by CDPHE (including natural levels that meet the definition of source material); c) NORM/TENORM radionuclides mixed with RCRA hazardous wastes; and d) radium processing wastes.

"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 2.58×10^{-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, or legs above the knees.

CLEAN HARBORS DEER TRAIL LLC
STANDARD OPERATING PROCEDURE ON
AIRBORNE MONITORING FOR REGULATED WASTE

Approved by:

Senior Vice President Compliance and Regulatory Affairs

Radiation Safety Officer

Date: October 14, 2005

Effective Date: Date License is Issued

1.0 OBJECTIVE: To define regulated waste airborne monitoring that shall be generated established, conducted, and maintained for Deer Trail operations involving regulated waste to ensure that radiation doses from inhalation and radon effluents during operations are maintained within limits.

2.0 SCOPE: This procedure applies to all regulated waste treatment and disposal activities at the Deer Trail landfill. Workplace and ambient airborne monitoring programs are intended to measure and monitor the airborne concentrations of radioactive materials from regulated waste at the Deer Trail landfill to:

- Document background concentrations of airborne radionuclides and radon,
- Document airborne concentrations of radioactive materials,
- Determine radon effluent levels around the perimeter of the disposal cells,
- Detect changes in airborne concentrations, over time,
- Detect any gradual buildup of airborne radioactive materials,
- Verify the effectiveness of engineering controls in preventing or reducing levels of airborne radioactive materials,
- Produce results that shall be used to estimate internal radiation doses from inhalation to Deer Trail workers, as described in the *Standard Operating Procedure on Estimating Inhalation Doses* and the *Standard Operating Procedure on Individual and Area Dosimetry*, and
- Allow a statistical analysis of the airborne radon levels from the disposal cell(s) in comparison to background radon levels.

3.0 POLICY: All Deer Trail activities that could result in airborne regulated waste and radon effluents shall be subject to the airborne monitoring program.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer Trail Radiation Safety Plan.

5.0 AIRBORNE MONITORING PROCEDURE:

5.1 Airborne Monitoring Responsibility: The Deer Trail RSO shall:

- Oversee and operate the airborne monitoring program according to the following specifications:
    - The airborne sampling system consists of a model VS23-1023CV ¾ HP oil less rotary vane pump, flow rate controller, elapsed timer, 47 mm diameter filter holder with 3/8 inch quick disconnect, stainless steel gooseneck to set sample point a approximately 59 inches above ground, rain and wind shield, outdoor instrument weather house. Each sampling station operates continuously when the wind is from the direction ≥ 180 degrees and ≤ 270 degrees and will be controlled by a R.M. Young Wind Monitor AG.
    - The data will be recorded on a Campbell Scientific data logger (CR205 at two stations and a CR10X at one station). Note that the sampler located in the treatment building is not dependent on wind direction. Filters will be model LB-5211in a 47mm diameter.
    - Quarterly flow calibration will be done with a Model AFC-Complete-6 NIST traceable digital air flow calibrator.
    - Sample filters will be collected approximately every week and analyzed using the onsite Alpha Beta sample counter.
    - Monthly composites of the sample filters will be sent to a laboratory for analysis.
- Ensure that airborne monitoring samples are evaluated and documented on a weekly and quarterly basis, or more frequently for dusty locations or special operations, as necessary, and
- Oversee the use of the airborne monitoring results in the quarterly estimation of radiation doses to Deer Trail workers.

5.2 Performing Airborne Monitoring: Monitoring of airborne concentrations of regulated waste shall be conducted using continuous air monitors with the following considerations:

- Determination and documentation of the elapsed filter exposure time prior to replacement of each air filter,
- Maintaining flow rates consistent with the manufacturer's recommendations so that sample volumes can be accurately estimated, and
- Maintaining calibration and testing according to the manufacturer's recommendations.

5.3 Preliminary Assessment: Upon removal of the air filter, a preliminary, qualitative assessment shall be conducted using the Ludlum Model 3 survey meter with a Ludlum 44-9 Pancake G-M probe to determine gross contamination levels. Background samples shall be taken at upwind locations that are unaffected by landfill operations. If background levels of radon or thoron progeny interfere, prompt field assessments may not be possible. In this situation, the sample will be allowed to decay for one week before the preliminary assessment is conducted. If the preliminary assessment indicates radioactive contamination levels in excess of background plus two standard deviations, the Deer Trail RSO shall evaluate the need for additional dust suppression activities. All air filters shall be sent CHDT laboratory for analysis using the Ludlum Model 3000 Alpha Beta Counter and the results recorded using the form in Attachment 1. These airborne monitoring results shall be plotted using the form in Attachment 1 on a weekly basis for purposes of trending. Such trending shall:

- Provide indication of the continued effectiveness of the existing exposure controls,
- Warn of localized deterioration of control equipment or operating procedures, and
- Identify long-term variations in airborne radioactivity levels.

5.4 Offsite analysis: On a monthly basis, the Deer Trail RSO will send the air filters from each airborne monitoring location for composite analysis by an analytical laboratory. The analysis of each of these filters shall include:

- Gamma Spectra Analysis, including $^{226, 228}$Ra plus progeny, and man-made photon emitters with a detection limit of 0.2 pCi/g of sample
- Gross Alpha with a detection limit of 10 pCi/g of sample
- Gross Beta with a detection limit of 10 pCi/g of sample
- $^{228, 230, 232}$Th with a detection limit of 1 pCi/g of sample
- $^{234, 235, 238}$U with a detection limit of 1 pCi/g of sample
- The analytical results will be converted to units of μCi/mL, and recorded using the form in Attachment 2.

The results of these analyses shall be recorded using the form in Attachment 2. The information shall include: Specific monitor location, model number or identifier for the monitor, name of analytical laboratory, instrument sensitivity, collection efficiency, flow rate, filter medium, correction factors applied, exchange dates and times, monitoring duration, analytical results, background activity, net activity, and total net activity, as well as net activity and estimated error, by radionuclide. The completed form in Attachment 2, and all laboratory quality control/quality assurance results, will be maintained as records by the RSO as described in Section 7.0 of this procedure.

5.5 RADON MONITORING PROCEDURE: Monitoring will be conducted in the following manner:

- Monitoring of radon concentrations shall be conducted using passive alpha track radon detectors.
- CHDT will utilize the Landauer Alpha Track Rad-Trak Outdoor Air Detector item # 3409 type DRNF, or equivalent.
- The manufacturers procedure for use of these detectors shall be followed.
- Background Radon Detectors shall be placed in each location where a particulate air sampler is located.
- Landfill Cell Radon Detectors shall be placed on all four sides of each open landfill cell at the perimeter of the cell.
- Each detectors shall be used for a period of ninety (90) days,
- At the end of each ninety-day period, the detectors shall be sent to the manufacturer for analysis.
- The manufacturers report of analysis will be sent to CHDT for review. The report will include the detector number/location, exposure in pCi/L days, and the average radon concentration in pCi/L.

6.0 DETERMINATION OF INHALATION RADIATION DOSES FROM REGULATED WASTE: Radiation doses to Deer Trail workers from inhalation of airborne regulated waste shall be evaluated on a quarterly basis, as described in the *Standard Operating Procedure on Estimating Inhalation Doses* and the *Standard Operating Procedure on Individual and Area Dosimetry*. The procedure on individual dosimetry relies on a determination of the corrected airborne concentration of each radionuclide, in units of μCi/ml, using the information recorded on the form in Attachment 2.

7.0 EVALUATION OF RADON RESULTS: The quarterly analytical report of measured radon concentrations will be evaluated by the Deer Trail RSO. Background radon levels will be statistically evaluated in order to determine average and peak natural radon levels. Radon effluent levels at the edge of the open landfill cell(s) will be compared with background levels in order to evaluate the effectiveness of the interim cover. If excessive levels are encountered, the landfill operations will be reviewed and modified, as appropriate, to limit radon effluents.

8.0 RECORDS: The Deer Trail RSO shall maintain records of the workplace airborne monitoring and radon effluent results for each monitoring location and record the information, quarterly and annually, on the forms provided in Attachments 2 and 3.

ATTACHMENT 1 WEEKLY AIRBORNE MONITORING RECORD

Clean Harbors Deer Trail LLC
WEEKLY AIRBORNE MONITORING RECORD For the Period: to

Sample Location: _____ Sampler Model No. _____

Collection Efficiency: _____ Flow Rate: Start:_____End:_____Average:_____

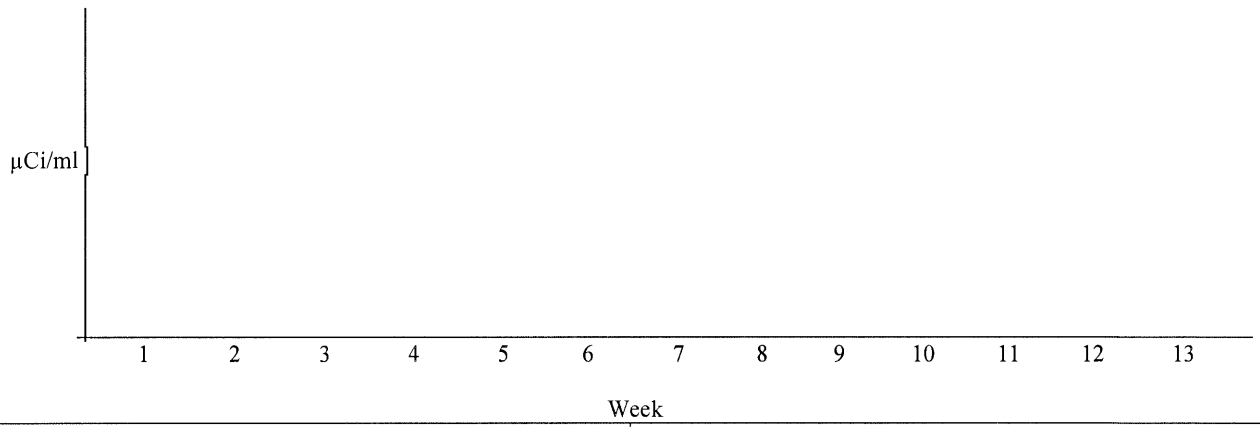
Correction Factors: _____ Comments: _____

Ludlum Model 3030 Efficiency: alpha_____pCi/cpm beta_____pCi/cpm

Background Alpha/Beta	Monitoring Duration[(a)]/ Total Air Flow[(b)]	Alpha Activity Gross/Net	Beta Activity Gross/Net	Estimated Air Concentration (μCi/ml)[(c)]
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)
cpm/ cpm	hr/ m^3	cpm/ cpm	cpm/ cpm	(μCi/ml)

(a) Elapsed hours between filter deployment and recovery.
(b) Flow rate times elapsed hours of filter deployment.
(c) Calculated as follows: [(net alpha activity) x (alpha efficiency) + (net beta activity) x (beta efficiency)]/Total Air Flow in ml

Trending Analysis:



Weekly Record Completed By:

Name (Print) _____

Signature _____

Comments

ATTACHMENT 2 AIRBORNE MONITORING ANALYTICAL RECORD

Clean Harbors Deer Trail LLC
AIRBORNE MONITORING QUARTERLY ANALYTICAL RECORD

Sample Location: _____ Sampler Model No. _____

Analytical Laboratory: _____ Sensitivity (Estimated Error): _____

Collection Efficiency: _____ Correction Factors: _____

Quarterly Evaluation Dates for Calendar Year	Dates Start of Period: End of Period: Average Flow Rate:	Dates Start of Period: End of Period: Average Flow Rate:	Dates Start of Period: End of Period: Average Flow Rate:	Dates Start of Period: End of Period: Average Flow Rate:
Monitoring Duration	hr	hr	hr	hr
Gross Alpha Activity	µCi/ml	µCi/ml	µCi/ml	µCi/ml
Gross Beta Activity	µCi/ml	µCi/ml	µCi/ml	µCi/ml
Total Activity	µCi/ml	µCi/ml	µCi/ml	µCi/ml
Background Activity	µCi/ml	µCi/ml	µCi/ml	µCi/ml
Net Activity	µCi/ml	µCi/ml	µCi/ml	µCi/ml
Radionuclide Net Activity	µCi/ml	µCi/ml	µCi/ml	µCi/ml
	µCi/ml	µCi/ml	µCi/ml	µCi/ml
	µCi/ml	µCi/ml	µCi/ml	µCi/ml
	µCi/ml	µCi/ml	µCi/ml	µCi/ml
	µCi/ml	µCi/ml	µCi/ml	µCi/ml
	µCi/ml	µCi/ml	µCi/ml	µCi/ml
	µCi/ml	µCi/ml	µCi/ml	µCi/ml
	µCi/ml	µCi/ml	µCi/ml	µCi/ml
	µCi/ml	µCi/ml	µCi/ml	µCi/ml
	µCi/ml	µCi/ml	µCi/ml	µCi/ml

Comments: (add additional pages, if necessary)

Record Completed By:	Record Reviewed By:
Name (Print) _____	Name (Print) _____
Signature _____	Signature _____

ATTACHMENT 3 AIRBORNE RADON MONITORING ANALYTICAL RECORD

Clean Harbors Deer Trail LLC **AIRBORNE RADON MONITORING QUARTERLY ANALYTICAL RECORD**				
	Start of Period: End of Period:	Start of Period: End of Period:	Start of Period: End of Period:	Start of Period: End of Period:
Sampling Location/ Sampler No.	Gross Radon Concentration: (pCi/L)	Gross Radon Concentration: (pCi/L)	Gross Radon Concentration: (pCi/L)	Gross Radon Concentration: (pCi/L)
Background:				
Background:				
Background:				
Background:				
Peak Background:				
Average Background:				
Background Corrected Radon Concentration:	Net Radon Concentration: (pCi/L)	Net Radon Concentration: (pCi/L)	Net Radon Concentration: (pCi/L)	Net Radon Concentration: (pCi/L)
Comments: (add additional pages, if necessary)				
Record Completed By: Name (Print) _____ Signature _____		Record Reviewed By: Name (Print) _____ Signature _____		

CLEAN HARBORS DEER TRAIL LLC
STANDARD OPERATING PROCEDURE ON
INDIVIDUAL AND AREA DOSIMETRY

Approved by:

Senior Vice President Compliance and Regulatory Affairs

Radiation Safety Officer

Date: October 4, 2005

Effective Date: Date License is Issued

1.0 OBJECTIVE: To define general and specific methods and procedures for conducting individual and area dosimetry for Deer Trail.

2.0 SCOPE: Individual dosimetry for Deer Trail workers who may be exposed to radiation from regulated waste and for identified areas within and in the immediate area around the Deer Trail landfill shall be performed:

- To determine individual worker radiation doses from external radiation,
- To monitor individual worker doses against the 25 millirem/year ALARA goal, and
- To determine potential dose from background and ambient radiation levels.

3.0 POLICY: Individual and area dosimetry shall be performed to verify that radiation doses to Deer Trail workers and members of the public are maintained at levels as low as reasonably achievable (ALARA) but in no case exceeding 100 millirem/year, with an ALARA goal of 25 millirem/year. The standard issue Deer Trail dosimeter shall be a thermoluminescent dosimeter in a plastic case used in a manner consistent with the manufacturer's specifications and requirements.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer Trail Radiation Protection Plan.

5.0 INDIVIDUAL DOSIMETER PROGRAM:

5.1 Dosimeter Issue: All Deer Trail workers, visitors, and outside contractors who are in the proximity of radiation from regulated waste as part of their routine employment shall be issued and wear an individual dosimeter. Dosimeters are issued to only one person; dosimeters 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 Deer Trail 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 Deer Trail 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, Deer Trail dosimeters shall not be:

- 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.
- Stored near sources of radiation,
- Exposed to high heat, chemical or physical insults, or washed in a washing machine,
- Worn while working for another employer or institution (employees shall notify the Deer Trail RSO if they are concurrently working for another employer and working with natural or man-made sources of ionizing radiation),
- Worn during medical or dental x-ray examinations,
- Worn during or after medical administration of radioactive materials (thyroid ablation therapy, cardiac stress tests, diagnostic nuclear medicine tests, etc.) until approved by the Deer Trail RSO.

5.2 Changes in Worker Job Status: If a worker's job status changes, the Deer Trail RSO shall:

- 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 radiation from regulated waste.
- 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 radiation from regulated waste.

5.3 Nonoccupational Radiation Doses: Dosimeter users:

- Are responsible for ensuring that dosimeters are not exposed to nonoccupational 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 Deer Trail RSO prior to receiving medical injections of radionuclides.
- Shall notify the Deer Trail RSO if their dosimeter is exposed to nonoccupational radiation sources.

The Deer Trail 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 nonoccupational sources and determine the corrections that are necessary for recording the employee's radiation dose.

5.4 Exchanging Dosimeters: Employees shall return used dosimeters to the Deer Trail RSO promptly after receiving replacement dosimeters at the beginning of a new wear period. The Deer Trail RSO shall:

- Be responsible for establishing a program for dosimeter exchange, processing (consistent with the manufacturer's specifications), and recording and reporting of the results.
- Ensure dosimeters are exchanged on a quarterly basis, unless the Deer Trail RSO or his designee determines a change in exchange frequency is warranted to ensure radiation doses to workers and the public are maintained at levels ALARA but in no case exceeding 100 millirem/year, with an ALARA goal of 25 mrem/y.
- Verify that all dosimeters are exchanged and either note that dosimeters are in good condition or note the damage if they are not.
- Note the actual date of dosimeter exchange.
- Verify that all dosimeter results are recorded in a spreadsheet.
- Modify the quarterly doses to include potential inhalation doses, as estimated using the Deer Trail *Standard Operating Procedure on Estimating Inhalation Doses*.
- Develop and report all dose results to the employees on an annual basis.
- Serve as the Deer Trail point of contact for individual dosimetry issues.
- Ensure that individual worker doses are recorded, by quarter and annually using the form in Attachment 1, and maintained in their personnel file.
- Ensure that the doses to declared pregnant workers are tracked on the dosimetry forms in Attachments 1 and 2 and maintained at levels not to exceed 100 mrem during the pregnancy, plus ALARA.
- 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 consistent with the Deer Trail records management procedures.
- Ensure that individual doses are reported to the Department using the form in Attachment 3 consistent with the Deer Trail records management procedures.

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

- 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 5 millirem in any quarter.

- Re-assign the work duties for individual workers whose quarterly radiation dose equals or exceeds 5 millirem in any two consecutive quarters to reduce their exposure to radiation from regulated waste.

- Monitor annual worker radiation doses against the 25 mrem/y ALARA goal and take appropriate measures, such as modifying job assignments or specific work procedures, when this goal is challenged.

5.6 Records Requests: Any person who handles or disposes of regulated waste on behalf of Deer Trail may request a copy of his or her dosimetry records at any time. These records are maintained by and are available from the Deer Trail RSO upon written request. All contact with the dosimetry service provider is to be made through the Deer Trail RSO.

5.7 Employment Termination Dose Report: After termination of employment, a dose report (termination report) shall be provided to all persons who received doses exceeding 20% of the 25 mrem/y ALARA goal in the applicable reporting period. This report shall be provided using the latest copy of Attachment 1 found in the employees 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 quarterly or more frequently, as determined by the Deer Trail RSO, using special-issue dosimeters in locations:

- Where workers are routinely in the proximity of regulated waste such as the weight station and disposal cell,

- Where it is unlikely that regulated waste would be present such as the change room, lunch room, and maintenance areas, and

- Remote from regulated waste that will record the ambient background.

6.2 Responsibilities: The Deer Trail RSO shall:

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

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

- Maintain a map of the location of each dosimeter.

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

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

- Exchange the dosimeters, consistent with the exchange procedures for employees, on a quarterly or other basis, as determined by the Deer Trail RSO.

- Maintain records for each area dosimeter location in a dosimetry spreadsheet.

- Note any special conditions including tampering, damage, or loss of dosimeter, in the records.
- Investigate any missing or damaged dosimeters.
- Resolve anomalous data, and track and trend data for routine annual and other special reports, as required.
- Serve as the point of contact for area dosimetry issues. Ensure that a corporate record of area radiation doses, by quarter and annually, is developed using the form in Attachment 4 and maintained as a log consistent with the Deer Trail *Standard Operating Procedure on Worker Radiation Protection Records*.

ATTACHMENT 1 – ANNUAL INDIVIDUAL DOSIMETRY RECORD

Clean Harbors Deer Trail LLC
ANNUAL INDIVIDUAL DOSIMETRY RECORD

Individual _____ Payroll No. _____

Is this individual a declared pregnant worker? ☐ Yes ☐ No

Exchange Dates for Calendar Year _____ (a)	Deployed: Recovered:	Deployed: Recovered:	Deployed: Recovered:	Deployed: Recovered:	
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)	Deployed: Recovered:	Deployed: Recovered:	Deployed: Recovered:	Deployed: Recovered:	
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)	Deployed: Recovered:	Deployed: Recovered:	Deployed: Recovered:	Deployed: Recovered:	
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 – ANNUAL WORKER DOSIMETRY LOG

Clean Harbors Deer Trail LLC
ANNUAL WORKER DOSIMETRY LOG

Exchange Dates[a]	Deployed: Recovered:	Deployed: Recovered:	Deployed: Recovered:	Deployed: Recovered:	
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 – 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 – QUARTERLY AND ANNUAL AREA DOSIMETRY LOG

Clean Harbors Deer Trail LLC
QUARTERLY AND ANNUAL NORM/TENORM AREA DOSIMETRY LOG

Exchange Dates:	Deployed: Recovered:	Deployed: Recovered:	Deployed: Recovered:	Deployed: Recovered:	
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)

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

CLEAN HARBORS DEER TRAIL LLC STANDARD OPERATING PROCEDURE ON ROUTINE RADIATION SURVEYS

Approved by:

Senior Vice President Compliance and Regulatory Affairs

Radiation Safety Officer

Date: October 4, 2005

Effective Date: Date License is Issued

1.0 OBJECTIVE: To define general and specific methods and procedures for conducting routine and job or task-specific radiation surveys.

2.0 SCOPE: Radiation surveys for regulated waste shall be performed to determine and document ambient radiation and contamination levels in locations around and within the Deer Trail landfill and to evaluate if controls are necessary when performing routine maintenance or other tasks that could encounter regulated waste.

3.0 POLICY: Radiation surveys shall be conducted to ensure that contamination control is maintained and to maintain the doses to Deer Trail workers as low as reasonably achievable (ALARA) but in no case exceeding 100 mrem/y.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer Trail Radiation Protection Plan.

5.0 GENERAL SURVEY METHODS: Routine radiation surveys shall be conducted using a Ludlum Model 3 Portable survey Meter with a Ludlum 44-9 Pancake G-M probe for localized (hot spot) measurements, a Ludlum Model 193-6 Survey Wand for large area scanning measurements, supported by CHDT laboratory sample analyses using the Ludlum 3030 alpha beta sample counter, as described below.

5.1 Count Rate Meter Instrument Check List: Prior to use of the Ludlum Model 3 Survey Meter with a Ludlum Model 44-9 Pancake G-M probe or the Ludlum Model 193-6 Survey Wand, the operation of the meter and probe used shall be checked using the following procedure:

- 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.

- Check Count Rate Meter Speaker
  - Turn the audio switch, if present, to "ON."
  - Set the Fast-Slow toggle switch to "f."
  - 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.

- Check Background
  - Go to an area removed from the regulated waste. Note, the Ludlum Model 193-6 Survey Wand has a six inch diameter by one inch thick plastic scintillation detector which will automatically accumulate background to determine an alarm setting. The alarm setting shall be determined by the Deer Trail RSO as described in Section 5.3 below.
  - Note the background count rate when the count rate meter is set to the "X1" scale (this rate may vary from about 10 to 100 counts per minute).
  - Do not use the meter if it does not register a background reading.

- Check Count Rate Meter Probe
  - Hold the supplied check source up to the probe window.
  - Note the count rate.
  - Do not use the survey meter if the counts per minute registered do not fall within ± 20% of the expected reading for the source.

Note: f or the Ludlum Model 193-6 Survey Wand, although the surveys shall be conducted for the detection of radiation above background, the alarm set point shall be 1.5 times background to account for the normal variability in the background count rates.

5.2 Exposure Rate Meter Check List: Prior to using the Ludlum Model 19 MicroR Meter, the instrument shall be checked using the following procedure:

- Check Batteries
  - Turn the meter on and check the battery using the battery test button.
  - The meter reading should be within the "BAT TEST" range on the meter display.
  - Replace batteries if needed before use (two standard D cell batteries are required).

- Check Background
  - Turn the meter on and set the black range selector switch to the 0-25 range.
  - Set the Fast-Slow toggle switch to "f."
  - The reading should be about 16 μR/h, ± about 10 μR/h.
  - Do not use the meter if a background reading is not recorded.

5.3 Ambient Work Area Radiation Levels: Surveys using the Ludlum Model 19 MicroR Meter shall be performed in the landfill defined in the CHDT *Standard Operating Procedure on Landfill Operations,* where workers could receive a measured total effective dose equivalent. Surveys shall be performed by holding the meter at waist height in a manner and frequency that is representative of the receipt and disposal of

regulated waste. At a minimum, these surveys shall be performed daily when regulated waste is received or where workers could be reasonably exposed (i.e., in the landfill) and recorded in units of μR/h as the routine ambient work area radiation survey readings on the CHDT survey form, shown in Attachment 1. Enter both the gross and net (background corrected) exposure rates.

5.4 Ambient Work Area Contamination Levels: Ambient work area contamination level surveys shall be performed daily when regulated waste is received and recorded on the CHDT survey form, shown in Attachment 1. For solid surfaces in the landfill or treatment building, combined fixed (or bulk) and removable surface contamination (when appropriate) shall be surveyed using the Ludlum Model 3 survey meter with a Ludlum Model 44-9 Pancake G-M probe for localized (hot spot) measurements (by holding the probe about 1 cm from the surface for a static count), and the Ludlum Model 193-6 Survey Wand for large area scanning measurements (by holding the probe within two inches of the surface with a scanning rate of about 4 inches per second). The survey limits shall be the detection of radiation levels above 1.5 times background to account for the normal variability in background readings. Removable contamination shall be measured at representative locations using a two inch diameter filter paper to wipe the surface. The filter paper shall be applied to the surface with moderate pressure, and shall wipe about 100 cm^2 (about four inches by four inches) of surface area. The filter paper shall then be held within 1 cm of the count rate meter probe for one minute to determine the presence of elevated levels of removable contamination. As shown in the survey form in Attachment 1, the measured counts per minute (cpm) shall be converted to disintegrations per minute (dpm), using a dpm/cpm conversion factor. Based on the manufacturer's specifications, for mixtures of natural uranium including radium, a conversion factor is about 5, or as modified by the Deer Trail RSO, shall be used. The gross and net (background corrected) results for both combined (fixed plus removable) and removable surface contamination shall be recorded in dpm per 100 cm^2 above background as the routine ambient work area radiation survey readings on the CHDT survey form, shown in Attachment 1. Locations where removable contamination is present shall be noted and those samples shall be sent to the laboratory for measurement using the Ludlum Model 3030 Alpha Beta Sample Counter. These samples will be counted for five minutes to determine the presence of removable surface contamination. As a contamination control measure, any areas demonstrating contamination levels above background shall be decontaminated by sweeping the surface and collecting the material, or using soap and water, and paper towels. Any waste generated during decontamination shall be disposed in the landfill.

5.5 Ambient Clean Area Radiation Levels: For the purpose of ensuring contamination control, exposure rate surveys using the Ludlum Model 19 MicroR Meter shall be performed by holding the meter at waist height on a monthly basis in the areas of the facility that are defined as clean in the CHDT *Standard Operating Procedure on Landfill Operation.* The results of these surveys shall be recorded in units of μR/h as the clean area radiation survey readings on the CHES survey log, shown in Attachment 2.

5.6 Ambient Clean Area Contamination Levels: Contamination level surveys shall be conducted on a monthly basis in areas of the facility defined as clean in the CHDT *Standard Operating Procedure on Landfill Operations.* Combined fixed and removable surface contamination (when appropriate) shall be surveyed using the Ludlum Model 3 survey meter with a Ludlum Model 44-9 Pancake G-M probe for localized measurements (by holding the probe about 1 cm from the surface for a static count), and the Ludlum

Model 193-6 Survey Wand for large area scanning measurements (by holding the probe within two inches of the surface with a scanning rate of about 4 inches per second). These areas shall include the change room, lunch room, administrative offices, haul roads weight station and other areas that are identified as part of the Area Dosimetry program (see the CHDT *Standard Operating Procedure on Individual and Area Dosimetry*). The survey limits shall be the detection of radiation levels above 1.5 times background to account for the normal variability in background. If contamination above this limit is found in a clean area, the RSO shall be immediately notified. As shown in the survey form in Attachment 2, the measured counts per minute (cpm) shall be converted to disintegrations per minute (dpm), using a dpm/cpm conversion factor. Based on the manufacturer's specifications, for mixtures of natural uranium including radium, a conversion factor is about 5, or as modified by the Deer Trail RSO, shall be used. Total or bulk contamination shall be measured directly at the surface of the contamination with the count rate meter held at close proximity to the surface, without direct contact with the probe. A slow scanning speed, of about 2 inches per second, shall be used for such direct measurements, and locations where readings are above background shall be noted. Removable contamination shall be detected and measured by using a two inch diameter filter paper to wipe the surface. The filter paper shall be applied to the surface with moderate pressure, and shall wipe about 100 cm^2 of surface area (about 4 inches by 4 inches). The filter paper shall then be held in close proximity of the count rate meter probe for one minute to determine the presence of elevated levels of removable contamination. Locations where removable contamination is present shall be noted and those samples shall be sent to the laboratory for measurement using the Ludlum Model 3030 Alpha Beta Sample Counter. These samples will be counted for five minutes to determine the presence of removable surface contamination. Any areas demonstrating contamination levels above background in the clean areas of the facility shall be decontaminated by sweeping the surface or using soap and water, and paper towels. Any waste generated during decontamination shall be disposed in the landfill. The gross and net (background corrected) results for both combined (fixed plus removable) and removable surface contamination shall be recorded in dpm per 100 cm^2 on the monthly radiation survey log shown in Attachment 2 and maintained in a log book controlled by the Deer Trail Radiation Safety Officer (RSO). An annual review of the survey data shall be conducted by the RSO.

5.7 Work or Task Planning Surveys: For equipment that may become contaminated with NORM/TENORM radionuclides, or for work in close proximity to regulated waste, special radiation surveys shall be conducted. The purpose of these surveys is to determine the exposure rates and/or contamination levels encountered for a specific work task, and to determine if special radiation work procedures need to be developed. The surveys shall be conducted as outlined in Sections 5.3 and 5.4 above, with the results entered into the CHDT survey form in Attachment 1. Following completion of the survey, the survey form shall be submitted to the Deer Trail RSO for evaluation. This evaluation shall determine which, if any, controls will be required to perform the specific job task. For example, the radioactive waste concentrations and exposure rates associated with leachate from the disposal cells shall be determined and appropriate controls developed prior to leachate processing. The goal will be to maintain exposure rates during leachate processing to less than 100 μR/h and maintain worker exposures ALARA.

6.0 EVALUATION OF DETECTOR EFFICIENCIES

Based on information from the manufacturer, the estimated detection efficiency for both the Ludlum Model 3 with Ludlum Model 44-9 Pancake G-M probe and the Ludlum Model 193-6 Survey Wand is about 5 (i.e., a 10 cpm reading would equate to 50 dpm). On a periodic basis, (initially at operations and as needed based on changing types of wastes and conditions), the Deer Trail RSO shall conduct an evaluation of the detector efficiency and modify the assumed efficiencies and alarm set points established in this procedure. To conduct the evaluation, the Deer Trail RSO shall obtain uniform samples of waste, determine the instrument readings in units of cpm using standard survey methods described in Section 5.4 of this procedure, and send the samples offsite to a laboratory for comparative analysis. Using the procedure outlined in Attachment 3, the Deer Trail RSO shall confirm/modify the instrument response information. It is noted that, because of variable geometries and waste forms encountered under actual field conditions, it may not be possible to accurately define instrument responses for all conditions. Therefore, the Deer Trail RSO shall provide a discussion of the evaluation, with commentary on the instrument response versus waste concentrations, and a final determination either confirming or modifying the detector efficiencies used for performing radiation surveys at Deer Trail. It is also noted that an onsite verification of instrument response can be made using smear samples analyzed with the survey instruments and the Ludlum Model 3030 Alpha Beta Sample counter, with a comparison of the results using these two methods.

7.0 REFERENCES

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

Instruction Manual Model 19 Micro R Meter, Ludlum Measurements, Inc.

ATTACHMENT 1 – AMBIENT WORK AREA OR TASK PLANNING SURVEY LOG

Clean Harbors Deer Trail LLC SURVEY LOG			**Survey No.**
Date	Time	Location	
Job Description			

Instrument/Probe Model	Ludlum Model 3 Meter with a Pancake GM Probe or Model 193-6 Wand	Ludlum Model 19 Micro R Exposure Rate Meter	Instrument Comments
Serial No.			
Efficiency		N/A	
Correction Factor (dpm/cpm)	5 for Ra, 10 for U	N/A	
Background Reading (Observed/Corrected)	cpm/ dpm	μR/h	
Ludlum Model 193-6 Alarm Set Point	% of full scale deflection		

Description	GROSS/NET EXPOSURE RATES	GROSS/NET CONTAMINATION LEVELS	
	Gross/Net Exposure Rate (μR/h)	Gross/Net Fixed Contamination Level (dpm/ 100cm^2)	Gross/Net Removable Contamination Level (dpm/100 cm^2)
	/	/	/
	/	/	/
	/	/	/
	/	/	/
	/	/	/
	/	/	/
	/	/	/
	/	/	/
	/	/	/
	/	/	/

Comments: (add additional pages, if necessary)

For laboratory smear sample analysis: samples counted for_____ minutes to determine removable contamination levels.

Survey Conducted By:	Survey Report Reviewed By:
Name (Print) _____	Name (Print) _____
Signature _____	Signature _____

ATTACHMENT 2 – ROUTINE NON-WORK AREA SURVEY LOG

Clean Harbors Deer Trail LLC
MONTHLY ROUTINE SURVEY LOG

Instrument/Probe Model	Ludlum Model 3 Meter with a Pancake GM Probe	Ludlum Model 19 Micro R Exposure Rate Meter	Instrument Comments
Serial No.			
Efficiency		N/A	
Correction Factor	5 for Ra, 10 for U	N/A	
Background Reading (Observed/Corrected)	cpm/ dpm	µR/h	
Ludlum Model 193-6 Alarm Set Point	% of full scale deflection		

Date/Time	Monthly Survey Conducted by: (initials)	Location	GROSS/NET EXPOSURE RATES (µR/h)	GROSS/NET SURFACE CONTAMINATION LEVELS Gross/Net Total (Removable plus Fixed) (dpm/100 cm^2)	Gross/Net Removable (dpm/100 cm^2)
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/
			/	/	/

Comments: (add additional pages, if necessary)

For laboratory smear sample analysis: smear samples counted for 5 minutes to determine removable contamination levels.

Annual Survey Log Reviewed By:

Name (Print) _____

Signature _____

ATTACHMENT 3 – EVALUATION OF DETECTOR EFFICIENCIES

Clean Harbors Deer Trail LLC
DETECTOR EFFICIENCY EVALUATION FORM

Date	Purpose of Evaluation

Procedure: This procedure/form is to be used to confirm/modify instrument response information from the instrument manufacturer. Establish background readings for the instrument(s) under evaluation. Obtain about a 200 gram dry sample of waste with uniform particle size (roughly equal to or less than that of construction sand). Measure out about 100 grams of waste and spread uniformly over a surface area of about 300 cm^2 (roughly 10 inches by 10 inches) and record the sample weight and gross cpm readings below. Determine the net count rate in cpm. Divide cpm readings by the sample weight. Record the total weight of the remaining sample (about 100 grams) and send to an offsite laboratory for analysis (may include gross alpha and beta-gamma and/or radionuclide analyses to determine total activity per sample). Use generator supplied waste characterization information for reference/discussion only. Follow footnotes below.

Instrument/Probe Model	Ludlum Model 3 With Model 44-9 Pancake G-M Probe	Ludlum Model 3 With Model 44-9 Pancake G-M Probe Corrected to cpm/g	Ludlum Model 193-6 Survey Wand	Ludlum Model 193-6 Survey Wand Corrected to cpm/g
Serial No.				
Background Reading	cpm	N/A	cpm	N/A
Gross Reading	cpm	cpm/g	cpm	cpm/g
Net Reading	cpm	cpm/g	cpm	cpm/g

Radionuclide[1]	Generator Supplied Waste Characterization, by Radionuclide and Total	Additional Sample Analysis, by Radionuclide and Total (If available)
	pCi/g	pCi/g
	pCi/g	pCi/g
	pCi/g	pCi/g
	pCi/g	pCi/g
	pCi/g	pCi/g
	pCi/g	pCi/g
	pCi/g	pCi/g
	pCi/g	pCi/g
Total Activity[2]	pCi/g	pCi/g
Converted to dpm[3]	dpm	dpm
Determination of cpm/dpm for Instrument 1[4]		
Determination of cpm/dpm for Instrument 2[4]		

Total Sample Weight: _____ grams

Onsite Analysis Sample Weight: _____ grams

Sample Weight Sent to Lab: _____ grams

Weight of Sample Analyzed by Lab: _____ grams

Discussion of Instrument Response versus Waste Concentrations: (Note, the RSO may elect to continue using the manufacturer's recommendations, or an alternative efficiency factor based on this evaluation)

Evaluation Conducted By:

Name (Print) _____

Signature _____

CLEAN HARBORS DEER TRAIL LLC
STANDARD OPERATING PROCEDURE ON
PERSONNEL SURVEYS

Approved by:

Senior Vice President Compliance and Regulatory Affairs

Radiation Safety Officer

Date: October 7, 2005

Effective Date: Date License is Issued

1.0 OBJECTIVE: To define general and specific methods and procedures for conducting radiation surveys of Clean Harbor's personnel.

2.0 SCOPE: Radiation surveys for regulated waste shall be performed to ensure that workers are free of regulated waste contamination when leaving the landfill areas as defined in the CHDT *Standard Operating Procedure on Landfill Operations,* and to support personnel decontamination.

3.0 POLICY: Personnel radiation surveys shall be conducted by trained Deer Trail staff to verify that personnel leaving the landfill waste areas are free of radioactive contamination, and to document the effectiveness of decontamination procedures, when required.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer Trail Radiation Protection Plan.

5.0 GENERAL SURVEY METHODS: Personnel surveys shall be conducted using a Portable Ludlum Model 3 with a Model 44-9 Pancake G-M probe, or a Stationary Ludlum Model 177 Alarm Ratemeter with a Model 44-9 Pancake G-M probe, supported by CHDT laboratory sample analyses using the Ludlum 3030 alpha beta sample counter, as described below.

5.1 Ludlum Model 3 Portable Survey Meter Check List: Prior to use of the Ludlum Model 3 Portable Survey Meter, the operation of the meter and probe will checked using the following procedure:

- 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.

- Check Count Rate Meter Speaker
  - Turn the audio switch, if present, to "ON."
  - Set the Fast-Slow toggle switch to "f."
  - 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.

- Check Background
  - Go to an area removed from the regulated waste.
  - Note the count rate when the count rate meter is set to the "X1" scale (this rate may vary from about 10 to 100 counts per minute).
  - Do not use the meter if it does not register a background reading.

- Check Count Rate Meter Probe
  - Hold the supplied check source up to the probe window.
  - Note the count rate.
  - Do not use the survey meter if the counts per minute registered do not fall within ± 20% of the expected reading for the source.

5.2 Ludlum Model 177 Stationary Alarm Ratemeter Check List: Prior to use of the Ludlum Model 177 Stationary Alarm Ratemeter, the operation of the meter and probe will checked using the following procedure:

- Check Power supply
  - Turn the switch to "ON."
  - The needle on the meter face should move to a position representative of background readings in the X1 position.

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

- Check Background
  - Note the count rate when the count rate meter is set to the "X1" scale (this rate may vary from about 10 to 100 counts per minute).
  - Do not use the meter if it does not register a background reading.

- Check Count Rate Meter Probe
  - Hold the supplied check source up to the probe window.
  - Note the count rate.
  - Do not use the survey meter if the counts per minute registered do not fall within ± 20% of the expected reading for the source.

Note: although the surveys shall be conducted for the detection of radiation above background, the alarm set point shall be 1.5 times background to account for variability in the background count rates.

5.3 PERSONNEL SURVEYS: Personnel surveys shall be conducted using a count rate survey meter and the following procedure:

- Turn on the meter and perform the checklist for the count rate meter (Sections 4.1 or 4.2 above).

- The survey limits should be the positive detection of radiation levels above background (i.e., given the variability of background, readings that are consistently in excess of 1.5 times the recorded background count rate).

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

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

- If consistent count rates consistently in excess 1.5 times background are detected, decontamination according to the procedure in Section 5.4 shall be followed prior to re-surveying.

- The survey order will be from head to foot, as follows:

    - Frisk the hands before picking up the probe (for the stationary meter, while the probe is still in the meter holder).
    - Head – pause at the mouth and nose for five seconds
    - Neck
    - Arms
    - Chest and abdomen
    - Back, hips, and seat of pants
    - Legs – pause at the knees and cuffs for five seconds
    - Tops of shoes
    - Bottom of shoes
    - Personal items – hats, gloves, notebooks, equipment, etc.

- If elevated contamination is found on personnel, contact the Deer Trail RSO. Determination of removable contamination shall be made using a two inch diameter filter paper to wipe a surface (i.e., clothes, shoes, or other items). The filter paper shall be applied to the surface with moderate pressure, and shall wipe about 100 cm^2 (about four inches by four inches) of surface area. The filter paper shall then be held in close proximity of the count rate meter probe to determine the presence of elevated levels of removable radioactive contamination. Verification of positive contamination, if encountered, shall be accomplished by sending smear samples to the CHDT laboratory for analysis using the Ludlum 3030 Alpha Beta Sample counter.

5.4 PERSONNEL DECONTAMINATION: When decontamination is required, the initial and final results of the survey shall be recorded on the CHDT survey form shown in Attachment 1 to verify and document the effectiveness of personnel decontamination. Regulated waste on personnel shall be decontaminated and re-surveyed. As shown in the personnel decontamination survey form in Attachment 1, the measured counts per minute (cpm) shall be converted to disintegrations per minute (dpm), using a dpm/cpm conversion factor. Based on the manufacturer's specifications, for mixtures of radium or thorium the conversion factor is 5; for natural uranium the conversion factor is 10. These factors shall be confirmed or modified by the Deer Trail RSO. The gross and net

(background corrected) results for both combined (fixed plus removable) and removable surface contamination shall be recorded in dpm per 100 cm^2 above background on the survey form, shown in Attachment 1. The following are the procedures for personnel decontamination:

- Protective clothing may be removed and shoes or other items may be brushed clean. If clothing will not decontaminate, it shall be removed and exchanged with supplied coveralls or protective clothing.
- Skin contamination may be removed by washing the area with lukewarm water and mild soap. If contamination cannot be removed, contact the Deer Trail RSO.
- Personnel may flush ears/eyes/nose with cool, clear water to decontaminate those areas. If contamination cannot be removed, contact the Deer Trail RSO.
- Contaminated clothing can be hand washed, rinsed, and dried onsite prior to re-surveying. When the clothing is free of detectable contamination, it can be released. Collected wash and rinse water shall be managed as part of the leachate recovery system.

6.0 REFERENCES

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

Instruction Manual Model 177 Alarm Ratemeter, Ludlum Measurements, Inc.

ATTACHMENT 1 – PERSONNEL DECONTAMINATION SURVEY FORM

Clean Harbors Deer Trail LLC **PERSONNEL DECONTAMINATION SURVEY REPORT**			**Survey No.**
Date	Time	Location	

Individual's Name and Description of the Contamination Incident:

Instrument/Probe Model	Ludlum Model 3 or Model 177 Meter with a Pancake GM Probe	Instrument Comments
Serial No.		
Efficiency		
Correction Factor	5 for Ra, 10 for U	
Background Reading (Observed/Corrected)	cpm/ dpm	

Measurement Description	GROSS/NET CONTAMINATION LEVELS	
	Gross/Net Fixed Contamination Level (dpm/ 100cm^2)	Gross/Net Removable Contamination Level (dpm/100 cm^2)
	/	/
	/	/
	/	/
	/	/
	/	/
	/	/
	/	/
	/	/
	/	/
	/	/

Comments: (add additional pages, if necessary)

For laboratory sample analysis: samples counted for_____ minutes to determine removable contamination levels.

Survey Conducted By:	Survey Report Reviewed By:
Name (Print) _____	Name (Print) _____
Signature _____	Signature _____

CLEAN HARBORS DEER TRAIL LLC
STANDARD OPERATING PROCEDURE ON
EQUIPMENT SURVEYS

Approved by:

Senior Vice President Compliance and Regulatory Affairs

Radiation Safety Officer

Date: October 4, 2005

Effective Date: Date License is Issued

1.0 OBJECTIVE: To define general and specific methods and procedures for conducting routine radiation surveys for release of equipment.

2.0 SCOPE: Radiation surveys for regulated waste shall be performed to support release or decontamination of equipment.

3.0 POLICY: Radiation surveys of radionuclides from regulated waste on equipment, including trucks used to haul waste to the Deer Trail landfill, shall be conducted to verify waste concentrations meet unrestricted release limits, and to document the effectiveness of decontamination prior to unrestricted release.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer Trail Radiation Protection Plan.

5.0 GENERAL SURVEY METHODS: Surveys of equipment shall be conducted using a Ludlum Model 3 Portable survey Meter for localized (hot spot) measurements with a Ludlum Model 44-9 Pancake G-M probe, and a Ludlum Model 193-6 Survey Wand for large area scanning measurements, supported by CHDT laboratory smear sample analyses using the Ludlum 3030 alpha beta sample counter, as described below.

5.1 Count Rate Meter Instrument Check List: Prior to use of the Ludlum Model 3 Survey Meter or the Ludlum Model 193-6 Survey Wand, the operation of the meter and probe used shall be checked using the following procedure:

- 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.

- Check Count Rate Meter Speaker
  - Turn the audio switch, if present, to "ON."
  - Set the Fast-Slow toggle switch to "f."
  - 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.

- Check Background
  - Go to an area removed from the regulated waste. Note, the Ludlum Model 193-6 Survey Wand has a six inch diameter by one inch thick plastic scintillation detector which will automatically accumulate background to determine an alarm setting. The alarm setting shall be determined by the Deer Trail RSO as described in Section 5.2 below.
  - Note the background count rate when the count rate meter is set to the "X1" scale (this rate may vary from about 10 to 100 counts per minute).
  - Do not use the meter if it does not register a background reading.

- Check Count Rate Meter Probe
  - Hold the supplied check source up to the probe window.
  - Note the count rate.
  - Do not use the survey meter if the counts per minute registered do not fall within $\pm$ 20% of the expected reading for the source.

5.2 EQUIPMENT AND TRUCK SURVEYS: Equipment surveys shall be conducted for equipment leaving the areas designated in the CHDT *Standard Operating Procedure on Landfill Operations.* These surveys shall be performed for trucks or containers leaving the disposal cells, and earthmoving equipment used to emplace and cover the waste. The surveys shall be conducted in a designated survey and decontamination area located outside of the operating landfill cell, and adjacent to the haul road. Equipment and truck surveys shall be recorded on the Deer Trail Daily Survey Log, shown in Attachment 1. The survey limits shall be set to meet the levels in ANSI/HPS N13.12-1999, "Surface and Volume Radioactivity Standards for Clearance." These values are summarized in Table 1 for radionuclides or radionuclide mixtures found in regulated waste. For example, using a detector efficiency of 0.1 for the Ludlum Model 3 survey meter and Model 44-9 G-M probe for uranium mixtures, and an average background rate of 20 cpm, the ANSI/HPS N13.12 Group 2 value for uranium mixtures of 6,000 dpm per 100 cm^2 from Table 1 would equate to an instrument reading of:

(6,000 dpm per 100 cm^2) x (15 cm^2/100 cm^2) x (0.1) = 90 cpm above background

For radium and decay chain only mixtures, the reading on the Ludlum Model 3 survey meter with the Model 44-9 G-M probe with a beta-gamma efficiency of 20% for ANSI/HPS N13.12 Group 1 radionuclides would be 20% of this value, or 18 cpm above background. Note that this level would result in an instrument reading about twice the average background count rate.

For the Ludlum Model 193-6 Survey Wand, the plastic scintillator detector has a surface area of about 180 cm^2 and an efficiency for uranium mixtures of about 12%. The ANSI/HPS N13.12 Group 2 value for uranium mixtures would equate to an instrument reading of:

(6,000 dpm per 100 cm^2) x (180 cm^2/100 cm^2) x (0.12) = 1,300 cpm above background

For radium and decay chain only mixtures, the reading on the Ludlum Model 193-6 Survey Wand for ANSI/HPS N13.12 surface contamination levels would be 20% of this value, or about 260 cpm above background.

The Deer Trail RSO will evaluate the instrument response and confirm or modify the detector efficiency, and determine the appropriate alarm setting for the survey instruments. For simplicity, surveys shall be conducted using ANSI/HPS N13.12, Group 1 levels for both instruments. If contamination levels are detected in excess of these values, the Deer Trail RSO shall be notified and a determination of the radionuclide mixture shall be made using the waste profile information for the specific shipment. If the radionuclide mixture is consistent with ANSI/HPS N13.12 Group 2 for uranium mixtures, the RSO shall authorize use of the Group 2 values for the release survey. If the survey results exceed the appropriate limits, the equipment shall be decontaminated using Section 5.3 of this procedure.

Additional determination of alpha contamination (Group 2 radionuclides in Table 1) shall be accomplished by sending samples to the CHDT laboratory for analysis using the Ludlum 3030 Alpha Beta Sample counter. The general procedure for equipment and truck surveys is as follows:

- An area immediately outside to the landfill exit shall be designated as the survey/decontamination area. This area is located on the concrete road leading to the landfill. The area shall be marked and designated by signs, paint or chalk markings, traffic cones, barricades, or other means. The survey/decontamination area shall be used to conduct exit surveys, inspection, and decontamination of waste trucks exiting the landfill.

- For trucks, after the waste is unloaded and the truck bed is visually inspected, the truck shall exit the landfill and proceed to the decontamination area. Truck tires shall have any visible soil particles removed by sweeping. Through the *Standard Operating Procedure on Landfill Operations,* truck tires should only come into contact with clean soil. The cargo space shall be surveyed using the survey limits described above using Ludlum Model 193-6 Survey Wand, supported by the Ludlum Model 3 survey meter and G-M probe for localized (hot spot) measurements. When it is suspected that the truck tires may have become contaminated, they will be surveyed using the Ludlum Model 193-6 Survey Wand, supported by the Ludlum Model 3 survey meter and Model 44-9 G-M probe, as required, for localized (hot spot) contamination. If radioactive material is detected, the cargo space and/or tires shall be decontaminated as described in Section 5.3 below.

- A total of at least four representative smear samples shall be obtained from the cargo space and/or tires (when necessary) and sent to the CHDT laboratory for analysis using the Ludlum 3030 Alpha Beta Sample counter.

- For scanning surveys, hold the probe 1 cm from the surface being surveyed and move the probe slowly over the surface, approximately 2 inches per second.

- If the count rate increases, or if the alarm sounds, pause for 5 to 10 seconds over the area to provide for adequate time for instrument response.

- If surface contamination in excess of the Table 1 values is detected, the area shall be decontaminated as described in Section 5.3 below and surveyed again.

- Contaminated equipment shall be surveyed in a manner consistent with that described for Trucks above, with a focus on areas likely to retain radioactive contamination.

5.3 EQUIPMENT DECONTAMINATION: When decontamination of trucks or equipment is required, the initial and final results of the survey shall be recorded on the CHDT equipment decontamination survey form shown in Attachment 2 to verify and document the effectiveness of decontamination. For trucks, if radioactive material is detected, the cargo space and/or tires, when required, shall be decontaminated. The primary method will be to sweep surfaces clean followed by washing, if necessary. For equipment, dusty or dirty areas likely to retain contamination from regulated waste shall be swept clean or washed to remove surface contamination. Decontamination shall continue until the survey limits are met.

Table 1. Screening Levels for Clearance from ANSI/HPS N13.12 (1999)

Radionuclide Group	**Screening Levels (S.I. Units)**	**Surface Screening Levels (Conventional Units)**
	(Bq/cm^2 or Bq/g)	($dpm/100\ cm^2$)[a]
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
Group 2 Uranium: ^{234}U, ^{235}U, ^{238}U, Natural Uranium[c] and associated decay chains	1	6,000

(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.

6.0 REFERENCES

ANSI/HPS N13.12-1999 "Surface and Volume Radioactivity Standards for Clearance"

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

ATTACHMENT 1 – TRUCK AND EQUIPMENT DAILY SURVEY LOG

Clean Harbors Deer Trail LLC
TRUCK AND EQUIPMENT DAILY SURVEY LOG

Date	Time	Location

	Ludlum Model 193-6	Ludlum Model 3 – Model 44-9 Probe	Instrument Comments
Serial No.			
Efficiency			
Correction Factor (Convert to dpm)	Radium = 5 Uranium = 10	Radium = 5 Uranium = 10	
Background Reading	cpm dpm	cpm dpm	
ANSI/HPS Group 1 Screening Limit (Above Background)	130 cpm	18 cpm	
ANSI/HPS Group 2 Screening Limit (Above Background)*	1,300 cpm	180 cpm	
Ludlum Model 193-6 Alarm Set Point	(% of full scale deflection)		

Equipment/ Truck ID	Survey Performed by: (Initials)	Ludlum Model 193-6		Ludlum Model 3 – Model 44-9 Probe		Ludlum 3030 Alpha Beta Counter	
		Pass (check box)	Fail (Reference Decontamination Survey Form)	Pass (check box)	Fail (Reference Decontamination Survey Form)	Pass (check box)	Fail (Reference Decontamination Survey Form)

Daily Survey Log Reviewed By:

Name (Print) _____

Signature _____

ATTACHMENT 2 – TRUCK AND EQUIPMENT DECONTAMINATION SURVEY FORM

Clean Harbors Deer Trail LLC **TRUCK AND EQUIPMENT DECONTAMINATION SURVEY REPORT**			**Survey No.**
Date	Time	Location	
Truck/Equipment Identification and Description of the Contamination Incident:			

Instrument/Probe Model	Survey Meter	Instrument Comments
Serial No.		
Efficiency		
Correction Factor (Convert to dpm)	Radium = 5 Uranium = 10	
Background Reading	cpm dpm	
Ludlum Model 193-6 Alarm Set Point	% of full scale deflection	

Measurement Description	CONTAMINATION LEVELS	
	Gross/Net Fixed Contamination Level ($dpm/100cm^2$)	Gross/Net Removable Contamination Level ($dpm/100\ cm^2$)
	/	/
	/	/
	/	/
	/	/
	/	/
	/	/
	/	/
	/	/
	/	/

Comments: (add additional pages, if necessary)

For laboratory sample analysis: samples counted for_____ minutes to determine removable contamination levels.

Survey Conducted By:	Survey Report Reviewed By:
Name (Print) _____	Name (Print) _____
Signature _____	Signature _____

CLEAN HARBORS DEER TRAIL LLC
STANDARD OPERATING PROCEDURE ON
SURVEYS FOLLOWING SPILLS

Approved by:

Senior Vice President Compliance and Regulatory Affairs

Radiation Safety Officer

Date: October 4, 2005

Effective Date: Date license is issued.

1.0 OBJECTIVE: To define general and specific methods and procedures for conducting radiation surveys following spills.

2.0 SCOPE: Radiation surveys for regulated waste shall be performed to support and determine the effectiveness of any spill cleanup procedures that may be required.

3.0 POLICY: Radiation surveys shall be conducted to verify the effectiveness of cleanup operations following spills of regulated waste.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer Trail Radiation Protection Plan.

5.0 GENERAL SURVEY METHODS: Radiation surveys following spills of regulated waste shall be conducted using a Ludlum Model 3 Portable Survey Meter, and a Ludlum Model 193-6 Survey Wand for large area scanning, supported by CHDT laboratory sample analyses using the Ludlum 3030 Alpha Beta Sample Counter, as described below.

5.1 Count Rate Meter Instrument Check List: Prior to use of the Ludlum Model 3 Survey Meter or the Ludlum Model 193-6 Survey Wand, the operation of the meter and the probe used shall be checked using the following procedure:

- 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.

- Check Count Rate Meter Speaker
  - Turn the audio switch, if present, to "ON."
  - Set the Fast-Slow toggle switch to "f" depending on type of survey.
  - 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.

- Check Background
  - Go to an area removed from the regulated waste.
  - Note the count rate when the count rate meter is set to the "X1" scale (this rate may vary from about 10 to 100 counts per minute).
  - Do not use the meter if it does not register a background reading.

- Check Count Rate Meter Probe
  - Hold the supplied check source up to the probe window.
  - Note the count rate.
  - Do not use the survey meter if the counts per minute registered do not fall within $\pm$ 20% of the expected reading for the source.

5.2 SURVEYS FOLLOWING SPILLS: As part of cleanup of spills, radiation surveys shall be conducted on spill areas using the count rate meter using the following procedure:

- Turn on the meter and perform the checklist for the count rate meter (Section 5.1 above).
- The survey limits shall be set to meet the levels in ANSI/HPS N13.12-1999, "Surface and Volume Radioactivity Standards for Clearance." These values are summarized in Table 1 for radionuclides or radionuclide mixtures in regulated waste. For example, using a detector efficiency of 0.1 for the Ludlum Model 3 survey meter and Model 44-9 G-M probe for uranium mixtures, and an average background rate of 20 cpm, the ANSI/HPS N13.12 Group 2 value for uranium mixtures of 6,000 dpm per 100 cm^2 from Table 1 would equate to an instrument reading of:

  (6,000 dpm per 100 cm^2) x (15 cm^2/100 cm^2) x (0.1) = 90 cpm above background

  For radium and decay chain only mixtures, the reading on the Ludlum Model 3 survey meter with the Model 44-9 G-M probe with a beta-gamma efficiency of 20% for ANSI/HPS N13.12 Group 1 radionuclides would be 20% of this value, or 18 cpm above background. Note that this level would result in an instrument reading about twice the average background count rate.

  For the Ludlum Model 193-6 Survey Wand, the plastic scintillation detector has a surface area of about 180 cm^2 and an efficiency for uranium mixtures of about 12%. The ANSI/HPS N13.12 Group 2 value for uranium mixtures would equate to an instrument reading of:

  (6,000 dpm per 100 cm^2) x (180 cm^2/100 cm^2) x (0.12) = 1,300 cpm above background

  For radium and decay chain only mixtures, the reading on the Ludlum Model 193-6 Survey Wand for ANSI/HPS N13.12 surface contamination levels would be 20% of this value, or about 260 cpm above background.

- The Deer Trail RSO will evaluate the instrument response and confirm or modify the detector efficiency, and determine the appropriate alarm setting for the survey instruments using the procedures outlined in the *Standard Operating Procedure on*

Routine Surveys. For simplicity, surveys shall be conducted using ANSI/HPS N13.12, Group 1 levels for both instruments. If contamination levels are detected in excess of these values, the Deer Trail RSO shall be notified and a determination of the radionuclide mixture shall be made using the waste profile information for the specific shipment. If the radionuclide mixture is consistent with ANSI/HPS N13.12 Group 2 for uranium mixtures, the RSO shall authorize use of the Group 2 values for the release survey. If the instrument readings are in excess of the Table 1 or Table 2 values, as appropriate, decontamination will proceed as defined below.

- Determination of alpha contamination (Group 2 radionuclides in Table 1), when appropriate, shall be accomplished by sending samples soiled with material in the area of the spill to the CHDT laboratory for analysis using the Ludlum 3030 Alpha Beta Sample counter with comparison to the surface contamination values in Table 1, Group 2, for the uranium decay chain. Note that the intent of this analysis is to determine contamination levels for alpha emitters in excess of background.

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

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

5.3 DECONTAMINATION FOLLOWING SPILLS: If count rates in excess of the survey limits are detected, the area shall be decontaminated and surveyed again.

- Decontamination shall consist of removing or collecting spilled or contaminated material by sweeping or shoveling (for safe disposal in the landfill).

- Following decontamination, the spill area shall be surveyed again using the procedure provided in Section 5.2 above. If contamination levels still exceed the survey limits, the area shall be decontaminated again. This process shall be repeated until the survey limits are met.

- As a final verification, smear samples soiled with material from the area of the spill shall be sent to the CHDT laboratory for analysis using the Ludlum 3030 Alpha Beta Sample counter with comparison to the surface contamination values in Table 1, Group 2, for the uranium decay chain.

- The initial and final results of the survey shall be recorded on the CHDT Spill Recovery form shown in Attachment 1 to verify and document the effectiveness of spill recovery methods.

Table 1. Screening Levels for Clearance from ANSI/HPS N13.12 (1999)

Radionuclide Group	**Screening Levels (S.I. Units)**	**Surface Screening Levels (Conventional Units)**
	(Bq/cm^2 or Bq/g)	($dpm/100\ cm^2$)[a]
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
Group 2 Uranium: ^{234}U, ^{235}U, ^{238}U, Natural Uranium[c] and associated decay chains	1	6,000

(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.

6.0 REFERENCES

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

ATTACHMENT 1 – REGULATED WASTE SPILL RECOVERY SURVEY FORM

Clean Harbors Deer Trail LLC **REGULATED WASTE RECOVERY SURVEY REPORT**			**Survey No.**
Date	Time	Location	
Spill Location and Description of the Incident:			

Instrument/Probe Model	Survey Meter	Instrument Comments
Serial No.		
Efficiency		
Correction Factor	(Convert to dpm) 5 for radium, 10 for uranium	
Background Reading	cpm	

Measurement Description	CONTAMINATION LEVELS Total net β-γ (dpm/100 m^2)	Removable net β-γ or α (dpm/100 cm^2)

Comments: (add additional pages, if necessary)

For laboratory sample analysis: samples counted for_____ minutes to determine removable contamination levels.

Survey Conducted By:	Survey Report Reviewed By:
Name (Print) _____	Name (Print) _____
Signature _____	Signature _____

CLEAN HARBORS DEER TRAIL LLC
STANDARD OPERATING PROCEDURE ON
WORKER RADIATION PROTECTION RECORDS

Approved by:

Senior Vice President Compliance and Regulatory Affairs

Radiation Safety Officer

Date: October 4, 2005

Effective Date: Date License is Issued

1.0 OBJECTIVE: To define general and specific worker radiation protection records that shall be generated and maintained for Deer Trail general employees who may be exposed to radiation from regulated waste.

2.0 SCOPE: This procedure applies to all worker radiation protection records generated for workers at the Deer Trail landfill. These records include:

- Radiation Protection Policy Statements,
- Radiation Protection Plan,
- Personnel radiation safety training (course records and individual records),
- Standard Operating Procedures covering regulated waste, including:
    - Standard Operating Procedure on Individual and Area Dosimetry
    - Standard Operating Procedure on Airborne Monitoring for Regulated Waste
    - Standard Operating Procedure on Estimating Inhalation Doses
    - Standard Operating Procedure on Routine Radiation Surveys
    - Standard Operating Procedure on Personnel Surveys
    - Standard Operating Procedure on Equipment Surveys
    - Standard Operating Procedure on Surveys Following Spills
    - Standard Operating Procedure on Use of the Gate Monitor
    - Standard Operating Procedure on Gamma Spectra Analysis
    - Standard Operating Procedure on Use of the Alpha Beta Sample Counter
    - Standard Operating Procedure on Landfill Operations
    - Standard Operating Procedure on Radiation Protection Training
    - Standard Operating Procedure on Worker Radiation Protection Records
    - Standard Operating Procedure on Waste Tracking
    - Any other Standard Operating Procedures defined by the Radiation Protection Plan
- Radiological survey results,
- Individual and area dosimetery results, and
- Individual Radiation Doses.

3.0 POLICY: All records pertaining to Deer Trail worker activities associated with the receipt, treatment, and disposal of regulated waste shall be maintained in their personnel files. 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.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer Trail Radiation Safety Plan.

5.0 WORKER RADIATION PROTECTION RECORDS PROCEDURE:

5.1 Requirements: Record keeping requirements are defined in the Deer Trail Radiation Protection Plan, including identified retention periods. The Deer Trail 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 (as described in 5.2 below), and
   iii. Individual monitoring results, for routine, planned special exposures, accidents, and emergency conditions using the occupational exposure record form provided in Attachment 3 of the CHDT *Standard Operating Procedure on Individual and Area Dosimetry.*
d. Records of waste disposal
e. Annual ALARA program audits (duration of license)
f. Incident investigation reports (duration of license)
g. Declarations of pregnancy (3 years)
h. Environmental monitoring data and reports (duration of license)
i. Operating and emergency procedures (current)
j. Procedure manuals from Deer Trail RSO (current)

5.2 Training: The Deer Trail Radiation Safety Officer (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 form (Attachment 1), 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 Deer Trail Administrative filing system and shall include:
  - Course Title, name of instructor, and date(s) of training,
  - Course completion rosters,
  - Course Syllabus or Content Outline,
  - 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 the CHDT *Standard Operating Procedure on Individual and Area Dosimetry*, are recorded and filled in the Deer Trail Administrative filing system:

- Individual dosimetry results shall be filed in each worker's personnel file, and in a separate administrative file showing quarterly data for all monitored staff, and

- 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 NORM/TENORM individual worker quarterly and annual radiation doses obtained using the CHDT *Standard Operating Procedure on Individual and Area Dosimetry*, and the CHDT *Standard Operating Procedure on Estimating Inhalation Doses*, are recorded on the appropriate forms and filed in the Deer Trail Administrative filing system. Individual radiation dose results shall be filed in each worker's personnel file, and in a separate administrative file showing quarterly data and annual doses for all monitored staff.

ATTACHMENT 1 – DEER TRAIL GENERAL EMPLOYEE RADIOLOGICAL CONTROL TRAINING RECORD

Course Title: _____

Instructor: _____ **Signature:** _____

Date of Course: _____

Name	Test Score	Comments/Waivers/Exceptions/Extensions

Attach Course Syllabus or Course Content Outline and Handouts or Viewgraphs Used

CLEAN HARBORS DEER TRAIL LLC
STANDARD OPERATING PROCEDURE ON
USE OF THE GATE MONITORING SYSTEM

Approved by:

Senior Vice President Compliance and Regulatory Affairs

Radiation Safety Officer

Date: October 4, 2005

Effective Date: Date License is Issued

1.0 OBJECTIVE: To define general and specific methods and procedures for conducting monitoring of incoming waste shipments using the Deer Trail gate monitoring system.

2.0 SCOPE: The Deer Trail gate monitoring system shall be used to screen:

- Shipments of regulated waste for concentrations within the waste acceptance criteria,
- RCRA waste shipments for radiation levels from man-made radioactive materials or radioactive material not acceptable for disposal at Deer Trail, and
- Against the disposal of lost, sealed sources of radioactive material.

3.0 POLICY: Consistent with the Deer Trail Radioactive Materials License, it is Deer Trail's policy to receive only regulated waste with a total activity of less than 2,000 picocuries per gram (pCi/g) (natural uranium and thorium decay chain products only), and with a maximum ^{226}Ra concentration less than 400 pCi/g. All other types of licensed radioactive waste in the broader definition of low-level radioactive waste, including other licensed forms of man-made radioactive materials, are prohibited.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer Trail Radiation Protection Plan.

5.0 PROCEDURES FOR USING THE DEER TRAIL GATE MONITOR:

5.1 Radiation Screening: The Deer Trail facility shall operate scintillation-type radiation monitoring equipment that conforms to the specifications described in Attachment 1 of this procedure. The equipment shall be used to screen all incoming waste material for unacceptable levels of radiation. Any deviation must receive prior approval from the Deer Trail RSO.

5.2 Regulated Waste: For regulated waste, the Deer Trail Gate Monitor shall be operated in a manner to alarm at an initial alarm set point determined through modeling analysis to be 100 microroentgens per hour (μR/hr) above background. For an average background reading of 16 μR/h, this equates to a total dose rate of 116 μR/hr. This alarm set point shall be periodically re-evaluated for actual waste shipments, as described in Section 5.4 below. Each shipment shall pass slowly (at a speed less than 5 miles per hour) between the detectors. During this time, the radiation monitoring equipment shall survey the truck for radiation to determine if it exceeds the alarm point for regulated waste.

5.2.1 Waste Passing the Screening: For waste that passes the screening (i.e., within the alarm limits) and passes the other surveys upon receipt, the recorded dose rates, time and date of receipt, and other required information shall be recorded on the manifest consistent with the Records Management and Reporting requirements set forth in the Deer Trail Radiation Protection Plan. If the waste passes all of the waste acceptance criteria and onsite screening surveys, the waste shall be cleared for disposal.

5.2.2 Waste Failing the Screening: If an alarm condition results during a scan of an incoming vehicle, then the waste shall be rejected consistent with the Enforcement Policy in Section 6.0 of this procedure.

5.3 RCRA Waste Gate Monitor Set Point: For RCRA waste, the Deer Trail Gate Monitor shall be operated to alarm at an average background reading of 16 μR/h. All vehicles entering Deer Trail for disposal of RCRA waste (i.e., hazardous waste) shall drive through the gate monitor to confirm that the waste does not contain radioactive materials or lost sealed radioactive sources. Each shipment shall pass slowly (at a speed less than 5 miles per hour) between the detectors. During this time, the radiation monitoring equipment shall survey the truck for radiation to determine if it exceeds the alarm point for RCRA waste.

5.3.1 Waste Passing the Screening: For RCRA waste that passes the screening (i.e., within the alarm limits) and other surveys upon receipt, the recorded dose rates, time and date of receipt, and other information shall be recorded on the manifest consistent with the Records Management and Reporting requirements set forth in the Deer Trail Resource Conservation and Recovery Act (RCRA) Permit. If the waste passes all of the waste acceptance criteria and onsite screening surveys, the waste shall be cleared for disposal.

5.3.2 Waste Failing the Screening: If an alarm condition results during a scan of an incoming vehicle, then the waste shall be rejected consistent with the Enforcement Policy in Section 6.0 of this procedure.

5.4 Determination of the Alarm Set Point: Because of the variability of waste loads both in content and geometry, the Deer Trail RSO shall evaluate and confirm, or propose modification to the alarm set point used. The evaluation shall consist of recording the gate monitor response, comparing the concentrations shown on the shipping manifest, considering external dose rates measured with the Ludlum Model 19 MicroR meter or supplied by the generator, and/or obtaining waste samples for analysis. The alarm set point will then be confirmed or the proposed modification will be documented by the Deer Trail RSO, as appropriate, using the manifest information and the evaluation form provided in Attachment 2. The revised alarm set point will only be adopted after review and approval by the Department.

6.0 ENFORCEMENT POLICY: If an alarm condition results during a scan of an incoming vehicle, then the waste shall be rejected consistent with the following policy:

6.1 Radiation Alarm - General Level (dose rates greater than the alarm set point for Regulated Waste or 16 μR/h above background for RCRA Waste):

Step 1 - Record the radiation monitor reading on a Clean Harbors Waste Discrepancy Report along with the hauler's identity and truck number. If possible, also obtain and record the generator's identity.

Step 2 - Inform the hauler that the load he is hauling exceeds Clean Harbor Deer Trail's policy limits for radioactive materials and that the load is being rejected.

Step 3 - Record the date and time that the hauler leaves with the rejected load.

Step 4 - File all discrepancy reports for radioactivity in a designated file for future reference.

6.2 Post-Alarm Follow-Up: It is reasonable to believe that very few incoming regulated waste streams will fail to meet the Deer Trail waste acceptance criteria because of sampling controls placed on the generator/shipper under RCRA. In the event that this limit is exceeded and the load is rejected, follow-up action on the part of the landfill or hauler is advisable to prevent a reoccurrence of this problem. The following conditions and guidelines shall be implemented if a load is rejected due to radioactivity:

Condition 1 - Outside Waste: Upon rejection of a load from a non-Clean Harbors source for exceeding the Clean Harbors Deer Trail radioactive limit, the RSO shall contact the hauling company as soon as possible and give date, time, and the reason for rejecting the load. A follow-up letter to the hauling company should then be sent confirming the telephone conversation and Clean Harbors Deer Trail policy on radioactive materials.

Condition 2 - Clean Harbors Deer Trail-Hauled Waste: If the rejected load is hauled by Clean Harbors, the preferred approach is for the RSO to direct the District Manager or District Sales Manager to contact the generator by telephone as soon as possible after the time of load rejection. If necessary, a personal visit to the generator may be advisable to help the customer resolve the problem and prevent future loads from containing radioactive materials above the Clean Harbors Deer Trail waste acceptance criteria.

Condition 3 - Notification of Customers: For the Landfill and District - It is recommended that 45 days prior to initiating the radiation screening process, that the landfill and district notify their respective customers of Clean Harbors Deer Trail's policy on radioactive materials, the specific date on which radioactivity screening will begin, and the enforcement policy that will be implemented if the limits are exceeded.

ATTACHMENT 1 – GATE MONITOR SPECIFICATIONS

The Deer Trail gate monitor is a Ludlum Model 3502 Gate Monitor. It utilizes two 2" x 2" Sodium Iodide Crystals. They are located 7 feet above the ground and 12 feet apart. One points 90 degrees to the truck and one points about 70 degrees from the truck. The truck drives through the two monitors and parks on the scale. In this way, the entire truck has gone past the monitors. The monitor will be set to alarm at the specified set point.

MECHANICAL/ENVIRONMENTAL

Size: Less than 12 x 12 x 12 inch (Readout Unit)
Less than 6 inch diameter x 12 inch (Detector Unit with Shield)

Operating Temperatures:

At least 40 degrees F - 90 degrees F (Readout Unit)
At least -30 degrees F to 120 degrees F (Detector Unit)

Radiological Shielding:

At least 1 inch of lead in approximately 3π directions behind and around active detector area.

Weight:

Less than 10 pounds (Readout Unit)
Less than 75 pounds (Detector Unit with Shield)

Environmental:

Detector, Cable, and Connector shall be water resistant in the installed configuration.

Cables: 20 foot Coaxial Cable with Connectors between Detector Unit and Readout Unit. A.C. Power Cord.

ELECTRICAL/ELECTRONIC:

Power: 115 VAC (nominal) less than 2 amps current with internal 12-hour battery reserve. (Readout Unit) Detector Unit power supplied from Readout Unit.

Meter: Counts per minute display with a digital readout. Range at least 10 to 100,000 CPM.

Alarm: Tone Alarm, non-latching, adjustable over full range of meter scale above a minimum set point of not more than 250 cpm. Set point must be displayed or displayable on the meter scale.

Accuracy: Displayed value must be accurate to with +5% of a constant input signal over the entire range of the display.

Display/Alarm Time Constant:

The digital display should update at least every 6 seconds. Update times may be adjustable above or below 6 seconds.

High Voltage: Adjustable to supply Detector Unit.

Detector Failure Indicator: Readout Unit shall have a visible indicator other than the display that actuates it when the detector has not produced a signal for more than 15 seconds.

An automatic data-logger shall be included.

Discriminator: Readout Unit shall be able to discriminate against gamma energies below 200 keV in an adjustable manner. Readout Unit shall have a speaker with an adjustable volume that sounds with each incoming detector pulse.

RADIOLOGICAL

Detector Type: Two 2 inch by 2 inch thallium-doped NaI(T1) crystal scintillators.

Minimum Sensitivity: Must be photon (gamma and x-ray) sensitive. Must alarm on a 100 μCi Cs-137 source at 10 feet within 15 seconds in a constant background field of 10 μR/h of Ra-226 in equilibrium with progeny.

False Alarms: When set for the minimum sensitivity condition above, false alarms to normal background shall be less than once every three months.

ATTACHMENT 2 – GATE MONITOR ALARM SET POINT EVALUATION FORM

Clean Harbors Deer Trail LLC
GATE MONITOR ALARM SET POINT EVALUATION FORM

Date	Time	Waste Generator

Waste Description (Long-Term Client/Episodic)

Instrument/Probe Model	Ludlum Model 19 Micro R Exposure Rate Meter Response	Ludlum Model 3502 Gate Monitor Response	Generator Supplied Exposure Rate Information	Comments
Serial No.		N/A	N/A	
Background Reading	μR/h	μR/h	μR/h	
Gross Reading	μR/h	μR/h	μR/h	
Net Reading	μR/h	μR/h	μR/h	

Radionuclide	Generator Supplied Waste Characterization, by Radionuclide and Total	Additional Sample Analysis, by Radionuclide and Total (If available)	Comments
Total Activity			

Evaluation of Gate Monitor Alarm Set Point versus Waste Concentrations:

Evaluation Conducted By:

Name (Print) _____

Signature _____

CLEAN HARBORS DEER TRAIL LLC
STANDARD OPERATING PROCEDURE ON
GAMMA SPECTRA ANALYSIS

Approved by:

Senior Vice President Compliance and Regulatory Affairs

Radiation Safety Officer

Date: October 7, 2005

Effective Date: Date License is Issued

1.0 OBJECTIVE: To define general and specific methods and procedures for conducting gamma spectra analysis to identify radionuclides in waste received at the Deer Trail landfill.

2.0 SCOPE: Radiation surveys for regulated waste shall be performed to ensure that waste received at the Deer Trail landfill is consistent with the regulated waste acceptance criteria as defined in the CHDT Radiation Protection Plan, and to verify that licensed radioactive materials from other sources is rejected.

3.0 POLICY: Radiation surveys shall be conducted by trained Deer Trail staff for all waste shipments, and to verify that radioactive materials from other sources are not disposed at the Deer Trail landfill.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer Trail Radiation Protection Plan.

5.0 GENERAL METHODS FOR SPECTRA ANALYSIS: The Exploranium GR-135 Identifier (hand held gamma spectrometer) shall be used by trained Deer Trail staff to determine the relative contribution of radionuclides in waste received at the Deer Trail Landfill. The measurements shall not be used to establish personnel dose rates. Measurements shall be taken where the exposure rate is less than 2 mR/hour. When using the GR-135 spectrometer, the following procedure shall be used:

- Verify that the GR-135 Identifier is seated in the charger with the display reading "SYSTEM READY."
- Verify that the battery icon in the upper right corner of the display indicates the battery is at least ½ charged.
- Remove the GR-135 Identifier from the charger and place in the tripod at a height of 6 feet, at the midpoint of the waste shipment.
- The GR-135 Identifier will be in the "SEARCH" mode.

- Note that if the GR-135 is to be transported to another location, then it shall be shut down for transport and turned on again at the desired location. To turn off the GR-135 Identifier, push the thumb lever to the "OFF" position AND hold it there until the unit reads "TURNING OFF" AND counts down 3-2-1 AND the screen goes blank, then reverse the lever.

- To turn on the GR-135 Identifier, push the thumb lever to "ON" for 2 seconds, then release. The GR-135 should be in the "SEARCH" mode. If this does not occur, discontinue use and contact the Deer Trail RSO.

- In "SEARCH" mode, the GR-135 Identifier will display the current dose rate in μR/hour in the bottom left corner of the display.

- The GR-135 will alarm when the dose rate increases above the initial level measured at the time the GR-135 was turned on.

- To characterize the type of material in a radioactive source, push the thumb lever to "ON" for approximately 2 seconds and release.

- The GR-135 will count for the time interval displayed on the left lower portion of the display (typically 10 minutes).

  - If the box in the upper right portion of the display reads "OK," then allow the GR-135 to count until count is complete and the GR-135 beeps. The GR-135 will either display "NO NUCLIDES Detected" or display a list of radionuclides detected in the sample. The GR-135 will display a text message "SPECTRUM STORED AS #XX" at the bottom of the display window; record details for each collected spectrum for later reference and analysis on Attachment 1 – Exploranium GR-135 Data Log.

  - If the box in the upper right portion of the display reads "MOVE CLOSER," THEN move the GR-135 closer to the source of radiation being characterized until the display reads "OK." Go to the previous step for operation.

  - If the box in the upper right portion of the display reads "MOVE AWAY," THEN move the GR-135 farther away from the source being characterized until the display reads "OK."

  - Note that sometimes the radiation levels are too low to register in a ten minute sample period, and the unit will show "NO NUCLIDES FOUND." In some cases, increasing the sample analysis time will improve the analysis. If this occurs, or if a longer count time is wanted, push the thumb level to "OFF" and release it to obtain a longer sample count time.

  - To count a different sample, press the thumb lever momentarily to 'OFF," which will switch the unit to the "SEARCH" mode. Repeat the above steps to count a new spectrum.

- When finished, place the GR-135 into the Docking Station.

6.0 SAVING A SPECTRUM TO A COMPUTER FOR ANALYSIS:

- On a personal computer with "Identiview 135" software installed, open the software. The computer will display download progress and count down the number of spectra remaining to be downloaded. The computer will display a box with the words "SO YOU WANT TO SAVE THE DATA?"

- Under a filename, input the data in YYYYMMDD format, followed by up to 30 characters and spaces of additional text to help identify the recorded spectrum.

- Enter this filename on Attachment 1 – Exploranium GR-135 Data Log.

- Click on the Save box.

- The computer will prompt "DATA STORED DO YOU WANT TO ERASE THE GR-135 MEMORY;" select "YES." The computer will prompt, "ARE YOU SURE?" Select "YES."

- The spectral data may be viewed, if desired. When finished, shut down the program by double clicking on the red "X" in the upper right hand corner of the Identiview software window. When finished, place the GR-135 in the charger to charge the batteries and stabilize the unit.

6.0 REFERENCES

GR-135 The Identifier System Manual, Part #87317, Exploranium, Inc.

ATTACHMENT 1 – EXPLORANIUM GR-135 DATA LOG

Clean Harbors Deer Trail LLC EXPLORANIUM GR-135 DATA LOG	
Spectrum Collected by:	Date:
Filename:	**YYYYMMDD + 6 Characters:**
Spectrum #	**Details/Comments**

CLEAN HARBORS DEER TRAIL LLC
STANDARD OPERATING PROCEDURE FOR
TREATMENT OPERATIONS

Approved by:

_____ Corporate Officer

_____ Radiation Safety Officer

Date: October 14, 2005

Effective Date: Date License is Issued

1.0 OBJECTIVE: To define operational procedures for control of contamination from waste treatment operations in the CHDT treatment building.

2.0 SCOPE: This SOP defines and directs procedures for contamination control of Regulated Waste treatment operations. It covers 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 in such a way to prevent radioactive material from leaving the treatment building except in authorized waste movements. The goal is to prevent the spread of contamination to people, equipment and the environment and to keep other parts of the CH Deer Trail facility free from radiological contamination. To fulfill this goal, several operational measures will be implemented. A portion of the treatment building will be dedicated for use with radioactive material during treatment campaigns. The building floor around the treatment basins dedicated to these campaigns will be kept clean by washing with water daily. Vehicles and equipment leaving the dedicated area of the treatment building will be frisked for radioactive contamination.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer Trail Radiation Protection Plan.

5.0 DEFINITIONS:

5.2 Bed Liner: A bed liner is a sheet of plastic material that is used to form an impervious liner in the bed of a dump truck, dump trailer, or roll-off box.

5.3 Decon Bay: This is a personnel decontamination and changing area located adjacent to the Regulated Waste Loading and Unloading Area.

5.4 Contaminated Equipment: means any CHDT trucks or equipment whose exteriors come into direct contact with Regulated Waste. In the treatment building, this will be the trackhoe excavator dedicated for use with Regulated Waste. Contaminated Equipment shall undergo decontamination procedures and pass a radiation survey, as defined in the CHDT *Standard Operating Procedure on Regulated Surveys for Equipment*, before it can be considered uncontaminated.

5.5 Frisk Out: Frisk out (i.e., radiation survey) procedures shall involve a check of vehicle tires and surfaces, or personnel for radiological contamination through the use of hand held gamma survey equipment, using the CHDT *Standard Operating Procedure on*

Regulated Surveys for Equipment and/or the CHDT *Standard Operating Procedure on Regulated Surveys for Personnel.*

5.6 Loading Area: This is a section of the treatment building located immediately adjacent to treatment basin D-1. This area will be used for loading and unloading of waste material. The Loading Area consists of a concrete floor that slopes toward treatment basin D-1 and drains to it. Treatment Basin D-1 located in this area will be used for treatment mixing operations.

5.7 Regulated Waste: Waste that includes: a) NORM/ TENORM radionuclides in solid waste; b) Regulated radionuclides in material licensed by CDPHE (including natural levels that meet the definition of source material); c) Regulated radionuclides mixed with RCRA hazardous wastes; and d) radium processing wastes.

5.8 South Side of Treatment Building: This half of the treatment building is isolated from the north half of the building and the Drum Storage Warehouse. All treatment operations of Regulated Waste will take place in this side of the building.

5.9 Treatment Building: The building located inside the CHDT surface impoundment where all waste treatment operations are performed.

6.0 Loading, Unloading and Treatment operations: A section of the Treatment Building will be dedicated to Regulated Waste operations on an as needed basis. This section will be marked and restricted. It will normally comprise Basin D1 and the unloading area adjacent to it. Additional treatment basins will be dedicated for use if necessary. Once dedicated for use, they will remain so until decontaminated per the SOP on surveys.

6.1 Unloading Operations: Facility personnel will direct the transporter to the Regulated Waste 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 normally be equipped with bed liners for solid and sludge materials. These bed liners will prevent the Regulated Waste from contacting the truck bed. After the truck has dumped, the interior of the truck will be inspected for the presence of visible contamination. If the bed liner has functioned properly, there should be no contamination of the truck interior. If visible contamination is detected, the truck bed will be raised and it will be rinsed with water with the rinsate directed into the treatment basin. The floor of the unloading area will be washed with water daily each day that regulated waste operations are conducted in the area. This will ensure that all vehicles will drive only on clean surfaces. The wash water will be directed into the treatment basin, and treated with other waste.

6.2 Exit Procedures for Incoming Waste Trucks: If the bedliner has functioned properly and no contamination is observed, not further relase procedures are necessary. If waste has contacted the interior of the truck, the interior of the truck trailer or roll-off bin will be surveyed for contamination in accordance with the CHDT *Standard Operating Procedure on Surveys for Equipment*. If contamination is detected, the interior of the truck dump trail or roll-off bin trailer will be decontaminated until the interior of the truck dump trailer or roll-off bin is determined to meet the release criteria in the SOP. Decontamination will normally be accomplished by washing with water. The wash water will be directed into the treatment basin. A cleaning agent such as soap will be used if necessary. The truck tires will not be routinely surveyed for radiation contamination since the truck is traveling only on clean unloading areas washed daily (i.e., truck tires will not contact Regulated Waste) and since a survey of the dedicated treatment area will be performed in accordance with Section 6.6. If the truck tires contact Regulated Waste (e.g., the truck driver accidentally spills Regulated Waste on the floor during dumping), the truck tires shall be surveyed for the presence of radioactivity above background using

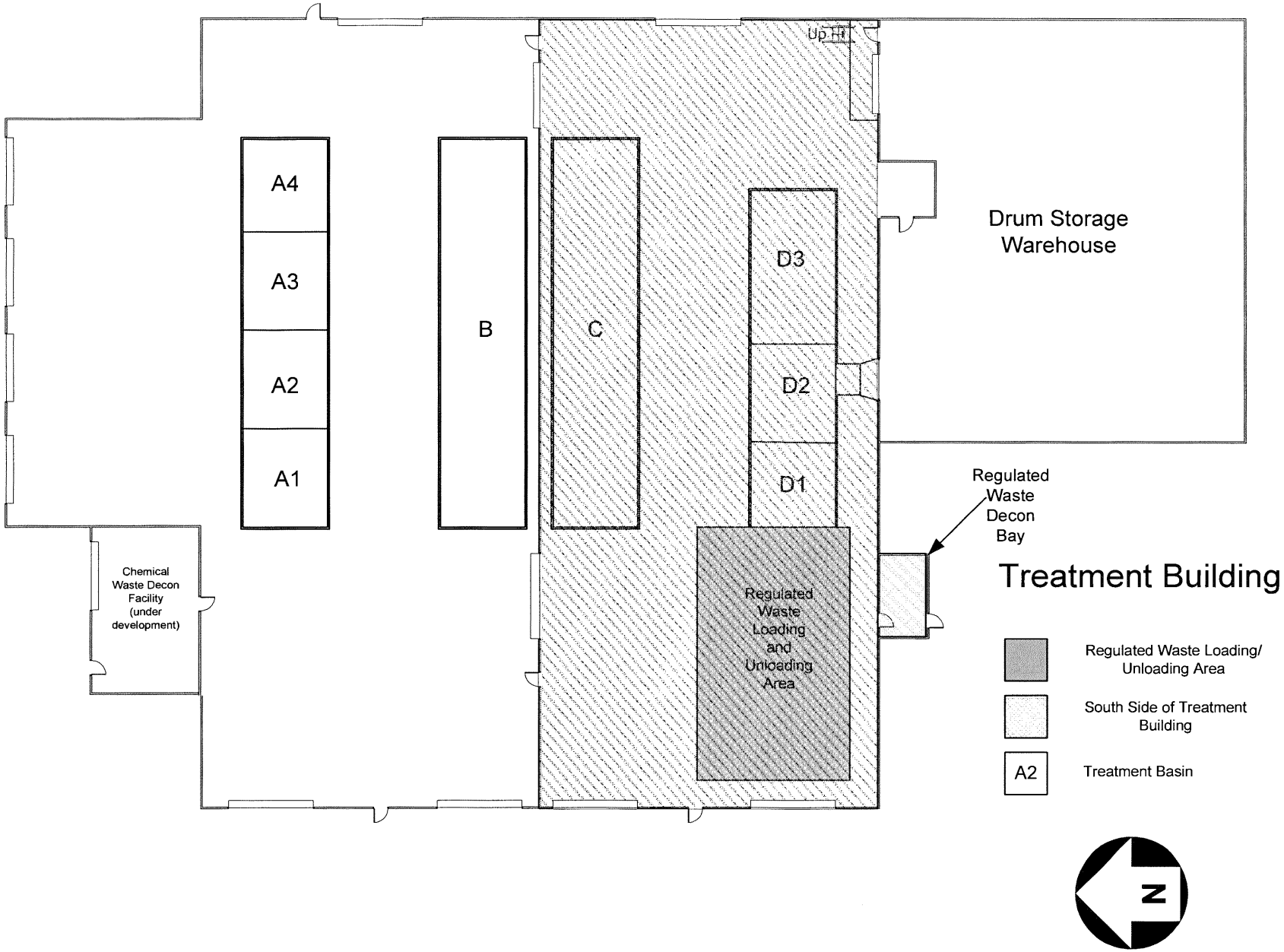
gamma survey equipment as defined in the CHDT *Standard Operating Procedure on Regulated Surveys for Equipment*. If radioactive material is detected, the truck tires shall be decontaminated by washing with water. The rinsate will be directed into the treatment basin. The unloading area floor will be washed daily. The floor in this area slopes toward Basin D-1 and the rinsate will be treated along with the waste.

6.2 Loading Operations: After waste has been treated in the treatment basin and meets specifications for landfill, the waste will be loaded into site haul trucks and transported to the landfill cell. The haul truck will back into the loading area adjacent to the treatment basin. Waste will be transferred to the site haul truck using a backhoe bucket. Before the beginning of loading operations, plastic sheeting will be spread on the ground along side the haul truck. The purpose of the plastic sheeting is to prevent the spill of Regulated Waste directly onto the concrete floor. At the conclusion of the loading operations, the plastic sheeting will either be disposed of in the landfill, or stored for reuse.

6.3 Exit Procedures for Site Haul Trucks: The truck tires will not be routinely surveyed for radiation contamination since the truck is traveling only on clean haul roads and unloading areas washed daily (i.e., truck tires will not contact Regulated Waste) and since a survey of the dedicated treatment area will be performed in accordance with Section 6.6. If the truck tires contact Regulated Waste, (e.g., the truck driver accidentally spills Regulated Waste on the floor during dumping, the truck tires shall be surveyed for the presence of radioactivity above background using gamma survey equipment as defined in the CHDT *Standard Operating Procedure on Regulated Surveys for Equipment*. If radioactive material is detected, the truck tires shall be decontaminated by washing with water. The rinsate will be directed into the treatment basin and treated with other waste. Site haul trucks normally do not leave the facility. If they leave the facility, the interior of the truck bed will be decontaminated. In order to be considered decontaminated, they will be surveyed for radionuclide contamination in accordance with the CHDT *Standard Operating Procedure on Surveys for Equipment*. If contamination is detected, the interior of the truck dump trail or roll-off bin trailer will be swept and/or washed, if necessary, until the interior of the truck is determined to meet the release criteria in the CHDT *Standard Operating Procedure on Surveys for Equipment*.

6.4 Mixing Operations: Mixing operations in the treatment building are conducted using a backhoe 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 to verify proper treatment. 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. Proper operation of the emission control system is delineated in SOP on the Air Handling System.

7.0 PPE AND PERSONNEL DECON: 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. Personnel may leave the treatment building on foot or in a vehicle. Drivers delivering waste to the treatment building may not leave their vehicles until they have exited the treatment building. Persons working in the Regulated Waste area of the treatment building shall exit through the decon bay and undergo frisk out procedures. These procedures are delineated in the CHDT *Standard Operating Procedure on Personnel Surveys*. If the frisk out determines that radioactive material is present, the PPE shall if be removed and disposed and the individual frisked out again. Reusable PPE such as boots and respirators may be decontaminated if contaminated. Other PPE may be used as long as they provide equivalent protection. Contaminated PPE will be disposed of in the landfill.


Up Ht
A4
A3
A2
A1
B
C
D3
D2
D1
Drum Storage Warehouse
Regulated Waste Decon Bay
Chemical Waste Decon Facility (under development)
Regulated Waste Loading and Unloading Area
Treatment Building
Regulated Waste Loading/ Unloading Area
South Side of Treatment Building
A2
Treatment Basin
N

CLEAN HARBORS DEER TRAIL LLC
STANDARD OPERATING PROCEDURE FOR
TREATMENT OPERATIONS

Approved by:

_____ Corporate Officer

_____ Radiation Safety Officer

Date: October 14, 2005

Effective Date: Date License is Issued

1.0 OBJECTIVE: To define operational procedures for control of contamination from waste treatment operations in the CHDT treatment building.

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3.0 POLICY: Treatment Operations will be conducted in such a way to prevent radioactive material from leaving the treatment building except in authorized waste movements. The goal is to prevent the spread of contamination to people, equipment and the environment and to keep other parts of the CH Deer Trail facility free from radiological contamination. To fulfill this goal, several operational measures will be implemented. A portion of the treatment building will be dedicated for use with radioactive material during treatment campaigns. The building floor around the treatment basins dedicated to these campaigns will be kept clean by washing with water daily. Vehicles and equipment leaving the dedicated area of the treatment building will be frisked for radioactive contamination.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer Trail Radiation Protection Plan.

5.0 DEFINITIONS:

5.2 Bed Liner: A bed liner is a sheet of plastic material that is used to form an impervious liner in the bed of a dump truck, dump trailer, or roll-off box.

5.3 Decon Bay: This is a personnel decontamination and changing area located adjacent to the Regulated Waste Loading and Unloading Area.

5.4 Contaminated Equipment: means any CHDT trucks or equipment whose exteriors come into direct contact with Regulated Waste. In the treatment building, this will be the trackhoe excavator dedicated for use with Regulated Waste. Contaminated Equipment shall undergo decontamination procedures and pass a radiation survey, as defined in the CHDT *Standard Operating Procedure on Regulated Surveys for Equipment*, before it can be considered uncontaminated.

5.5 Frisk Out: Frisk out (i.e., radiation survey) procedures shall involve a check of vehicle tires and surfaces, or personnel for radiological contamination through the use of hand held gamma survey equipment, using the CHDT *Standard Operating Procedure on*

Regulated Surveys for Equipment and/or the CHDT *Standard Operating Procedure on Regulated Surveys for Personnel.*

5.6 Loading Area: This is a section of the treatment building located immediately adjacent to treatment basin D-1. This area will be used for loading and unloading of waste material. The Loading Area consists of a concrete floor that slopes toward treatment basin D-1 and drains to it. Treatment Basin D-1 located in this area will be used for treatment mixing operations.

5.7 Regulated Waste: Waste that includes: a) NORM/ TENORM radionuclides in solid waste; b) Regulated radionuclides in material licensed by CDPHE (including natural levels that meet the definition of source material); c) Regulated radionuclides mixed with RCRA hazardous wastes; and d) radium processing wastes.

5.8 South Side of Treatment Building: This half of the treatment building is isolated from the north half of the building and the Drum Storage Warehouse. All treatment operations of Regulated Waste will take place in this side of the building.

5.9 Treatment Building: The building located inside the CHDT surface impoundment where all waste treatment operations are performed.

6.0 Loading, Unloading and Treatment operations: A section of the Treatment Building will be dedicated to Regulated Waste operations on an as needed basis. This section will be marked and restricted. It will normally comprise Basin D1 and the unloading area adjacent to it. Additional treatment basins will be dedicated for use if necessary. Once dedicated for use, they will remain so until decontaminated per the SOP on surveys.

6.1 Unloading Operations: Facility personnel will direct the transporter to the Regulated Waste 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 normally be equipped with bed liners for solid and sludge materials. These bed liners will prevent the Regulated Waste from contacting the truck bed. After the truck has dumped, the interior of the truck will be inspected for the presence of visible contamination. If the bed liner has functioned properly, there should be no contamination of the truck interior. If visible contamination is detected, the truck bed will be raised and it will be rinsed with water with the rinsate directed into the treatment basin. The floor of the unloading area will be washed with water daily each day that regulated waste operations are conducted in the area. This will ensure that all vehicles will drive only on clean surfaces. The wash water will be directed into the treatment basin, and treated with other waste.

6.2 Exit Procedures for Incoming Waste Trucks: If the bedliner has functioned properly and no contamination is observed, not further relase procedures are necessary. If waste has contacted the interior of the truck, the interior of the truck trailer or roll-off bin will be surveyed for contamination in accordance with the CHDT *Standard Operating Procedure on Surveys for Equipment*. If contamination is detected, the interior of the truck dump trail or roll-off bin trailer will be decontaminated until the interior of the truck dump trailer or roll-off bin is determined to meet the release criteria in the SOP. Decontamination will normally be accomplished by washing with water. The wash water will be directed into the treatment basin. A cleaning agent such as soap will be used if necessary. The truck tires will not be routinely surveyed for radiation contamination since the truck is traveling only on clean unloading areas washed daily (i.e., truck tires will not contact Regulated Waste) and since a survey of the dedicated treatment area will be performed in accordance with Section 6.6. If the truck tires contact Regulated Waste (e.g., the truck driver accidentally spills Regulated Waste on the floor during dumping), the truck tires shall be surveyed for the presence of radioactivity above background using

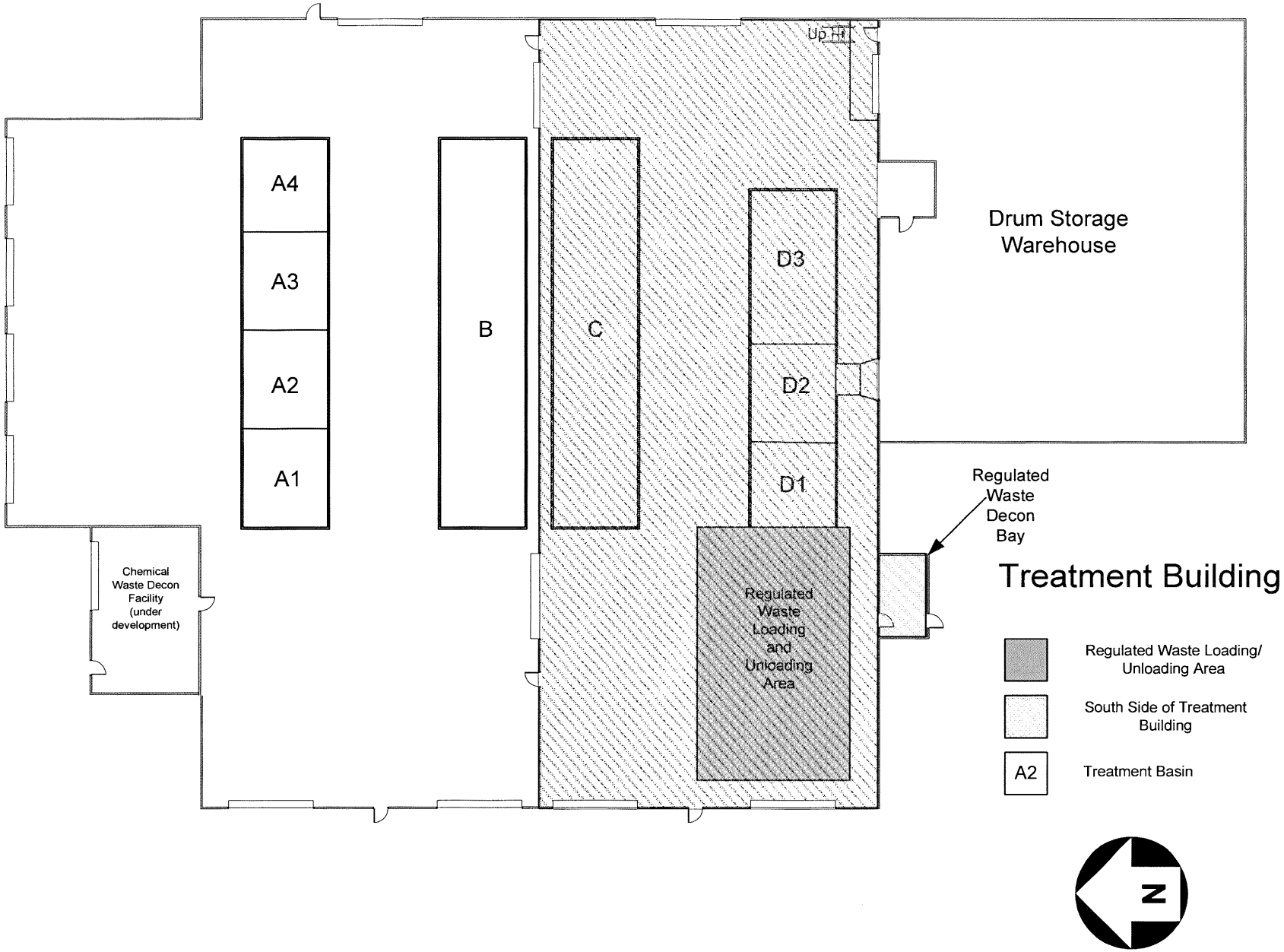
gamma survey equipment as defined in the CHDT *Standard Operating Procedure on Regulated Surveys for Equipment*. If radioactive material is detected, the truck tires shall be decontaminated by washing with water. The rinsate will be directed into the treatment basin. The unloading area floor will be washed daily. The floor in this area slopes toward Basin D-1 and the rinsate will be treated along with the waste.

6.2 Loading Operations: After waste has been treated in the treatment basin and meets specifications for landfill, the waste will be loaded into site haul trucks and transported to the landfill cell. The haul truck will back into the loading area adjacent to the treatment basin. Waste will be transferred to the site haul truck using a backhoe bucket. Before the beginning of loading operations, plastic sheeting will be spread on the ground along side the haul truck. The purpose of the plastic sheeting is to prevent the spill of Regulated Waste directly onto the concrete floor. At the conclusion of the loading operations, the plastic sheeting will either be disposed of in the landfill, or stored for reuse.

6.3 Exit Procedures for Site Haul Trucks: The truck tires will not be routinely surveyed for radiation contamination since the truck is traveling only on clean haul roads and unloading areas washed daily (i.e., truck tires will not contact Regulated Waste) and since a survey of the dedicated treatment area will be performed in accordance with Section 6.6. If the truck tires contact Regulated Waste, (e.g., the truck driver accidentally spills Regulated Waste on the floor during dumping, the truck tires shall be surveyed for the presence of radioactivity above background using gamma survey equipment as defined in the CHDT *Standard Operating Procedure on Regulated Surveys for Equipment*. If radioactive material is detected, the truck tires shall be decontaminated by washing with water. The rinsate will be directed into the treatment basin and treated with other waste. Site haul trucks normally do not leave the facility. If they leave the facility, the interior of the truck bed will be decontaminated. In order to be considered decontaminated, they will be surveyed for radionuclide contamination in accordance with the CHDT *Standard Operating Procedure on Surveys for Equipment*. If contamination is detected, the interior of the truck dump trail or roll-off bin trailer will be swept and/or washed, if necessary, until the interior of the truck is determined to meet the release criteria in the CHDT *Standard Operating Procedure on Surveys for Equipment*.

6.4 Mixing Operations: Mixing operations in the treatment building are conducted using a backhoe 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 to verify proper treatment. 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. Proper operation of the emission control system is delineated in SOP on the Air Handling System.

7.0 PPE AND PERSONNEL DECON: 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. Personnel may leave the treatment building on foot or in a vehicle. Drivers delivering waste to the treatment building may not leave their vehicles until they have exited the treatment building. Persons working in the Regulated Waste area of the treatment building shall exit through the decon bay and undergo frisk out procedures. These procedures are delineated in the CHDT *Standard Operating Procedure on Personnel Surveys*. If the frisk out determines that radioactive material is present, the PPE shall if be removed and disposed and the individual frisked out again. Reusable PPE such as boots and respirators may be decontaminated if contaminated. Other PPE may be used as long as they provide equivalent protection. Contaminated PPE will be disposed of in the landfill.


Up Ht
A4
A3
A2
A1
B
C
D3
D2
D1
Drum Storage Warehouse
Regulated Waste Decon Bay
Chemical Waste Decon Facility (under development)
Regulated Waste Loading and Unloading Area
Treatment Building
Regulated Waste Loading/ Unloading Area
South Side of Treatment Building
A2
Treatment Basin
N

CLEAN HARBORS DEER TRAIL LLC
STANDARD OPERATING PROCEDURE FOR
REGULATED WASTE LANDFILL OPERATIONS

Approved by:

Senior Vice President Compliance and Regulatory Affairs

Radiation Safety Officer

Date: October 14, 2005

Effective Date: Date License is Issued

1.0 OBJECTIVE: To define operational procedures for control of regulated waste.

2.0 SCOPE: This SOP defines and directs procedures for the proper operation of the landfill, and procedures for regulated waste unloading operations. It also directs and prescribes procedures to prevent regulated contamination from leaving the landfill.

3.0 POLICY: Landfill operations shall be performed as appropriate to prevent radioactive contamination from leaving the landfill. The goal is to prevent the spread of radioactive contamination to people, equipment and the environment and to keep other parts of the Deer Trail facility free from radioactive contamination.

4.0 RESPONSIBILITIES: Responsibilities of the Deer Trail Radiation Safety Officer (RSO), management, and staff are defined in the Deer trail Radiation Protection Plan.

5.0 DEFINITIONS:

5.1 Landfill: means the area or spaced located inside the landfill liner system.

5.2 Decon Area: means an area immediately outside the landfill exit that will be used to conduct inspections, exit surveys, and/or decontamination of trucks exiting the landfill immediately after unloading regulated waste. The area shall be marked and designated by signs, paint or chalk markings, traffic cones, barricades, or other means.

5.3 Bed Liner: means a sheet of plastic material that is used to form an impervious liner in the bed of a dump truck, dump trailer, or roll-off box.

5.4 Clean Equipment: means any CHDT trucks or equipment of which the equipment exterior does not come directly into contact with regulated waste. Examples of this may include the CAT D8 Bulldozer, the Dresser Bulldozer, Volvo A-25 haul trucks, pickups, service trucks and other site equipment that does not directly contact regulated waste.

5.5 Contaminated Equipment: means any CHDT trucks or equipment whose exteriors come into direct contact with regulated waste. Examples include the CAT D6 Bulldozer and CAT 815 Compactor used in the landfill. Contaminated equipment shall undergo

decontamination procedures and a radiation survey, as defined in the CHDT *Standard Operating Procedure on Equipment Surveys*, before it can be considered to be clean equipment.

5.6 Landfill Equipment: means earthmoving equipment (e.g., CAT D6 bulldozer and/or CAT 815 compactor) that is normally located inside the landfill and used in the landfill to push, spread and compact waste material.

5.7 Clean Area: means areas of the facility that are not associated with regulated waste treatment or disposal and landfill areas that have been covered with two inches of soil to prevent individuals or equipment (e.g., trucks, earthmoving equipment, etc.) from potentially contacting regulated waste.

6.0 LANDFILL OPERATIONS: The Deer Trail facility will be operated in two different modes, depending on the type of waste received. They are the regulated waste mode and the RCRA only waste mode. The following describes the two different modes of operation and the different operations that will occur in the landfill.

6.1 RCRA Only Mode of operation will allow for the disposal of hazardous and nonhazardous waste in the landfill in accordance with the RCRA hazardous waste facility permit. After a load of hazardous waste or nonhazardous waste has met the waste acceptance criteria specified in the Waste Analysis Plan (WAP) in the RCRA hazardous waste permit, the truck will proceed to the landfill as directed by facility staff. The truck will enter the landfill via a dirt haul road. The truck will proceed to an area and discharge the waste load in an unloading area specified by facility personnel. The dirt haul road inside the landfill will be marked using signs, paint, chalk, traffic cones, barricades or some other means to direct truck traffic to the designated area. After the waste has been unloaded, the truck will exit the landfill, usually via the entrance road. In future cells, the landfill may be constructed with a separate entrance and exit dirt haul road(s). The waste in the unloading area will be pushed by a bulldozer or compactor to its burial location and compacted as described in Section 6.4 of this SOP. CHDT anticipates that the landfill will be operated mainly in this mode of operation. This mode of operation will not require an assessment for radionuclide contamination since the truck will be traveling on clean soil and will not contact radioactive material. In addition, the unloading area location and haul road(s) locations will be modified to support operations as the landfill is filled to capacity.

6.2 Regulated Waste mode of operation shall consist of facility personnel directing the transporter to the landfill, the truck traveling on clean dirt haul roads inside the landfill, where the haul road(s) and unloading area shall be delineated as mentioned in the RCRA only mode of operation in Section 6.1, and the waste being compacted as described in Section 6.4. As the truck exits the landfill, the truck shall be required to follow the procedures in Section 6.3 depending on whether or not the truck was transporting regulated waste. Covering the regulated waste burial area with clean soil may occur anytime during the operating day or at the end of the operating day depending on the time of day, the amount of hazardous and/or nonhazardous waste to be received, or the amount of regulated waste be accepted. In any event, the burial area shall be covered with clean soil prior to returning the landfill to the RCRA only mode of operation. CHDT intents to coordinate its operations by having loads of regulated waste scheduled for acceptance to limit the amount of time the landfill will be operated in the regulated waste mode of operation.

6.3 Landfill Exiting Procedures for Trucks Transporting Regulated Wastes: the landfill exiting procedures for a truck transporting regulated waste are as follows: After a truck containing regulated waste is unloaded and the interior of the truck bed or roll-off bin is inspected for residual waste material, the truck shall exit the landfill and proceed to the decon area. The truck bed will be inspected in the unloading area to verify that all of the regulated waste has been removed from the truck. Typically, the truck bed or roll-off-bin will be lined with a bed liner which prevents the waste from contacting the inside of the truck bed or roll-off bin. After all visible evidence of waste residue has been removed, the truck will travel to the decon area at the exit of the landfill.

The truck tires will not routinely be surveyed for radioactive contamination since the truck travels on haul roads and unloading areas constructed of clean soil, separating the vehicle tires from the regulated waste (i.e., truck tires will not contact radioactive materials) and since a survey of the haul road will be performed in accordance with Section 6.6. If the truck tires contact regulated waste (e.g., the truck driver accidentally backs over a pile of regulated waste or drives off the clean soil onto areas contaminated with regulated waste), the truck tires shall be swept to remove soil particles. After sweeping, the truck tires shall be surveyed for the presence of radioactivity as defined in the CHDT *Standard Operating Procedure on Equipment Surveys*. If radioactive material is detected above the survey limits, the truck tires shall be decontaminated and re-surveyed.

For trucks transporting regulated waste, the interior of the truck dump trailer or roll-off bin will be surveyed for radioactive contamination in accordance with the CHDT *Standard Operating Procedure on Equipment Surveys*. If contamination is detected above the survey limit, the interior of the truck dump trail or roll-off bin trailer will be swept and/or washed, if necessary, until the interior of the truck dump trailer or roll-off bin is determined to meet the release criteria in the CHDT *Standard Operating Procedure on Equipment Surveys*.

6.4 Waste Placement and Compaction: Regulated waste shall 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. Multiple passes with the CAT D6 Bulldozer, the CAT 815 compactor, or other similar equipment shall accomplish compaction. Debris-like waste shall be mixed with soil like waste and compacted in place. All void spaces in the waste shall be filled with waste or eliminated through compaction. No debris placement shall be permitted near the liner. In order to protect the synthetic liner from possible punctures, a two-foot thick protective soil layer shall be placed on the immediate liner surface. All waste placement and compaction shall be done in compliance with the requirements of the RCRA Operating permit.

6.5 Prevention of Wind Dispersal: Several mechanisms shall be used to prevent the wind dispersal of waste outside the landfill. Cover material shall be placed over the waste at the end of each landfill shift. Types of cover material may include 2 inches of soil, geotextile fabrics, spray foam, or other effective materials. The facility is equipped with a wind gauge and an alarm system which provides a warning if sustained wind speeds exceed 35 miles per hour. If the wind speed exceeds a sustained speed of 35 miles per hour, truck-unloading operations in the landfill will cease. A stockpile of cover material

shall be kept in the landfill whenever waste placement is above the rim of the landfill liner system. If 35 mile per hour sustained wind speeds occur, any exposed areas of waste shall be covered immediately.

6.6 Maintenance of Haul Roads: At the end of each operating day of regulated waste disposal in the landfill, clean soil shall be brought into the landfill and spread over the haul road and the dumping area. Clean soil shall be placed using the clean equipment. Equipment contaminated by regulated waste shall stay off all designated clean areas. Landfill haul roads shall have dry soil placed on them after a precipitation event, if necessary. Area surveys shall be conducted each time clean soil is emplaced using the CHDT *Standard Operating Procedure on Area Surveys* to ensure isolation of regulated waste.

6.7 Removal of Landfill Equipment from the landfill: Equipment contaminated by regulated waste (e.g., CAT D6 bulldozer, CAT 815 compactor) shall be decontaminated before removal from the landfill. Alternatively, it may be transported to the treatment building for washing and decontamination.

6.8 CHDT Haul Trucks and Clean Equipment: Clean equipment may enter and leave the landfill, as needed, provided they only travel on areas of the landfill that are covered with clean soil. Frisk out shall not be done on this equipment unless it leaves the clean areas of the landfill.

6.9 RUN ON/RUN OFF CONTROL: Run On/Run Off Controls and procedures are presented in detail in Section VI of the RCRA operating permit.

6.10 LEACHATE COLLECTION: Requirements for leachate collection are presented in detail in Section VI of the RCRA operating permit

7.0 PERSONAL PROTECTIVE EQUIPMENT AND PERSONNEL DECONTAMINATION: 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. Personnel may leave the landfill whether on foot or on a vehicle. Persons entering the vehicle on clean vehicles may not leave the vehicle in the landfill except in clean areas such as the haul road and the dump area. Persons working in equipment contaminated with regulated waste or walking on the regulated waste landfill surface shall be surveyed after leaving the landfill using the CHDT *Standard Operating Procedure on Personnel Surveys.* If the survey results determine that radioactive material is present, the PPE shall if be removed and disposed and the individual surveyed again. Reusable PPE such as boots and respirators may be decontaminated, if necessary, and reused. Other PPE may be used as long as they provide equivalent protection.

ATTACHMENT B

Air Monitoring Instruments - Manufactures Data

ATTACHMENT B

Air Monitoring Instruments - Manufactures Data

Continuous Duty Air Samplers

HI-Q

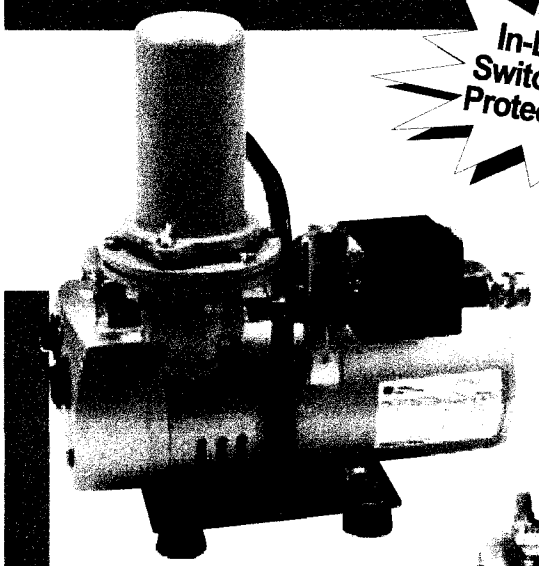
New In-Line Toggle Switch with Fuse Protection Option

VS23-SERIES

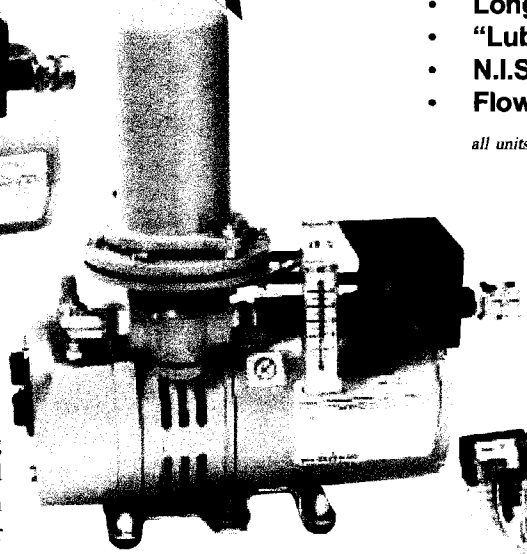
Continuous Duty, Constant Flow Air Sampling Systems

- **Automatic Flow Control Valve**
- **Continuous Duty/Constant Flow**
- **Longer Vane Life**
- **"Lubricated for Life" Bearings**
- **N.I.S.T. Traceable Flow Meter**
- **Flow Ranges of 0.1 - 9.0 CFM**

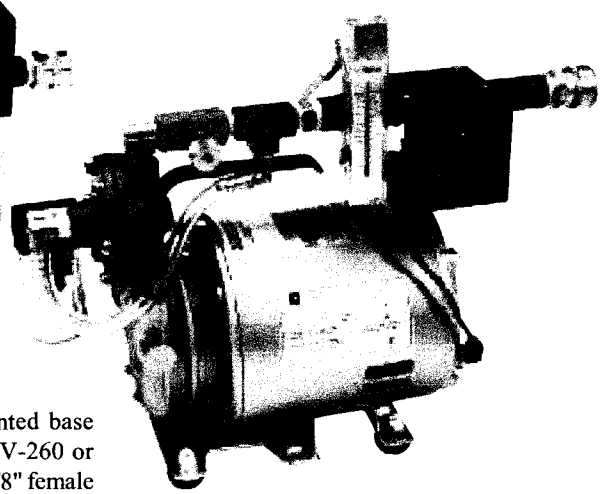
all units shown with optional elapsed timer



VS23-1023CV (3/4 HP)



VS23-0523CV (1/4 HP)



VS-0211-CRNV (1/6 HP)

The VS-Series Air Sampling Systems can be either incorporated as the primary vacuum source in air monitoring instrumentation or used in conjunction with filter holders and filter media for the collection of particulate and/or gaseous constituents. The systems are furnished complete with a shock mounted base motor/pump, carrying handle, heavy duty constant air flow control valve (MCV-260 or MCV-22), venturi flow meter, exhaust muffler, 6 foot grounded power cord, and a 3/8" female quick disconnect for easy filter holder and sample line replacement. All rotary vane motor/pumps have automatic overload cut off and are warranted for one year after purchase.

Ordering Information

Model Number (Order)	Net Wt. Lbs.	Power (VAC)	Motor (HP)	RPM 50/60 Hz	Max. Vac.	Max LPM (open air)	Max CFM (open air)
VS-0211-CRNV	21 lbs.	115	1/6 HP	NA/1725	20" Hg	22 LPM	0.78 CFM
VS23-0523CV	35 lbs.	115/230	1/4	1425/1725	26" Hg	127 LPM	4.5 CFM
VS23-1023CV	55 lbs.	115/230	3/4	1425/1725	26" Hg	255 LPM	9.0 CFM

Air Mover:	Oilless, Rotary Vane, Vacuum Pump with 1/6, 1/4, or 3/4 HP, 115 or 230 VAC, Shock Mounted Motor.
Control Valve: (MCV-260)	Mechanical, Heavy Duty, Automatic Flow Control Valve. This valve controls the air flow rate to ±5% of the operator set flow rate.
Control Valve: (MCV-22)	Mechanical, Heavy Duty, Differential Type Automatic Flow Controller. Maintains operator pre-set flow rate within ±5%.
Timer Option:	Optional, see Elapsed Timer Options.
Filter Holders:	See Filter Holders For Air Sampling, "RV-Series"
Filter Cartridges:	See Analytical Cartridges
Filter Paper:	See Filter Paper For Air Sampling
Air Flow Calibrator:	See Air Flow Calibrators
Replacement Pumps/Kits:	See Replacement Rotary Vane Vacuum Pumps & Service Kits in the "Air Sampling Accessories" section of this catalog.

VS-Series Air Sampler Options:

EET13-B
Elapsed, Electronic, Resettable Minute Timer with Mounting Bracket. 6-Digit, Minutes & Tenths of Minutes Display.

EET11-B
Elapsed, Electronic, Resettable, Hour Timer with Mounting Bracket. 6-Digit, Hours & Tenths of Hours Display.

EET11-VAC-SWTCH
115 VAC Vacuum Activated Elapsed, Resettable Electronic Timer in Hours & Tenths of Hours with Mounting Bracket & 3/8" MNPT inlet/outlet.

VS-VACUUM-GAUGE
Hard Mounted 0"-30" Hg Vacuum Gauge.

VS-ON/OFF-SWITCH New
In-Line ON/OFF Power Switch with fuse protection.

7386 Trade Street / San Diego, CA 92121 / Phone 858-549-2820 / Fax 858-549-9657 / WWW.HI-Q.NET

Paper Only Filter Holders

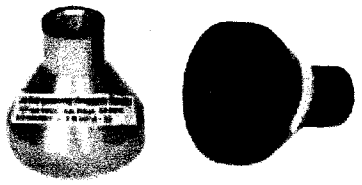
The following filter holders are used for the collection of particulate from the air (in-line or open faced) taken with either high or low volume pumps. Choosing the correct filter holder is dependent on three factors: 1. Type of Pump (Rotary Vane or Centrifugal Fan), 2. Filter paper dimensions (i.e.: 2" dia., 47mm dia., 8" x 10", etc....), and 3. Type of connecting fitting (i.e.: 3/8" male quick disconnect or thread type). All of HI-Q's filter holders are machined from 6061-T6 Aluminum (unless otherwise specified) and anodized Black, Gold or Blue depending upon the filter type. **Add a "-SS" to unit model number for Stainless Steel holder construction.**

Abbreviations:			
	MQD = Male Quick Disconnect	**MPT** = Male Pipe Thread	**SPT** = Straight Pipe Thread
	FQD = Female Quick Disconnect	**FPT** = Female Pipe Thread	**TPI** = Threads Per Inch
	Black Anodize = 2" Ø Paper Holder	**Gold Anodize** = 47mm Ø Paper Holder	**Clear Anodize** = 4" Ø Paper Holder

RVPH-Series

Open Faced Paper Only Holders. Includes 3/8" male quick disconnect coupling.

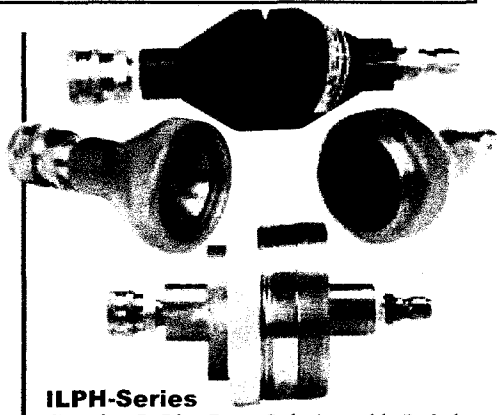
Model	Paper Size Dia.	(Fitting)
RVPH-20	2 Inch.	(3/8" MQD)
RVPH-25	47mm	(3/8" MQD)
RVPH-102	4 Inch.	(3/8" MQD)



RVPA-Series

2",47mm, & 4" Diameter Paper Only, In-Line Adapter Cones.

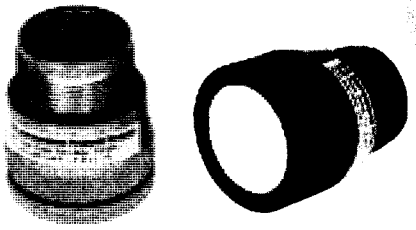
Model	Paper Size Dia.	(Fitting)
RVPA-10	2 Inch.	(3/8" FPT)
RVPA-15	47mm	(3/8" FPT)
RVPA-102	4 Inch.	(3/8" FPT)
RVPA-5	47mm	(1/2" FPT)
RVPA-13	47mm	(3/4" FPT)
RVPA-17	47mm	(1" FPT)



ILPH-Series

Complete, In-Line, Paper Only Assembly. Includes one 3/8" male & female quick disconnect.

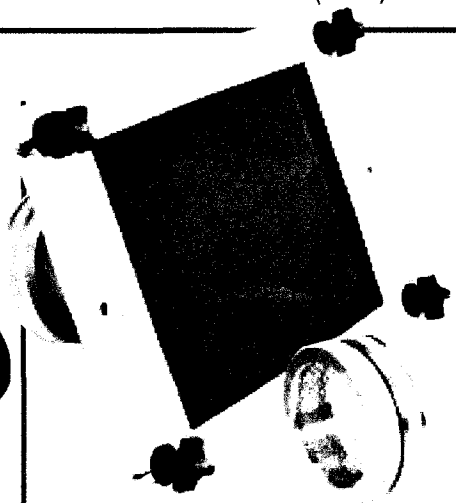
Model	Paper Size Dia.	(In-Out Fitting)
ILPH-20	2 Inch.	(3/8" FQD-3/8MQD)
ILPH-47	47mm	(3/8" FQD-3/8MQD)
ILPH-102	4 Inch	(3/8" FQD-3/8MQD)
ILPH-5	47mm	(1/2" FPT-3/8MQD)
ILPH-13	47mm	(3/4" FPT-3/8MQD)
ILPH-17	47mm	(1" FPT-3/8MQD)



CFPH-Series

Open Faced Paper Only Holders. 1½" male SPT, 11½ TPI male threaded fitting.

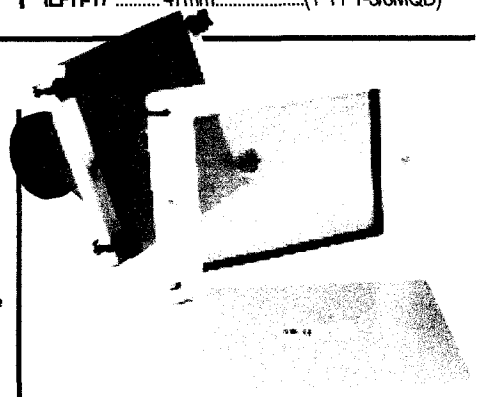
Model	Paper Size Dia.	(thread)
CFPH-20	2 Inch.	(1.5 male SPT)
CFPH-25	47mm	(1.5 male SPT)
CFPH-102	4 Inch	(1.5 male SPT)



CFPH-Series

4" Dia. & 8" x 10" Filter Paper Holder Attach CFPH-45 & CFPH-810 to units with 4" dia., threaded intake fittings.

Model	Paper Size
CFPH-45	4" dia. Paper Only Holder.
CFPH-810	8" x 10" Paper only



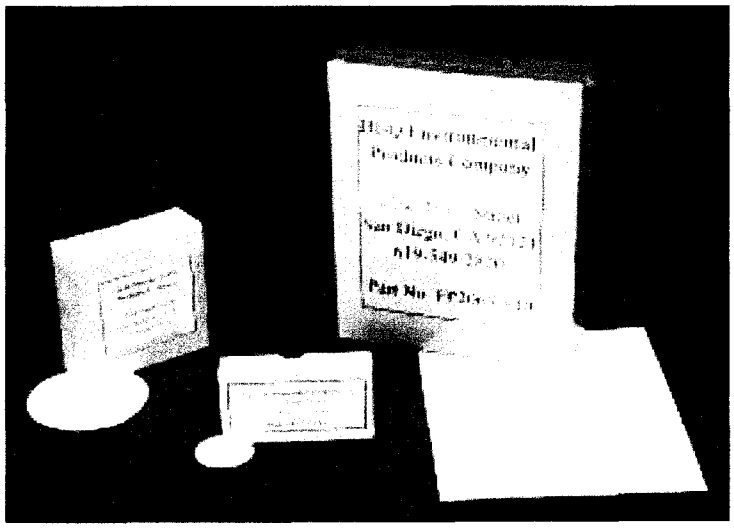
8" x 10" Removable Filter Paper Cartridge

Allows a user to pre-load & remove existing 8" x 10" filter collection media in a controlled environment. When in the field the user is able to replace the existing (used) cartridge with the pre-loaded (new) cartridge without having to directly handle the filter collection media.

Mode	Description
810-CARTRIDGE	8" x 10" removable filter paper cartridge w/ snap on cover.

Filter Paper for Air Sampling

Glass Fiber, Ashless Cellulose, & Carbon Impregnated Filter Paper



General Information: Environmental air sampling uses two major categories of filter paper media, Cellulose and Glass fiber. Carbon Impregnated filter paper is occasionally called out for in the determination of the presence of airborne Iodine.

Glass Fiber Filter Media

Glass fiber filter media is made from 100% micro-fine borosilicate glass fibers. Glass fiber filters are used where high flow rate and micron/sub-micron filtration is required. The filter media can be used for both liquid and air filtration. In the highest purity form, HI-Q offers a binderless "AE" grade glass filter media. With its' excellent purity, using the **FPAE** series filter paper reduces the overall possibility of extractable organics commonly found in cellulose filter paper. Where greater structural strength filter papers are needed (high pressure drop, vacuum applications), either a spun polyester backing is used, Type **FP5211**, or a minimal amount of acrylic resin binder is used, Type **FP2063 & FP2061**, to keep up the integrity of the glass fibers during and after sampling/analysis. Some PM-10 sampling applications specifically call out for Whatman's "EPM-2000", HI-Q part number **FP2000**. FP2000 was developed and produced especially for use in high volume PM-10 air sampling equipment that collects atmospheric particulates and aerosols.

Properties of Glass Fiber Media: The borosilicate glass fibers are inert and resistant to all but strongly alkaline bases or acids such as hydrofluoric acid. The fibers are heat resistant and will only begin to soften at over 600°C. The borosilicate glass has a refractive index of 1.51, and when immersed in a solvent of a similar refractive index like benzene, the fibers will be transparent. Particles collected on the media then become easier to visibly identify. NOTE: BENZENE HAS BEEN DETERMINED TO BE A TOXIC SUBSTANCE.

Particle Retention: For air and gas filtration, collection of sub-micron (less than one micrometer in aerodynamic diameter) particles is sometimes required. In nuclear environmental air testing, the protocol is for sub-micron collection. Use of glass fiber media is therefore recommended. The test procedure for determining the effectiveness of particle retention is known as the DOP smoke test. In this test, DOP (di octyl phthalate) is heated, the vaporized compound is dispersed into the air where it is cools and condenses into mono-molecular particles of 0.3 micron size. By drawing these airborne particles through the filter media and measuring the amount of breakthrough particle, a retention efficiency is established. See tabular results in "General Performance Summary on Glass Fiber Paper". NOTE: DOP HAS BEEN DETERMINED TO BE A CARCINOGEN.

FP2063-XX, Hydrophobic Glass Fiber Filter Paper

This hydrophobic, high purity filter media is recommended for use in general purpose, high and low volume air sampling applications for particulate collection. It is composed of 100% high quality borosilicate glass microfibers. Both the FP2063 & FP2061 filter paper grades are excellent for the removal of micron and sub-micron size particulate from ambient air and stack gases. Because glass fibers are brittle and do not naturally bind together, a small amount of acrylic resin binder (composition of which is described in CFR Title 21, Part 177.2260, Filters, Resin Bonded. ASTM Spec) is used to retain the filter paper integrity during air sampling and routine handling. The total borosilicate glass microfiber composition found in the FP2063 & FP2061 filter media contains less than 5% acrylic resin binder.

FP2061-XX, Hydrophilic Glass Fiber Filter Paper

This high purity filter paper has all the same properties of the type FP2063, except that it is hydrophilic. Choose the paper best suited for your sampling application and particle identifying method.

FP5211-XX Glass Fiber Filter Paper

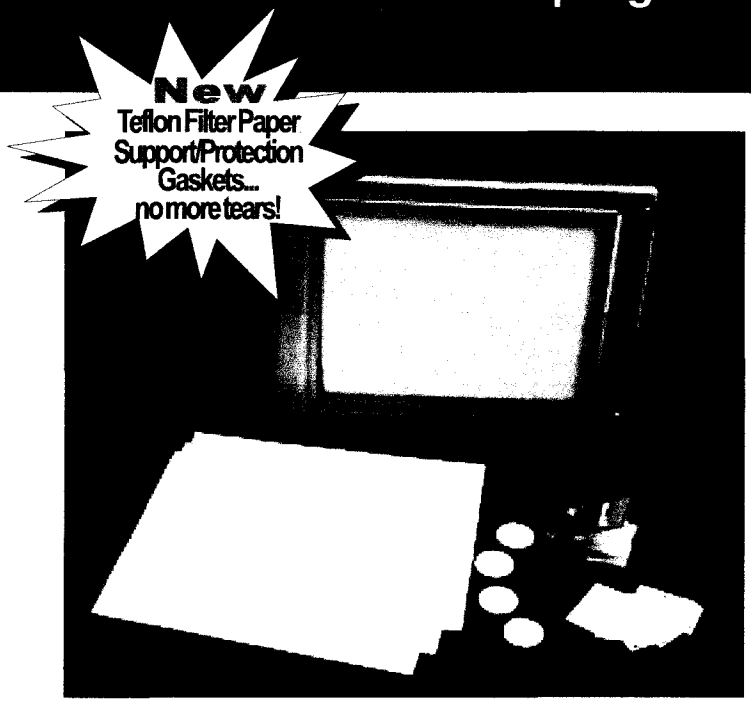
This laminated Glass Fiber filter paper is a high-efficiency multi-purpose filter medium with good heat resistance. It is particularly recommended for both gas and liquid filtration in medical and air monitoring applications. The base material consists of glass microfibers with a 3-7% acrylic resin binder. The supporting scrim maintains the integrity of the glass fibers under flow stress compaction. The scrim can be applied to either side depending on the filter design. The scrim is bonded to the glass media using a polyester hot melt which has a melting point of 325° F.

FPAE-XX, Binderless, Ultra-Pure, Glass Fiber Filter Paper

This binderless, high efficiency, high purity, HEPA quality filter media is commonly used in the collection of alpha, beta, and gamma emitting particulate. It is an excellent all around analytical grade filtration media for use in the removal of micron and submicron size particulates from both liquids and gases.

FP2000-XX, Binderless, Ultra-Pure, Glass Fiber (Whatman EPM-2000)

The EPM-2000 grade paper was developed and produced especially for use in high volume PM-10 air sampling equipment that collects atmospheric particulates and aerosols. It is manufactured from 100% pure borosilicate glass of special purity enabling detailed chemical analysis of trace pollutants to take place with the minimum of interference or background. EPM-2000 was selected by the EPA to be the standard filter for use in the nationwide network of Hi-Vol air samplers. 8" x 10" sheets are individually numbered to facilitate identification.



Glass Fiber, Ashless Cellulose, & Carbon Impregnated Filter Paper

Glass Fiber Filter Media

Ashless Cellulose Filter Paper

Cellulose fiber filter paper such as the **Whatman 41**, is commonly used in quantitative analytical techniques such as gravimetric analysis. E.G.: To convert precipitate to a stable weighing form, a chemist may wish to ignite the filter paper containing collected precipitate in a pre-weighed crucible, thereby removing the filter paper with minimal and uniform residual "ash". Cellulose paper is also commonly used for smears or swipes. Cellulose paper is not recommended with pumps that can't overcome large pressure drops (e.g. battery operated centrifugal type) or, where required, to maintain a constant flow rate over the entire sampling period.

FP1441-XXX, Whatman, Grade 41: 20-25µm
The fastest ashless filter paper, recommended for analytical procedures involving coarse particles or gelatinous precipitates (i.e., iron or aluminum-hydroxides). Also used in quantitative air pollution analysis. Cellulose paper is also commonly used for smears or swipes.

TEFLON-GSKT-XX, Teflon Support Gaskets:
Teflon Support Gaskets may be placed above and below the filter paper disc creating a protective barrier between the occasional sharp edges of filter paper holder support screens and retaining rings. The inner & outer diameters of the Teflon rings are punched to a specifically tight tolerance to minimize any flow disturbance and to maximize filter collection media face exposure. Punched Teflon thickness is 0.020.

Carbon Impregnated Filter Media

Carbon impregnated cotton fiber filter paper, type **FPAIC**, is found in applications where the determination of an airborne Iodine species are required.

FPACI-XX
Carbon impregnated cotton fiber filter media contains 50-55% Carbon by weight. The paper is available in all standard die sizes and is generally used to qualitatively determine the presence of Iodine in a sampling environment. The paper resists most dilute acids (not suitable for warm alkaline solutions).

General Performance Summary on Glass Fiber Paper:

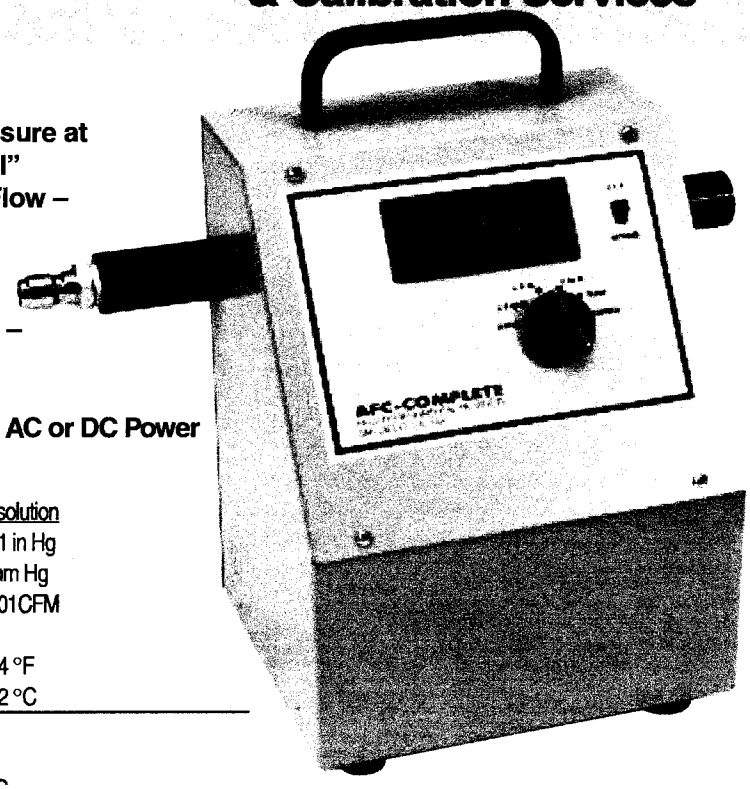
Filter Type:	FP2063	FP2061	FP5211	FPAE	FP2000
Basic Weight pounds per 3000 sq.ft.:	48	48	54	42	41
Caliper Thickness:	0.016" @ 4psi	0.016" @ 4psi	0.015" @ 7.3psi	0.020" @ 0.5psi	0.017"
DOP Smoke Penetration @ 0.3um @ 32 lpm:	97%	97%	99.985%	99.99%	99.99%
Air Flow Resistance (mm of water) @ 32 lpm:	14.5 mm H_2O	14.5 mm H_2O	38 mm H_2O	48 mm H_2O	NA
Binder:	Acrylic	Acrylic	Acrylic	None	None
Backing:	None	None	Spunbonded Polyester	None	None

Ordering Information (Filter Paper Packaged 100 pcs./box.)

Paper Type	47 mm Dia.	2" Dia.	4" Dia.	8" x 10"
FP1441	FP1441-47	FP1441-20	FP1441-102	FP1441-810
FP2063	FP2063-47	FP2063-20	FP2063-102	FP2063-810
FP2061	FP2061-47	FP2061-20	FP2061-102	FP2061-810
FP5211	FP5211-47	FP5211-20	FP5211-102	FP5211-810
FPAE	FPAE-47	FPAE-20	FPAE-102	FPAE-810
FP2000	FP2000-47	N/A	N/A	FP2000-810
FPACI	FPACI-47	FPACI-20	FPACI-102	FPACI-810
TEFLON-GSKT	TEFLON-GSKT-47 (ID: 41mm, OD: 47mm, SOLD: 10/PK)	TEFLON-GSKT-20 (ID: 1-3/4", OD: 2", SOLD: 10/PK)	TEFLON-GSKT-102 (ID: 3-3/8", OD: 4", SOLD: EACH)	N/A

Note: HI-Q stocks many other punched filter paper sizes not shown in table above (i.e.: 21mm, 37mm, 50mm, 24" x 24"....). Call for additional custom sizes.

The "All-In-One" Digital Air Flow Calibrator



- **Correction for Standard Temperature & Pressure at the Flip of a Switch – Select "STP" or "Actual"**
- **Temperature Measurement of "In-Line" Air Flow – Display either °F or °C**
- **Barometric Pressure Measurement – Display Either Inch Hg or mm Hg**
- **Durable Rotary Power/Unit Selection Switch – Positive Option Selection**
- **Large Digital Display – 1/2" LCD**
- **Battery Operated – Unit May Be Run On Either AC or DC Power**

Specifications:

Parameter	Display Range	Resolution
Barometer	0-31 in Hg;	0.01 in Hg
	0-770 mm Hg	1 mm Hg
Air Flow	See "Calibration Range" under "Ordering Information"	0.001CFM
Temperature	14 °F to 140 °F	0.04 °F
	-10 °C to 60 °C	0.02 °C

Measurement Accuracy:	Flow Rate: ±2.0% of Full Scale
	Temperature: ±0.9°F (±0.5 °C)
	Barometric Pressure: ±1.5 mmHg @25 °C
Flow Display:	Cubic Feet per Minute; Liters per Minute; Cubic Meters per Minute
Panel SwitchesRotary:	OFF, SCFM, SLPM, SCMM, TEMP (°C), BARO (mm Hg)
(6 positions)(Slide = STP)	(STP = Reading corrected to Standard Temperature & Pressure)
Panel SwitchesRotary:	OFF, ACFM, ALPM, ACMM, TEMP (°F), BARO (in Hg)
(6 positions)(Slide = ACTUAL)	(ACTUAL, "A" = Actual or Apparent flow reading)
Power Requirements:	Voltage, wall adapter: 12 VoltsCurrent: 80 milliamps
	Batteries: Six "c" cells, 1.2 V NiCd
Overall Dimensions:	12"W X 6"D X 11"H (Includes handle & inlet/outlet fittings)
Weight:	8 pounds 4 ounces; (3.74 kg)
Storage Temperature:	-4°F to 158°F (-20°C to + 70°C)
Operating Temperature:	14°F to 140°F (-10°C to + 60°C)
Calibration:	Factory calibration is recommended once per year.
	Note: Serial Port Calibration Module available under options.

"The field technician's first choice"

HI-Q's AFC-COMPLETE, digital air-flow calibrator, is *"the field technicians first choice"* when it comes to air-flow calibration. This microprocessor based air-flow calibrator incorporates the use of a differential pressure sensor, a precision thermistor, an absolute barometric pressure sensor, and a precision machined venturi tube, to measure and calculate instantaneous flow rate in either CFM*, LPM*, or CMM*, air temperature in either °F or °C, and Barometric Pressure in either Inches of Hg or mmHg.

* "STP" may be selected for volumetric unit correction to Standard Temperature & Pressure.

Ordering Information

Select the desired flow range:	Calibration Range			Meter
Model Number	CFM	LPM	CMM	Connection
AFC-COMPLETE-1	0.1 to 1	3 to 30	0.003 to 0.030	3/8" Male QD
AFC-COMPLETE-2	0.2 to 2	6 to 56	0.006 to 0.056	3/8" Male QD
AFC-COMPLETE-3	0.3 to 3	9 to 85	0.009 to 0.085	3/8" Male QD
AFC-COMPLETE-4	0.4 to 4	11 to 113	0.011 to 0.113	3/8" Male QD
AFC-COMPLETE-5	0.5 to 5	14 to 142	0.014 to 0.142	3/8" Male QD
AFC-COMPLETE-10	1 to 10	28 to 280	0.028 to 0.280	3/8" Male QD
AFC-COMPLETE-15	2 to 15	56 to 425	0.056 to 0.425	1½" MSTP
AFC-COMPLETE-30	5 to 30	140 to 850	0.140 to 0.850	1½" MSTP
AFC-COMPLETE-40	5 to 40	140 to 1130	0.140 to 1.130	1½" MSTP
AFC-COMPLETE-50	5 to 50	140 to 1400	0.140 to 1.400	1½" MSTP
AFC-COMPLETE-70	10 to 70	280 to 1980	0.280 to 1.980	1½" MSTP
AFC-COMPLETE-XX *Replace "-XX" with uppermost flow rate.*	Dependent upon flow range	Dependent upon flow range	Dependent upon flow range	Dependent upon flow range

Ordering Options

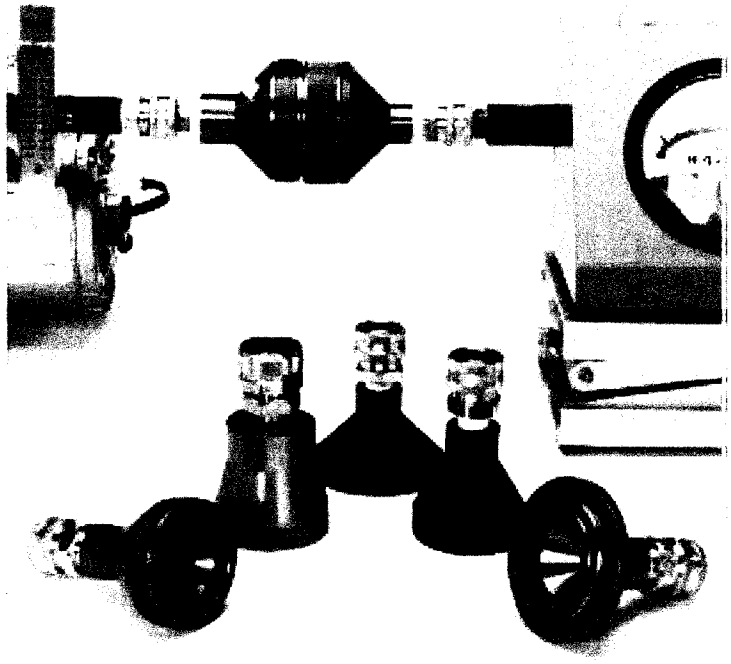
COMPLETE-CALMOD
"In-House" Calibration Module for AFC-COMPLETE Series Air Flow Calibrators. Connects to Serial Port on rear of unit.

COMPLETE-BATTERY
Spare Battery Pack for AFC-COMPLETE Series Air Flow Calibrators.

Calibrator Adapter Fittings

Air Flow Calibrators are generally used to verify the displayed sample flow rate accuracy of complete air sampling systems. Along with the flow measuring device to be calibrated, it is recommended that a "Complete" system for calibration should also includes the actual filter holder and filter media in order to duplicate realistic pressure drops experienced in a true sampling environment. The following adapters allow a technician to connect an Air Flow Calibrator at the end of (open to air) an "In-Line" High, Medium or Low Volume Air Sampling calibration set up.

Standard Calibration set-up, from right to left, (as shown in picture) is as follows: 1.) Open to Air, 2.) Air Flow Calibrator, 3.) Calibrator Adapter Fitting, 4.) Filter Holder & Media, 5.) Flow meter to be Calibrated, 6.) Flow Control Valve, and finally 7.) Vacuum Pump.



Ordering Information

Choose In-Line Calibration Adapter Cone with reference to your filter media holder and male fitting included with your air flow calibrator.

Combination Filter & Paper Holder In-Line Adapter Cones

Model	Connects to Holder Type	Quick Disconnect
RVA-10-CA	Combination, 2" Paper	3/8" Female QD
RVA-15-CA	Combination, 47mm Paper	3/8" Female QD
RVA-2-CA	Combination, 2" Paper	1/2" Female QD
RVA-5-CA	Combination, 47mm Paper	1/2" Female QD
CFA-20-CA	Combination, 2" Paper	1 1/2" FSPT
CFA-25-CA	Combination, 47mm Paper	1 1/2" FSPT

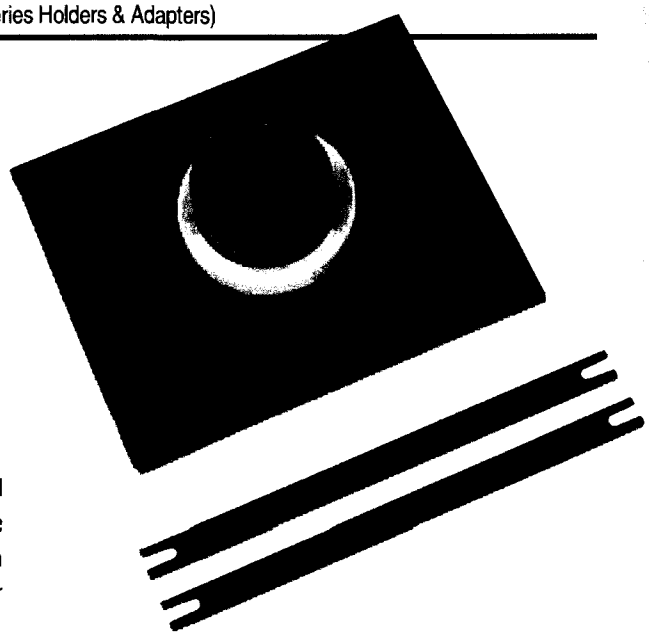
Paper Only Filter Holder In-Line Adapter Cones

Model	Connects to Holder Type	Quick Disconnect
RVPA-10-CA	Paper Only, 2" Paper	3/8" Female QD
RVPA-15-CA	Paper Only, 47mm Paper	3/8" Female QD
RVPA-2-CA	Paper Only, 2" Paper	1/2" Female QD
RVPA-5-CA	Paper Only, 47 mm paper	1/2" Female QD
CFPA-30-CA	Paper Only, 2" Paper	1 1/2" FSPT
CFPA-35-CA	Paper Only, 47mm Paper	1 1/2" FSPT

Note: FSPT = Female Straight Pipe Thread (CF-Series Holders & Adapters)

Calibration Adapter Plates (High Flow)

HI-Q Environmental Products Company's "FHA-Series" adapters are designed to reduce overall pressure drop found during the calibration of standard 4" diameter and 8" x 10" filter paper sampling applications. The FHA's unique design reduces the overall paper to adapter fitting contact, thereby allowing the maximum obtainable free cross-sectional surface area through which unrestricted air can pass. This is done to duplicate the conditions of ambient air, open face, sampling procedure's and to reduce the overall error in calibration.



Ordering Information

FHA-4CF
4" Dia. Disc x 1½" Female Straight Pipe Thread.

FHA-810CF
8" x 10" Plate x 1½" Female Straight Pipe Thread.

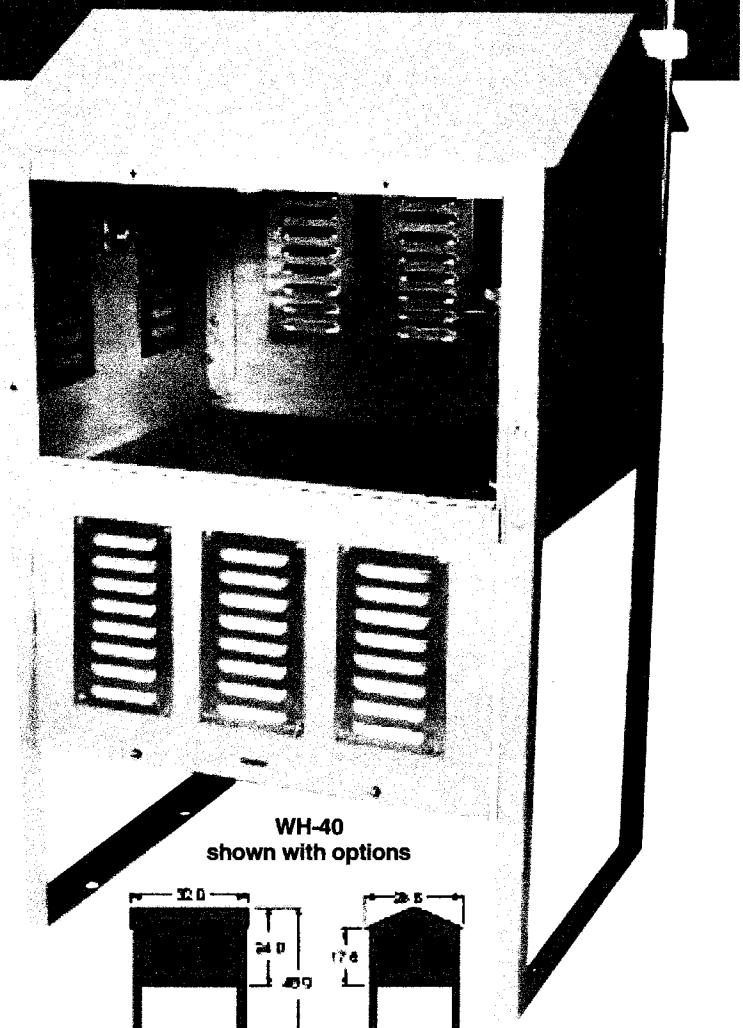
FHA-810X810
In-line 8" x 10" filter holder adapter with minimal flow disturbance. Assembly includes one inverted standard 8" x 10" holder complete with two mounting rails and a foam gasket. Filter holder inlet: 1½" female straight pipe thread.

WH-36 & WH-40

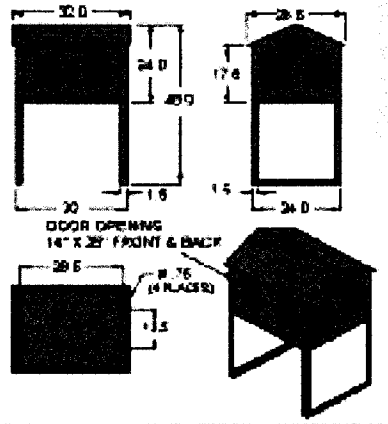
Instrument Weather House

- **DEPENDABLE- Built for Heavy-Duty Use in All Environments.**
- **SECURE- Double Thumb Twist Locks with Pad Lockable Hasp on Each Access Door.**
- **RIGID- Pop-Riveted Housing with "U" Frame, Bolt on Leg Set.**
- **DURABLE- Built from 0.090" Thick Sheet Aluminum. 26" Long Piano Style Hinges Support Each Access Door. Individual Unit Components are Acid Primed and Then Painted with 2-Component, High Solid Polyurethane Paint, Then Baked.**

HI-Q's Instrument Weather House with its heavy gauge, primed and painted, aluminum body is ideal for protecting instruments from harsh outdoor sampling environments. The WH-36 & 40 series Instrument Weather Houses conveniently house and protect air sampling and other instrumentation. Two, large, 14" x 26" piano hinged access doors allow an operator to conveniently mount and maintain instrumentation and equipment. Both access doors may be closed with twist pins and then secured with a padlock.



WH-40
shown with options



Ordering Information

WH-36
Standard Instrument Weather House.

WH-40
Instrument Weather House with Internal Screens & Louvers. The WH-40's internal screened louvers are removable for easy cleaning. The counter mounting of the internal louvers prevents rain or snow from blowing directly into the housing and onto instrumentation.

Color Choices:

- Metallic Blue
- White
- Anodized Aluminum

Accessories:

All accessories are mounted free of charge when ordered with instrument weather house.

SD-90100
Snap Disc Thermostat Switch. Turns on Axial fan at 100°F and Off at 90°F

PO-5
Power outlet with mounting bracket, 16/3 grounded wire, 5 outlets, 15 Amp breaker.

WH-LS
Lamp outlet with pull chain. Used for lighting or a heat lamp.

GN-R&WS
Rain & Wind Shield for filter holders externally mounted on gooseneck. Includes 3/8" male & female quick disconnect for easy installation.

AF-100
Axial Fan, 110V, 50/60 Hz., 100 CFM free air capacity, mounts in the apex of weather house roof. Removes excess heat generated by pumps or sun.

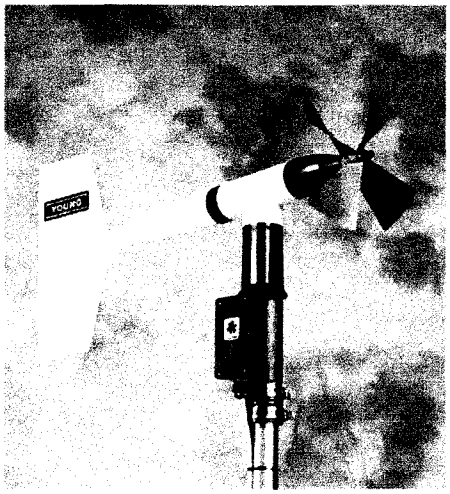
WH-EL
Extended Legs, elevates weather house to 67" above the ground (to peak).

WH-GN
Stainless Steel Gooseneck assembly, 3/8" NPT inlet/outlet. Allows operator to sample at EPA designated breathing levels by mounting the filter holder assembly externally 59" above the ground. Custom tubing lengths available.

WH-6X10LS
Replacement 6" x 10" Internal screen & louver set (3 set louvered door).

WH-7X10LS
Replacement 7¼" x 10¼" Internal screen & louver set (old style, 2-set louvered door).

The Wind Monitor-AQ is a high resolution wind sensor designed specifically for air quality applications. It combines simple, corrosion-resistant construction with low threshold, fast response and excellent fidelity.



The Wind Monitor-AQ meets the requirements of the following regulatory agencies:

U.S. Environmental Protection Agency- Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD).

U.S. Nuclear Regulatory Agency- NRC Regulatory Guide 1.23 Meteorological Programs in Support of Nuclear Power Plants.

American Nuclear Society- Standard for Determining Meteorological Information at Power Plants.

Wind speed is sensed by a lightweight, carbon fiber thermoplastic (CFT), helicoid propeller. Propeller rotation produces an AC sine wave voltage signal with frequency directly proportional to wind speed. Slip rings and brushes are not used.

The wind direction sensor is a lightweight vane with performance characteristics that assure excellent fidelity in fluctuating wind conditions. Vane position is sensed by a precision potentiometer. Output is a DC voltage directly proportional to vane angle.

The instrument body is UV stabilized plastic with stainless steel and anodized aluminum fittings. Precision grade, stainless steel ball bearings are used throughout. Transient protection and cable terminations are located in a convenient junction box. The instrument mounts on standard 1 inch pipe.

The Wind Monitor-AQ is available with two additional output signal options. **Model 05305V** offers calibrated 0-1 VDC outputs (0-5 VDC optional), convenient for use with many dataloggers. **Model 05305L** provides a calibrated 4-20 mA current signal for each channel, useful in high noise areas or for long cables (up to several kilometers). Signal conditioning electronics are integrated into the sensor junction box.

Ordering Information MODEL

WIND MONITOR-AQ	**05305**
WIND MONITOR-AQ *0-1 VDC OUTPUTS*	**05305V***
WIND MONITOR-AQ *4-20mA OUTPUTS*	**05305L***

**** SPECIFY SUFFIX FOR DESIRED WIND SPEED SCALE:***

0-50 M/S	***ADD SUFFIX "M"***
0-100 MPH	***ADD SUFFIX "P"***
0-100 KNOTS	***ADD SUFFIX "N"***
0-200 KM/HR	***ADD SUFFIX "K"***

Specifications

Range:
Wind speed: 0-50 m/s (112 mph)
Azimuth: 360° mechanical, 355° electrical (5° open)

Accuracy:
Wind speed: ±0.2 m/s (0.4 mph)
Wind direction: ±3 degrees

Threshold:*
Propeller: 0.4 m/s (0.9 mph)
Vane: 0.5 m/s (1.0 mph) at 10° displacement

Dynamic Response:*
Propeller distance constant (63% recovery): 2.1 m (6.9 ft)
Vane delay distance (50% recovery): 1.2 m (3.9 ft)
Damping ratio: 0.45
Damped natural wavelength: 4.9 m (16.1 ft)
Undamped natural wavelength: 4.4 m (14.4 ft)

Signal Output:
Wind speed: magnetically induced AC voltage, 3 pulses per revolution. 1800 rpm (90 Hz) = 9.2 m/s (20.6 mph)
Azimuth: analog DC voltage from conductive plastic potentiometer- resistance 10K Ω, linearity 0.25%, life expectancy- 50 million revolutions

Power Requirement:
Potentiometer excitation: 15 VDC maximum

Dimensions:
Overall height: 38 cm (15.0 in)
Overall length: 65 cm (25.6 in)
Propeller: 20 cm (7.9 in) diameter
Mounting: 34 mm (1.34 in) diameter (standard 1 inch pipe)

Weight:
Sensor weight: 0.7kg (1.5 lbs)
Shipping weight: 2.3 kg (5 lbs)

**Nominal values- determined in accordance with ASTM standard procedures Shielded bearings lubricated with Type LO-1 light General Purpose Instrument Oil.*

MODEL 05305V **0-1 VDC outputs**

Power Requirement:
8-24 VDC (5 mA @ 12 VDC)

Operating Temperature:
-50 to 50° C

Output Signals:
0-1.00 VDC full scale
0-5.00 VDC optional

MODEL 05305L **4-20 mA outputs**

Power Requirement:
8-30 VDC (40 mA max.)

Operating Temperature:
-50 to 50° C

Output Signals:
4-20 mA full scale

CE *Complies with applicable CE directives.*

Specifications subject to change without notice.

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YOUNG
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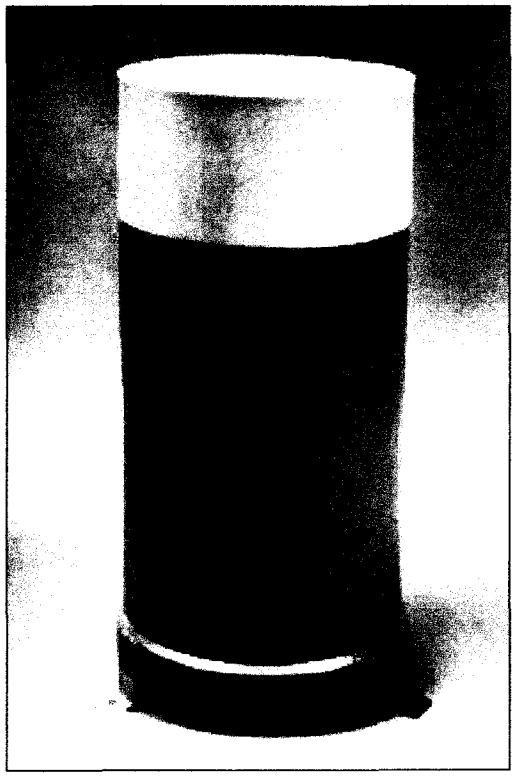
E-mail: met.sales@youngusa.com
Web Site: www.youngusa.com

Precipitation Gauges

300 Series

The accurate measurement of rain and snow precipitation remains one of the most basic elements of meteorology. To enable accurate measurement of precipitation in all environments, Met One Instruments provides a series of instruments incorporating a tipping bucket mechanism. The tipping bucket design allows accurate, repeatable measurements, requires no regular operator maintenance, and is economical and proven in operation.



The Model 370 Rain Gauge

Features

- Jeweled bearings
- Teflon coated bucket
- Reed switch
- Self-emptying
- Corrosion resistant materials
- Quality construction

Each model in the series is optimized to meet a particular site and sampling requirement.

Operation

A dual-chambered tipping bucket assembly is located below the collection funnel. When a precise amount of precipitation has been collected in one side of the bucket, gravity tips the assembly and activates a reed switch. A momentary electrical contact closure through the switch is provided for each increment of rainfall. The sample is discharged through the base of the gauge. For environments that can typically expect a significant amount of frozen precipitation, internal sensor heaters are available. The heating elements are thermostatically controlled to melt and measure the water content of snow and frozen rain, but to avoid evaporative loss.

Construction

The heavy machined aluminum base provides a stable platform for the tipping assembly. The bucket is made from stainless steel and is Teflon coated to prevent retention of the sample. The bucket pivots are precision machined and fitted with jeweled bearings to reduce wear and friction. The funnel is powder coated aluminum and has two screens for preventing leaves and other debris from entering or clogging the gauge. A circular bubble-level and adjustable feet facilitate proper mounting of the unit. Major components are finished in catalyzed polyurethane paint, with a color and texture chosen to allow the sensor to blend into the environment.

Met One Instruments, Inc.
Corporate Sales & Service: 1600 Washington Blvd., Grants Pass, OR 97526, Phone (541) 471-7111, Fax (541) 471-7116
Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com • metone@metone.com

Specifications

Rain Gauges

Model Number	Funnel Diameter	Standard Calibration	Optional Calibration
370	8 in (20.3 cm)	0.01 in	0.2 or 0.25 mm
372	8 in (20.3 cm)	0.5 mm	N/A
380	12 in (30.5 cm)	0.01 in	0.2 or 0.25 mm
382	12 in (30.5 cm)	0.1 mm	N/A

Rain and Snow Gauges

Model Number	Funnel Diameter	Standard Calibration	Optional Calibration	Heater Voltage
375	8 in (20.3 cm)	0.01 in	0.2 or 0.25 mm	115 VAC, 315 watts
376	8 in (20.3 cm)	0.01 in	0.2 or 0.25 mm	220 VAC, 315 watts
377	8 in (20.3 cm)	0.5 mm	N/A	115 VAC, 315 watts
379	8 in (20.3 cm)	0.5 mm	N/A	220 VAC, 315 watts
385	12 in (30.5 cm)	0.01 in	0.2 or 0.25 mm	115 VAC, 315 watts
386	12 in (30.5 cm)	0.01 in	0.2 or 0.25 mm	220 VAC, 315 watts
387	12 in (30.5 cm)	0.1 mm	N/A	115 VAC, 315 watts
389	12 in (30.5 cm)	0.1 mm	N/A	220 VAC, 315 watts

Thermostat Set Point:	Funnel Heater	40°F (4.4°C)
	Base Heater	40°F (4.4°C)
Heaters:	Funnel	240 watts, composite with built-in thermostat
	Base	75 watts, composite with built-in thermostat
Operating Temperature:	-50°C to +50°C	
Accuracy:	at 0.5"/hr	±0.5%
	at 1" to 3"/hr	±1.0%
Switch:	Type	Reed
	Rating	10 mA, 28 VDC
Height:	8 in Gauges	18 in (46 cm)
	12 in Gauges	20.5 in (52 cm)
Weight:	8 in Rain Gauges	6 lbs (2.7 kg)
(not including cabling)	12 in Rain Gauges	7.5 lbs (3.4 kg)
	8 in Rain/Snow	6.5 lbs (3 kg)
	12 in Rain/Snow	11.5 lbs (5.2 kg)
Shipping Weight:	8 in Rain Gauges	8.5 lbs (3.9 kg)
(not including cabling)	12 in Rain Gauges	10 lbs (4.5 kg)
	8 in Rain/Snow	9 lbs (4 kg)
	12 in Rain/Snow	14 lbs (6.4 kg)

Finish: White gloss/beige textured powder coat and clear anodized aluminum

Ordering Information

Specify Model Number, calibration factor, cable length(s), and accessories

Cable:	Signal	PN 1566-xx (xx=length in feet)
	Power (as required)	PN 2517-xx (xx=length in feet)

Accessories

Model 820440 Wind Screen: The improved Alter-design screen is constructed of 32 free-swinging, separated leaves. It can greatly improve the accuracy of the precipitation catch by reducing local turbulence.

CR10X Specifications

Electrical specifications are valid over a -25° to +50°C range unless otherwise specified; non-condensing environment required. To maintain electrical specifications, Campbell Scientific recommends recalibrating dataloggers every two years.

PROGRAM EXECUTION RATE

Program is synchronized with real-time up to 64 Hz. One channel can be measured at this rate with uninterrupted data transfer. Burst measurements up to 750 Hz are possible over short intervals.

ANALOG INPUTS

NUMBER OF CHANNELS: 6 differential or 12 single-ended, individually configured. Channel expansion provided by AM16/32 or AM416 Relay Multiplexers and AM25T Thermocouple Multiplexers.

ACCURACY: ±0.1% of FSR (-25° to 50°C);
±0.05% of FSR (0° to 40°C);
e.g., ±0.1% FSR = ±5.0 mV for ±2500 mV range

RANGE AND RESOLUTION:

Full Scale Input Range (mV)	*Resolution (µV) Differential*	*Resolution (µV) Single-Ended*
±2500	333	666
±250	33.3	66.6
±25	3.33	6.66
±7.5	1.00	2.00
±2.5	0.33	0.66

INPUT SAMPLE RATES: Includes the measurement time and conversion to engineering units. The fast and slow measurements integrate the signal for 0.25 and 2.72 ms, respectively. Differential measurements incorporate two integrations with reversed input polarities to reduce thermal offset and common mode errors.

Fast single-ended voltage:	2.6 ms
Fast differential voltage:	4.2 ms
Slow single-ended voltage:	5.1 ms
Slow differential voltage:	9.2 ms
Differential with 60 Hz rejection:	25.9 ms
Fast differential thermocouple:	8.6 ms

INPUT NOISE VOLTAGE (for ±2.5 mV range):
Fast differential: 0.82 µV rms
Slow differential: 0.25 µV rms
Differential with 60 Hz rejection: 0.18 µV rms

COMMON MODE RANGE: ±2.5 V

DC COMMON MODE REJECTION: >140 dB

NORMAL MODE REJECTION: 70 dB (60 Hz with slow differential measurement)

INPUT CURRENT: ±9 nA maximum

INPUT RESISTANCE: 20 Gohms typical

ANALOG OUTPUTS

DESCRIPTION: 3 switched, active only during measurement, one at a time.

RANGE: ±2.5 V

RESOLUTION: 0.67 mV

ACCURACY: ±5 mV; ±2.5 mV (0° to 40°C)

CURRENT SOURCING: 25 mA

CURRENT SINKING: 25 mA

FREQUENCY SWEEP FUNCTION: The switched outputs provide a programmable swept frequency, 0 to 2.5 V square wave for exciting vibrating wire transducers.

RESISTANCE MEASUREMENTS

MEASUREMENT TYPES: The CR10X provides ratiometric bridge measurements of 4- and 6-wire full bridge, and 2-, 3-, and 4-wire half bridges. Precise dual polarity excitation using any of the switched outputs eliminates dc errors. Conductivity measurements use a dual polarity 0.75 ms excitation to minimize polarization errors.

ACCURACY: ±0.02% of FSR plus bridge resistor error.

PERIOD AVERAGING MEASUREMENTS

The average period for a single cycle is determined by measuring the duration of a specified number of cycles. Any of the 12 single-ended analog input channels can be used. Signal attentuation and ac coupling are typically required.

INPUT FREQUENCY RANGE:

Signal peak-to-peak[1] Min.	*Max.*	*Min. Pulse w.*	*Max Freq.[2]*
500 mV	5.0 V	2.5 µs	200 kHz
10 mV	2.0 V	10 µs	50 kHz
5 mV	2.0 V	62 µs	8 kHz
2 mV	2.0 V	100 µs	5 kHz

[1]Signals centered around datalogger ground
[2]Assuming 50% duty cycle

RESOLUTION: 35 ns divided by the number of cycles measured

ACCURACY: ±0.01% of reading (number of cycles 100)
±0.03% of reading (number of cycles <100)

TIME REQUIRED FOR MEASUREMENT: Signal period times the number of cycles measured plus 1.5 cycles + 2 ms

PULSE COUNTERS

NUMBER OF PULSE COUNTER CHANNELS: 2 eight-bit or 1 sixteen-bit; software selectable as switch closure, high frequency pulse, and low level ac.

MAXIMUM COUNT RATE: 16 kHz, eight-bit counter; 400 kHz, sixteen-bit counter. Channels are scanned at 8 or 64 Hz (software selectable).

SWITCH CLOSURE MODE
Minimum Switch Closed Time: 5 ms
Minimum Switch Open Time: 6 ms
Maximum Bounce Time: 1 ms open without being counted

HIGH FREQUENCY PULSE MODE
Minimum Pulse Width: 1.2 µs
Maximum Input Frequency: 400 kHz
Voltage Thresholds: Count upon transition from below 1.5 V to above 3.5 V at low frequencies. Larger input transitions are required at high frequencies because of input filter with 1.2 µs time constant. Signals up to 400 kHz will be counted if centered around +2.5 V with deviations ± 2.5 V for 1.2 µs.
Maximum Input Voltage: ±20 V

LOW LEVEL AC MODE
(Typical of magnetic pulse flow transducers or other low voltage, sine wave outputs.)

Input Hysteresis: 14 mV

Maximum ac Input Voltage: ±20 V

Minimum ac Input Voltage:

(Sine wave mV RMS)	Range (Hz)
20	1.0 to 1000
200	0.5 to 10,000
1000	0.3 to 16,000

DIGITAL I/O PORTS

8 ports, software selectable as binary inputs or control outputs. 3 ports can be configured to count switch closures up to 40 Hz.

OUTPUT VOLTAGES (no load): high 5.0 V ±0.1 V; low < 0.1 V

OUTPUT RESISTANCE: 500 ohms

INPUT STATE: high 3.0 to 5.5 V; low -0.5 to 0.8 V

INPUT RESISTANCE: 100 kohms

SDI-12 INTERFACE STANDARD

Digital I/O Ports C1-C8 support SDI-12 asynchronous communication; up to ten SDI-12 sensors can be connected to each port. Meets SDI-12 Standard version 1.2 for datalogger and sensor modes.

CR10XTCR THERMOCOUPLE REFERENCE

POLYNOMIAL LINEARIZATION ERROR: Typically <±0.5°C (-35° to +50°C), <±0.1°C (-24° to +45°C).

INTERCHANGEABILITY ERROR: Typically <±0.2°C (0° to +60°C) increasing to ±0.4°C (at -35°C).

CE COMPLIANCE (as of 09/01)

STANDARD(S) TO WHICH CONFORMITY IS DECLARED:
EN55022: 1995 and EN61326: 1998

EMI and ESD PROTECTION

IMMUNITY: Meets or exceeds following standards:
ESD: per IEC 1000-4-2; ±8 kV air, ±4 kV contact discharge
RF: per IEC 1000-4-3; 3 V/m, 80-1000 MHz
EFT: per IEC 1000-4-4; 1 kV power, 500 V I/O
Surge: per IEC 1000-4-5; 1 kV power and I/O
Conducted: per IEC 1000-4-6; 3 V 150 kHz-80 MHz

Emissions and immunity performance criteria available on request.

CPU AND INTERFACE

PROCESSOR: Hitachi 6303

PROGRAM STORAGE: Up to 16 kbytes for active program; additional 16 kbytes for alternate programs. Operating system stored in 128 kbytes Flash memory.

DATA STORAGE: 128 kbytes SRAM standard (approximately 60,000 data values). Additional 2 Mbytes Flash available as an option.

OPTIONAL KEYBOARD DISPLAY: 8-digit LCD (0.5" digits)

PERIPHERAL INTERFACE: 9 pin D-type connector for keyboard display, storage module, modem, printer, card storage module, and RS-232 adapter.

BAUD RATES: Selectable at 300, 1200, 9600 and 76,800 bps for synchronous devices. ASCII communication protocol is one start bit, one stop bit, eight data bits (no parity).

CLOCK ACCURACY: ±1 minute per month

SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 Vdc

TYPICAL CURRENT DRAIN: 1.3 mA quiescent, 13 mA during processing, and 46 mA during analog measurement.

BATTERIES: Any 12 V battery can be connected as a primary power source. Several power supply options are available from Campbell Scientific. The Model CR2430 lithium battery for clock and SRAM backup has a capacity of 270 mAhr.

PHYSICAL SPECIFICATIONS

SIZE: 7.8" x 3.5" x 1.5" - Measurement & Control Module; 9" x 3.5" x 2.9" - with CR10WP Wiring Panel. Additional clearance required for serial cable and sensor leads.

WEIGHT: 2 lbs

WARRANTY

Three years against defects in materials and workmanship.

We recommend that you confirm system configuration and critical specifications with Campbell Scientific before purchase.

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