
DRAFT
CLOSURE REPORT FOR RCRA DRUM STORAGE
GENERAL MOTORS POWERTRAIN DIVISION
FREDERICKSBURG FACILITY
FREDERICKSBURG, VIRGINIA
EPA ID #VAD091222588

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1.0 INTRODUCTION

This report has been prepared to describe closure procedures for the two hazardous waste storage areas at the General Motors (GM) Powertrain Division Fredericksburg Facility, located in Fredericksburg, Virginia (see Figure 1). (Note: This facility was previously part of the Delco Moraine Division of GM). The U.S. Environmental Protection Agency (U.S. EPA) identification number for the facility is VAD 091222588. This report has been prepared in accordance with the Approved Closure Plan dated August 3, 1990 along with the proposed Addendum (dated August 1993). This closure report is a revision of the September 1992 closure report and incorporates the results of the health-based evaluation specified in the proposed Addendum.

The existing hazardous waste container storage area is a 30 feet by 80 feet portion of a larger paved concrete area located outside and northwest of the main manufacturing building. The pad was used for the storage of heat treatment process sludge, a solid waste that was characterized as ignitable (U.S. EPA Hazardous Waste Identification Number D001) because it was thought to be an oxidizer.

However, prior to closure, the waste was reclassified by the U.S. EPA and Virginia Department of Waste Management (now known as the Virginia Department of Environmental Quality, Waste Division) and classified as a solid waste. EPA and DEQ reviewed sludge test results from the U.S. Department of Transportation (DOT) test methods for oxidizers and the Toxicity Characteristic Leaching Procedure (TCLP) and determined that the sludge should not be classified as an ignitable hazardous waste. The test results indicated that the sludge does not exhibit the characteristic of ignitability as defined by the Federal regulations and the Virginia Hazardous Waste Management Regulations. The waste was stored in 55-gallon drums that were placed on wooden pallets. Approximately 90 drums were accumulated every three to four months at which time they were shipped off-site for disposal.

The existing storage area was in operation from 1981 to closure in 1991. Prior to operation of the existing container storage unit, the Fredericksburg facility stored hazardous waste in a former storage area located approximately 280 feet north of the existing unit. The former container storage area was an approximately 20 feet by 60 feet portion of the concrete area northwest of the main manufacturing building. It was used to store empty drums and drums containing heat treatment process sludge. The storage area is no longer in use and was closed along with the existing storage area.

The Fredericksburg facility pursued a RCRA Part B permit for the future flexibility of plant operations, and as required, submitted a permit application to the Commonwealth of Virginia, Department of Environmental Quality (DEQ), Waste Division (previously Virginia Department of Waste Management) on November 8, 1988. Since that time, the Fredericksburg facility has decided to operate as a hazardous waste generator only, accumulating waste on-site for less than 90 days. Therefore, the use of the existing

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- PROPERTY BOUNDARY
- x- FENCE
- △ GATE
- SECURITY



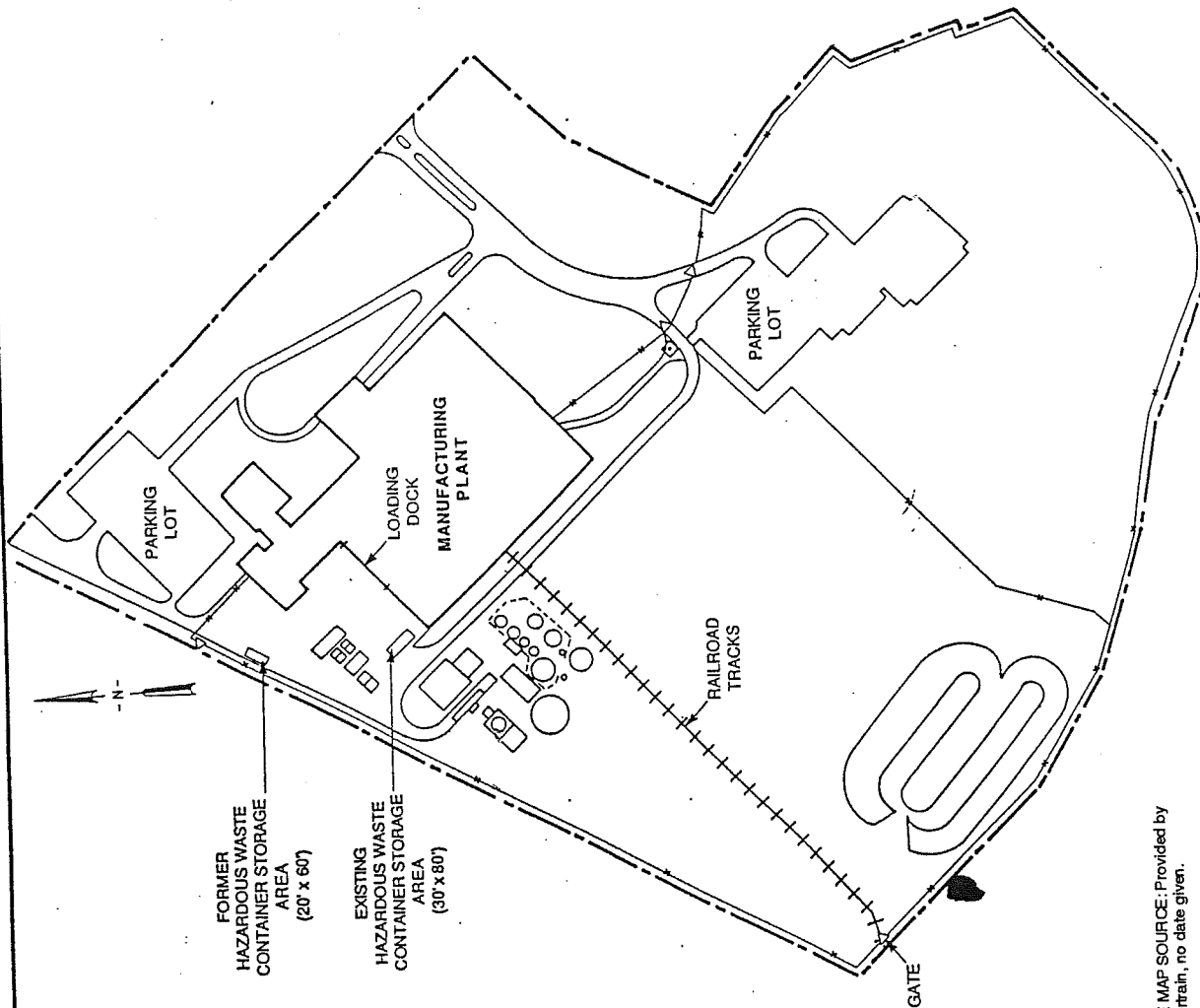
POWERTRAIN FACILITY
FREDERICKSBURG, VIRGINIA

FIGURE 2

SITE LAYOUT MAP

JOB NO. 299-171-122

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BASE MAP SOURCE: Provided by Powertrain, no date given.

container storage area was discontinued and closure procedures were implemented, and internal procedures for less than 90-day storage were prepared and followed.

During prior closure activities, it was determined that soils beneath the existing and former storage areas have not been significantly impacted by on-site activities and can be considered to be uncontaminated. However, the existing and the former storage area were not considered to have been adequately decontaminated based on the results of the Student's t-test. Therefore, the facility recommended both pads be decontaminated a second time using results of rinse water from a washed, unused pad as representative of background. The Virginia DEQ agreed with the conclusion and recommendations, as stated in their letter dated August 16, 1991.

The results from the second cleaning indicated that the rinsate levels were statistically elevated above background levels. Consistent with VHWMR Amendment 12, the facility proposed comparing the rinsate concentrations with health-based comparison criteria to determine if clean closure is appropriate. The rinsate data, presented herein, from the second decontamination are compared to background rinsate data (from a washed, unused concrete pad) using the Student's t-test and are compared to health-based comparison criteria to determine if clean closure that will be protective of human health and the environment is possible. The methodology to derive the health-based comparison criteria is presented in the Addendum and is included in Section 5.0. As presented in this report, the results of the health-based evaluation indicate that "clean closure" of the two RCRA storage pads is reasonable and appropriate.

2.0 FIELD PROGRAM

The field investigation program that was conducted at the facility consisted of pressure cleaning the two pads and collecting the final rinsate for comparison to rinsate from an unused concrete pad on site. The pads were decontaminated with a pressure rinse and water samples were collected from the rinse water used for the cleaning of the pads. The rinse water data were used to evaluate whether residual chemicals remained on the pad after the decontamination activities were completed. All field activities for rinse water sampling are described in more detail below.

On June 30, 1992 Dames & Moore personnel supervised pad decontamination procedures conducted by facility personnel.

Cleaning methodology was essentially the same for both the existing and former storage pads. Facility personnel washed the pads with water applied via a high pressure cleaner. Excess water was reclaimed via a high power vacuum attached to a 55-gallon drum. Once the pads were washed thoroughly, facility personnel rinsed the pads three times using water and the high pressure cleaner. For sampling purposes, the final rinse was collected in a separate drum.

A portion of concrete pad not used for any plant activities was washed in a similar manner to the first two pads with the high pressure cleaner. The final rinsate was collected in a 55-gallon drum. Five background rinse water samples identified as R-1 through R-5 and a duplicate (split) sample were collected from the 55-gallon drum. These samples serve as background on the quality of the water used in the pad decontamination process.

Prior to final rinsate sample collection, the cleaning equipment was decontaminated, and the vacuum was attached to a clean drum so that only the final rinsate would be collected. Five rinsate samples and one duplicate (split) sample were collected from the final rinsate at each pad.

The results of the rinse water sampling are presented in Section 4.0 along with statistical analysis of the data. The health-based evaluation is presented in Section 5.0.

3.0 ANALYTICAL PROGRAM

All water samples collected during the June 1992 field events were submitted for analyses of the following constituents:

<u>Parameters</u>	<u>Test Method</u>	<u>Method Detection Limit</u>
Arsenic	SW-846, 7060	.001 mg/l
Barium	SW-846, 7081	.002 mg/l
Cadmium	SW-846, 7131	.0001 mg/l
Chromium	SW-846, 7191	.001 mg/l
Lead	SW-846, 7421	.001 mg/l
Mercury	SW-846, 7470	.0002 mg/l
Selenium	SW-846, 7741	.002 mg/l
Silver	SW-846, 7761	.0002 mg/l
Total Kjeldahl Nitrogen	EPA-600/2-78-054	0.1 mg/l
pH	SW-846, 9040	N/A

The analyses were performed by Commonwealth Laboratory, of Richmond, Virginia. The analytical and quality control results are presented in Appendix A.

4.0 STATISTICAL ASSESSMENT

This section presents the analytical data that were collected during the field events and provides a statistical evaluation of the background and drum storage samples. As specified in the Approved Closure Plan (dated August 3, 1990) for the Fredericksburg facility, the Student's t-test must be applied to compare the background and pad rinse water samples at the 95 percent confidence level (0.05 level of significance) for a one-tailed test. The "t" test is used to evaluate whether the two sample means (averages) are statistically different. If the calculated "t" value (t^*) for the two data sets is less than the comparison value, (t_c) calculated from the "t" distribution table, then the two means are not statistically different.

Cochran's Approximation to the Behrens-Fisher Students' t-test was used to perform the statistical analysis (Commonwealth of Virginia, 1988). The t-test uses the background (from a washed, unused concrete pad) and storage area means and variances to calculate a t-statistic (t^*) and comparison t-statistic (t_c) (see Table 1 for the equations used). Note that the t-values to calculate the comparison t-statistic (t_c) are obtained from Table 2, which provides the percentiles of the "t" distribution for both one and two-tailed tests at five (5) degrees of freedom. The degrees of freedom were constant at five, since five samples and a duplicate were collected for the background and storage area data sets. The "t" value is compared to the t_c value to determine if there is a statistical difference between the two data sets. If t^* is equal to or greater than t_c , then it is determined that there has been a statistical increase (in this case, above background) in the measured analyte. However, if t^* is less than t_c then it can be concluded that there has not been a change in this parameter (i.e., the measured value is not statistically greater than the background concentration).

As shown in Table 1, the calculated t-statistic (t^*) for each of the constituents analyzed in the samples collected from rinse water from the former storage area are below the comparison t-statistic (t_c), except for lead, cadmium, chromium, and TKN. Note that 2.1 mg/l was detected in the blank sample, that was collected from the potable water source used to perform the high pressure washing. This concentration is similar to the levels detected in the background rinsate samples. Therefore, the former storage area data are statistically elevated above the background data.

The t^* for all analytes analyzed in the samples collected from the existing storage area were below the t_c value except for lead, chromium, and TKN; the value for these three constituents did exceed t^* . The rinsate data for these constituents are further assessed in Section 5.0 using a health-based evaluation to evaluate whether the constituent concentrations present a hazard to human health and the environment.

Table 1
Calculation of Student's t-Test
Fredericksburg Facility

Compound[1]	Background Storage Area Rinsate Samples (mg/L)						R – SPLIT	n(b)	x(b)	s2(b)
	R – 1	R – 2	R – 3	R – 4	R – 5					
Arsenic	0.011	0.012	0.004	0.004	0.005	0.001 LT[2]	6	6.17E-03	1.90E-05	
Barium	0.15	0.18	0.16	0.14	0.15	0.002 LT	6	1.30E-01	4.14E-03	
Cadmium	0.0001 LT	0.0001 LT	0.0001 LT	0.0001 LT	0.0001 LT	0.0001 LT	6	1.00E-04	0.00E+00	
Chromium	0.001	0.001 LT	0.001 LT	0.001 LT	0.001 LT	0.001 LT	6	1.00E-03	0.00E+00	
Lead	0.001	0.001	0.001	0.001 LT	0.001 LT	0.001 LT	6	1.00E-03	0.00E+00	
Mercury	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	6	2.00E-04	0.00E+00	
Selenium	0.002 LT	0.002 LT	0.002 LT	0.002 LT	0.002 LT	0.002 LT	6	2.00E-03	0.00E+00	
Silver	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	6	2.00E-04	0.00E+00	
TKN	2.2	2.2	2.1	2.3	2.2	0.1 LT	6	1.85E+00	7.39E-01	

	Existing Storage Area Rinsate Samples (mg/L)						ER – SPLIT	n(s)	x(s)	s2(s)
	ER – 1	ER – 2	ER – 3	ER – 4	ER – 5					
Arsenic	0.005	0.005	0.003	0.004	0.002	0.002	6	3.50E-03	1.90E-06	
Barium	0.12	0.14	0.14	0.13	0.15	0.22	6	1.50E-01	1.28E-03	
Cadmium	0.002	0.0001 LT	0.0001 LT	0.0001 LT	0.0001 LT	0.0001 LT	6	4.17E-04	6.02E-07	
Chromium	0.002	0.003	0.003	0.003	0.004	0.003	6	3.00E-03	4.00E-07	
Lead	0.003	0.003	0.003	0.003	0.003	0.009	6	4.00E-03	6.00E-06	
Mercury	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	6	2.00E-04	0.00E+00	
Selenium	0.002 LT	0.002 LT	0.002 LT	0.002 LT	0.002 LT	0.002 LT	6	2.00E-03	0.00E+00	
Silver	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	6	2.00E-04	0.00E+00	
TKN	3.3	3.5	3.3	3.0	3.1	3.5	6	3.28E+00	4.17E-02	

	Former Storage Area Rinsate Samples (mg/L)						FR – SPLIT	n(s)	x(s)	s2(s)
	FR – 1	FR – 2	FR – 3	FR – 4	FR – 5					
Arsenic	0.003	0.005	0.003	0.001 LT	0.001 LT	0.01	6	3.83E-03	1.14E-05	
Barium	0.22	0.19	0.21	0.19	0.23	0.11	6	1.92E-01	1.86E-03	
Cadmium	0.002	0.002	0.0001 LT	0.0001 LT	0.0001 LT	0.001	6	8.83E-04	8.70E-07	
Chromium	0.003	0.002	0.002	0.001	0.002	0.002	6	2.00E-03	4.00E-07	
Lead	0.003	0.004	0.004	0.002	0.003	0.003	6	3.17E-03	5.67E-07	
Mercury	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	6	2.00E-04	0.00E+00	
Selenium	0.002 LT	0.002 LT	0.002 LT	0.002 LT	0.002 LT	0.002 LT	6	2.00E-03	0.00E+00	
Silver	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	0.0002 LT	6	2.00E-04	0.00E+00	
TKN	5.2	4.9	4.8	5.5	4.5	4.7	6	4.93E+00	1.31E-01	

[1] All metals results are for total metals. TKN = Total Kjeldahl Nitrogen.

[2] LT = Less than the detection limit. Concentration = mg/L.

Table 1 (Cont'd)

CALCULATED t VALUES:

Analyte	t*	t(c)	Is t*>t(c) ?
<u>Existing Storage Area</u>			
Arsenic	-1.43	2.02	NO
Barium	0.65	2.02	NO
Cadmium	1.00	2.02	NO
Chromium	7.75	2.02	YES
Lead	3.00	2.02	YES
Mercury	0.00	2.02	NO
Selenium	0.00	2.02	NO
Silver	0.00	2.02	NO
TKN	3.97	2.02	YES
<u>Former Storage Area</u>			
Arsenic	-1.04	2.02	NO
Barium	1.94	2.02	NO
Cadmium	2.06	2.02	YES
Chromium	3.87	2.02	YES
Lead	7.05	2.02	YES
Mercury	0.00	2.02	NO
Selenium	0.00	2.02	NO
Silver	0.00	2.02	NO
TKN	8.10	2.02	YES

Table 2
Standard t-Tables
0.05 Level of Significance

<u>Degrees of Freedom</u>	<u>t-values (one tail)</u>	<u>t-values (two tail)</u>
1	6.314	12.706
2	2.920	4.303
3	2.353	3.182
4	2.132	2.776
5	2.015	2.571
6	1.943	2.447
7	1.895	2.365
8	1.860	2.306
9	1.833	2.262
10	1.812	2.228
11	1.796	2.201
12	1.782	2.179
13	1.771	2.160
14	1.761	2.145
15	1.753	2.131
16	1.746	2.120
17	1.740	2.110
18	1.734	2.101
19	1.729	2.093
20	1.725	2.086
21	1.721	2.080
22	1.717	2.074
23	1.714	2.069
24	1.711	2.064
25	1.708	2.060
30	1.697	2.042
40	1.684	2.021

Adopted from Table III of "Statistical Tables for Biological, Agricultural, and Medical Research" (1974, R. A. Fisher and F. Yates).

5.0 HEALTH-BASED EVALUATION

The methodology to determine whether two RCRA storage pads at the Fredericksburg facility may be closed in a manner that protects human health and the environment is presented in this section. The methodology generally follows the approach used in conducting risk assessments at hazardous waste sites as described in U.S. Environmental Protection Agency (USEPA) guidance documents (USEPA, 1989a, 1989b, 1991a, 1993) and is consistent with that specified in the Addendum to the approved Closure Plan (Dames & Moore, August 1993). The principal components of this methodology are the following:

- Identification of Contaminants of Concern
- Toxicity Assessment
- Exposure Assessment
- Development of Health-Based Comparison Criteria
- Comparison of Health-Based Criteria with Storage Pad Rinse Water Results

Identification of Contaminants of Concern. Contaminant identification involves the identification of those constituents detected in the rinse water which may be related to the use of the pads to store heat treatment process sludge. As described in Section 4.0, the Student's t-test was used to compare analytical results for the RCRA storage pads with background rinse water sample results to identify potential contaminants of concern. This is the only screening performed on the analytical results prior to their comparison with health-based comparison criteria. Based on this screen, four constituents--cadmium, chromium, lead, and total Kjeldahl nitrogen (TKN)--are considered to be contaminants of concern because concentrations of these constituents detected in the RCRA pad rinse water "failed" the Student's t-test.

Toxicity Assessment. The toxicity assessment summarizes quantitative estimates of chemical-specific toxicity based on published USEPA data. For this methodology, the toxicity criteria used were obtained from an USEPA Region III "Memorandum on Risk-Based Concentration Table" (USEPA, 1993), which lists noncarcinogenic reference doses (RfDs) and carcinogenic slope factors obtained from USEPA's Integrated Risk Information System (IRIS) through December 1992, USEPA Health Effects Assessment Summary Tables (HEAST) through July 1992, USEPA's Office of Health and Environmental Assessment-Cincinnati, and other USEPA sources. Toxicity criteria for the four contaminants of concern based on oral ingestion and dermal absorption are presented in Table 3. Some of the assumptions and limitations in the development and use of the toxicity criteria are discussed in the following paragraphs.

Because of practical and experimental limitations, the determination of dermal RfDs or slope factors for the contaminants of concern is not possible (USEPA, 1989a). Most oral toxicity criteria are expressed as the amount of substance administered per unit time and unit body weight, whereas exposure estimates for the dermal route of exposure are expressed as absorbed doses (i.e., the amount of a substance absorbed through the skin and

TABLE 3
Toxicity Criteria for Contaminants of Concern in
RCRA Pad Rinse Water at the Fredericksburg Facility

Chemical	Noncarcinogenic Oral RfD (mg/kg/day)	Carcinogenic Oral Slope Factor (SF) 1/(mg/kg/day)	Oral Absorption Factor (%) (a)	Dermal RfD Derived from Oral RfD (mg/kg/day)	Dermal SF Derived from Oral SF 1/(mg/kg/day)
Cadmium	5E-04	ND	5	3E-05	--
Chromium	5E-03	ND	2.1	1E-04	--
Lead	ND	ND	--	--	--
Nitrate (b)	1.6E+00	ND	100	1.6E+00	--
Nitrite (b)	1E-01	ND	100	1E-01	--

ND = No data available (see USEPA, 1993).

(a) Obtained from references presented in text.

(b) No toxicity criteria are available for total Kjeldahl nitrogen; toxicity criteria for nitrate and nitrite are considered appropriate for use in calculating health-based comparison criteria.

into the body). General guidance for adjusting oral toxicity values from administered to absorbed doses using oral absorption factors is provided in Appendix A of USEPA (1989a) and is summarized in the equation below:

$$\text{Absorbed dose RfD} = \text{Admin dose oral RfD (mg/kg/day)} \times \text{OAF (unit less)}$$

where the oral absorption factor (OAF) equals the fraction of the amount ingested which is absorbed through the gastrointestinal tract. The absorbed dose RfD, referred to as the dermal RfD in Table 1, is then the appropriate toxicity criterion to compare with exposure estimates based on dermally absorbed doses.

Table 3 presents the derivation for toxicity values for dermal exposures for the contaminants of concern. It should be noted that little data concerning absorption of various contaminants after oral exposure in humans are available; therefore, some oral absorption factors are based on one or more animal studies. USEPA recommends an oral absorption value of 5 percent for cadmium in water (USEPA, 1991b). Based on human fecal and urinary excretion data (Anderson *et al.*, 1983), absorption of an oral dose of hexavalent chromium is at least 2.1 percent. Studies in animals indicate that both nitrate and nitrite are readily and nearly completely absorbed by the gastrointestinal tract (USEPA, 1990a).

With respect to lead, no RfD appropriate for use in developing a health-based comparison criterion is currently available; therefore, an alternative method for identifying a health-based criterion for lead is used. A health-based criterion of 15 ug/L was taken from a USEPA memorandum regarding the development of a protective cleanup level for lead in groundwater usable as drinking water (USEPA, 1990b). A 15-ug/L lead level in drinkable groundwater is considered by USEPA to provide substantial health protection for the majority of young children, who--although not likely to be exposed to RCRA storage pad rinse water on-site--are the exposure group of greatest concern with respect to lead.

Since samples were analyzed for total chromium, the form of chromium present in the rinse water is unknown; as a conservative measure, the toxicity criterion for hexavalent chromium, which is the more toxic form of chromium, and, therefore, has the lowest RfD, is used to develop health-based comparison criteria.

TKN is considered to be as measure of "free" nitrogen, i.e., the forms of nitrogen which are available for use by organisms. Since various forms of nitrogen may be included in the TKN measurement, there are no specific toxicity criteria available for TKN. Since nitrate and possibly nitrite are forms of nitrogen that may be included in the TKN measurement, toxicity criteria for both nitrate and nitrite were considered appropriate to use in calculating health-based comparison criteria for this constituent.

Exposure Assessment. The exposure assessment is conducted to identify transport mechanisms for the contaminants of concern and potential human receptors, and to determine the types of exposures that individuals may have to the contaminants of concern that are present at or potentially migrating from the site. Exposure pathway(s) that are selected for use in calculating health-based comparison criteria are those that have the highest probability for human exposure as well as those which, although less likely to occur, may have a greater adverse health impact on exposed individuals. Other less significant

complete pathways are identified and discussed, but are not used to calculate health-based comparison criteria. Based on information available to date, the following exposure pathways are considered to be the most appropriate for evaluating potential human health hazards:

- Direct contact with and dermal absorption of contaminants in surface water runoff (from the pads) during nonshowering activities by industrial workers and local residents.
- Ingestion of drinking water contaminated by pad runoff by industrial workers and by local residents.
- Direct contact with and dermal absorption of contaminants transported via surface water runoff from the pads during showering by local residents.

Given the distance between the facility and residential areas, the probability that residents can be significantly exposed to constituents migrating with surface water runoff from the RCRA pads on-site is considered very low; therefore, on-site industrial worker-related exposure scenarios, as opposed to residential exposure scenarios, are considered more likely to occur.

Given the relatively small amount of surface water runoff expected from the RCRA pads, the lateral and vertical distance that contaminants in runoff would have to travel prior to reaching drinking water supplies (i.e., private groundwater wells or the Rappahannock River), and the fact that significant dilution would likely occur as contaminants migrate with surface runoff to potential drinking water sources, exposure scenarios involving ingestion of drinking water by either workers or residents are not considered reasonable. Similarly, residential exposure during showering is not considered a reasonable scenario.

Based on the above discussion, the remaining potential exposure pathway--direct contact with and dermal absorption of contaminants in surface water runoff during nonshowering activities by industrial workers--is considered to be the most likely and most reasonable exposure scenario at the site and is therefore selected for use in calculating health-based comparison criteria.

As noted in the EPA document, Dermal Exposures Principles and Application (USEPA, 1992), dermal contact is the least understood of the major direct exposure routes (i.e., ingestion, inhalation, and dermal contact), very little chemical-specific data are available, and predictive techniques are not well validated. In addition, dose-response relationships specific to dermal contact are not commonly available; therefore, there is considerable uncertainty associated with the estimation of dermal exposures and risks. For these reasons, a less likely exposure scenario, the ingestion of drinking water by industrial workers, also is used to calculate health-based comparison criteria. This drinking water exposure scenario is based on more reliable chemical-specific data and dose-response relationships than the dermal absorption scenario and will yield more conservative health-based comparison criteria. Since they are based on a more protective (albeit less realistic)

exposure scenario, these drinking water-based criteria may serve as back-up values to aid in determining whether clean-closure of the two RCRA storage pads is appropriate.

Development of Health-Based Comparison Criteria. Using the toxicity criteria and the two exposure pathways selected above (i.e., dermal absorption and drinking water ingestion by industrial workers), health-based comparison criteria are developed for the contaminants of concern identified in the rinse water from the two RCRA pads. The general methods described in USEPA, 1993 are used to calculate the criteria, along with equations and exposure factors found in various USEPA guidance documents such as, Risk Assessment Guidance for Superfund, Volume I, Risk Assessment Guidance for Superfund, Volume I, Supplemental Guidance, and Dermal Assessment: Principles and Applications (USEPA, 1989a, 1991a, 1992). As can be seen from the toxicity criteria presented in Table 3, none of the contaminants of concern are considered to have carcinogenic effects via the potential exposure routes discussed above; therefore, comparison criteria were developed based solely on noncarcinogenic effects. With the exception of lead, comparison criteria for chemicals having noncarcinogenic toxic effects are defined as residual chemical concentrations in water that result in hazard quotients that do not exceed 1 (40 CFR, Subpart E, Section 300.430). As discussed above, the health-based comparison criterion selected for lead is the USEPA action level of 15 ug/L.

Table 4 presents the methods and assumptions used to calculate health-based comparison criteria for the direct contact exposure scenario for industrial workers. For this screening evaluation, the concentrations measured in samples from the final rinse water collected during pad decontamination activities (see Table 1) are assumed to represent concentrations in surface water runoff to which the workers may be exposed. Actual concentrations are likely to be less than these rinse water values, because dilution is likely to occur. The dermally absorbed dose of the contaminants of concern is estimated by relating the measured rinse water constituent concentrations to the assumed rates of worker dermal contact with the surface water runoff [i.e., skin surface area available for contact (SA)) and the chemical-specific dermal permeability constant (K_p), modified by consideration of the exposure time (ET), exposure frequency (EF), exposure duration (ED), averaging time (AT), and the body weight (BW)]. Experimentally measured K_p values for cadmium and chromium in aqueous media were found in USEPA (1992). Data concerning the absorption of nitrate and nitrite from water after dermal exposure in humans or animals were not located in readily available literature; therefore, values for nitrate and nitrite were assumed to be the same as that of water (i.e., absorbed at same rate as water), as cited in USEPA (1992). It should be noted that the actual values for certain parameters (e.g., exposure frequency and duration) may be less than the assumed values provided in Table 4; however, the EPA-referenced default assumptions allow conservative health-based criteria to be calculated.

The method used for the industrial drinking water scenario is described in USEPA, 1993 and summarized in Table 5. Unlike the residential scenario presented in USEPA, 1993, however, default industrial drinking water intake assumptions (e.g., intake of 1 L/day, 250 days/year, for 25 years) are substituted for residential assumptions using standard default exposure factors presented in USEPA, 1991a. The ingested dose of the

contaminants of concern is estimated by relating the measured rinse water constituent concentrations to the assumed rates of drinking water ingestion by workers, modified by consideration of the EF, ED, AT, and the BW.

Comparison of Criteria with Rinse Water Concentrations. The two sets of health-based comparison criteria calculated using the above methods are compared with maximum concentrations detected in rinse water from both RCRA pads to determine whether clean closure of the pads is feasible. Table 6 presents the results of these comparisons.

Maximum concentrations of cadmium, chromium, and TKN in rinse water samples collected from both the former and the existing RCRA storage pads are several orders of magnitude less than their respective health-based comparison criteria, based on the dermal absorption-related exposure scenario. They are also more than ten times less than the health-based comparison criteria which were based on the more protective (albeit less realistic) drinking water ingestion exposure scenario. The maximum concentrations of lead detected in rinse water from both RCRA pads also were well less than the USEPA-recommended action level of 15 ug/L, as discussed previously.

Based on the above results, clean closure of the two RCRA storage pads is considered to be reasonable and appropriate. The health-based methodology used to evaluate potential exposure and risk to human health and the environment incorporates conservative risk evaluation measures and is consistent with the approach used in conducting EPA risk assessments at hazardous waste sites. The health-based methodology provides an appropriate measure of the potential risk to exposure to constituents in the rinse water because --

- it provides for a comparison to rinsewater concentrations from the cleaning of a background concrete pad (i.e., one that has not been used for storage of hazardous constituents);
- it uses the most recent EPA toxicity criteria from published EPA sources;
- for those constituents with multiple ionic species (i.e. hexavalent chromium, total chromium, nitrate, and nitrite), the toxicity data from the more toxic species is used to evaluate potential risk; and
- the method considers both a realistic dermal absorption exposure scenario and a conservative, more protective, although less realistic, drinking water ingestion exposure scenario.

Therefore, based on the results of the health-based evaluation (which indicated that the maximum concentrations of the constituents of concern detected in the rinse water were well below, and in some cases, several orders of magnitude less than their respective health-based comparison criteria), the existing and former pads should be considered **clean closed**. The measures taken to date are deemed sufficient to ensure the protection of human health and the environment. No further cleanup activities should be necessary.

TABLE 4

**Quantitative Summary of Health-Based Comparison Criteria Calculation
For Dermal Absorption Exposure Pathway Under Industrial Land Use Conditions**

Description:

Direct contact with and dermal absorption of contaminants in surface water runoff by workers during non-showering activities

Comparison Criteria Formula:

Health-Based
Criterion =
$$\frac{THQ \times CF1 \times BW \times AT \times RfC \times CF2}{SA \times Kp \times ET \times EF \times ED}$$

Parameter Definitions and Units:

Health-Based Criterion in mg/L
THQ = Target hazard quotient (unitless)
SA = Skin surface area available for contact (cm²)
Kp = Chemical-specific dermal permeability constant (cm/hr)
ET = Exposure time per day (hr/day)
CF1 = Conversion factor for volume units (1E+03 cm³/l)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (days)
RfC = Noncarcinogenic reference dose (mg/kg/day)
CF2 = Conversion factor for mass units (1000 ug/mg)

Assumptions,

Light Industrial:

SA = 3,200 cm² (adult upper extremities; USEPA, 1989b)
Kp = chemical specific (see below)
 = 1E-03 cm/hr for cadmium (USEPA, 1992)
 = 1E-03 cm/hr for chromium (USEPA, 1992)
 = 1E-03 cm/hr for nitrate (assumed to be the same as water, USEPA, 1992)
 = 1E-03 cm/hr for nitrite (assumed to be the same as water, USEPA, 1992)
ET = 30 min/day or 0.5 hr/day (estimated time/workday with hands on water source)
EF = 250 days/yr (USEPA, 1991a)
ED = 25 years (USEPA, 1991a)
BW = 70 kg (USEPA, 1991a)
AT = 25 years x 365 days/yr = 9,125 days for noncarcinogens (USEPA, 1991a)
RfC = Chemical-specific (see Table 1)
THQ = 1

Sample Calculation, Cadmium

Health-Based
Criterion =
$$\frac{1 \times 1E+03 \text{ (cm}^3\text{/L)} \times 70 \text{ (kg)} \times 9,125 \text{ (days)} \times 5E-04 \text{ (mg/kg/day)} \times 1000 \text{ (ug/mg)}}{3,200 \text{ (cm}^2\text{)} \times 1E-03 \text{ (cm/hr)} \times 0.5 \text{ (hr/day)} \times 250 \text{ (day/yr)} \times 25 \text{ (yr)}}$$

= 3.2E+04 ug/L

TABLE 5

**Quantitative Summary of Health—Based Comparison Criteria Calculation
For Drinking Water Ingestion Exposure Pathway Under Industrial Land Use Conditions**

Description:

Ingestion of contaminated drinking water by industrial workers

**Comparison Criteria
Formula:**

Health—Based
Criterion =
$$\frac{\text{THQ} \times \text{CF} \times \text{BW} \times \text{AT} \times \text{RfC}}{\text{IR} \times \text{EF} \times \text{ED}}$$

**Parameter Definitions
and Units:**

Health—Based Criterion in mg/L
THQ = Target hazard quotient (unitless)
IR = Ingestion Rate (L/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (days)
RfC = Noncarcinogenic reference dose (mg/kg/day)
CF = Conversion factor for mass units (1000 ug/mg)

**Assumptions,
Light Industrial**

THQ = 1
IR = 1 L/day (USEPA, 1991a)
EF = 250 days/yr (USEPA, 1991a)
ED = 25 years (USEPA, 1991a)
BW = 70 kg (USEPA, 1991a)
AT = 25 years x 365 days/yr = 9,125 days for noncarcinogens (USEPA, 1991a)
RfC = Chemical—specific (see Table 1)

**Sample Calculation
Cadmium**

Health—Based
Criterion =
$$\frac{1 \times 1\text{E}+03 \text{ (ug/mg)} \times 70 \text{ (kg)} \times 9,125 \text{ (days)} \times 5\text{E}-04 \text{ (mg/kg/day)}}{1 \text{ (L/day)} \times 250 \text{ (day/yr)} \times 25 \text{ (yr)}}$$

= 51 ug/L

TABLE 6
Comparison of RCRA Pad Rinse Water Concentrations at the
Fredericksburg Facility with Health-Based Comparison Criteria

Chemical	Maximum Conc. in Rinse Water from RCRA Storage Pads (ug/L)		Health-Based Comparison Criteria--Dermal Absorp. (ug/L)	Sample Conc. less than Dermal Absorp. Health-Based Criteria?		Health-Based Comparison Criteria--DW Ingestion (ug/L)	Sample Conc. less than DW Ingestion Health-Based Criteria?	
	Existing	Former		Existing	Former		Existing	Former
Cadmium	2	2	1,597	Yes	Yes	51	Yes	Yes
Chromium	4	3	6,388	Yes	Yes	511	Yes	Yes
Lead	9	4	15 (a)	Yes	Yes	15 (a)	Yes	Yes
TKN	3,500	5,500	1.0E+08 (nitrate) 6.4E+06 (nitrite)	Yes	Yes	160,000 (nitrate) 10,220 (nitrite)	Yes	Yes

DW = Drinking water

TKN = Total kjeldahl nitrogen

(a) No toxicity criteria available for lead; therefore, comparison value is USEPA-recommended action level for drinking water.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The following section outlines the conclusions and recommendations from the closure activities performed at the Fredericksburg facility to date.

6.1 Conclusions

As a result of the field efforts, the analytical results of the samples collected and data review and evaluation, GM Powertrain presents the following conclusions:

- Based on the results of a Students' t-test, final rinsate from the existing storage pad has exceeded "background" levels of chromium, lead and TKN.
- Based on the results of a Students' t-test, final rinsate from the former storage pad has exceeded "background" levels of cadmium, chromium, lead and TKN.
- The results of the health-based evaluation indicate that the maximum concentrations of cadmium, chromium, lead, and TKN in final rinsate samples are below the health-based comparison criteria for both the dermal absorption and drinking water ingestion scenarios.

6.2 Recommendations

Thus, GM Powertrain recommends the following:

- That both the existing and former pad be considered **clean closed** based on the results of the health-based evaluation in accordance with Virginia Hazardous Waste Management Regulations. These results demonstrate the consideration that human health and the environment will be protected without the necessity of any further actions.

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APPENDIX A

ANALYTICAL RESULTS



FOUNDED 1959

COMMONWEALTH LABORATORY

INCORPORATED

CHEMISTS BUILDING, 2209 EAST BROAD STREET

RICHMOND, VIRGINIA 23223

P.O. BOX 8025
AREA CODE 804
TELEPHONE: 648-8358
FAX 644-5820

CERTIFICATE OF ANALYSIS FOR:

Mr. James Spencer
Dames & Moore
2807 North Parham Road Suite 114
Richmond, Virginia 23294DATE: July 31, 1992
SAMPLE NUMBER: 92-3079
SAMPLE RECEIVED: July 1, 1992
Nineteen (19) samples
IDENTIFIED AS: GMC Delco #00299-195
Rinsate Water

METHOD OF ANALYSIS: EPA

ANALYTICAL RESULTS:

UNIT OF MEASUREMENT: mg/L

Analyzed For	FWP (Former Waste Pad)					SP (FR-Split)
	FR-1	FR-2	FR-3	FR-4	FR-5	
TKN as N	5.2	4.9	4.8	5.5	4.5	4.7
Arsenic	.003	0.005	0.003	ND	ND	0.010
Barium	0.22	0.19	0.21	0.19	0.23	0.11
Cadmium, Furnace	0.002	0.002	ND	ND	ND	0.001
Chromium, Furnace	0.003	0.002	0.002	0.001	0.002	0.002
Lead, Furnace	0.003	0.004	0.004	0.002	0.003	0.003
Mercury	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND

Analyzed For	EP (Existing Pad)					FR-SP (FR-Split)
	FR-1	FR-2	FR-3	FR-4	FR-5	
TKN as N	3.3	3.5	3.3	3.0	3.1	3.5
Arsenic	0.005	0.005	0.003	.004	.002	.002
Barium	0.12	0.14	0.14	0.13	0.15	0.22
Cadmium, Furnace	0.002	ND	ND	ND	ND	ND
Chromium, Furnace	0.002	0.003	0.003	0.003	0.004	0.003
Lead, Furnace	0.003	0.003	0.003	0.003	0.003	0.009
Mercury	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND

Virginia Drinking Water Certification No. 00070. North Carolina State Certification No. 31. South Carolina Laboratory I.D. No. 93001.

92-3079

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Analyzed For	BL (Background Pad)					
	R-1	R-2	R-3	R-4	R-5	R-SF (R-Split)
TKN as N	2.2	2.2	2.1	2.3	2.2	ND
Arsenic	0.011	0.012	.004	0.004	0.005	ND
Barium	0.15	0.18	0.16	0.14	0.15	ND
Cadmium, Furnace	ND	ND	ND	ND	ND	ND
Chromium, Furnace	0.001	ND	ND	ND	ND	ND
Lead, Furnace	.001	.001	.001	ND	ND	ND
Mercury	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND
Silver, Furnace	ND	ND	ND	ND	ND	ND

Trip

TKN as N	2.1
Arsenic	ND
Barium	ND
Cadmium, Furnace	ND
Chromium, Furnace	ND
Lead, Furnace	ND
Mercury	ND
Selenium	ND
Silver, Furnace	ND

Additional Analytical Information:

Parameters	Limits of Detection
TKN as N	.1
Arsenic	.001
Cadmium	.0001
Chromium	.001
Lead	.001
Mercury	.0002
Selenium	.002
Silver	.0002

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Parameters

Method
SW 846

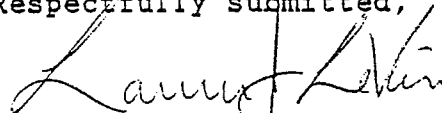
Arsenic	7060
Barium	7081
Cadmium	7131
Chromium	7191
Lead	7421
Mercury	7470
Selenium	7741
Silver	7761

Method
EPA 600/2-78-054

TKN as N

351.3

Respectfully submitted,



Lawrence J. Levine
Manager, Laboratory Services

LJL:cpk