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RASMUSSEN SITE STEERING COMMITTEE

EVALUATION OF PROPOSED PLAN AND RECOMMENDED MODIFICATIONS

Rasmussen Site
Livingston County, Michigan

OCTOBER 1990
REF. NO. 2433 (12)

CONESTOGA-ROVERS & ASSOCIATES

EXECUTIVE SUMMARY

The Michigan Department of Natural Resources (MDNR) and the United States Environmental Protection Agency, Region V (USEPA) issued their Proposed Plan for the final remedy at the Rasmussen Site on August 31, 1990. This Proposed Plan presented the MDNR/USEPA (the "Agencies") preferred remedial alternatives to address the municipal landfill and the groundwater beneath the Rasmussen Site.

The Agencies' Proposed Plan consisted of two primary components. The proposed remedial components and the associated areas of concern to be addressed by each component are:

- Municipal Landfill

  The Agencies propose to construct a Michigan Act 64 cap over the area identified as the Top of Municipal Landfill (TML) Area. The area referred to as the Northeast Buried Drum (NEBD) Area is located within the areal limits of the TML Area and would be capped under the Proposed Plan. The cap is proposed to be a total of five feet thick and comprised of a one-foot thick vegetated soil layer, a one-foot thick drainage layer, and a three-foot thick clay layer with a permeability of 1×10^{-7} cm/s or less. In addition to the cap, the Agencies propose the use of access restrictions, such as fencing, around the capped area and the use of institutional controls, such as deed restrictions, to prevent future land use of the capped areas.

- Groundwater

  The Agencies propose to construct a groundwater extraction system to capture the impacted groundwater and to halt its migration until groundwater cleanup levels are achieved. Extracted groundwater is proposed to be treated by a combination of process options including removal of heavy metals (i.e. lead, cadmium) by chemical precipitation followed by pH adjustment; removal of the bulk of the organic constituents, including ketones, by a biological treatment system; removal of residual organics by air stripping; and further removal of residual organics by granular activated carbon adsorption. The Agencies propose discharge of treated groundwater to a seepage basin situated over the Industrial Wastes (IW) and Probable Drum Storage Leakage Disposal (PDSLD) Areas. In addition, the Agencies propose fencing and deed restrictions to ensure the integrity of the remedy.

Conestoga-Rovers & Associates (CRA) has been retained by the Rasmussen Site Steering Committee (RSSC) to review the Proposed Plan. This review addresses both components of the Agencies' preferred remedy.

CRA and the RSSC concur that the concept of capping is appropriate to the Rasmussen Site. However, the type of cap proposed by the Agencies represents a misapplication of Applicable or Relevant and Appropriate Requirements (ARARs). Also, technical details of the proposed cap design are either unwarranted and unnecessary or are inappropriate for the Site conditions. Based on this analysis, an alternate cap design is presented in this document which would provide improved hydraulic performance and improved long term integrity compared to the Agencies' proposed cap design.

CRA and the RSSC concur that groundwater remediation at the Rasmussen Site is appropriate. However, the RSSC has numerous concerns regarding the appropriateness of the groundwater remedy presented in the Proposed Plan. These concerns include:

- the method by which groundwater cleanup indicator chemicals were selected;
- the calculation of risks associated with groundwater at the Site and the difference between the cleanup approach presented in the Proposed Plan and that suggested in the MDNR/USEPA risk assessment;
- the data and assumptions used by the Agencies for calculating appropriate cleanup criteria and limitations of analytical chemistry in establishing groundwater cleanup levels; and
- the selection of groundwater treatment technologies and the underestimation of costs associated with the groundwater remedy.

A detailed analysis of the Proposed Plan was conducted to address these concerns regarding both the municipal landfill component and the groundwater remedy component. Based on this evaluation, more appropriate remedial components were identified. The conclusions of this evaluation, by remedial component, include the following:

MUNICIPAL LANDFILL CAP COMPONENT

With respect to the municipal landfill cap component, we conclude:

1) The Agencies' proposed Michigan Act 64 cap design is neither applicable nor relevant and appropriate to the capping of the Rasmussen municipal landfill. Due to the response actions completed to date, the remaining landfill materials are characterized as primarily municipal garbage. Consequently, capping requirements established by RCRA and Michigan Act 64 are not relevant to the proposed capping of the Rasmussen Site. Relevant and appropriate capping requirements are those established by Michigan's Solid Waste Management Act.

2) The RSSC's proposed alternative cap design will satisfy capping ARARs, address technical flaws evident in the Agencies' proposed design, and provide a cover system which best addresses the public's concerns regarding cap longevity and long-term integrity.

3) Comparison of the Agencies' proposed cap to the RSSC's alternate design has shown that the RSSC's alternate design addresses the NCP's nine evaluation factors to the greatest possible extent. Evaluation factors which favor the RSSC's alternate cap include:

    - Overall Protection of Human Health and the Environment;
    - Compliance with ARARs;
    - Long-Term Effectiveness and Performance;
    - Short-Term Effectiveness;

- Implementability;
- Cost; and
- Community Acceptance.

Evaluation factors which either are not applicable or neutral include:

- Reduction of Toxicity, Mobility, or Volume Through Treatment; and
- Support Agency Acceptance.

In comparison, the Agencies' cap does not adequately address these evaluation factors in light of Site-specific conditions. Design measures incorporated into the RSSC's proposed alternate cap would provide improved longevity and long-term integrity compared to the Agencies' cap design. The RSSC's proposed design uses best design practice and positive measures to mitigate potential Site-specific problems.

4) The RSSC's proposed alternate cap design will provide an improved level of hydraulic performance compared to the Agencies' proposed Act 64 cap. The estimated percent reduction in infiltration through the cap for the RSSC's and Agencies' cap designs are 95.6% and 95.9%, respectively. However, the integrity of the Agencies' cap against frost and dessication cracking cannot be ensured. Consequently, in actual practice, the RSSC's alternate cap design will prove superior to the Agencies' Act 64 cap.

5) The FS cost estimates for the Agencies' proposed cap contain numerous calculational errors. The corrected capital cost of the Agencies' proposed cap ranges from $8,248,860 to $11,395,715 which is significantly greater than the $2,993,290 presented in the Proposed Plan. In comparison, the RSSC's proposed alternative cap is more cost effective because the estimated capital cost is $2,623,390. In addition, the FS has underestimated the O&M costs for the Agencies' cap. A lower-bound O&M cost estimate for the Agencies' cap is expected to be approximately $0.5 million.

GROUNDWATER REMEDIAL COMPONENT

With respect to the groundwater extraction/treatment remedial component, we conclude:

1) The Proposed Plan has inappropriately identified a number of proposed indicator chemicals which should be deleted. Of the 24 groundwater cleanup indicator chemicals presented in the Proposed Plan, 17 of the proposed indicator chemicals should be deleted based on a detailed evaluation of:

   - the method by which groundwater cleanup indicator chemicals were selected;
   - the calculation of risks associated with groundwater at the Site and the difference between the cleanup approach presented in the Proposed Plan and that suggested in the MDNR/USEPA risk assessment; and
   - the data and assumptions used by the Agencies for calculating appropriate cleanup criteria and limitations of analytical chemistry in establishing groundwater cleanup levels.

2) The RSSC proposed list of groundwater cleanup indicator chemicals differs significantly from the listing of chemicals identified to be of concern in the Proposed Plan. The selection of indicator chemicals fails to consider frequency of detection. Chemicals which should be deleted, based on low frequency of detection, include:

   - 1,1-dichloroethene;
   - tetrachloroethene;
   - benzyl alcohol;
   - 2-chlorophenol; and
   - isophorone.

3) The potential carcinogenic risks presented in the Proposed Plan are inaccurate and in disagreement with the Agencies' risk assessment. The difference in total risk estimates is potentially one-half to one complete order of magnitude for maximum concentrations and potentially two orders of magnitude for average concentrations. Based on the Agencies' risk assessment, chemicals which should be deleted include:

- bis(2-ethylhexyl)phthalate;
- 1,1-dichloroethene;
- tetrachloroethene; and
- isophorone.

4) The cleanup approach taken in the Proposed Plan differs from the approach taken in the Agencies' risk assessment. The risk assessment used a Site-specific analysis whereas the Proposed Plan used a misapplication of the Michigan 307 Rules. Because Superfund risk assessment methodology uses the 307 Rules Type C analysis, the erroneous application of the 307 Rules, as in the Proposed Plan, effectively invalidates the entire Superfund risk assessment process.

5) Based on the detailed evaluation of the Agencies' proposed cleanup criteria, only seven indicator chemicals are retained as appropriate for groundwater cleanup at the Rasmussen Site. Retained indicator chemicals and appropriate cleanup levels include:

Chemical	*Appropriate Cleanup Level (µg/L)*
PDSLD/IW Area	
benzene	5
chlorobenzene	100
ethylbenzene	30
toluene	40
vinyl chloride	2
xylenes	20
South Slopes Area	
trichloroethene	5

With the exception of benzene and vinyl chloride, these cleanup levels are determined from monitoring in the affected groundwater zones. Cleanup levels for benzene and vinyl chloride are based on maximum levels at the Rasmussen well.

6) Two of the Agencies' proposed groundwater treatment technologies have been inappropriately selected. Based on the groundwater characterization from the RSSC's supplemental sampling events, metals treatment is not necessary nor feasible and biological treatment is unnecessary and unwarranted.

7) The Proposed Plan has significantly underestimated O&M costs based on a low estimate of remedial duration which the MDNR has acknowledged is unrealistic. The total cost is expected to range from $14,670,000 to $21,531,000 based on the proposed treatment processes for a system operating in perpetuity. This cost is significantly greater than the $7,320,000 presented in the Proposed Plan. A more realistic estimate of the groundwater remedial costs, based on the RSSC's proposed changes to the remedy, would be $3,583,640 for a 10-year operating period. This cost is $17,947,360 less than that estimated for the Agencies' proposed groundwater remedy.

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

The Michigan Department of Natural Resources (MDNR) and the United States Environmental Protection Agency, Region V (USEPA) issued their Proposed Plan for the final remedy at the Rasmussen Site on August 31, 1990. This Proposed Plan presented the MDNR/USEPA (the "Agencies") preferred remedial alternatives to address the municipal landfill and the groundwater beneath the Rasmussen Site.

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organics by granular activated carbon adsorption. The Agencies propose discharge of treated groundwater to a seepage basin situated over the Industrial Wastes (IW) and Probable Drum Storage Leakage Disposal (PDSLD) Areas. In addition, the Agencies propose fencing and deed restrictions to ensure the integrity of the remedy.

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CRA and the RSSC concur that the concept of capping is appropriate to the Rasmussen Site. However, the type of cap proposed by the Agencies represents a misapplication of Applicable or Relevant and Appropriate Requirements (ARARs). The Agencies' cap design is based on Michigan Act 64 requirements which were inappropriately selected as ARARs. Also, technical details of the proposed cap design are either unwarranted and unnecessary or are inappropriate for the Site conditions. An alternate cap design is presented in this document which would provide improved hydraulic performance and improved long term integrity compared to the Agencies' proposed cap design.

CRA and the RSSC have a significant number of concerns regarding the Agencies' proposed groundwater remedy. These include:

- the method by which groundwater cleanup indicator chemicals were selected;
- the calculation of risks associated with groundwater at the Site and the difference between the cleanup approach presented in the Proposed Plan and that suggested in the MDNR/USEPA risk assessment;
- the data and assumptions used by the Agencies for calculating appropriate cleanup criteria and limitations of analytical chemistry in establishing groundwater cleanup levels; and
- the selection of groundwater treatment technologies and the underestimation of costs associated with the groundwater remedy.

Appropriate groundwater cleanup levels previously were evaluated and presented to MDNR/USEPA in the document entitled "Proposed Groundwater Cleanup Levels"[1]. The key points of discussion presented in this previous document remain relevant and are reiterated in this document where appropriate.

The results of the RSSC's recent groundwater sampling conducted in October 1990 are provided for MDNR/USEPA's use in preparing the Record of Decision. This new data provides technical support for the RSSC's previous position on the inaccuracy of the Remedial Investigation (RI) characterization of the groundwater at the Rasmussen Site; the selection of groundwater cleanup indicator chemicals; and the appropriate application of Michigan's Act 307 Rules.

Comments regarding the Agencies' proposed cap and proposed groundwater remedy are presented below in Sections 2.0 and 3.0, respectively.

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[1] Refer to "Proposed Groundwater Cleanup Levels - Rasmussen Site - Livingston County, MI" prepared by Conestoga-Rovers & Associates dated August 2, 1990

2.0 MUNICIPAL LANDFILL CAP COMMENTS

The Agencies' proposed municipal landfill cap design is based on the Michigan Act 64 cap design presented in the Feasibility Study[2] (FS) under Site Wide Alternative 2, "Clay cap with no further excavation and restricted access". Areas to be capped under Site Wide Alternative 2 included the TML Area (which includes the NEBD Area), the IW Area, and the PDSLD Area. These areas are identified on Figure 2.1.

The FS identified these three areas as areas of concern based on the findings from the MDNR/USEPA Remedial Investigation[3] (RI) and Risk Assessment[4] (RA). Based on the results of the supplemental soil sampling conducted by the MDNR in December 1989/January 1990, the Agencies determined that the IW/PDSLD Areas were not areas of concern as originally indicated. Consequently, the Agencies required capping of only the TML Area in the Proposed Plan.

The RSSC concurs with the amendment to the FS which removes the requirement for capping of the IW/PDSLD Areas. The RSSC also concurs that a cap remedy is appropriate for the municipal landfill component of the Rasmussen Site.[5]

Since the issuance of the FS and the Proposed Plan, however, Site Wide Alternative 2 has been amended by MDNR/USEPA to increase the acreage of the proposed cap significantly beyond the limits of the TML Area.[6] This increased cap area is unwarranted and unnecessary given that the Agencies' risk assessment has determined that dermal/contact risks

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[2] Refer to "Final Draft, Feasibility Study, Detailed Evaluation, Spiegelberg and Rasmussen Dump Sites, Livingston County,MI" prepared by NUS Corporation and Warzyn Engineering

[3] Refer to "Final Remedial Investigation Report, Spiegelberg and Rasmussen Dump Sites, Green Oak Township, Livingston County, MI, Volumes I through VII", prepared by NUS Corporation, dated September 1988.

[4] Refer to "Final Risk Assessment, Spiegelberg and Rasmussen Dump Sites, Green Oak Township, Livingston County, MI ", prepared by NUS Corporation, dated September 1988

[5] The RSSC had previously proposed capping of the municipal landfill to the Agencies. Refer to "Proposed Remedial Plan, Rasmussen Site", prepared by CRA, dated August 10, 1989

[6] Amendment to FS cost estimate tables and addition of Figure 9-1B by MDNR dated September 10, 1990

associated with the south landfill slopes are acceptable. In addition, the type of cap and several technical design details presented in the Proposed Plan are also inappropriate.

During both the informal pre-meeting held July 31, 1990 and the formal meeting held on September 13, 1990, the public expressed concern regarding the longevity and long term integrity of a cap remedy for the on-Site landfill. The RSSC is proposing an alternate cap design which will provide improved longevity, improved long term integrity and improved hydraulic performance. This alternate design best addresses the public's concerns and includes design features which are technically more sound, administratively feasible and more cost-effective.

Comments regarding the applicability of the Agencies' proposed cap, appropriateness of technical design features which would affect cap longevity and integrity, details of the alternate cap design proposed by the RSSC, and FS cost estimates for the Agencies' proposed cap design are detailed below.

2.1 APPLICABILITY OF MICHIGAN ACT 64 CAP

The Agencies' proposed cap for the Rasmussen Site apparently is based on the Agencies' determination that the requirements of Michigan Act 64 are Applicable or Relevant and Appropriate Requirements (ARARs). However, Act 64 is neither "applicable" nor is it "relevant and appropriate" based on current Site conditions.

Potential ARARs identified in the Agencies' FS for the proposed cap include the requirements of the Federal Resource Conservation and Recovery Act of 1976 (RCRA) and Michigan Act 64. For an ARAR to be "applicable", the circumstances at the Site must satisfy all of the jurisdictional prerequisites of that ARAR. The FS determined that neither the RCRA nor Act 64 capping requirements are legally applicable. The FS, however, assumed that these requirements were "relevant and appropriate".

Relevant and appropriate requirements are those that address problems or situations sufficiently similar to those encountered at the Site such that the use of those requirements is well suited to the particular Site [7]. In some circumstances, a requirement may be relevant but not appropriate for the specific situation. In order to determine whether the RCRA or Act 64 requirements are relevant and appropriate to the municipal landfill portion of the Rasmussen Site, it is necessary to examine the Site-specific conditions existing at the Site taking into consideration remedial actions which have been completed to date.

The landfill portion of the Rasmussen Site contains municipal wastes at the present time. The drum and soil removal conducted by USEPA in 1984 resulted in the removal of the drummed industrial wastes which were evident on the landfill surface and near-surface. In addition, areas identified in the Agencies' Remedial Investigation as containing buried drummed industrial wastes have been remediated. In late 1989 and early 1990, the RSSC undertook an Immediate Response Action to address these areas. This remedial action involved the excavation and off-Site removal of drummed wastes and associated affected soils/debris from the NEBD Area, the IW Area, and an area referred to as the Surface Drum (SD) Area located on the Top of the Municipal Landfill. Based on the findings from the investigations conducted to date and the two completed removal actions, the remaining landfill materials are primarily municipal garbage[8]. Consequently, capping requirements established by RCRA and Michigan Act 64 for hazardous waste landfills are not relevant to the proposed capping of the Rasmussen Site.

However, even if the RCRA Act 64 capping requirements for hazardous waste landfills were relevant to the on-Site municipal landfill, they would not be appropriate for use at the Site. As noted by USEPA in its draft guidance on CERCLA compliance with other laws, "RCRA covers are generally not appropriate for large municipal landfills . . . where the waste is generally of a low toxicity and the Site encompasses an area that bears little

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[7] 46 FR 8742

[8] The MDNR has stated during both the pre-meeting held July 31, 1990 and the public meeting held September 13, 1990, that the "remaining waste materials are primarily the municipal garbage". Refer to page 34 of transcript for September 13, 1990 public meeting.

resemblance to the discrete units regulated under RCRA Subtitle C."[9] The municipal landfill at the Rasmussen Site is a large municipal landfill and it bears little resemblance to the discrete units regulated under RCRA Subtitle C. In addition, the waste in the landfill is of a low toxicity and does not resemble RCRA/Act 64 hazardous waste.

Consequently, the RCRA/Act 64 hazardous waste landfill final capping requirements are neither legally applicable nor are they relevant and appropriate for use at the Rasmussen Site.

The Agencies' FS did not identify any landfill capping ARARs other than those applicable to hazardous waste landfills. However, other ARARs applicable to the capping of municipal waste landfills have been promulgated by the State of Michigan.

Final covers for municipal landfills in Michigan are governed by the requirements of Michigan's Solid Waste Management Act, M.C.L. §§ 299.401 et seq. ("SWMA"). Because the Rasmussen Site was closed in 1972, the SWMA final cover requirements are not legally applicable. However, the final cover requirements promulgated pursuant to the SWMA were designed to address problems and situations sufficiently similar to those at the Rasmussen Site such that their use is well suited to this Site. Therefore, the final cover requirements of the SWMA are relevant and appropriate requirements.

The RSSC alternate cap design proposed below meets the SWMA requirements. In addition, Site specific design features of the alternate cap proposed by the RSSC provide improved longevity and long term integrity compared to the Agencies' proposed cap.

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[9] CERCLA Compliance With other Laws Manual, Interim Final, EPA/540/G-89/006, pg.2-21, dated August 8, 1988.

2.2 RSSC PROPOSED ALTERNATE CAP DESIGN

The above evaluation of the Agencies' proposed cap design for the Rasmussen Site has determined that the Act 64 cap design is neither applicable nor relevant and appropriate to the Site conditions.

Based on this evaluation, the RSSC proposes an alternate cap design which will satisfy capping ARARs, address technical flaws evident in the Agencies' proposed design, and provide a cover system which best addresses the public's concerns regarding cap longevity and long-term integrity.

Specific remedial activities associated with the proposed alternate capping of the municipal landfill include the following:

- The north slopes of the landfill would be backfilled and pregraded to the approximate contours shown on Figure 2.2 to stabilize the north escarpment face. To the extent possible, fill for pregrading would be obtained from the areas within the fenced portion of the Site located outside of the limits of the municipal landfill and the PDSLD/IW Areas. The fill would be placed in terraces to minimize erosion damage and long-term maintenance problems that would be associated with a single continuous slope.

- The soil excavated from the PDSLD Area in 1987 (Ramsey excavation) would be excavated and reconsolidated back in the PDSLD Area.

- The TML Area would be pregraded using fill as indicated on Figure 2.2 to flatten existing steeper slopes to minimize the potential for erosion damage to the landfill cap.

- A clay cap and cover system as depicted on Figure 2.3 would be constructed over the TML Area.

- A landfill perimeter collection drain would be constructed around the cap perimeter to collect surface water runoff and subsurface drainage from the cap. This collection system would convey the collected water to the base of the landfill slopes; thereby minimizing the amount of surface water runoff available to erode the landfill slopes.

- The areas outside of the limits of the landfill cap would be revegetated for surface water control and to promote stable surfaces.

The proposed alternate cap consists of capping of the TML Area as shown on Figure 2.2. The cap would extend over the TML Area, thereby encompassing the remediated NEBD and Surface Drum Areas. The Agencies' risk assessment has determined that dermal/contact risks associated with the south slopes adjacent to the TML Area are acceptable. Therefore, the cap need not extend over these areas. As stated in the Agencies' Proposed Plan, the Site fence would further minimize potential exposure to trespassers by restricting access. Consequently, capping of these south slopes is neither warranted nor necessary.

In addition, the south slopes are presently stable and heavily vegetated as indicated by the photographs presented in Appendix A. The steep grades on the south slopes currently promote rapid runoff of surface water from the heavily vegetated slopes; thereby minimizing infiltration in these soil areas. Due to the severe topography on these slopes as illustrated on Figure 2.4, it is anticipated that any disturbance of this area would produce unstable conditions and result in severe erosion and subsequent potential undercutting of the municipal landfill. In essence, the Proposed Plan calls for undoing the substantial vegetative cover which has been effectively established naturally over a large number of years and then requires a new vegetative cover to be created under conditions certain to result in significant and continued erosion problems. Therefore, it is inappropriate to disturb the south slopes.

2.3 COMPARISON OF AGENCIES' PROPOSED CAP AND RSSC PROPOSED ALTERNATE CAP

In addition to the concern raised in Section 2.1 regarding the applicable or appropriate type of landfill cap, a number of technical design features of the

Agencies' proposed cap presented in the FS and Proposed Plan are inappropriate for the Site conditions.

Several technical design features of the Agencies' proposed cap are unwarranted and unnecessary; would detract from the longevity and long-term integrity of the proposed cap; would be difficult to implement; would be administratively difficult; and would result in unnecessary increased cost. In addition, the Agencies' cap is significantly larger than necessary. The extent of cap in the Proposed Plan will encompass soil areas which are not areas of concern. Consequently, the large size of the proposed cap is unwarranted and unnecessary. The large cap area also is not technically and administratively feasible, and would impact the longevity and long term integrity of the proposed cap remedy.

The NCP [10] provides nine criteria to evaluate the Agencies' proposed cap and the RSSC's alternate cap. These criteria include:

- Overall Protection of Human Health and the Environment;
- Compliance with ARARs;
- Long-term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility or Volume through Treatment;
- Short Term Effectiveness;
- Implementability;
- Cost;
- Support Agency Acceptance; and
- Community Acceptance.

For the reasons discussed in detail below, the Agencies' proposed design does not adequately address these evaluation factors. In comparison, the alternate cap design proposed by the RSSC addresses these evaluation factors to the greatest possible extent.

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[10] National Contingency Plan, 40 CFR Part 300.

i) <u>Overall Protection of Human Health and the Environment</u>

The Agencies' proposed cap design would provide overall protection of human health and the environment in the long term but not in the short term. In comparison, the RSSC proposed alternate cap would provide improved overall protection of human health and the environment in the long term and short term.

The Agencies' and the RSSC's cap designs both address dermal/contact risk and potential risks to groundwater. Consequently, both the Agencies' proposed cap and the RSSC's proposed alternate cap would be protective in the long term.

However, construction of the Agencies' proposed cap would not be protective of human health and the environment in the short term. The proposed grading of landfill wastes onto unaffected soil areas outside the present limits of the landfill would result in exposing a large volume of landfill materials to rainfall and surface water infiltration during cap construction. This method of construction is not protective of the environment. Disturbance of the landfill wastes also may cause nuisance conditions and unnecessary exposures in adjacent areas during grading operations. In comparison, the RSSC's proposed design does not require grading of landfill wastes; thereby eliminating the potential for these short term concerns.

Based on the discussion under other evaluation factors, the overall protectiveness of the Agencies' cap design cannot be ensured due to questions regarding longevity and long term integrity. In comparison, the positive measures proposed in the RSSC's alternate cap design to control stormwater and erosion will ensure that overall protection of human health and the environment is maintained in the long term.

ii) <u>Compliance with ARARs</u>

As evaluated in Section 2.1, the Agencies' proposed cap design was based on an inappropriate selection of cap ARARs. Although the

Agencies' proposed cap would meet the cap cover ARARs established by Michigan's Solid Waste Management Act, it would not utilize best design practices for landfill covers.

The Michigan Solid Waste Management Regulations pursuant to the SWMA require that soil erosion control measures be implemented to comply with the Michigan soil erosion and sedimentation control act (R299.4316(4)). The Agencies' cap design does not take appropriate measures against erosion in light of the severe Site topography. In comparison, the RSSC's proposed cap design takes positive measures to comply with this ARAR.

iii) Long-Term Effectiveness and Permanence

The Agencies' proposed design does not adequately consider Site specific conditions which impact permanence or utilize current best design practice for landfill cover systems to ensure long term integrity.

Pertinent factors which were not addressed in the Agencies' proposed design include:

- stormwater and erosion management,
- drainage,
- cover design for climatic conditions, and
- vegetative cover design.

Details of pertinent factors not considered by the Agencies' proposed cap are discussed below.

a) Stormwater and Erosion Management

The Agencies' large proposed cap area does not promote proper stormwater and erosion management. The proposed cap area is 15.8 acres. This is significantly larger (factor of three times) than the actual 5.2-acre area encompassed by the TML Area. Consequently, the surface and subsurface drainage systems must effectively control three times the volume of stormwater which would otherwise be required. The grading design shown on Figure 9-1B of the FS identifies long continuous cap slopes at a steep grade of 25 percent due to the severe Site topography. This type of design results in rapid surface water runoff and subsurface drainage conditions having significant erosive potential. Combined with the significant stormwater volume produced as a result of the large cap area, severe soil erosion of the landfill cover by surface water runoff is expected. The resulting development of erosion rills and gullies requiring frequent attention and repair would impair the permanence of the proposed remedy.

In addition to the erosion of surface soil, the rapid drainage and increased volume of water to be controlled by the subsurface drainage layer, based on the Agencies' proposed cap, would increase the potential for internal erosion ("piping") within the drainage layer. As well, surface seeps would develop along the lower slopes of the cap due to the large volume of water to be conveyed through the subsurface drain layer. In either instance, the landfill cover system would be subject to internal erosion as well as surface erosion. Consequently, the integrity and longevity of the Agencies' cap would be compromised.

In comparison, the RSSC's proposed alternate cap design uses best design practice for proper stormwater and erosion management. Positive design measures include:

- the use of a smaller cap area to minimize the volume of stormwater runoff; and
- the use of terraces and perimeter drains to interrupt and intercept surface water runoff.

b) Drainage

The Agencies' large proposed cap area would also cause drainage problems in adjacent areas. Soils outside of the limits of the municipal landfill presently consist of permeable soils which allow for infiltration of rainfall. In comparison, a cap would effectively preclude infiltration. To illustrate the magnitude of drainage concerns, approximately 3,218,000 gallons of water would be shed annually by the Agencies' cap through the subsurface drainage layer (assumed 30 inches rainfall and 25% drainage). This is the equivalent of a depth of 22 inches of standing water over the 5.2-acre TML Area. The Agencies' proposed design would cause a significant portion of this drainage volume to occur onto the adjacent Spiegelberg property. Temporary flooding of adjacent lands following periods of significant rainfall has not been addressed by the Agencies' proposed design.

In comparison, the RSSC's proposed alternate cap design takes positive measures to address these drainage concerns. The use of permeable sideslope soils outside of the limits of the TML area will promote surface water infiltration and reduce lateral drainage. The proposed terraces will slow the rate at which surface drainage occurs and the perimeter drains allow for redirection of drainage waters. These measures will reduce drainage requirements and minimize drainage-related off-Site impacts.

c) Cover Design for Climatic Conditions

The Agencies' proposed cap consists of one foot of vegetated soil and one foot of drainage layer overlying the clay barrier layer. This cover system is inappropriate to the Site climatic conditions. The proposed cover design would promote cracking of the clay barrier layer by frost action and by desiccation, thereby decreasing cap longevity and long-term integrity.

Current practice for the design of landfill cover systems requires that sufficient cover be provided over the barrier layer to prevent frost damage. Frost damage to the clay barrier occurs when insufficient cover is available to insulate the clay layer. The ensuing cyclic freezing and thawing of the clay barrier layer results in vertical cracks which allow for water infiltration; thereby negating its purpose. Good practice requires placing sufficient cover over the clay barrier to prevent frost from penetrating to the depth of the clay barrier. Based on USEPA guidance, the frost penetration depth at the Rasmussen Site is approximately 30 inches [11]. Consequently, the Agencies' proposed cover thickness of 24 inches is inadequate for ensuring long term integrity against frost damage.

The Agencies' proposed drain layer design follows conventional design practice which is based on rapid removal of subsurface water. However, this design practice may be detrimental to long term cap integrity. Best design practice would use positive measures to prevent excessive moisture loss from clay soils under summer drought conditions. This would minimize the degree of soil volume changes resulting from moisture loss which could induce vertical cracks in the clay layer. Best design practice would keep clay barriers moist to prevent desiccation damage from occurring; therefore, rapid drainage design practices as used for the Agencies' cap design would be inappropriate. Based on discussions with local clay suppliers, locally available clay meeting the Agencies' permeability requirements of 1×10^{-7} cm/s is a "heavy" clay which is more sensitive to moisture changes and thus more susceptible to desiccation cracking. The Agencies' proposed thick drain layer design does not address these factors which affect long term integrity.

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[11] Refer to Figure 6 in "Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments", EPA/530-SW-89-047, dated July 1989.

In comparison, the RSSC proposed alternate cover design uses best design practice for climatic conditions. Positive design measures include:

- the use of a thicker soil cover to insulate the clay barrier layer and protect against frost-related damage; and
- the use of a thinner subsurface drain layer to ensure adequate moistening of the clay layer to prevent desiccation cracking from occurring.

d) Vegetative Cover Design

The Agencies' proposed thickness of one foot for the vegetated soil layer does not promote the growth of productive surface vegetation which would be resistant to erosion and drought. A one-foot thick vegetative soil layer does not allow for the planting of more durable grass species (with deeper root structures) because of the need to prevent roots from penetrating into the clay barrier layer. This lack of deep rooted species will detract from the benefit of a deeper root zone which provides improved mechanical anchorage of the cover system against erosion. A thicker vegetative soil layer would also increase the depth of soil capable of holding water from infiltrating rainfall. A thicker soil layer would increase the total available moisture-holding capacity of the cover layer. This increased available moisture is necessary to maintain a viable vegetated cover system under drought conditions. Otherwise, under drought conditions the soil cover would be barren of vegetation and susceptible to erosion. This would be of particular concern for the long steep slope design proposed by the Agencies. Consequently, the Agencies' proposed design does not promote productive cover vegetation to ensure long term integrity and permanence.

In comparison, the RSSC's proposed alternate cap design uses a thicker soil layer to increase available soil moisture capacity for improved vegetative growth.

These Site specific features incorporated into the RSSC's proposed design will ensure long term effectiveness and permanence.

iv) Reduction of Toxicity, Mobility or Volume Through Treatment

As indicated in the Proposed Plan, this is not a pertinent factor for a cap remedy. However, mobility would be effectively reduced due to the reduction of surface water infiltration by a low permeability cap. The positive measures to ensure integrity of the RSSC proposed design would provide a more effective reduction of mobility through reduction of surface water infiltration.

v) Short-Term Effectiveness

The Agencies' proposed cap design does not adequately address short-term effectiveness factors. The Proposed Plan identifies that short-term risks potentially posed to the community and workers can be effectively eliminated through engineering measures and protective equipment for workers. The Proposed Plan estimates the implementation period to be one to two years. However, based on the large cap area and proposed grading plan, this estimated time frame is unrealistic. Approximately 127,300 cubic yards (8,900 truckloads based on 1.4 tons/cubic yard) of cover materials is needed to construct the Agencies' proposed cap. The transport of this material quantity to Site would potentially cause significant disturbance to the community.

In addition, as discussed under "overall protection of human health and the environment", the grading of the landfill wastes is not protective of the environment during construction and may cause nuisance conditions.

In comparison, the RSSC's proposed cap minimizes off-Site borrow requirements (71,100 cubic yards of soil compared to 127,300 cubic yards of import borrow for Agencies' cap) and does not require grading of wastes; therefore these potential concerns regarding the Agencies' cap design are either minimized or not relevant. The reduced cap area and smaller volume of borrow fill required for the RSSC design (approximately 4,980 truckloads compared to Agencies' 8,900 truckloads) will result in a shorter implementation period and therefore result in less disturbance to the community and less potential risk to workers during construction.

vi) <u>Implementability</u>

The large area of the Agencies' proposed cap would impact implementability. Due to the large size of the proposed cap and proposed grading, construction timing is important. It is unlikely that the Agencies' proposed cap would be constructed within the estimated implementation period due to severe winter working conditions at the Site.

In comparison, the smaller RSSC cap design would be more easily implemented because construction timing is less critical due to the shorter implementation period required.

The Agencies' proposed final grade design would also detract from its implementability. The long steep slope design presented in the Proposed Plan will result in difficult working conditions during placement of clay in wet weather. In addition, the proposed slope design promotes rapid surface water runoff which would promote erosion and increase the difficulty in reestablishing a vegetative cover.

In comparison, the RSSC's cap design is more implementable. The RSSC design limits the size of the area requiring clay cover and does not require placing clay over steep slopes. The terraces and stormwater control systems would minimize surface erosion during revegetation of the landfill slopes.

As previously mentioned under the "long-term effectiveness and permanence" factors for the Agencies' proposed design, easements and deed restrictions would be required along two sides of the Spiegelberg property based on the proposed lateral extent of the capped area and drainage considerations. Based on past experience and concerns raised by the public, it may be administratively difficult to prevent disturbance of a constructed cap over these areas. The temporary flooding caused by drainage from the Agencies' proposed cap would potentially lead to greater difficulties in enforcing deed restrictions and would affect property and resource use. In comparison, the limited extent of the RSSC proposed cap would minimize, if not eliminate, administrative concerns regarding easements and deed restrictions on adjacent property.

vii) Costs

The Agencies' proposed cap is not cost effective compared to the RSSC's proposed cap. The TML Area occupies 5.2 acres. However, the cap presented on Figure 9-1B of the Agencies' FS covers approximately 15.8 acres and extends significantly beyond the limits of the TML Area. This is most evident to the south of the municipal landfill where the cap extends 300 feet beyond the TML Area and onto the adjacent Spiegelberg property. The extent of cap shown on Figure 9-1B, which has been selected as part of the Proposed Plan, differs markedly from the extent of cap shown on Figure 9-1 of the FS which previously included capping of the IW/PDSLD Areas. This previous cap design covered only 11.0 acres (including the IW/PDSLD Areas) and limited the south extent of cap to approximate the limits of the TML Area. No rationale is provided in the Proposed Plan for this significant proposed increase in the extent of cap beyond the limits of the TML Area. It appears that this increase in cap size is due to the proposed grading of landfill materials onto unaffected soils. The Agencies' design would encompass 15.8 acres without providing any increase in overall protection of human health and the environment.

The Agencies have erroneously estimated the capital cost of their proposed cap to be $2,940,247. As discussed in Section 2.5, corrected estimates of capital cost for the Agencies' design are in excess of $8,248,860.[12]

In addition to costs resulting from the size of the proposed cap, the Agencies' design would incur unnecessary costs from extensive grading of the municipal landfill wastes. The proposed grading would result in the direct placement of municipal waste onto otherwise clean soils surrounding the landfill.

Grading of the landfill wastes is proposed apparently for the purpose of minimizing the quantity of borrow fill which would otherwise be needed for proper grading of the landfill slopes. However, grading of landfill wastes is not cost-effective due to Site topography. Due to the significant elevation drop along the undermined north side of the landfill, grading of the wastes cannot be performed as a single operation. Instead, grading would consist of excavation, on-Site transport to the bottom of the slope, and recompaction of the placed municipal wastes. The cost associated with such a material handling operation would be significant. Consequently, this proposed grading would result in significant unjustified costs because the pregrading of available on-Site soil supplemented by the use of import borrow fill is more economical.

In addition to concerns regarding capital costs, there are concerns regarding the accuracy of the Agencies' estimates of operation and maintenance (O&M) costs as detailed in Section 2.5. The Proposed Plan estimates the present worth of O&M costs to be $53,043.[13] Based on the concerns regarding inappropriate erosion control design measures, a significant level of effort and associated cost would likely be incurred in repairing and maintaining the Agencies' proposed cap for a number of

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[12] Based on corrected quantity estimates provided by MDNR contractor with appropriate adjustments to FS costs for increased soil layer thicknesses and soil layers not included in FS, but included in Proposed Plan.

[13] The Proposed Plan incorrectly cited the FS present worth cost of $53,043 as being a one-year O&M cost.

years, if not indefinitely. The O&M cost estimate of approximately $0.5 million for the RSSC proposed cap described in Section 2.2 is likely a more realistic lower bound estimate of O&M costs for the Agencies' cap design.

In comparison, the RSSC's proposed alternate cap design is cost-effective. The estimated capital cost of the RSSC's proposed design is approximately $2,623,000 and the upper end O&M cost is estimated to be approximately $0.5 million based on a 30-year maintenance period[14]. The substantive provisions of the RSSC's design to ensure long term effectiveness and permanence would likely reduce this estimated O&M cost.

viii) Support Agency Acceptance

This criterion cannot be addressed by the RSSC. However, the alternate design is consistent with the SWMA and utilizes current best design practice for landfill covers.

ix) Community Acceptance

The community has already expressed significant concern regarding the long-term integrity and longevity of the Agencies' proposed cap remedy. Based on the foregoing evaluation of factors, in particular "long-term effectiveness and permanence", the Agencies' proposed cap does not adequately address the public's concerns. In comparison, the RSSC design takes positive measures to address the community concerns regarding cap longevity and integrity.

* * *

In summary, it is clear that the Agencies' proposed cap does not represent an appropriate cap design for the Rasmussen Site. In comparison,

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[14] *Refer to Appendix B for RSSC cost estimates.*

the RSSC's proposed cap addresses the evaluation factors to the greatest extent possible and represents an appropriate cap design for the Rasmussen Site.

2.4 COMPARISON OF HYDRAULIC PERFORMANCE

In addition to substantively addressing all nine of USEPA's evaluation criteria, the RSSC proposed alternate cap design will provide an improved level of hydraulic performance compared to that provided by the Agencies' proposed Act 64 cap design.

The effectiveness of the RSSC proposed alternate cap design in reducing infiltration was evaluated using the Hydrologic Evaluation of Landfill Performance (HELP) model[15] . For purposes of comparison, model runs were performed for both the proposed alternate cap design and the Agencies' proposed Act 64 cap. The typical cap sections used for modeling purposes are shown on Figures 2.3 and 2.5, respectively.

Table 2.1 summarizes the results of this modeling which are contained in Appendix C. These results show that both cap designs are equally effective in reducing infiltration (95.9% reduction for the Agencies' Act 64 cap compared to a 95.6% reduction for the proposed alternate cap) and thus, are functionally equivalent in this respect.

However, the HELP model overstates the effectiveness of the Agencies' cap by assuming ideal conditions. Assumptions implicit to the HELP model include the assumption that no cracks in the clay barrier layer have resulted from frost damage or desiccation damage. From the evaluation conducted in Section 2.3, such an assumption could not be ensured for the Agencies' proposed cap design. Consequently, in actual practice, the RSSC proposed alternate cap design will prove superior to the Agencies' Act 64 cap.

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[15] The HELP model was developed by USEPA for evaluation of landfill cover performance.

TABLE 2.1

SUMMARY OF HELP MODEL OUTPUT
PROPOSED CAP DESIGN COMPARISON

Type of Landfill Cap	*Precipitation (in/yr)*	*Surficial % Runoff*	*% Evapotransp.*	*% Lateral Drainage*	*% Reduction in InfiltrationThrough Cap*	*Comments*
MDNR Act 64 Cap	30.00	1.72	69.31	24.05	95.9	12" topsoil, 12" sand drain, 36" clay
RSSC Proposed Alternate Landfill Cap	30.00	1.70	69.88	23.12	95.6	6" topsoil, 18" uncompacted common fill, 6" sand drain, 24" clay

Notes:

1) All values are mean annual values over a 5-year period.
2) The lateral drainage distance was 200 feet.
3) A 12% lateral drainage slope was used in all cases.
4) Refer to Appendix C for HELP model run outputs.

2.5 FS CAP COST ESTIMATES

The FS cost estimates for the Agencies' proposed cap contain numerous calculational errors which have resulted in a severe underestimation of the capping costs. The Agencies' cost estimates for the proposed cap have been revised several times without adjusting for appropriate changes to unit costs or quantity estimates, and without making cost allowance for cap components which were not included in the original FS cap design. Errors in the cost estimates include the following:

i) The cost for supply and placement of clay is based on a 2-foot thick layer and not 3 feet as presented in the Proposed Plan.

ii) There are two conflicting unit costs presented for supply and placement of clay. Under the unit costs for "clay cover", the unit cost is $10.00/CY whereas under "multimedia cover", the unit cost is $17.00/CY. It appears that the higher unit cost is intended to apply to a clay having a permeability of less than 1×10^{-7} cm/s. However, the Agencies' cost estimate assumed the lower unit cost.

iii) The unit cost for topsoil supply and placement is based on a 6-inch thick layer and not one foot as presented in the Proposed Plan.

iv) The Agencies' cost estimate does not include the cost of supply and placement of the sand drainage layer.

v) The Agencies' cost estimate for grading of the landfill materials is based on a prorating of the Agencies' previous estimates and is not based on the quantity estimate for grading conducted by the Agencies' contractor.

vi) The Agencies' unit cost for grading of the landfill materials is too low. The unit cost of $10.00/CY assumes no stockpiling and minimal clearing and grubbing. These assumptions are not consistent with the double-handling requirements due to existing topography (i.e. physical restrictions imposed by the escarpment) and the clearing requirements for existing trees within the areal limits of the Agencies' proposed cap. A more appropriate unit cost would be approximately $18.00/CY.

Table 2.2 provides the corrected cost for the Agencies' proposed cap design consistent with the method of calculation used in the FS using the FS unit costs. Table 2.3 includes additional adjustment for the low unit cost for grading of the landfill materials. Based on corrections for calculational errors only, the Agencies' cap is estimated to cost $8,248,860. With additional correction for the low unit price for grading landfill materials, the total capital cost would be $11,395,715. Consequently, the correct capital cost for the Agencies' cap is $5,255,570 to $8,402,425 greater than that presented in the Proposed Plan. These costs are significantly greater than the $2,993,290 presented by the Agencies and clearly show that the Agencies' cap is not cost-effective.

In comparison, the RSSC's proposed cap is estimated to cost $2,623,390 (refer to Appendix B). This cost is substantially less than the $8,248,860 to $11,395,715 estimated for the Agencies' cap. Because the RSSC's proposed design provides improved hydraulic performance and positively addresses each of the NCP evaluation criteria, the RSSC proposed cap is very cost-effective compared to the Agencies' proposed design

In addition, the FS did not conduct an evaluation of O&M costs for the proposed cap. Reference is made in the FS to the use of a percentage of the capital cost as an estimate of O&M costs. However, this percentage is not stated in the FS and cannot be deduced from the O&M costs because of differing percentage values used in the FS. An estimate of O&M costs for the RSSC proposed cap is approximately $0.5 million. Because the Agencies' cap is unnecessarily larger than the RSSC cap and the design does not include positive measures against erosion, this estimate is likely a lower-bound O&M cost estimate for the Agencies' cap.

Consequently, the Agencies' proposed cap is not cost-effective in terms of capital and O&M costs. In comparison, the RSSC proposed design is cost-effective while being fully protective of public health and the environment.

TABLE 2.2

CORRECTED LOWER-BOUND AGENCY CAPITAL COST ESTIMATE

Item	*Description*	***Estimated Quantity***	*Unit*	*Unit Cost*	*Total Cost*
1	Grade Waste Material	188,390	CY	$10.00	$1,883,900
2	Low Permeability Clay (3-foot layer)	76,375	SY	17.00	1,298,375
3	Drainage Layer (1-foot layer)	76,375	SY	6.03	460,540
4	Topsoil (1-foot layer)	76,375	SY	3.82	291,750
5	Surface Drainage	76,375	SY	0.21	16,040
	Subtotal				$3,950,605
6	Mobilization (5%)				197,530
7	Health and Safety (10%)				395,060
8	Bid & Work Scope (30%)				1,185,180
	Subtotal				$5,728,375
9	Permit, Construction & Document (20%)				1,145,675
	Subtotal				$6,874,050
10	Design (20%)				1,374,810
TOTAL CAPITAL COST					$8,248,860

Notes:

1) All quantities and unit prices based on corrected quantity estimates provided by MDNR (done by Warzyn) and quantities/unit prices from FS.

TABLE 2.3

CORRECTED UPPER-BOUND AGENCY CAPITAL COST ESTIMATE

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
1	Grade Waste Material	188,390	CY	$18.00	$3,391,020
2	Low Permeability Clay (3-foot layer)	76,375	SY	17.00	1,298,375
3	Drainage Layer (1-foot layer)	76,375	SY	6.03	460,540
4	Topsoil (1-foot layer)	76,375	SY	3.82	291,750
5	Surface Drainage	76,375	SY	0.21	16,040
	Subtotal				$5,457,725
6	Mobilization (5%)				272,885
7	Health and Safety (10%)				545,770
8	Bid & Work Scope (30%)				1,637,310
	Subtotal				$7,913,690
9	Permit, Construction & Document (20%)				1,582,740
	Subtotal				$9,496,430
10	Design (20%)				1,899,285
TOTAL CAPITAL COST					$11,395,715

Notes:

1) All quantities and unit prices based on corrected quantity estimates provided by MDNR (done by Warzyn) and quantities/unit prices from FS except that unit prices for Item 1 (grade waste materials) has been increased to account for double-handling costs.

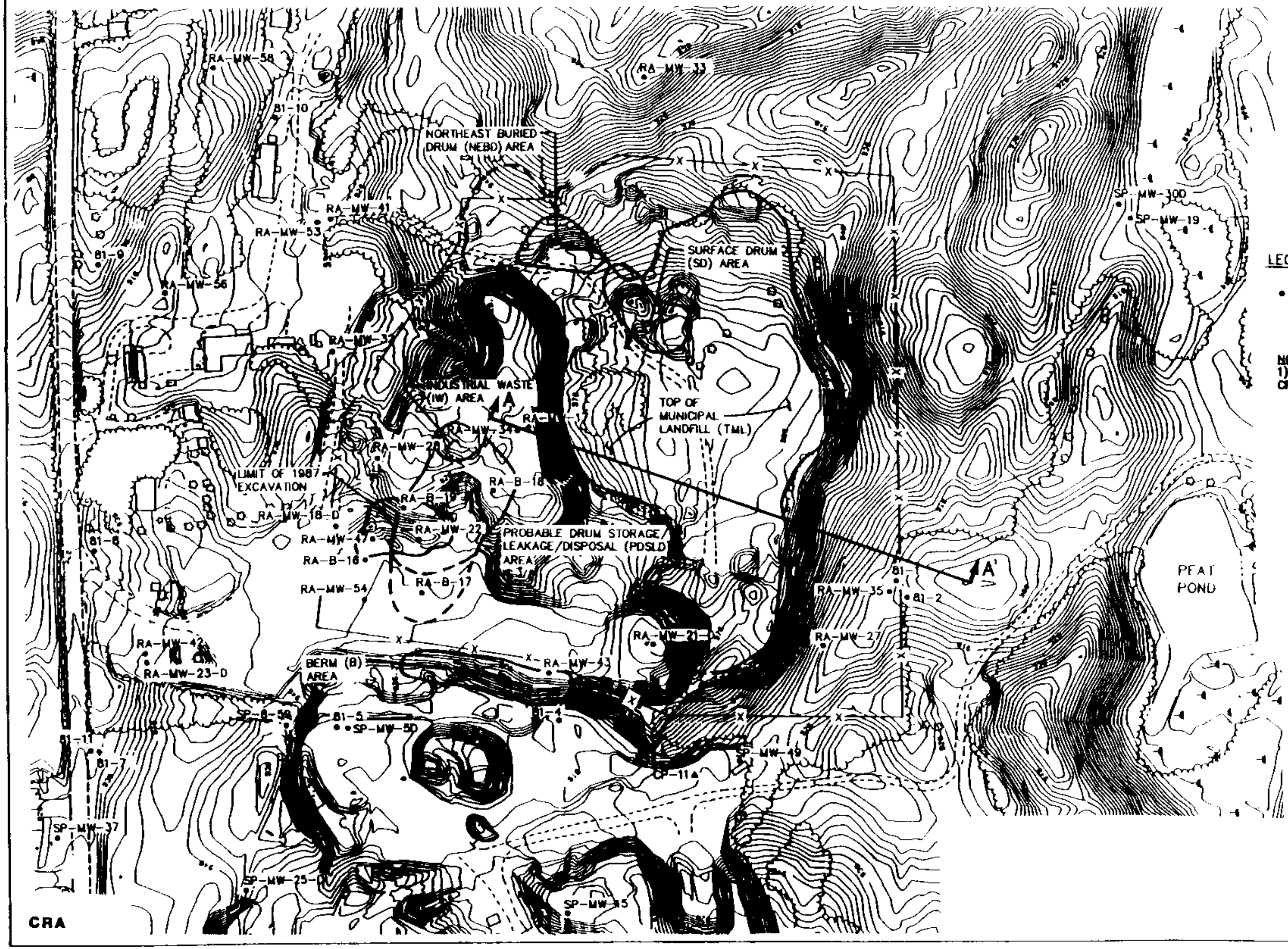


figure 2.1
SITE PLAN
Rasmussen Site

2433-18/10/90-12-0

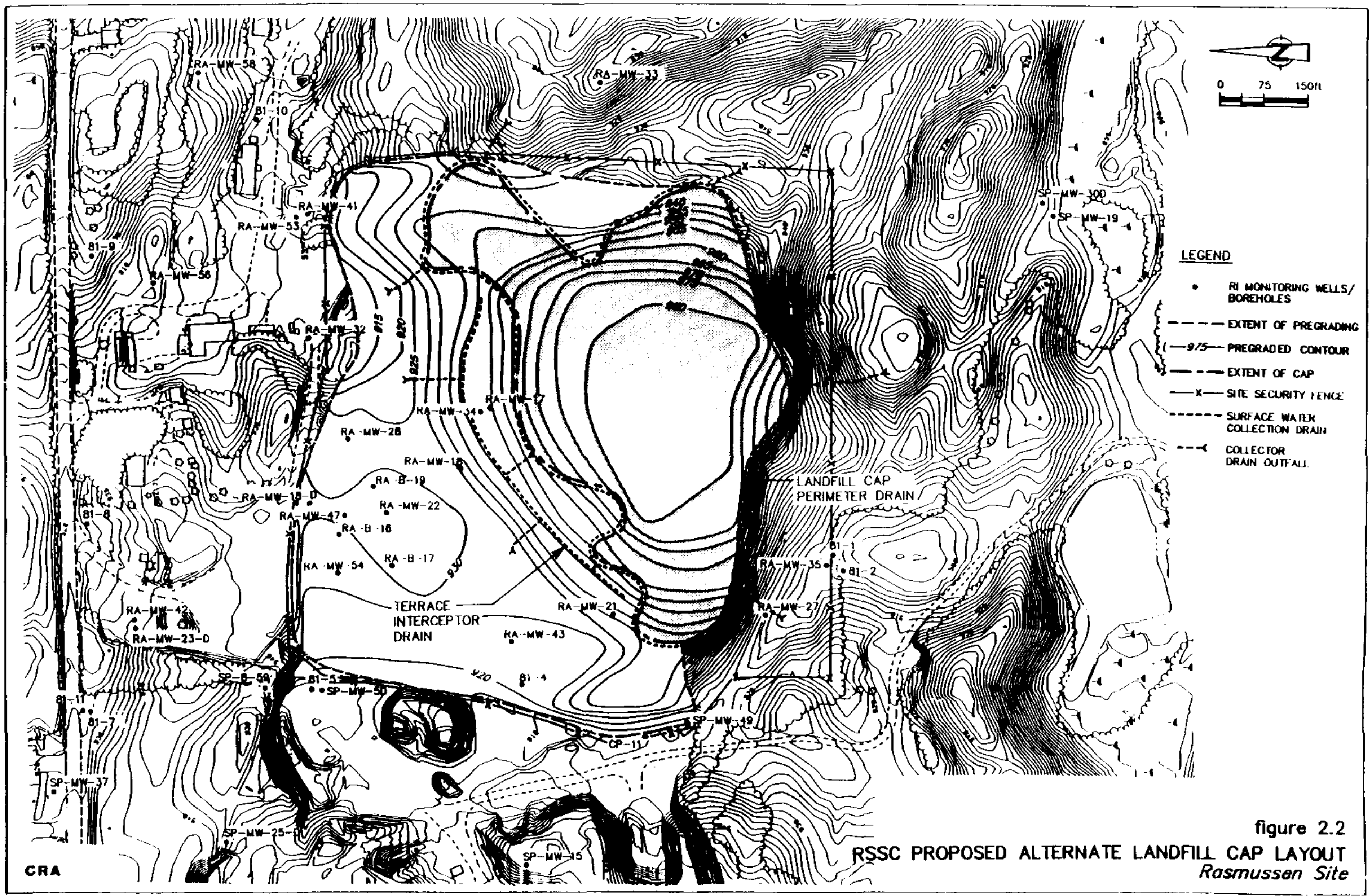


figure 2.2

RSSC PROPOSED ALTERNATE LANDFILL CAP LAYOUT

Rasmussen Site

2433-5/10/90-12-0

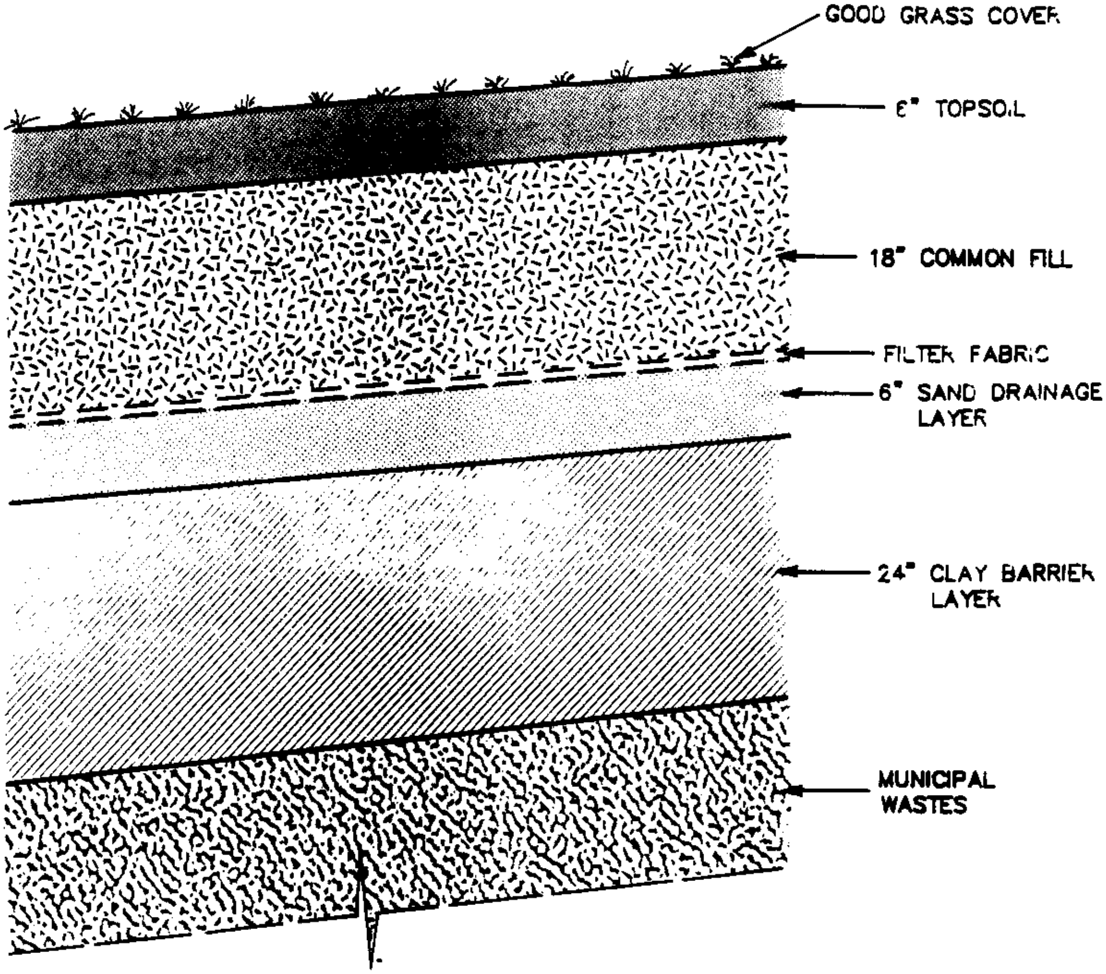
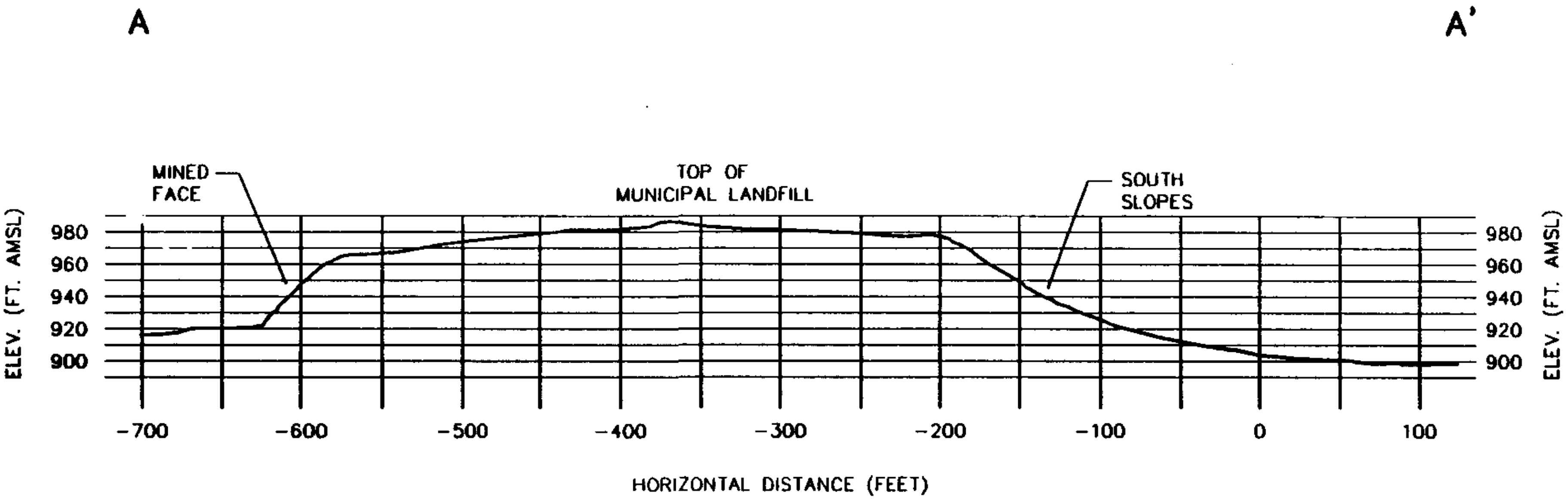


figure 2.3

TYPICAL SECTION
RSSC PROPOSED ALTERNATE LANDFILL CAP
Rasmussen Site

CRA

2433–5/10/90–12–0



NOTES:
1) REFER TO FIGURE 2.1 FOR LOCATION OF CROSS-SECTION

figure 2.4

CROSS-SECTION A-A'
Rasmussen Site

CRA

2433-18/10/90-12-0 (X-01)

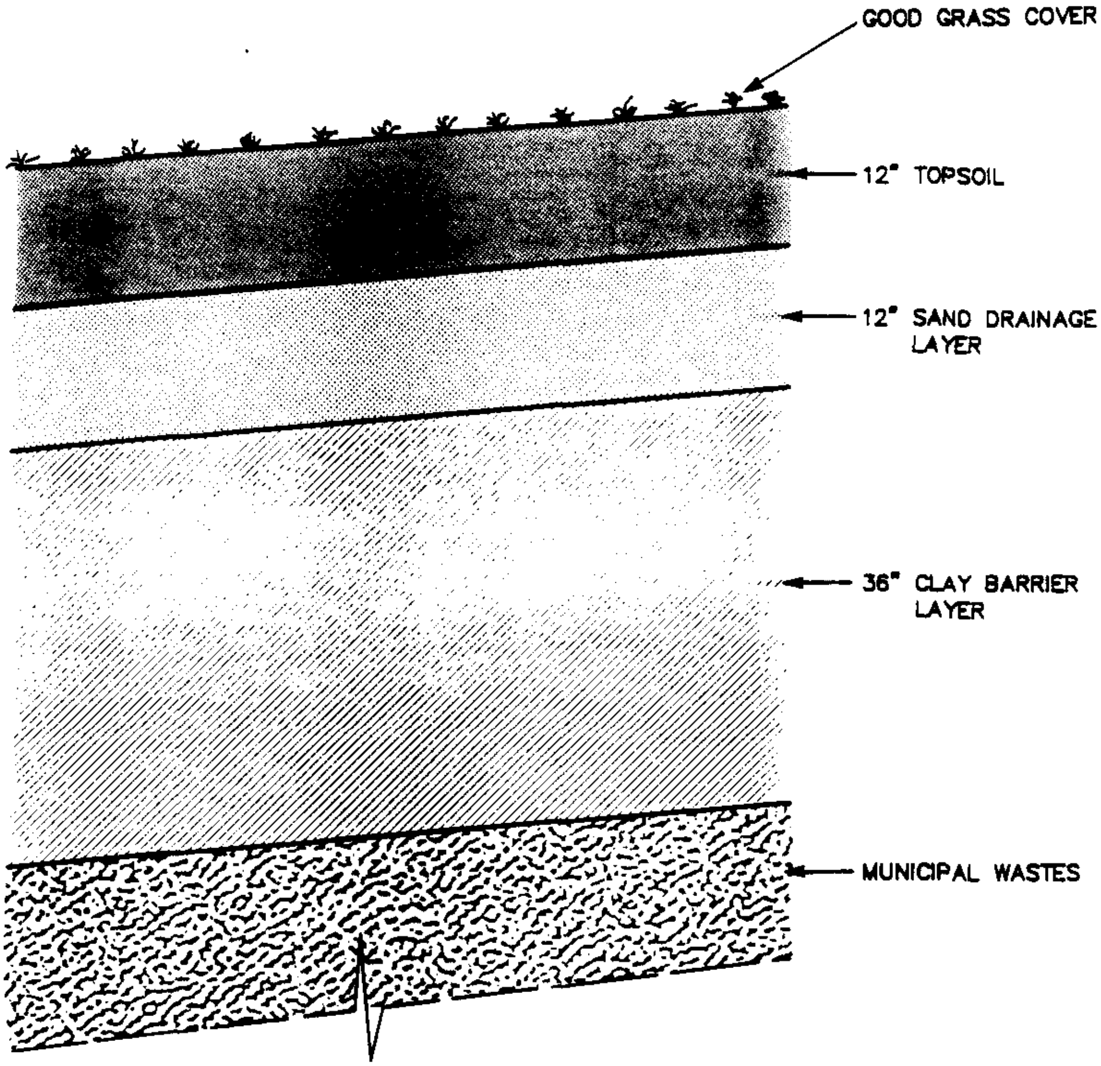


figure 2.5

TYPICAL SECTION
AGENCY PROPOSED LANDFILL CAP
Rasmussen Site

3.0 GROUNDWATER REMEDY COMMENTS

The RSSC agrees that groundwater remediation at the Rasmussen Site is appropriate. However, the RSSC has numerous concerns regarding the appropriateness of the groundwater remedy presented in the Proposed Plan. These concerns include:

- the method by which groundwater cleanup indicator chemicals were selected;
- the calculation of risks associated with groundwater at the Site and the difference between the cleanup approach presented in the Proposed Plan and that suggested in the MDNR/USEPA risk assessment;
- data and assumptions used by the Agencies for calculating appropriate cleanup criteria and limitations of analytical chemistry in establishing groundwater cleanup levels; and
- the selection of groundwater treatment technologies and the underestimation of costs associated with the groundwater remedy.

The RSSC's evaluation of the Agencies' proposed groundwater cleanup criteria has identified that a number of proposed indicator chemicals are inappropriately listed and should be deleted. The Agencies' proposed indicator chemical list and associated groundwater cleanup levels are shown on Table 3.1. Indicator chemicals which the RSSC believes should be deleted and the basis for the proposed deletion are summarized on Table 3.2. The rationale for deleting these chemicals from the Agencies' proposed groundwater cleanup indicator list are detailed in the following sections.

3.1 SELECTION OF GROUNDWATER CLEANUP INDICATOR CHEMICALS

The Proposed Plan identifies 24 groundwater cleanup indicator chemicals for the Rasmussen Site which include volatile organic compounds (VOCs), base neutral/acid extractable (BNA) compounds, and inorganic compounds. These proposed indicator chemicals and their associated cleanup levels are shown in Table 3.1.

TABLE 3.1

AGENCY PROPOSED GROUNDWATER CLEANUP CRITERIA

Chemical	*Agencies' Proposed Cleanup Level (ppb)*	*Agencies' Basis for Proposed Level*
Volatile Organic Compounds		
acetone	700.0	HLSC
benzene	1.2	1E-06
2-butanone	350.0	HLSC
chlorobenzene	50.0	T&O
1,1-dichloroethene	1.0	MDL
1,2-dichloroethene	100.0	MCL (P)
ethylbenzene	30.0	T & O
4-methyl-2-pentanone	350.0	HLSC
methylene chloride	5.0	1E-06
tetrachloroethene	0.7	1E-06
toluene	40.0	T & O
1,1,1-trichloroethane	200.0	MCL
trichloroethene	3.0	1E-06
vinyl chloride	0.5	MDL
xylenes	20.0	T & O
Base Neutral/Acid Extractable Compounds		
benzyl alcohol	9.0	HLSC
bis(2-ethylhexyl)phthalate	2.0	1E-06
2-chlorophenol	0.1	T & O
2,4-dimethylphenol	1.0	MDL
isophorone	8.0	1E-06
2-methylphenol	3.0	T & O
4-methylphenol	2.0	T & O
Inorganic Compounds		
cadmium	4.0	HLSC
lead	5.0	HLSC*

Notes:
MDL = Method Detection Limit
MCL = Maximum Contaminant Level (P = proposed)
1E-06 = One in One Million Carcinogenic Risk Level
T & O = Taste and Odor Threshold
HLSC = Human Lifecycle Safe Concentration
HLSC* = HLSC or Filtered Background (whichever is higher)

Source:
Proposed Plan, Rasmussen Dump Site, Livingston County, MI dated August 31, 1990

TABLE 3.2

INDICATOR CHEMICALS PROPOSED FOR DELETION

Chemical	*Basis for Proposed Deletion*	*Section Reference*
Volatile Organic Compounds		
Acetone	- Common laboratory artifact	Section 3.3.1.1
	- Not present above Agency proposed cleanup level based on RSSC data	Section 3.3.1.1
2-Butanone	- Not present in groundwater based on RSSC data	Section 3.3.1.1
1,1-Dichloroethene	- Low frequency of detection in RI data	Section 3.1
	- Risk shown in Risk Assessment based on RI maximum detected values within USEPA acceptable range	Section 3.2.1
	- Not present in groundwater based on RSSC data	Section 3.3.1.6
1,2-Dichloroethene	- Not present above Agency proposed cleanup level based on RSSC data	Section 3.3.1.1
4-Methyl-2-pentanone	- Not present above Agency proposed cleanup level based on RSSC data	Section 3.3.1.1
Methylene chloride	- Common laboratory artifact	Section 3.3.1.10
	- Not present in groundwater based on RSSC data	Section 3.3.1.10
Tetrachloroethene	- Low frequency of detection in RI data	Section 3.1
	- Risk shown in Risk Assessment based on RI maximum detected values within USEPA acceptable range	Section 3.2.1
	- Not present in groundwater based on RSSC data	Section 3.3.1.12
1,1,1-Trichloroethane	- Not present above Agency proposed cleanup level based on RSSC data	Section 3.3.1.1

TABLE 3.2

INDICATOR CHEMICALS PROPOSED FOR DELETION

Chemical	***Basis for Proposed Deletion***	*Section Reference*
<u>*Base Neutral/Acid Extractable Compounds*</u>		
Benzyl alcohol	- Low frequency of detection in RI data	Section 3.1
	- Not present in groundwater based on RSSC data	Section 3.3.1.2
Bis(2-ethylhexyl)phthalate	- Common laboratory artifact	Section 3.3.1.3
	- Risk shown in Risk Assessment based on RI maximum detected values within USEPA acceptable range	Section 3.2.1
2-Chlorophenol	- Low frequency of detection in RI data	Section 3.1
	- Not present in groundwater based on RSSC data	Section 3.3.1.5
	- Not reported above HLSC level in RI	Section 3.3.1.5
2,4-Dimethylphenol	- Not present above corrected Agency proposed cleanup level (HSLC) based on RSSC data	Section 3.3.1.7
Isophorone	- Low frequency of detection in RI data	Section 3.1
	- Risk shown in Risk Assessment based on RI maximum detected values within USEPA acceptable range	Section 3.2.1
	- Not present in groundwater based on RSSC data	Section 3.3.1.8
2-Methylphenol	- Not present above corrected Agency proposed cleanup level (HLSC) based on RSSC data	Section 3.3.1.9
4-Methylphenol	- Not present above corrected Agency proposed cleanup level (HSLC) based on RSSC data	Section 3.3.1.9

TABLE 3.2

INDICATOR CHEMICALS PROPOSED FOR DELETION

Chemical	*Basis for Proposed Deletion*	*Section Reference*
<u>*Inorganics*</u>		
Cadmium	- Dissolved form not present above Agency proposed cleanup level based on RSSC data	Section 3.3.1.15
Lead	- Dissolved form not present above corrected Agency proposed cleanup level based on RSSC data	Section 3.3.1.14
	- Total form not present above background levels from RI based on RSSC data	Section 3.3.1.14

The proposed list of groundwater cleanup indicator chemicals differs significantly from the listing of chemicals identified to be of concern in the Agencies' risk assessment. Of the 24 indicator chemicals listed in the Proposed Plan, only 14 were noted previously in the MDNR/USEPA risk assessment as being "major contributors" to the risks from potential ingestion of the groundwater. Compounds common to both the MDNR/USEPA RA and Proposed Plan listings include acetone; benzene; 2-butanone; chlorobenzene; 1,1-dichloroethene; ethylbenzene; methylene chloride; tetrachloroethene; toluene; trichloroethene; vinyl chloride; xylenes; bis(2-ethylhexyl)phthalate; and cadmium. The selection process for indicator chemicals indicated in the Proposed Plan fails to acknowledge the findings from the Agencies' own risk assessment. To be consistent with the indicator chemical selection process for other sites in Michigan and USEPA Region V, cleanup indicator chemicals should correspond to only those identified by the Agencies' risk assessment as being of concern.

Moreover, the proposed list of indicator chemicals is inappropriate when frequency of detection is taken into consideration. Table 3.3 lists the calculated frequency of detection for the Agencies' proposed indicator chemicals based on data collected during the Agencies' RI and supplemental data from the RSSC's sampling programs from May/June and October of 1990. The calculated frequency of detection for the RI data shown in Table 3.3 was based on the frequency of detection presented in Table 2-5 of the Agencies' risk assessment with appropriate adjustments for errors in the Agencies' calculations. Inspection of the Agencies' RI identified that data from monitoring wells 81-5 and SP-MW-5D were not included in the Agencies' analysis of frequency of detection. These wells apparently were erroneously not included in the analysis because they were located on the adjacent Spiegelberg property even though they were physically placed in the affected Rasmussen groundwater. Appropriate adjustments to include these wells resulted in the addition of eight samples to the total number of RI analyses for calculating the frequency of detection.

Review of Table 3.3 indicates that several of the Agencies' proposed indicator chemicals are inappropriate indicators for the purpose of

TABLE 3.3

CONCENTRATIONS AND FREQUENCY OF DETECTION OF PROPOSED GROUNDWATER CLEANUP INDICATOR CHEMICALS

	Remedial Investigation Results(1)		*RSSC Supplemental Results(2)*		*Combined Results*	
Chemical	*No. of Positive Detections/ No. of Samples*	*Range of Positive Detections (µg/L)*	*No. of Positive Detections/ No. of Samples (3)*	*Range of Positive Detections (µg/L)*	*No. of Positive Detections/ No. of Samples*	*Range of Positive Detections (µg/L)*
Volatile Organic Compounds						
acetone	6/22	110B-26,000B	2/11	5.5* - 6.5*	8/33	5.5* 0 26,000B
benzene	8/22	260J-700	7/11	2.8 - 170	15/33	2.8 - 700
2-butanone	5/22	22J-74,000B	0/11	–	5/33	22J - 74,000B
chlorobenzene	5/22	1,000-3,700	4/11	320T - 890	9/33	320T - 3,700
1,1-dichloroethene	1/22	2J	0/11	--	1/33	2J
1,2-dichloroethene	12/22	2J-590J	5/11	4.1T - 51	17/33	2J - 590J
ethylbenzene	5/22	500-2,400	4/11	120T - 680	9/33	120T - 2,400
4-methyl-2-pentanone	9/22	300J-30,000	3/11	53-67E	12/33	53 - 30,000
methylene chloride	6/22	1J-1,100BJ	0/11	--	6/33	1J - 1,100BJ
tetrachloroethene	1/22	2J	0/11	–	1/33	2J
toluene	5/22	18,000 B-71,000	2/11	30 - 900T	7/33	30 - 71,000
1,1,1-trichloroethane	8/22	2J-500	5/11	5.7 - 75	13/33	2J - 500
trichloroethene	5/22	8-500J	1/11	2.9	6/33	2.9 - 500J
vinyl chloride	2/22	1J-96J	4/11	6.6*-300ET	6/33	1J - 300ET
xylenes	5/22	3,700-11,000	4/11	460T - 4,100J	9/33	460T - 11,000

TABLE 3.3

CONCENTRATIONS AND FREQUENCY OF DETECTION OF PROPOSED GROUNDWATER CLEANUP INDICATOR CHEMICALS

	Remedial Investigation Results(1)		*RSSC Supplemental Results(2)*		*Combined Results*	
Chemical	*No. of Positive Detections/ No. of Samples*	*Range of Positive Detections (µg/L)*	*No. of Positive Detections/ No. of Samples (3)*	*Range of Positive Detections (µg/L)*	*No. of Positive Detections/ No. of Samples*	*Range of Positive Detections (µg/L)*
Base Neutral/Acid Extractable Compounds						
benzyl alcohol	2/22	2.2J-12	0/11	--	2/33	2.2J - 12
bis(2-ethylhexyl)phthalate	2/22	12B-14	5/11	9.5* - 64	7/33	9.5* - 64
2-chlorophenol	2/22	12-17	0/11	--	2/33	12 - 17
2,4-dimethylphenol	2/22	14-27	1/11	50	3/33	14 - 27
isophorone	3/22	91J-440	0/11	--	3/33	91J - 440
2-methylphenol	5/22	260-1,600	1/11	85	6/33	85 - 1,600
4-methylphenol	4/22	70-280	1/11	66T	5/33	66T - 280
Inorganic Compounds						
cadmium (total)	4/8	5-29	8/9	2.2 - 60	12/17	2.2 - 60
lead (total)	6/8	7-779	9/9	5.0 - 1,200	15/17	5.0 - 1,200
cadmium (dissolved)	--	--	3/9	0.60 - 1.50	3/9	0.60 - 1.50
lead (dissolved)	--	--	6/9	3.8*-9.7	6/9	3.8* - 9.7

Notes:

(1) Refer to Table 2-5, Final Risk Assessment. Values shown in Table 2-5 have been amended to include samples collected from wells 81-5 and SP-MW-5D.

(2) Based on data from RSSC supplemental sampling program conducted in July/August and October of 1990 for the following wells: RA-MW-18D, SP-MW-5D, 81-5, RA-MW-54, RA-MW-22, RA-MW-28 and RA-MW-34.

(3) Sample data qualified by laboratory artifacts are not included in number of positive detections.

groundwater cleanup. USEPA guidance indicates that 5 percent is an appropriate level for screening out chemicals on the basis of frequency of detection.[16] Following this guidance, proposed indicator chemicals which should be eliminated include the following:

- The compound 1,1-dichloroethene was detected only once during the combined RI and RSSC sampling programs. The calculated low frequency of detection (1/22 based on RI data; 1/33 based on combined data) combined with the fact that this singular detection is an estimated value (flagged with a "J") does not qualify this compound to be an appropriate indicator chemical for the Rasmussen Site. In addition, the RSSC's supplemental sampling data from May/June 1990 and October 1990 confirmed the absence of this chemical.

- Tetrachloroethene was detected only once during the combined sampling programs. The calculated low frequency of detection (1/22 based on RI data; 1/33 based on combined data) is insufficient for this compound to be listed as an indicator chemical. In addition, the RSSC's supplemental sampling programs from May/June 1990 and October 1990 did not detect the presence of this chemical.

- Benzyl alcohol was detected twice during the RI but its presence could not be confirmed by the RSSC's supplemental sampling programs. Based on this low frequency of detection (2/22 based on RI data; 2/33 based on combined data) and low reported concentrations, benzyl alcohol is inappropriate as a groundwater cleanup indicator chemical.

- The compound 2-chlorophenol was detected only twice during the RI and was not confirmed by the RSSC's supplemental sampling programs. Based on this low frequency of positive detections (2/22 based on RI data; 2/33 based on combined data) and the low concentrations of this compound which were reported, 2-chlorophenol is inappropriate as a groundwater cleanup indicator chemical.

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[16] Refer to "Risk Assessment Guidance for Superfund - Human Health Evaluation Manual - Part A - Interim Final" OSWER Directive 9285.7-01a, dated September 29, 1989.

- Isophorone was detected three times during the RI but its presence could not be confirmed by the RSSC's Supplemental Sampling programs. Based on this low frequency of detection (3/22 based on RI data; 3/33 based on combined data), isophorone is inappropriate as a groundwater cleanup indicator chemical.

In summary, based on the above evaluation of frequency of detection alone, several chemicals identified in the RI have been inappropriately selected as proposed groundwater cleanup indicator chemicals in the Proposed Plan. Based on a thorough review of the available data, chemicals which should be deleted on a frequency of detection basis include:

- 1,1-dichloroethene;
- tetrachloroethene;
- benzyl alcohol;
- 2-chlorophenol; and
- isophorone.

In addition, there are other reasons presented in the parameter-by-parameter analysis contained in Section 3.3 which further support the deletion of these chemicals from the proposed indicator chemical list.

3.2 GROUNDWATER RISKS AND CLEANUP APPROACH

3.2.1 Calculation of Groundwater Risks

Review of the Agencies' Proposed Plan has identified that the potential carcinogenic risks presented in Table 1 of the Proposed Plan are inaccurate and are in complete disagreement with the Agencies' own calculations presented in the MDNR/USEPA risk assessment.

During the formal public meeting held on September 13, 1990 by the Agencies to present the Proposed Plan, several members of the public expressed significant concern regarding the perceived level of risk associated with ingestion of groundwater from the Rasmussen Site. These concerns were based on the combined carcinogenic risk of 1.72E-02 presented in Table 1 of the Proposed Plan. This risk estimate should be clarified in light of the unrealistic worst case exposure scenario that this risk estimate represents.

The potential carcinogenic risk estimates shown for each chemical in Table 1 of the Proposed Plan effectively assume that a domestic or community supply well would be installed directly into the affected groundwater at the location of maximum chemical concentrations beneath the Rasmussen Site. The exposure scenario assumes that an individual would drink 2 liters of this groundwater daily for 70 years. This is clearly an unrealistic situation because this would require that the hypothetical supply well be deliberately relocated over time to coincide with the location of peak concentrations as the affected zone migrates with the regional groundwater flow. The exposure scenario further assumes that chemical concentrations are not attenuated over time and distance as the groundwater migrates. Of even greater significance, this exposure scenario effectively assumes that individuals would have access to the Rasmussen Site, notwithstanding the fact that the Site is secured by fencing and that groundwater development for community public water supplies is prohibited by Michigan's Safe Drinking Water Act.[17]

Although the Agencies' risk assessment used overly conservative exposure assumptions in calculating the potential risks to the public from ingestion of the groundwater, if left unremediated, the exposure assumptions in the risk assessment are more representative of the potential risk to the public than the estimates presented in the Proposed Plan.

The Proposed Plan presents a combined groundwater risk of 1.72E-02. By comparison, the Agencies' own calculations from their risk assessment estimate the potential risk to range from 1.75E-03 to 5.36E-03 based on maximum chemical concentrations and from 1.62E-04 to 4.93E-04 based on average chemical concentrations. For the maximum concentration case, the MDNR/USEPA total risk estimates are lower than that presented in the Proposed Plan by approximately one-half to one complete order of

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[17] Michigan's Safe Drinking Water Act (Act 299) Administrative Rules prohibit the installation of wells for public water supplies within 2,000 feet of large scale waste disposal sites or sanitary landfills. Refer to R325.10812.

magnitude. The difference is potentially as large as two orders of magnitude lower for the estimated total risk based on average chemical concentrations.

The RSSC recommends that the Agencies present the risk results from the Agencies' risk assessment shown on Table 3.4 to the public and clarify the unrealistic nature of the risk numbers presented in the Proposed Plan.

Inspection of Table 3.4 also indicates that several proposed indicator chemicals are inappropriately listed as such based on the level of risk associated with potential exposure to groundwater. USEPA typically uses maximum risk exposure scenarios to determine if remediation is warranted. Following this approach, several proposed indicator chemicals would have associated maximum risks within the acceptable risk range of 10^{-4} to 10^{-6} set forth in the NCP. Based on MDNR/USEPA's own risk calculations for maximum exposure scenarios shown on Table 3.4 (risk calculated with maximum chemical concentrations), indicator chemicals which should be eliminated on this basis include:

- bis(2-ethylhexyl)phthalate;
- 1,1-dichloroethene;
- tetrachloroethene; and
- isophorone.[18]

3.2.2 Cleanup Approach

The approach adopted in the Agencies' risk assessment to quantify Site-related risks and the approach to establishing groundwater cleanup criteria implicit in the Agencies' risk assessment (RA) differ significantly from the methodology and approach taken in the Proposed Plan for determining appropriate cleanup criteria.

The risk assessment procedures used in the Agencies' RA were based on the application of a Site-specific analysis which attempted to take into

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[18] Although not calculated in the MDNR/USEPA's risk assessment, isophorone should also be eliminated based on the acceptable risk presented in the Proposed Plan.

TABLE 3.4

AGENCY ESTIMATES OF CARCINOGENIC RISK

		MDNR/USEPA Risk Assessment(1)	
Chemical	*Risk Presented In Proposed Plan - Table 1*	*Risk Range Calculated with Maximum Chemical Concentrations*	*Risk Range Calculated with Average Chemical Concentrations*
benzene	5.8E-04	1.96E-04 to 5.98E-04	4.51E-05 to 1.37E-04
bis(2-ethylhexyl)phthalate	4.8E-06	9.6E-07 to 2.93E-06	7.2E-08 to 2.2E-07
1,1-dichloroethene	1.0E-02	1.59E-05 to 4.84E-05	7.94E-07 to 2.42E-06
isophorone	4.1E-05	not calculated in RA	not calculated in RA
methylene chloride	2.2E-04	1.03E-04 to 3.14E-04	8.99E-06 to 2.74E-05
tetrachloroethene	2.9E-06	6.03E-07 to 1.84E-06	3.01E-08 to 9.19E-08
trichloroethene	1.5E-04	5.28E-05 to 1.61E-04	5.7E-06 to 1.74E-05
vinyl chloride	6.2E-03	1.38E-03 to 4.23E-03	1.01E-04 to 3.08E-04
Total Risk	1.72E-02	1.75E-03 to 5.36E-03	1.62E-04 to 4.93E-04

Notes:

(1) From Table B-14 "Addendum and Errata Pages to Final Risk Assessment, Spiegelberg and Rasmussen Dump Sites, Green Oak Township, Livingston, MI" MDNR/USEPA November 1989

consideration various relevant factors at the Rasmussen Site. Section 4.0 of the Agencies' RA attempted to establish appropriate groundwater cleanup levels by calculating acceptable risk-based groundwater concentrations at a hypothetical receptor, located at Spicer Road, and extrapolating back to the present location of the affected zone by using groundwater modeling.

By comparison, the proposed groundwater cleanup levels presented in the Proposed Plan are based on a misapplication of the newly promulgated Michigan Act 307 Rules (hereinafter referred to as 307 Rules).

Three groundwater cleanup classifications, designated as Type A, Type B, and Type C, are established within the 307 Rules. Type A groundwater cleanup standards would require groundwater to be cleaned up to background levels or to analytical method detection limits as defined in the rules. Type B groundwater cleanup standards are based on an excess 1 X 10^{-6} incremental lifetime carcinogenic risk level for carcinogens and the Human Life Cycle Safe Concentration (HLSC) for noncarcinogens. The 307 Rules allow for the groundwater cleanup criteria established by the HLSC to be further adjusted to a Federal Secondary Maximum Contaminant Level (SMCL) or to concentrations represented by "the concentration which is documented as the taste or odor threshold or the concentration below which appearance or other aesthetic characteristics are not adversely affected". Type C groundwater cleanup standards require site-specific conditions to be addressed, thereby establishing groundwater cleanup standards through a site-specific risk assessment.

By failing to consider a Type C cleanup classification, the Agencies' Proposed Plan makes no allowance for Site-specific conditions and disregards issues of technical achievability, limitations of analytical chemistry, reasonable and foreseeable use of the Site, and cost-effectiveness. Current practice at Federal Superfund Sites, including sites located within USEPA Region V, typically follows the Type C approach. It should be recognized that the Agencies' own risk assessment for the Rasmussen Site followed the Type C approach. Even though the Agencies' risk assessment was issued prior to the issue of the final 307 Rules, the Type C approach implicit in the Agencies' risk assessment remains valid because groundwater cleanup levels determined from a Type C analysis are protective of human health and the environment. The Agencies' insistence on using only Type A and Type B groundwater cleanup levels, as presented in the Proposed Plan, fails to recognize the application of Type C groundwater cleanup levels where appropriate. Because Superfund risk assessment methodology uses the 307 Rules Type C analysis, the erroneous application of the 307 Rules effectively invalidates the entire Superfund risk assessment process.[19]

The RSSC previously submitted a document entitled "Proposed Groundwater Cleanup Levels, Rasmussen Site, Livingston County, MI" to MDNR/USEPA for their consideration in establishing appropriate groundwater cleanup criteria at the Rasmussen Site. This analysis was based on the framework established by the 307 Rules for determining groundwater cleanup levels. This analysis presented a combination of cleanup criteria based on the Type A, Type B, and Type C cleanup classifications. Where it was deemed to be technically achievable and appropriate, proposed groundwater cleanup levels were based on achieving a Type B cleanup criteria. Based on a detailed analysis of Site-specific factors, however, it was determined that Type B cleanup levels were neither achievable nor appropriate for benzene and vinyl chloride. The RSSC concluded that appropriate Type C cleanup levels for these two compounds were 5 μg/L and 2 μg/L, respectively, based on the Type C analysis which produced risk estimates for these two compounds which fell within the acceptable risk range stated in the NCP.

The RSSC reiterates that a combination of cleanup classifications is appropriate for the Rasmussen Site and is warranted for specific chemicals on issues of technical achievability, limitations of analytical chemistry, reasonable and foreseeable land and resource use, and cost-effectiveness. In addition, such an approach would be consistent with both Federal guidance and the requirements of the 307 Rules.

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[19] Refer to "Misapplication of the Act 307 Rules and Superfund Reauthorization Act to the Decision Process at the Rasmussen Site" prepared by Dickinson, Wright, Moon, Van Dusen and Freeman dated October 31, 1990.

3.3 DETAILED EVALUATION OF AGENCY PROPOSED CLEANUP CRITERIA

The RSSC has previously conducted a detailed parameter-by-parameter evaluation of groundwater cleanup criteria within the framework of the 307 Rules. This evaluation presented in the document entitled "Proposed Groundwater Cleanup Levels, Rasmussen Site" was submitted to MDNR/USEPA for their consideration in developing appropriate groundwater cleanup criteria for the Rasmussen Site. The conclusions of that analysis and analysis of additional parameters following the 307 Rules to correct for inaccurate calculations and assumptions in the Proposed Plan is presented below. Analytical results from the RSSC's October 1990 sampling event which support this analysis are presented in Appendix D. In addition, the previous evaluation contained a detailed discussion of achievable analytical detection limits. The RSSC reiterates that several cleanup criteria proposed by the Agencies are not analytically achievable.

3.3.1 Calculation of Cleanup Criteria

3.3.1.1 Acetone, 2-Butanone, 1,2-Dichloroethene, Ethylbenzene, 4-Methyl-2-pentanone, Toluene, 1,1,1-Trichloroethane and Xylenes

The proposed Type B cleanup levels for these parameters have been calculated correctly according to the 307 Rules. However, only three of these parameters are present above cleanup levels in the groundwater.

The RSSC supplemental sampling program conducted in May/June 1990 identified that several of these chemicals are either present in the groundwater at concentrations below their appropriate Type B cleanup levels or are present as a result of laboratory introduced sample contamination. In particular, compounds including acetone, 2-butanone, 1,2-dichloroethene and 1,1,1-trichloroethane were identified as being below their respective Type B cleanup levels.

The RSSC sampling program in October 1990 has verified that acetone, 1,2-dichloroethene, 4-methyl-2-pentanone and 1,1,1-trichloroethane are below their respective Type B cleanup levels. In addition, 2-butanone was not detected during either of the RSSC's two sampling events and acetone detected in the second sampling round was associated with laboratory introduced artifacts in each instance. Maximum concentrations detected by the RSSC's sampling events include:

Compound	*Maximum Detected Concentration (µg/L)*	*Proposed Cleanup Level (µg/L)*
acetone	6.5	700
2-butanone	not detected	350
1,2-dichloroethene	51	1000
4-methyl-2-pentanone	67	350
1,1,1-trichloroethane	75	200

These analytical results confirm that the RI characterization of the groundwater is incorrect and that setting cleanup levels for these parameters is inappropriate. These results are significant because all wells identified to be in the affected groundwater zone were sampled by the RSSC. In addition, well RA-MW-18D was sampled during both RSSC sampling rounds to verify that data would be reproducible between sampling rounds. The results from both sampling rounds for this well show good reproducibility in terms of detected analytes and concentrations.

Consequently, the RSSC data provides an accurate representation of the Rasmussen groundwater.

Based on these findings, chemicals which should be deleted from the cleanup indicator list include:

- acetone;
- 2-butanone;
- 1,2-dichloroethene;
- 4-methyl-2-pentanone; and
- 1,1,1-trichloroethane.

Only ethylbenzene, toluene, and xylenes should be retained as indicator chemicals.

3.3.1.2 Benzyl Alcohol

As noted previously, benzyl alcohol should be deleted from the indicator chemical list because its presence could not be confirmed by the RSSC's sampling events and based on low frequency of detection.

Even if benzyl alcohol were present, the Agencies have inappropriately selected it as an indicator chemical. The Type B cleanup level proposed by the Agencies for benzyl alcohol has been incorrectly calculated. Review of the Agencies' calculations has identified that the proposed HLSC is derived from a MgT value based on a LD_{50} value reported by a reference document from 1984. For comparison, USEPA has published a chronic RfD of 3E-1 mg/kg/day (Health Effects Assessment Summary Tables, Fourth Quarter, 1989 (HEAST)). Based on the USEPA published RfD, the Type B HLSC concentration for benzyl alcohol is 2,100 μg/L. Based on this calculated value for the HLSC and the low concentrations of benzyl alcohol identified at the Rasmussen Site from the RI, benzyl alcohol should be deleted from the cleanup indicator list, even if present in the groundwater.

3.3.1.3 Bis(2-ethylhexyl)phthalate

As noted previously, bis(2-ethylhexyl)phthalate should be deleted from the indicator chemical list because its risk in the Agencies' RA based on RI maximum detected values is within the USEPA's acceptable range.

Bis(2-ethylhexyl)phthalate also should be deleted as an indicator chemical because the proposed Type B cleanup level for bis(2-ethylhexyl)phthalate is at a concentration below that which can be distinguished from other potential sources of phthalates in typical analyses. Bis(2-ethylhexyl)phthalate is a common sample contaminant attributable to field and/or sample handling procedures (i.e. contact with sample gloves, sample containers) and for the purpose of environmental analyses is considered ubiquitous at low levels. The Agency for Toxic Substances and Disease Registry (ATSDR) has noted that "contamination of laboratory apparatus and solvents with DEHP is very common, since it is a component of many plastic and rubber products and is ubiquitous in the environment".[20] Therefore, for the purpose of cleanup at the Rasmussen Site, bis(2-ethylhexyl)phthalate should not be an indicator chemical. This chemical should be deleted from the cleanup indicator list.

3.3.1.4 Chlorobenzene

The RSSC has previously proposed a Type B cleanup level for chlorobenzene of 100 µg/L. This level was selected using the 307 Rules and was based on USEPA's final lifetime Health Advisory. The Agencies' proposed Type B cleanup level is based on a taste and odor threshold reported in a paper by Amoore and Hautala[21]. However, there is a published value of 100 µg/L for the taste and odor threshold reported in Verschueren[22] which the Agencies have also used as a reference source for other parameters in developing cleanup levels for the Rasmussen Site. The 307 Rules do not specify the use of the lowest published taste and odor value where multiple and conflicting values are available because this would represent an arbitrary application of the 307 Rules. Therefore, the Agencies' proposed Type B criteria should be revised to 100 µg/L consistent with USEPA's final lifetime Health Advisory.

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[20] Draft Toxicological Profile for Di(2-Ethylhexyl)Phthalate, ATSDR, December 1989.

[21] Odor as an Aid to Chemical Safety: Odor Thresholds Compared With Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilution; John A. Amoore and Earl Hautala; Journal of Applied Toxicology, Vol. 3, No. 6, 1983.

[22] Handbook of Environmental Data on Organic Chemicals, 2nd Edition, K. Verschueren, Van Nostrand Reinhold Company, 1983.

3.3.1.5 2-Chlorophenol

As noted previously, 2-chlorophenol should be deleted from the list of indicator chemicals because it has not been detected in either of the RSSC's two supplemental sampling events and has a low frequency of detection.

Even if 2-chlorophenol were present, the Agencies have selected an inappropriate cleanup level. The Agencies have evaluated Type B criteria for this compound and identified two alternate types of Type B levels. Consistent with a published RfD, the Agencies have calculated an HLSC of 40 μg/L. The Agencies have also identified a range of taste and odor thresholds published in Verschueren. The odor threshold is cited as being 0.18 μg/L whereas the taste threshold is cited as ranging from 0.1 μg/L to 6 μg/L. The Agencies have elected to select the lowest cited value as proposed cleanup criteria. This method of selecting cleanup criteria does not have a sound scientific basis and is arbitrary in nature. In particular, for 2-chlorophenol, the proposed cleanup level of 0.1 μg/L appears to be related to a reported case of tainting of fish which is not appropriate for the Rasmussen Site. In addition, the proposed cleanup level of 0.1 μg/L is below measurable analytical method detection limits.

As stated above, no cleanup level is required for 2-chlorophenol because it is not present in groundwater. Even if present, based on the conflicting range of reported taste and odor values, cleanup levels should be set at 40 μg/L consistent with the HLSC which is at a level that is analytically achievable. Because 2-chlorophenol, if present, is below this cleanup level based on the RI data, it should be deleted from the list of indicator chemicals.

3.3.1.6 1,1-Dichloroethene

As noted previously, 1,1-dichloroethene should be deleted from the cleanup indicator list because it has not been detected during the RSSC's sampling events and based on low frequency of detection and the acceptable risk determined by the Agencies' risk assessment.

Even if 1,1-dichloroethene were present, the Agencies proposed cleanup level has been established inappropriately. The Type B cleanup level proposed by the Agencies for 1,1-dichloroethene is based on carcinogenicity without taking other pertinent factors into consideration. USEPA has listed 1,1-dichloroethene as a Class C carcinogen indicating that carcinogenic effect in humans is suspected based on animal studies only and not based on evidence of carcinogenicity in humans. Typically, USEPA establishes the Maximum Contaminant Level Goal (MCLG) under the Federal Safe Drinking Water Act (SDWA) as zero for known or suspected human carcinogens. However, for 1,1-dichloroethene, USEPA has set both the MCL and MCLG at a level of 7 μg/L. USEPA's reason for establishing this level is that evidence of carcinogenicity is based on inhalation exposure and not oral exposure (refer to IRIS data file for 1,1-dichloroethene). As a result, USEPA's MCLG was set at 20% of the RfD similar to the 307 Rules HLSC. Consequently, to be consistent with the SDWA MCL and MCLG, the appropriate level of cleanup for 1,1-dichloroethene should be 7 μg/L if this chemical is present in groundwater. This cleanup level is both technically feasible and analytically detectable.

3.3.1.7 2,4-Dimethylphenol

The Agencies have incorrectly selected 2,4-dimethylphenol as a groundwater cleanup indicator based on the Agencies' evaluation of the 307 Rules. The Agencies cite 400 μg/L and 500 μg/L as the respective odor and taste thresholds in their evaluation based on USEPA's Ambient Water Quality Criteria Document for 2,4-dimethylphenol. However, the Agencies have arbitrarily elected to use a lower cleanup level by making the assumption that "insufficient toxicity data precludes the use of aesthetic data. There is no way to relate aesthetic data to verify that they (i.e. the numbers) are protective of groundwater and human health. Therefore, the method detection limit (1.0 ppb) will be the established cleanup level."[23]

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[23] Refer to MDNR supporting calculations for selection of groundwater cleanup levels.

Such an approach is arbitrary and does not follow sound toxicologic practice in extrapolating dose-response relationships between similar chemicals. Furthermore, this method of selecting cleanup levels is contrary to the 307 Rules.

Discussions with USEPA's RfD Workgroup for 2,4-dimethylphenol have identified that the RfD Workgroup is presently evaluating a draft RfD for 2,4-dimethylphenol. Based on this draft RfD of 2E-2 mg/kg/day, the HLSC calculated in accordance with the 307 Rules would be 140 µg/L. In comparison, the Federal Standard which would be set at the Rfd level would be 700 µg/L. The draft HLSC of 140 µg/L should be used as a cleanup criteria instead of the proposed 1 µg/L which is arbitrary and has no basis in sound toxicologic practice. However, maximum concentrations of 2,4-dimethylphenol identified during the RI and the RSSC's sampling events all have been well below 140 µg/L. Consequently, 2,4-dimethylphenol is present below appropriate cleanup levels and should be deleted from the cleanup indicator list.

3.3.1.8 Isophorone

As noted previously, isophorone should be deleted from the list of indicator chemicals because it was not detected during the RSSC's sampling events and based on the low frequency of detection and the acceptable level of risk associated with this chemical shown in the Proposed Plan (which is based on unrealistic assumptions). While the 307 Rules cleanup level for isophorone has been calculated correctly by the Agencies, even if present, isophorone would be removed as a result of cleanup for other chemicals.

3.3.1.9 2-Methylphenol and 4-Methylphenol

The Agencies' proposed cleanup criteria for 2-methylphenol and 4-methylphenol are based on the Agencies' interpretation of appropriate taste and odor criteria under Rule 709(2)(d) of the 307 Rules. This rule requires that "a taste or odor threshold concentration or a concentration adversely affecting appearance shall be determined according to methods approved by the Unites States EPA". For these two chemicals, the Agencies have elected to set cleanup criteria based on the lowest taste and odor value reported in the literature. The Agencies cite 3 µg/L and 2 µg/L as the taste thresholds reported in Verschueren, respectively. However, this reference also cites other threshold values. For 2-methylphenol, cited values include odor threshold values of 90, 260, 650 and 1400 µg/L. For 4-methylphenol, cited values include odor thresholds of 55 and 200 µg/L. Selection of taste and odor threshold values by selecting the lowest reported value is inappropriate and arbitrary. By analogy, selection of health-based criteria in this same manner would result in the selection of the lowest value reported for the most sensitive individual regardless of statistical distribution of values. This approach is inappropriate for health-based criteria and thus should also be inappropriate for aesthetic criteria.

The Agencies have identified the appropriate health-based HLSC for 2-methylphenol and 4-methylphenol to be 350 µg/L for both compounds. The HLSC should be used as a cleanup criteria for these two chemicals instead of taste and odor values for which there are multiple and conflicting values and which have no statistical justification. The reported groundwater concentrations for 4-methylphenol and 2-methylphenol based on the RSSC's supplemental data are all less than the HLSC. Based on these findings it is appropriate to delete these chemicals from the cleanup indicator list. Cleanup of these two chemicals, would occur as a result of cleanup for other chemicals.

3.3.1.10 Methylene Chloride

The Agencies have listed methylene chloride as a groundwater cleanup indicator chemical based on their assumption that the positive detections reported in the RI are not laboratory artifacts. However, the RSSC's two supplemental sampling events have not detected the presence of methylene chloride in groundwater aside from instances which can be attributed to laboratory-introduced contamination. These reported concentrations are significantly lower than those reported in the RI and at levels indicative of laboratory artifacts.

The analytical data collected during the RI were previously reviewed to determine the validity of the data and subsequent usefulness for characterizing the groundwater quality at the Spiegelberg and Rasmussen Sites. Due to the method of data reporting in the RI, where only positive detections were reported, it was necessary to conduct an independent Quality Assurance/Quality Control (QA/QC) review of the documentation presented in the original Organic Traffic Reports for each sample. In addition to the RI data review, analytical results reported by the MDNR and S.S. Papadopulos, for split samples collected in March 1987 were reviewed and compared.

One of the distinct problems observed with the analytical data for groundwater samples collected during the RI was the prevalence of methylene chloride in almost all types of quality control blank analyses, including laboratory and field rinsate blanks. The methylene chloride concentrations reported for QA/QC samples from the RI are shown on Table 3.5. Although not uncommon, the concentrations of methylene chloride in both laboratory and field blanks were on many occasions equivalent or greater than those observed in the actual groundwater samples.

Moreover, the Agencies' proposed groundwater cleanup level for methylene chloride does not consider the fact that USEPA data validation protocols outlined in the Contract Laboratory Program (CLP Statement of Work dated 2/88, Section E) consider 25 µg/L of methylene chloride to be an acceptable level of laboratory-introduced contamination in laboratory blanks. Comparison of this "allowable" level to the proposed cleanup level for methylene chloride clearly indicates that determining compliance at the Agencies' proposed level would be difficult if not impossible due to laboratory artifacts. Table 3.5 also shows the levels below which groundwater concentrations are qualified as non-detect based on USEPA data validation protocols. These results further support the finding that methylene chloride would be difficult to quantify if present.

Based on these concerns regarding the ability to demonstrate compliance at the Agencies' proposed levels due to laboratory artifacts, and the absence of methylene chloride in the RSSC's supplemental sampling

TABLE 3.5

COMPARISON OF LABORATORY BLANK SAMPLES AGAINST GROUNDWATER SAMPLE CONCENTRATIONS RASMUSSEN SITE

RI Groundwater Sample ID	*Compound Detected in Laboratory Blank*	*RI Results*		*Level Below Which Groundwater Concentrations are Qualified as Non Detect (1) (µg/L)*
		Groundwater Sample Concentrations (µg/L)	*Associated Laboratory Blank Concentrations (µg/L)*	
OBG-2	Methylene chloride	**7**	3	30
OBG-3	Methylene chloride	**15**	3	30
RA-GW-086	Methylene chloride	**9**	9	90
	Acetone	**16**	24	240
	2-Butanone	**4**	5	50
RA-GW-089	Methylene chloride	**33**	9	90
	Acetone	**43**	24	240
SP-GW-000	Methylene chloride	**7**	9	90
	Acetone	**13**	24	240
	2-Butanone	**8**	5	50
SP-GW-091	Methylene chloride	**7**	9	90
	Acetone	**9**	24	240
	2-Butanone	**4**	5	50

Note:

(1) Concentration equal to ten times laboratory blank concentration.

events, other than for artifactual levels, this chemical should be deleted from the list of indicator chemicals.

3.3.1.11 Benzene and Vinyl Chloride

The RSSC reiterates that the Agencies' proposed Type B cleanup levels for benzene and vinyl chloride are inappropriate. The RSSC's previous analysis of supporting factors demonstrated that Type C cleanup levels for benzene and vinyl chloride were more appropriate than Type B levels for groundwater remediation at the Rasmussen Site. Factors which were found to weigh significantly in favor of Type C criteria for these two parameters included:

- technical limitations imposed by analytical chemistry constraints which will result in an inability to monitor performance and determine compliance at low Type B cleanup levels,
- technical limitations imposed by remedial technologies which will preclude the attainment of low Type B cleanup levels, and
- lack of cost-effectiveness associated with attaining Type B levels which results in a disproportionate incremental cost compared to Type C levels while achieving only minimal benefit from reduction of risks below Type C levels which are protective of human health and the environment.

The RSSC's previous analysis of factors enumerated in Rule 717 supported the conclusion that Type C levels were more appropriate than Type B levels for these two parameters. Based on the previous evaluation of groundwater cleanup levels, Type C groundwater cleanup levels appropriate for the groundwater cleanup at the Rasmussen Site are:

Chemical	Cleanup Level (µg/L)
benzene	5
vinyl chloride	2

These groundwater cleanup levels represent peak concentrations applied at the Rasmussen well following shut-down of the proposed groundwater extraction system. Average concentrations at the Rasmussen well would be lower than the above cleanup concentrations.

3.3.1.12 Tetrachloroethene

As noted previously, tetrachloroethene should be deleted from the indicator chemical list because it was not encountered during either of the RSSC's two supplemental sampling events and based on low frequency of detection. In addition, the Agencies' calculations presented in the risk assessment have shown that the risk associated with the singular detection of tetrachloroethene do not warrant cleanup for this chemical, even under the conservative risk assumptions used in the RA.

Even if tetrachloroethene were present, the Type B cleanup level approach selected by the Agencies for cleanup of tetrachloroethene is inappropriate. The Type B level for tetrachloroethene is at a concentration where analysis of Type C factors, such as that previously conducted for benzene and vinyl chloride, is relevant and would support a Type C cleanup level analysis for this compound. USEPA has proposed a MCL for tetrachloroethene of 5 µg/L which is considered protective of the public health and welfare for community water supply systems. In lieu of a Type C analysis, the cleanup level for tetrachloroethene, if present, should be revised to the MCL level which is analytically achievable and technically feasible.

3.3.1.13 Trichloroethene

The Agencies have proposed a Type B cleanup criteria of 3 µg/L for trichloroethene. The RSSC agrees that it is appropriate to set cleanup criteria for trichloroethene. However, a more appropriate cleanup level is 5 µg/L which would be consistent with the Federal MCL for trichloroethene.

The Agencies have selected trichloroethene as a cleanup indicator chemical based on the assumption that this chemical is present in the groundwater beneath the PDSLD/IW Areas. The RSSC's two supplemental sampling programs have confirmed that trichloroethene is present in this groundwater zone, but at concentrations below the Agencies' proposed cleanup criteria. Consequently, trichloroethene is not an appropriate cleanup indicator for cleanup of the groundwater zone beneath the PDSLD/IW Areas.

However, review of the RI data and the RSSC's supplemental sampling data has confirmed that trichloroethene is present in groundwater below the south slopes in the vicinity of monitoring well RA-MW-27. The RSSC proposes to install a supplemental groundwater extraction well near this location for the purpose of groundwater cleanup for trichloroethene. Groundwater extraction combined with natural infiltration along the south slopes of the landfill would effectively remediate the groundwater in this area. The redirection of surface water runoff from the landfill cap perimeter drain, as shown for the RSSC's proposed landfill remedy, onto this uncapped area would effectively remediate any residual trichloroethene in soils.

This proposed remediation of groundwater below the south slopes represents an appropriate measure to ensure overall protection of human health and the environment in the long term. Groundwater remediation in this area could also be effectively implemented by allowing the groundwater to migrate to the PDSLD/IW Area groundwater extraction system for subsequent capture. However, the RSSC's proposed remedial approach is more cost-effective.

Trichloroethene is the only appropriate cleanup indicator chemical for remediation of the groundwater below the south slopes. Based on the statistically minor difference between the Type B level of 3 µg/L and the MCL level of 5 µg/L, the MCL is proposed as the appropriate cleanup level.

3.3.1.14 Lead

The RSSC reiterates that lead is not an appropriate cleanup indicator chemical for the Rasmussen Site.

Even if lead were an indicator chemical, the Agencies have used an inappropriate MDNR-generated interim RfD to calculate a proposed cleanup level for lead. Based on an acceptable blood level of lead of 5 µg/dL, the MDNR has derived a RfD of 0.4 µg/kg/day. This RfD was used to calculate an HLSC level of 3 µg/L. The MDNR's supporting calculations subsequently state that because "3 ppb is almost identical to 5 ppb (proposed MCL), 5 ppb is used as Type B cleanup level for lead in groundwater". The MDNR's calculation does not provide supporting documentation for the manner in which the acceptable blood level was determined or provide the exposure-close relationships used to calculate the RfD from the blood lead level. These factors need to be clearly established to demonstrate that the MDNR-generated HLSC is consistent with the 307 Rules. This documentation is necessary in light of the fact that USEPA has withdrawn the file for lead from the Integrated Risk Information System (IRIS) for further review.

The RSSC previously identified Acceptable Daily Intake (ADI) concentrations for lead for the Agencies consideration in establishing appropriate cleanup criteria for the Rasmussen Site. Oral and inhalation ADIs[24] of 1.4 µg/kg/day and 0.43 µg/kg/day, respectively, were identified for these two routes of exposure. It appears that the MDNR-generated RfD (0.4 µg/kg/day) has been selected on the basis of inhalation exposure. The inhalation exposure route is not appropriate for assessing risk from ingestion of groundwater. Based on the oral ADI, the appropriate HLSC for lead is 10 µg/L and not 5 µg/L as presented in the Proposed Plan.

Regardless, lead should not be a cleanup indicator chemical at the Rasmussen Site for two reasons.

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[24] Refer to Superfund Public Health Evaluation Manual, USEPA, October 1986.

First, during the RI, the levels of lead detected in groundwater samples collected from the PDSLD Area have been below the maximum lead level reported in the RI in upgradient, background samples for the Spiegelberg/Rasmussen Sites (maximum total lead concentration of 1280 µg/L). The results of the RSSC supplemental groundwater sampling programs conducted in May/June and October 1990 support this finding. The RSSC's results for total lead are shown on Table 3.6. These concentrations of total lead are less than the reported maximum background level of 1280 µg/L for the combined Spiegelberg/Rasmussen Sites.

Second, and more importantly, the results of the RSSC supplemental groundwater sampling programs show that dissolved lead levels in groundwater are less than the calculated HLSC level of 10 µg/L. Groundwater samples collected during the MDNR/USEPA RI were not filtered and were analyzed for total lead concentrations even though the samples contained significant levels of suspended solids. This approach in the RI resulted in significantly elevated lead concentrations. The results of the RSSC's rounds of supplemental sampling (see Table 3.6) clearly demonstrates the difference between filtered and unfiltered lead analysis. Figures 3.1, 3.2 and 3.3 graphically show the relationships between total lead, dissolved lead, and total suspended solids (particulates). The filtered lead analyses (dissolved lead) show that the HLSC level for dissolved lead is met in the affected groundwater zone without groundwater extraction and treatment and that essentially all the lead is associated with particulates. The HLSC criterion for lead is appropriately based on dissolved lead because particulate lead is not readily available for absorption in the gastrointestinal tract. In addition, particulates are not transported with groundwater flow, whereas dissolved constituents are.

Based on the above, lead is not an indicator chemical for the purpose of groundwater cleanup at the Rasmussen Site.

TABLE 3.6

ANALYTICAL RESULTS FOR LEAD
RSSC SUPPLEMENTAL GROUNDWATER SAMPLING PROGRAM
RASMUSSEN SITE

Round (1)	*Sample I.D.*	*Well*	*Total Lead (µg/L)*	*Dissolved Lead (µg/L)*
1	RAS-1	RA-MW-42	57	3
1	RAS-2	81-8	200	4
1	RAS-3	RA-MW-18D	510	4.8
1	RAS-4	RA-MW-18D (Duplicate)	390	9.7
1	RAS-5	RA-MW-41	23	5
1	RAS-6	SP-MW-5D	43	6.2
1	RAS-7	81-5	160	4
1	RAS-8	RA-MW-27	220	1.5
1	RAS-9	RA-MW-47	15	3.8
1	RAS-10	RA-MW-17	240	3.8
1	RAS-12	RA-MW-54	420	3.8
2	W-101190-WP-004	RA-MW-22	1,000	ND
2	W-101090-WP-005	RA-MW-22 (Duplicate)	1,200	ND
2	W-101090-WP-001	RA-MW-28	440	ND
2	W-101190-WP-006	RA-MW-32	360	ND
2	W-101090-WP-002	RA-MW-34	55	ND
2	W-101190-WP-009	SP-MW-25D	430	ND

Notes:

(1) Sampling Round 1 occurred May/June 1990;
Sampling Round 2 occurred October 1990.

(2) ND - None at stated Practical Quantitation Limit (PQL) of 5.0 µg/L for Round 2

3.3.1.15 Cadmium

The Agencies have incorrectly selected cadmium as a groundwater cleanup indicator chemical on the basis of total cadmium results reported in the RI.

Positive detections from the RI for cadmium ranged from 5 µg/L to 29 µg/L for the affected groundwater zone. In comparison, background levels in the RI were reported up to 18 µg/L. These RI detections were all based on total cadmium concentrations because groundwater samples collected during the RI were not filtered prior to analysis.

In comparison, the RSSC's supplemental sampling programs conducted analyses for both total and dissolved cadmium. These results are tabulated on Table 3.7 and shown graphically against total suspended solids levels on Figure 3.4. These results clearly demonstrate that dissolved cadmium levels presently meet the Agencies' proposed cleanup level and that cadmium is associated with particulates. Similar to lead, the HLSC criterion for cadmium is appropriately based on dissolved cadmium levels because particulate cadmium is not readily available for absorption in the gastrointestinal tract. In addition, particulates are not transported with groundwater flow whereas dissolved constituents are.

Consequently, cadmium should be deleted from the cleanup indicator list.

3.3.2 Limitations of Analytical Chemistry

The RSSC previously provided detailed comments regarding the limitations of analytical chemistry in the document entitled "Proposed Groundwater Cleanup Levels, Rasmussen Site". The RSSC reiterates that one of the technical limitations which will impact the ability to achieve low cleanup levels is the ability to measure low levels and to demonstrate compliance at these low levels. Limitations in analytical chemistry will result in an inability to determine when and if cleanup levels have been achieved

TABLE 3.7

ANALYTICAL RESULTS FOR CADMIUM
RSSC SUPPLEMENTAL GROUNDWATER SAMPLING PROGRAM
RASMUSSEN SITE

Round (1)	*Sample I.D.*	*Well*	*Total Cadmium (µg/L)*	*Dissolved Cadmium (µg/L)*
1	RAS-1	RA-MW-42	ND	ND
1	RAS-2	81-8	5.5	ND
1	RAS-3	RA-MW-18D	14	ND
1	RAS-4	RA-MW-18D (Duplicate)	11	ND
1	RAS-5	RA-MW-41	ND	ND
1	RAS-6	SP-MW-5D	ND	ND
1	RAS-7	81-5	ND	ND
1	RAS-8	RA-MW-27	12	ND
1	RAS-9	RA-MW-47	ND	ND
1	RAS-10	RA-MW-17	9.5	ND
1	RAS-12	RA-MW-54	18	ND
2	W-101190-WP-004	RA-MW-22	24	1.4
2	W-101090-WP-005	RA-MW-22 (Duplicate)	26	1.5
2	W-101090-WP-001	RA-MW-28	60	1.0
2	W-101190-WP-006	RA-MW-32	23	ND
2	W-101090-WP-002	RA-MW-34	2.2	0.6
2	W-101190-WP-009	SP-MW-25D	10	ND

Notes:

(1) Sampling Round 1 occurred May/June 1990;
Sampling Round 2 occurred October 1990.

(2) ND None detected at stated Practical Quantitation Limit (PQL) of 5.0 µg/L for Round 1 and 0.5 µg/L for Round 2

for proposed cleanup levels which are below practical quantitation limits. The cleanup levels in the Proposed Plan are set at "method detection limits" for several chemicals including 1,1-dichloroethene, 2,4-dimethylphenol, and vinyl chloride. In addition, the proposed cleanup levels for several chemicals have been set without even considering whether the proposed level was analytically achievable or not. These chemicals include benzene, 2-chlorophenol, 2-methylphenol, 4-methylphenol and tetrachloroethene.

Previous comments have identified that analytical detection limits can be influenced by analytical interferences introduced by the media being analyzed as well as by the competence and quality of the analytical laboratory. Physical and chemical properties inherent in some media, such as untreated groundwater or groundwater containing a variety of organic chemicals will tend to cause an increase in the analytical detection limits. The ability of the chemist and the quality of the equipment can also cause variability in the analytical detection limits.

USEPA has taken these factors into consideration by establishing "practical quantitation limits" specifically for groundwater monitoring purposes which USEPA has determined are typically achievable nationwide. These practical quantitation limits (PQLs) are distinct from method detection limits (MDLs) which are based on ideal analytical conditions. MDLs are determined by analyzing distilled water into which progressively smaller amounts of the pure analyte are added until the threshold of detection is reached. By using distilled water, matrix effects are minimized and the efficacy of the method and sensitivity of the instrument can be determined. However, groundwater requiring cleanup will likely not be well represented by distilled water in the majority of cleanup situations. Consequently, MDLs may not be achievable in a majority of cases. In comparison, PQLs represent USEPA's best estimate of the minimum measurable level of chemical constituents in actual environmental samples and thus represent "real world" measurable quantities. PQLs are not defined using ideal distilled water matrices but instead use actual environmental samples and the results of several laboratories in "round robin" studies to determine typically measurable levels.

USEPA's drinking water program established under the Safe Drinking Water Act is based on setting MCLs as close as practicable to the PQLs. USEPA's rationale for using the PQL as a target level considered protective of public health for community water supply systems is because enforcement of MCLs is only possible at concentrations which are analytically achievable and statistically defensible. PQLs are analytically achievable and statistically defensible whereas MDLs are not. These factors are equally relevant to the determination of groundwater cleanup levels.

To compound the difficulties in determining compliance at low levels, studies have shown that the accuracy of reported results at low levels is at best ±40% of the true value.[25] The Agencies also need to recognize that almost all analytical laboratories do not report results below the PQL because of the indefensible nature of such data. Results below the PQL, when reported, are noted as estimates only because the result is not statistically reliable. The Michigan Department of Public Health (MDPH) laboratory does not report detections below 1 µg/L for volatile organic analyses.[26] Given the mandate of the MDPH laboratory to monitor the quality of supplied water and protect human health for community water supply systems, it is also appropriate for groundwater cleanup levels to be set above 1 µg/L.

3.3.3 Summary of Detailed Evaluation of Agency Proposed Cleanup Criteria

The detailed evaluation of the Agencies' proposed cleanup criteria has identified that a number of groundwater indicator chemicals have been inappropriately selected and that several cleanup criteria have been incorrectly calculated. Table 3.2 has already identified indicator chemicals which should be deleted. Cleanup indicator chemicals retained by this detailed analysis and appropriate cleanup levels include:

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[25] Refer to "MCL Noncompliance: Is the Laboratory at Fault?", Steven J. Koorse, American Water Works Journal, Vol. 82, No. 2, February 1990.

[26] Refer to "Method for Purgeable Halocarbons and Aromatic Hydrocarbons in Water and Wastewater Samples by Simultaneous Analysis with the Photoionization Detector and Hall Electrolytic Conductivity Detector", MDNR Environmental Laboratory, January 4, 1988.

Chemical	*Appropriate Cleanup Level (μg/L)*
PDSLD/IW Area	
benzene	5
chlorobenzene	100
ethylbenzene	30
toluene	40
vinyl chloride	2
xylenes	20
South Slopes Area	
trichloroethene	5

With the exception of benzene and vinyl chloride, these cleanup levels are determined from monitoring in the affected groundwater zones. Cleanup levels for benzene and vinyl chloride are based on maximum levels at the Rasmussen well.

3.4 SELECTION OF GROUNDWATER TREATMENT TECHNOLOGIES AND ASSOCIATED COST ESTIMATES

The Agencies propose to treat the extracted groundwater using the following process options:

- removal of heavy metals (ie. lead, cadmium) by chemical precipitation followed by pH adjustment;
- removal of the bulk of the organic compounds, including ketones, by a biological treatment system;
- removal of residual organic compounds by air stripping; and
- further removal of residual organic compounds by granular activated carbon (GAC) adsorption.

The removal of heavy metals as a process option has already been eliminated based on the determination in Sections 3.3.1.14 and 3.3.1.15 that lead and cadmium are not appropriate indicator chemicals.

In addition, the Agencies' proposed groundwater treatment technologies have been evaluated for appropriateness and technical feasibility. Based on this evaluation, there are several concerns regarding the ability to remove lead and cadmium to the proposed levels, and the appropriateness of a biological system for treatment of organic compounds. There are also inaccuracies in the calculation of groundwater cleanup costs which need to be clarified.

3.4.1 Proposed Treatment Technologies

Proposed Treatment for Lead and Cadmium

As a preliminary matter, requiring the investment of capital in designing and building treatment processes to remediate chemicals which are not present above the Proposed Plan's action levels would be extremely wasteful. The removal of lead and cadmium by chemical precipitation with pH adjustment is neither warranted nor necessary. In addition, removal to the low cleanup levels proposed by the Agencies is not feasible.

Removal by chemical precipitation consists of the addition of chemicals such as alum, ferric chloride, or synthetic polymers coupled with pH adjustment to drive heavy metals into an insoluble form, to ionically bind metals to a settleable solid or to promote the creation of flocs which sweep inorganics out of the water. Current practice has shown chemical precipitation to be effective at elevated influent concentrations. However, typically achievable discharge levels are higher than the cleanup levels proposed by the Agencies and would likely require additional treatment.

To achieve the cleanup levels proposed by the Agencies, it would be necessary to resort to either more sophisticated or experimental treatment processes. These process technologies, however, are prone to interferences from other groundwater constituents. Technologies in these categories include reverse osmosis and experimental electrochemical processes.

Significant pretreatment for reverse osmosis (RO) would be required due to the characteristics of the Rasmussen groundwater. The RSSC supplemental groundwater results indicate elevated concentrations of iron and manganese are present in the Rasmussen groundwater. These inorganics would form iron and manganese oxides which would effectively foul the RO membranes. Consequently, extensive pretreatment would be required to remove the iron and manganese to ensure the effectiveness of an RO treatment system. Such a treatment system would be cost prohibitive.

The RSSC's supplemental groundwater data indicates that the removal of lead and cadmium, although not necessary, may be significantly simpler than that indicated in the Proposed Plan. The Agencies' proposed treatment process assumes that lead and cadmium are present in dissolved form in the groundwater. However, based on the RSSC's cadmium data presented in Table 3.7, it appears that cadmium is associated with particulates. The graphical representation of the RSSC's cadmium results on Figure 3.4 indicates this relationship more clearly. Similarly, Table 3.6 and Figure 3.1 indicate that elevated lead levels are also associated with particulates. These findings would indicate that the Agencies' proposed chemical precipitation system is inappropriate because a filtration system could achieve an equivalent, if not improved, level of treatment at significantly lower cost. Even this treatment for lead and cadmium is unnecessary and unwarranted given the concentrations of lead and cadmium in the groundwater.

Proposed Biological Treatment

The Agencies propose biological treatment to remove the bulk of the organic compounds prior to air stripping and granular activated carbon (GAC) adsorption. The Agencies selection of a biological system is based on the assumption that the groundwater is amenable to such treatment and that removal of ketones is necessary.

Based on the RSSC's supplemental data, the ratio of Biochemical Oxygen Demand (BOD) to Chemical Oxygen Demand (COD) of the groundwater is relatively constant. However, the reported values for BOD are very low in comparison to typical biological treatment systems (i.e. BOD range of 6 mg/L to 57 mg/L for the Rasmussen Site compared to typical values greater than 200 mg/L for municipal/industrial treatment systems). The groundwater at the Site is typical of most groundwaters which are nutrient deficient and which cannot support a viable biological treatment system. Consequently, biological treatment is not technically feasible at the Rasmussen Site.

Secondly, the Agencies have selected biological treatment for treatment of ketones including acetone, 2-butanone and 4-methyl-2-pentanone. However, based on the RSSC supplemental groundwater data, these compounds are presently below their respective cleanup levels or not even present in the case of 2-butanone. Therefore, the requirement for a biological system based on the removal of ketones is not justified.

3.4.2 FS Groundwater Remedy Cost Estimates

The RSSC reiterates that cost-effectiveness should be considered in remedy selection and setting of groundwater cleanups levels which are protective of public health and the environment.

The use of Type B groundwater cleanup levels instead of Type C levels for several carcinogens in the Proposed Plan will result in significant cost increases in the final groundwater remedy with minimal benefits. The additional costs are attributable to:

i) a substantial increase in operating and maintenance costs due to the longer time estimated to achieve the Type B levels, assuming that it could even be demonstrated that they are achievable;

ii) the increased capital costs to install a more sophisticated groundwater treatment system to meet discharge criteria which would likely be established at the Type B cleanup levels; and

iii) the significant increase in environmental monitoring costs resulting from the longer operational period.

As previously stated by the RSSC, the significant component of the increased costs can be attributed to the substantial increase in cost of operation, maintenance and monitoring. The Agencies' Proposed Plan estimates annual operation, maintenance and monitoring costs to be approximately $4,580,000, assuming five years of operation of the groundwater extraction and treatment system.[27]

The RSSC reiterates that the five-year cleanup period presented in the FS is overly optimistic. This has been acknowledged by the MDNR.[28] The FS estimate is based on the relative velocity of chemical migration compared to groundwater velocities. As such, the estimate significantly understates the complexity of sorption/desorption processes in the aquifer, in particular, the limiting rates imposed by partitioning kinetics. Based on current understanding of groundwater extraction technologies, the groundwater cleanup levels in the Proposed Plan will likely not be met in 15 years (Agencies' upperbound estimate of operating period), if ever. This minimum additional operating time can be estimated to result in an increased operation and maintenance present worth cost of approximately $4.6 million and a total cost of $11,760,000 for a 15-year operating period compared to the $7,170,000 presented in the FS. For a system operating in perpetuity, the increased operation and maintenance present worth cost is estimated to be approximately $7.5 million at a total cost of $14,670,000.

The FS estimates also assume a discount rate of ten percent for the present worth calculations. Using a more realistic discount rate of five percent, the present worth of the Agencies' O&M costs would be $18,791,000 for a system operating in perpetuity. The total cost of constructing and operating such a groundwater remedial system would be $21,531,000. This upperbound estimate is significantly greater than the $7,320,000 presented in the Proposed Plan.

These upperbound estimates clearly illustrate the huge incremental time and cost differences between a Type B and Type C cleanup level. This significant incremental expenditure, necessary to meet Type B cleanup levels,

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[27] The Proposed Plan incorrectly cited the FS present worth cost of $4,580,000 as being a one-year O&M cost.

[28] The MDNR stated that the groundwater remedy will likely be "effective somewhere in the neighborhood of five to fifteen years" in the September 13, 1990 public meeting. Refer to page 42 of the meeting transcript.

is not justified based on the acceptable difference in incremental lifetime cancer risk between the two types of cleanup previously calculated by the RSSC.

More realistic estimates of the groundwater remedial costs are presented in Appendix B. Based on the appropriate deletion of metals treatment and biological treatment, the capital cost is estimated to be $1,126,630 and the O&M costs are estimated to be $2,457,010 for a 10-year cleanup period; $3,582,610 for a 30-year cleanup period; and $4,591,880 for a 100-year cleanup period, respectively. For the RSSC's proposed Type C cleanup approach for several parameters, a 10-year cleanup duration may be realized. The incremental total cost of the Agencies' proposed groundwater remedy, operating in perpetuity, could thus be $17,947,360 greater than the total costs associated with implementing the RSSC's proposed groundwater remedy over a 10-year cleanup period.

These cost estimates show that the incremental costs associated with the Agencies' proposed remedy are not appropriately balanced by an incremental benefit resulting from a reduction of risk. Clearly, the changes to the Proposed Plan identified by the RSSC would result in a more cost-effective remedy while being protective of public health and the environment.

3.5 GROUNDWATER MONITORING

The Agencies have indicated in the public meetings that groundwater monitoring in all directions from the landfill (360-degree monitoring) for all parameters at both on and off Site locations may be a requirement of the final remedy. In addition to the significant costs that would be incurred by such a monitoring approach, monitoring in this manner is unwarranted and unneccessary and would fail to use knowledge of Site hydrogeology in a cost-efficient manner. Conducting groundwater monitoring downgradient of the affected groundwater zone based on the appropriate indicator chemical list is all that would be neccessary for protection of public health and the environment. Likewise, monitoring for all "priority pollutants" would be extremely wasteful in light of the RSSC's proposed indicator chemical list. Finally, monitoring of off-Site residential wells would be duplicative and is unnecessary. The best and safest place to monitor for efficacy of the remedy is downgradient and on the Site. This provides an early warning if a problem develops.

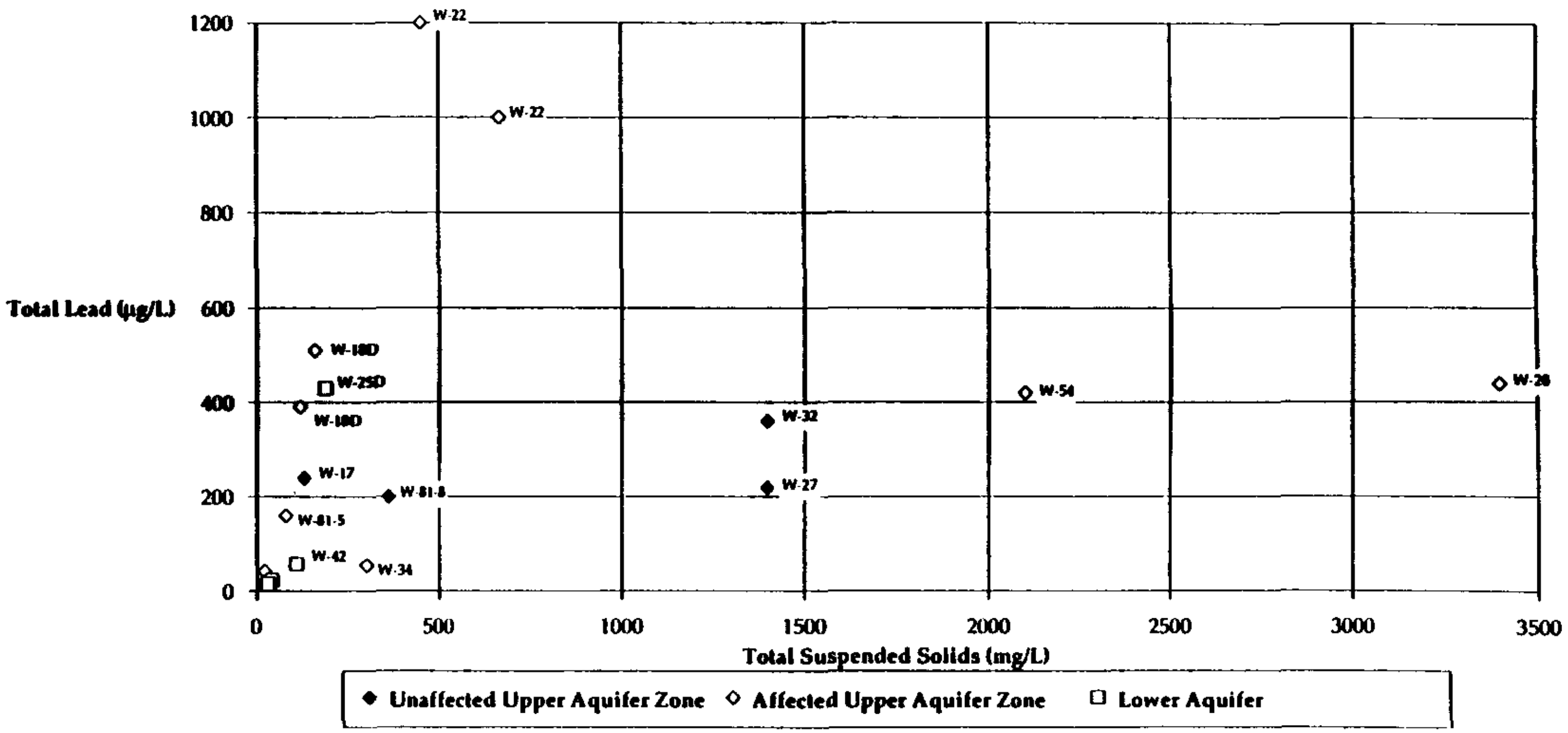

figure 3.1

TOTAL LEAD vs. TOTAL SUSPENDED SOLIDS
RSSC SUPPLEMENTAL GROUNDWATER RESULTS
Rasmussen Site

CRA

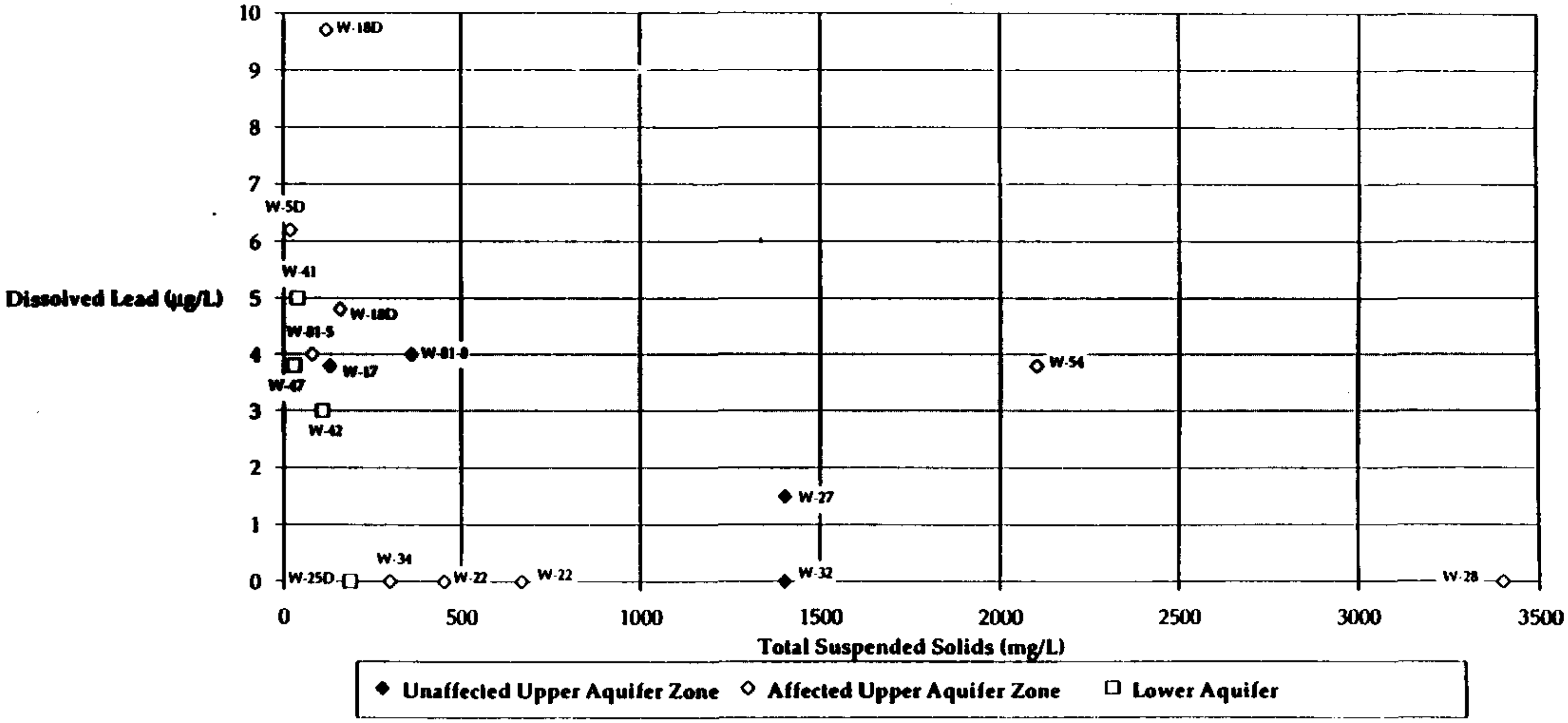

figure 3.2

DISSOLVED LEAD vs. TOTAL SUSPENDED SOLIDS
RSSC SUPPLEMENTAL GROUNDWATER RESULTS
Rasmussen Site

CRA

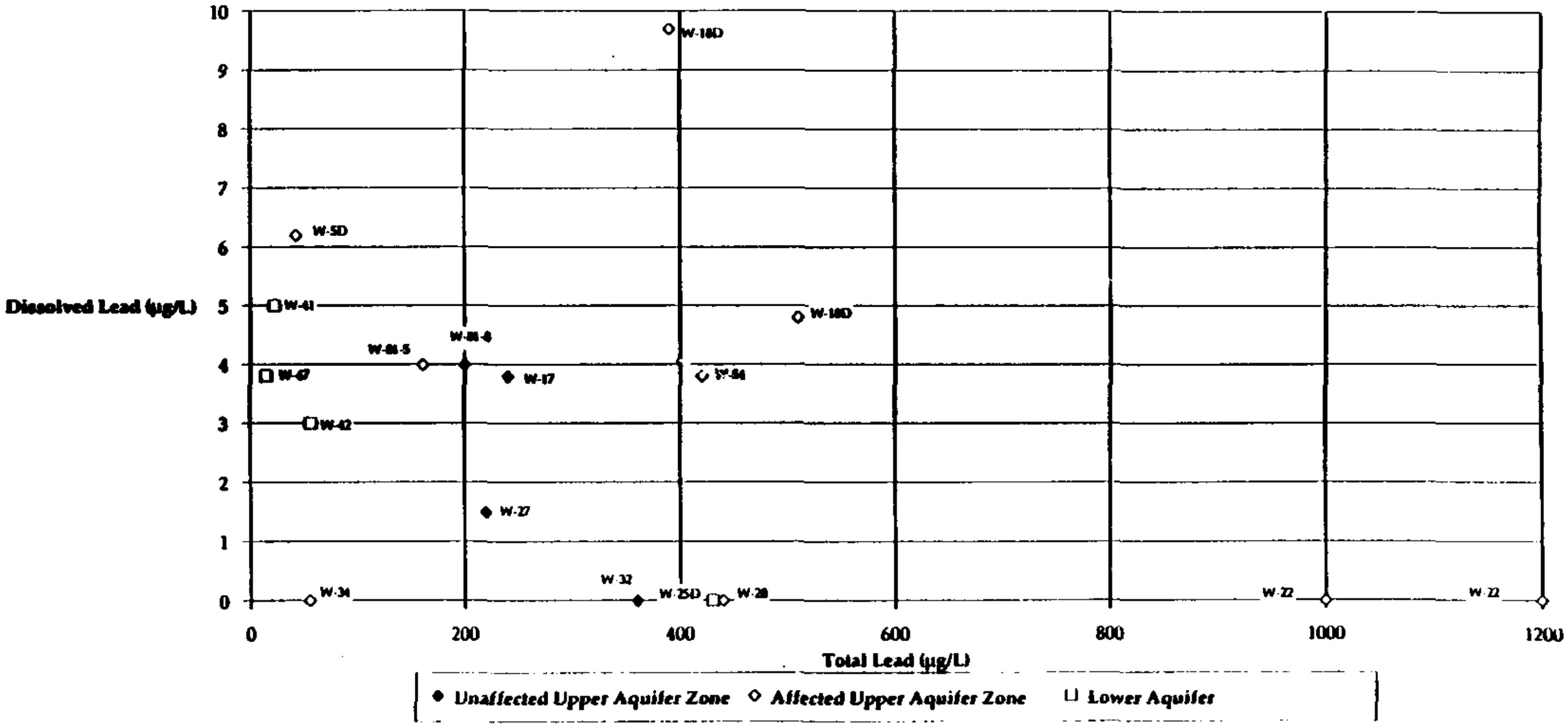

figure 3.3

DISSOLVED LEAD vs. TOTAL LEAD
RSSC SUPPLEMENTAL GROUNDWATER RESULTS
Rasmussen Site

CRA

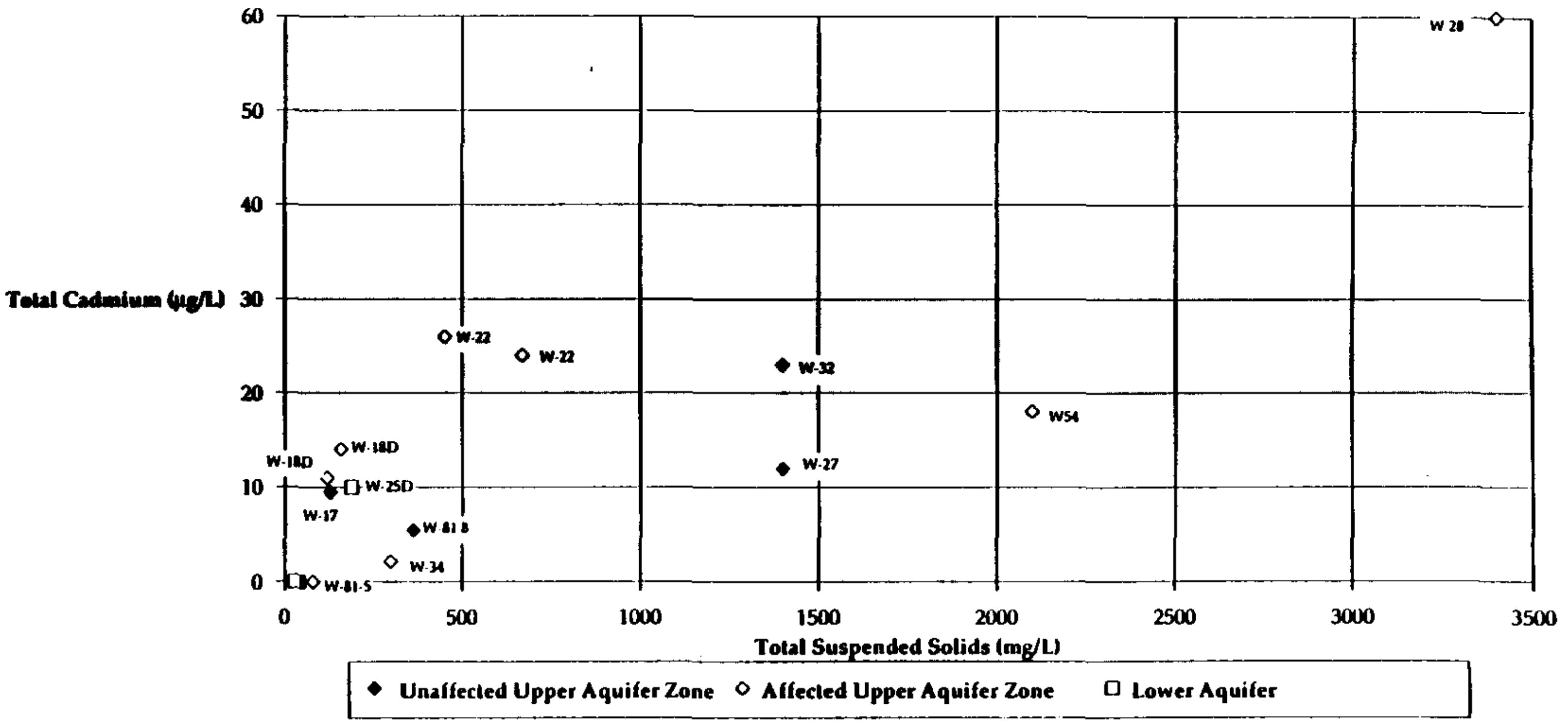

figure 3.4

TOTAL CADMIUM vs. TOTAL SUSPENDED SOLIDS
RSSC SUPPLEMENTAL GROUNDWATER RESULTS
Rasmussen Site

CRA

4.0 CONCLUSIONS

The Agencies' Proposed Plan for the Rasmussen Site consists of two components. These components include a cap for the municipal landfill and a groundwater extraction/treatment remedy for the affected groundwater zone. Each of these remedial components has been evaluated in detail.

Municipal Landfill Cap

With respect to the municipal landfill cap component, we conclude:

1) The Agencies' proposed Michigan Act 64 cap design is neither applicable nor relevant and appropriate to the capping of the Rasmussen municipal landfill. Due to the response actions completed to date, the remaining landfill materials are characterized as primarily municipal garbage. Consequently, capping requirements established by RCRA and Michigan Act 64 are not relevant to the proposed capping of the Rasmussen Site. Relevant and appropriate capping requirements are those established by Michigan's Solid Waste Management Act.

2) The RSSC's proposed alternative cap design will satisfy capping ARARs, address technical flaws evident in the Agencies' proposed design, and provide a cover system which best addresses the public's concerns regarding cap longevity and long-term integrity.

3) Comparison of the Agencies' proposed cap to the RSSC's alternate design has shown that the RSSC's alternate design addresses the NCP's nine evaluation factors to the greatest possible extent. Evaluation factors which favor the RSSC's alternate cap include:

   - Overall Protection of Human Health and the Environment;
   - Compliance with ARARs;
   - Long-Term Effectiveness and Performance;
   - Short-Term Effectiveness;
   - Implementability;
   - Cost; and

- Community Acceptance.

Evaluation factors which either are not applicable or neutral include:

- Reduction of Toxicity, Mobility, or Volume Through Treatment; and
- Support Agency Acceptance.

In comparison, the Agencies' cap does not adequately address these evaluation factors in light of Site-specific conditions. Design measures incorporated into the RSSC's proposed alternate cap would provide improved longevity and long-term integrity compared to the Agencies' cap design. The RSSC's proposed design uses best design practice and positive measures to mitigate potential Site-specific problems.

4) The RSSC's proposed alternate cap design will provide an improved level of hydraulic performance compared to the Agencies' proposed Act 64 cap. The estimated percent reduction in infiltration through the cap for the RSSC's and Agencies' cap designs are 95.6% and 95.9%, respectively. However, the integrity of the Agencies' cap against frost and dessication cracking cannot be ensured. Consequently, in actual practice, the RSSC's alternate cap design will prove superior to the Agencies' Act 64 cap.

5) The FS cost estimates for the Agencies' proposed cap contain numerous calculational errors. The corrected capital cost of the Agencies' proposed cap ranges from $8,248,860 to $11,395,715 which is significantly greater than the $2,993,290 presented in the Proposed Plan. In comparison, the RSSC's proposed alternative cap is more cost effective because the estimated capital cost is $2,623,390. In addition, the FS has underestimated the O&M costs for the Agencies' cap. A lower-bound O&M cost estimate for the Agencies' cap is expected to be approximately $0.5 million.

Groundwater Extraction/Treatment Remedy

With respect to the groundwater extraction/treatment remedial component, we conclude:

1) The Proposed Plan has inappropriately identified a number of proposed indicator chemicals which should be deleted. Of the 24 groundwater cleanup indicator chemicals presented in the Proposed Plan, 17 of the proposed indicator chemicals should be deleted based on a detailed evaluation of:

   - the method by which groundwater cleanup indicator chemicals were selected;
   - the calculation of risks associated with groundwater at the Site and the difference between the cleanup approach presented in the Proposed Plan and that suggested in the MDNR/USEPA risk assessment; and
   - the data and assumptions used by the Agencies for calculating appropriate cleanup criteria and limitations of analytical chemistry in establishing groundwater cleanup levels.

2) The RSSC proposed list of groundwater cleanup indicator chemicals differs significantly from the listing of chemicals identified to be of concern in the Proposed Plan. The selection of indicator chemicals fails to consider frequency of detection. Chemicals which should be deleted based on low frequency of detection include:

   - 1,1-dichloroethene;
   - tetrachloroethene;
   - benzyl alcohol;
   - 2-chlorophenol; and
   - isophorone.

3) The potential carcinogenic risks presented in the Proposed Plan are inaccurate and in disagreement with the Agencies' risk assessment. The difference in total risk estimates is potentially one-half to one

complete order of magnitude for maximum concentrations and potentially two orders of magnitude for average concentrations. Based on the Agencies' risk assessment, chemicals which should be deleted include:

- bis(2-ethylhexyl)phthalate;
- 1,1-dichloroethene;
- tetrachloroethene; and
- isophorone.

4) The cleanup approach taken in the Proposed Plan differs from the approach taken in the Agencies' risk assessment. The risk assessment used a Site-specific analysis whereas the Proposed Plan used a misapplication of the Michigan 307 Rules. Because Superfund risk assessment methodology uses the 307 Rules Type C analysis, the erroneous application of the 307 Rules, as in the Proposed Plan, effectively invalidates the entire Superfund risk assessment process.

5) Based on the detailed evaluation of the Agencies' proposed cleanup criteria, only seven indicator chemicals are retained as appropriate for groundwater cleanup at the Rasmussen Site. Retained indicator chemicals and appropriate cleanup levels include:

Chemical	*Appropriate Cleanup Level (μg/L)*
<u>PDSLD/IW Area</u>	
benzene	5
chlorobenzene	100
ethylbenzene	30
toluene	40
vinyl chloride	2
xylenes	20
<u>South Slopes Area</u>	
trichloroethene	5

With the exception of benzene and vinyl chloride, these cleanup levels are determined from monitoring in the affected groundwater zones.

Cleanup levels for benzene and vinyl chloride are based on maximum levels at the Rasmussen well.

6) Two of the Agencies' proposed groundwater treatment technologies have been inappropriately selected. Based on the groundwater characterization from the RSSC's supplemental sampling events, metals treatment is not necessary nor feasible and biological treatment is unnecessary and unwarranted.

7) The Proposed Plan has significantly underestimated O&M costs based on a low estimate of remedial duration which the MDNR has acknowledged is unrealistic. The total cost is expected to range from $14,670,000 to $21,531,000 based on the proposed treatment processes for a system operating in perpetuity. This cost is significantly greater than the $7,320,000 presented in the Proposed Plan. A more realistic estimate of the groundwater remedial costs, based on the RSSC's proposed changes to the remedy, would be $3,583,640 for a 10-year operating period. This cost is $17,947,360 less than that estimated for the Agencies' proposed groundwater remedy.

APPENDIX A

LANDFILL SOUTH SLOPE PHOTOGRAPHS

View looking upslope to north from east of well RA-MW-27

Rasmussen Site

CRA

View looking downslope to west from west end of landfill

View looking southeast crosslope from well RA-MW-27

CRA

Rasmussen Site

2433-29/10/90-12-0

View looking crossslope from center of south slopes area

View looking upslope from center of south slopes area

Rasmussen Site

CRA

APPENDIX B

RSSC COST ESTIMATES

TABLE B-1

CAPITAL CONSTRUCTION COSTS
RSSC PROPOSED ALTERNATE LANDFILL CAP

RASMUSSEN SITE

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
DIRECT CAPITAL COSTS					
1)	Project Start-Up and Mobilization	1	L.S.	$155,000.00	$155,000
2)	Construction Facilities	1	L.S.	46,300.00	46,300
3)	Temporary Access Roads	1	L.S.	35,000.00	35,000
4)	Clearing and Grubbing	1	Ac.	4,800.00	4,800
5)	Site Security Fencing				
	a) Install New Chain-Link Fencing	450	L.F.	15.00	6,750
	b) Relocate Existing Chain-Link Fencing	2100	L.F.	15.00	31,500
6)	Pregrading				
	a) Excavate, On-Site Transport, Place, Compact Available On-Site Soil	65,450	C.Y	7.00	458,150
	b) Proof roll Landfill Surface, Supply, Place, Compact Import Fill on Landfill Surface	4,220	C.Y	18.00	75,960
	c) Excavate, On-Site Transport, Place, Compact Soil Previously Excavated From PDSLD Area	7,000	C.Y	9.00	63,000
7)	Proposed Landfill Cover				
	a) Supply, Place, Compact 24 inches of 10-7 Clay	16,820	C.Y	11.50	193,430
	b) Supply, Place, Compact 6 inches of Sand	4,200	C.Y	10.50	44,100
	c) Supply and Install Filter Fabric	25,200	S.Y.	0.75	18,900
	e) Supply, Place, Compact 18 inches Imported Fill	12,600	C.Y	6.00	75,600
	f) Supply and Place 6 inches of Blended Topsoil	4,200	C.Y	11.00	46,200
	g) Hydroseed and Fertilize Cover	25,200	S.Y.	0.40	10,080
8)	Collection Drain System				
	a) Supply and Place 4 inch Diameter Perforated Drain Tile Around Municipal Landfill Perimeter	2,600	L.F.	3.50	9,100

TABLE B-1

CAPITAL CONSTRUCTION COSTS
RSSC PROPOSED ALTERNATE LANDFILL CAP

RASMUSSEN SITE

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
	b) Supply and Place 4 inch Diameter Perforated Drain Tile Along North Slope	700	L.F.	3.50	2,450
	c) Supply and Place 6 inch Diameter PVC Drainage Pipe	1,800	L.F.	4.50	8,100
	d) Revetment Pads Installed at Drain Outfalls	7	Ea.	200.00	1,400
9)	Supply and Place 6 inches of Blended Topsoil Over the Remaining Uncapped Area	8,060	C.Y	11.00	88,660
10)	Seed and Fertilize the Remaining Uncapped Area	48,400	S.Y.	0.40	19,360
11)	Cap Erosion Control Measures	1	L.S.	20,000.00	20,000
12)	Health and Safety				
	a) Implement Health and Safety Plan	1	L.S.	85,000.00	85,000
	b) Level C-PPE	1	L.S.	27,000.00	27,000
	c) Level B-PPE	1	L.S.	7,500.00	7,500
13)	Environmental Monitoring	1	L.S.	56,050.00	56,050
14)	Project Closeout and Demobilization	1	L.S.	25,000.00	25,000
	Subtotal - Direct Capital Costs				$1,614,390
INDIRECT CAPITAL COSTS					
	Administration and Legal (5% of Direct Capital Costs)				$80,720
	Engineering (10% of Direct Capital Costs)				$161,440
	Construction Supervision (15% of Direct Capital Costs)				$242,160
	Subtotal - Indirect Capital Costs				$484,320
	SUBTOTAL - CAPITAL COSTS				$2,098,710
	CONTINGENCY (25%)				$524,680
	TOTAL ESTIMATED CAPITAL COSTS				$2,623,390

TABLE B-2

OPERATION AND MAINTENANCE COSTS
RSSC PROPOSED ALTERNATE LANDFILL CAP

RASMUSSEN SITE

Item	*Description*	*Annual Costs*				*Present Worth*
		Estimated Quantity	*Unit*	*Unit Cost*	*Total Cost*	
DIRECT OPERATION AND MAINTENANCE COSTS						
Long Term Maintenance Costs						
1)	**Quarterly Inspection of Landfill Surface, Slopes, Fences,and on Site Well Network**	4	Insp.	500.00	2,000	30,740
2)	Annual Fertilizer Application (Apply fertilizer at a rate of 500 lbs./acre)	1	App.	7,000.00	7,000	107,600
3)	Annual Grass Cutting (if required)	1	Cut	2,400.00	2,400	36,890
4)	Repair Cover for Surface Water Runoff Erosion					
	a) Replace Eroded Soil Cover					
	• Provision for Year 1	400	C.Y.	15.00	6,000	5,710
	• Provision for Years 1 to 2	200	C.Y.	15.00	3,000	2,720
	• Provision after 2 Years	100	C.Y.	15.00	1,500	20,270
	b) Reseed Eroded Areas	3	Ac.	950.00	2,850	43,810
5)	Contingency for Site Fence and Sign Maintenance and Control of Burrowing Animals	1	L.S.	5,000.00	5,000	76,860
	Subtotal - Direct Operation and Maintenance Costs					$324,600

TABLE B-2

OPERATION AND MAINTENANCE COSTS
RSSC PROPOSED ALTERNATE LANDFILL CAP

RASMUSSEN SITE

Item	*Description*	*Annual Costs*				
		Estimated Quantity	*Unit*	*Unit Cost*	*Total Cost*	*Present Worth*
INDIRECT OPERATION AND MAINTENANCE COSTS						
Administration and Legal (20% of Subtotal)						$64,920
Subtotal - Indirect Operation and Maintenance Costs						$64,920
SUBTOTAL - OPERATION AND MAINTENANCE COSTS						$389,520
CONTINGENCY (25%)						$97,380
ESTIMATED PRESENT WORTH BASED ON A 5% NET DISCOUNT RATE, OVER A 30 YEAR PERIOD						$486,900

TABLE B-3

CAPITAL CONSTRUCTION COSTS
GROUNDWATER EXTRACTION/TREATMENT SYSTEM

RASMUSSEN SITE

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
DIRECT CAPITAL COSTS					
1)	Project Start-Up and Mobilization	1	L.S.	$54,000.00	$54,000
2)	Construction Facilities	1	L.S.	10,000.00	10,000
3)	Groundwater Extraction System				
	a) Install Extraction Wells (8" casing, 100' depth)	4	Ea.	18,000.00	72,000
	b) Install 4" HDPE, Extraction Forcemain to Treatment Plant	1,300	Feet	16.00	20,800
	c) Supply and Install Prefabricated Pump Stations	4	Ea.	15,000.00	60,000
	d) Extraction Well Pumps and Associated Mechanical /Electrical Equipment (pump, flowmeter, valves, level controls, misc. piping)	4	Ea.	10,000.00	40,000
	e) Electrical Service to GW Treatment Plant	1	L.S.	5,000.00	5,000
	f) Extraction Pump Control System	1	Ea.	10,000.00	10,000
	g) Electrical Conduit and Wiring to Pump Stations	2,500	Feet	15.00	37,500
	h) Pump Starters, Transformers, and Misc. Controls	1	L.S.	15,000.00	15,000
4)	Groundwater Treatment System				
	a) Treatability Study	1	L.S.	100,000.00	100,000
	b) Treatment System				
	• Equalization Tank	1	L.S.	10,000.00	10,000
	• Packed Tower Air Stripper	1	L.S.	35,000.00	35,000
	• Liquid Phase Carbon Contactors	1	L.S.	25,000.00	25,000
	• Vapor Phase Carbon Contactors	1	L.S.	25,000.00	25,000
	• Pumps and Piping	1	L.S.	10,000.00	10,000

TABLE B-3

CAPITAL CONSTRUCTION COSTS
GROUNDWATER EXTRACTION/TREATMENT SYSTEM

RASMUSSEN SITE

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
	• Electrical and Controls	1	L.S.	40,000.00	40,000
	• Treatment Plant Structure (approx. 20'x20')	1	L.S.	30,000.00	30,000
	• Site Services and Fencing	1	L.S.	18,000.00	18,000
5)	Discharge Systems				
	a) Forcemains				
	• 4" HDPE, Discharge Forcemain to Infiltration Bed System	250	Feet	16.00	4,000
	b) Treated Groundwater Infiltration Bed System	1	L.S.	35,000.00	35,000
6)	Health and Safety				
	a) Implement Health and Safety Plan	1	L.S.	20,000.00	20,000
	b) Level C PPE	1	L.S.	7,000.00	7,000
7)	Project Closeout and Demobilization	1	L.S.	10,000.00	10,000
	Subtotal - Direct Capital Costs				$693,300
INDIRECT CAPITAL COSTS					
	Administration and Legal (5% of Direct Capital Costs)				$34,670
	Engineering (10% of Direct Capital Costs)				$69,330
	Construction Supervision (15% of Direct Capital Costs)				$104,000
	Subtotal - Indirect Capital Costs				$208,000
	SUBTOTAL - CAPITAL COSTS				$901,300
	CONTINGENCY (25%)				$225,330
	TOTAL ESTIMATED CAPITAL COSTS				$1,126,630

TABLE B-4

OPERATION AND MAINTENANCE COSTS
GROUNDWATER EXTRACTION/TREATMENT SYSTEM

RASMUSSEN SITE

Item	*Description*	*Annual Costs* *Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*	*Present Worth*
DIRECT OPERATION AND MAINTENANCE COSTS						
Treatment Plant Operation						
1) Power costs						
a)	Annual costs for equipment for Years 0 to 30	1	LS	$13,600	$13,600	$209,060
2)	Operating staff for Years 0 to 30	1	LS	$30,000	$30,000	$461,160
3)	Capital replacement (20% of equipment costs)	1	LS	$20,000	$20,000	$307,440
4)	Sludge disposal (if required)	1	LS	$24,600	$24,600	$378,150
5)	Carbon replacement	1	LS	$50,000	$50,000	$768,600
6)	Sampling of extraction system and analysis for TCL VOCs					
a)	Perform quarterly for Years 0 to 30 (4 samples)	4	Round	$1,200	$4,800	$73,790
7)	Sampling of discharge system for TCL VOCs					
a)	Perform monthly for Months 0 to 6	6	Round	$300	$1,800	$1,800
b)	Perform quarterly for Months 6 to 12 (1 sample)	2	Round	$300	$600	$570
c)	Perform quarterly for Years 1 to 30 (1 sample)	4	Round	$300	$1,200	$17,300

TABLE B-4

OPERATION AND MAINTENANCE COSTS
GROUNDWATER EXTRACTION/TREATMENT SYSTEM

RASMUSSEN SITE

Item	*Description*	*Annual Costs* *Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*	*Present Worth*
Sampling of Wells						
A.	During Cleanup Operation					
	1) Sampling of downgradient well water and analysis for TCL VOCs					
	a) Perform annually for Years 0 to 30 (3 samples)	1	Round	$2,025	$2,025	$31,120
	b) Perform semi-annually for Years 0 to 30 (3 samples)	1	2 Rounds	$4,095	$4,095	$62,940
	2) Sampling of affected groundwater zone and analysis for TCL VOCs					
	a) Perform semiannually for Years 0 to 30 (2 samples)	2	Round	$1,365	$2,730	$11,820
	3) Sampling of affected groundwater zone perimeter and analysis for TCL VOCs					
	a) Perform annually for Years 0 to 30 (2 samples)	1	Round	$1,350	$1,350	$5,840
B.	Post Cleanup					
	1) Sampling of downgradient well water and analysis for TCL VOCs					
	a) Perform annually for Years 30 to 35 (4 samples)	1	Round	$2,700	$2,700	$9,160
	2) Sampling of affected groundwater zone and analysis for TCL VOCs					
	a) Perform annually for Years 30 to 35 (2 samples)	1	Round	$1,350	$1,350	$4,580

TABLE B-4

OPERATION AND MAINTENANCE COSTS
GROUNDWATER EXTRACTION/TREATMENT SYSTEM

RASMUSSEN SITE

		Annual Costs				
Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*	*Present Worth*
Hydraulic Monitoring						
A.	During Cleanup Operation					
	1) Collection of water levels					
	a) Biweekly for Month 0 to 3 (11 samples)	6	Round	$1,500	$9,000	$8,570
	b) Monthly for Month 3 to 12 (11 samples)	9	Round	$1,500	$13,500	$12,860
	c) Quarterly for Year 1 to 30 (11 samples)	4	Round	$1,500	$6,000	$20,260
B.	Post Cleanup					
	1) Collection of water levels					
	a) Annually for Years 30 to 35 (5 samples)	1	Round	$1,000	$1,000	$3,390
	Subtotal - Direct Operation and Maintenance Costs					$2,388,410
INDIRECT OPERATION AND MAINTENANCE COSTS						
	Administration and Legal (20% of Subtotal)					$477,680
	Subtotal - Indirect Operation and Maintenance Costs					$477,680
	SUBTOTAL - OPERATION AND MAINTENANCE COSTS					$2,866,090
	CONTINGENCY (25%)					$716,520
	ESTIMATED PRESENT WORTH BASED ON A 5% NET DISCOUNT RATE, OVER A 30 YEAR CLEANUP PERIOD AND 5 YEAR POST-CLEANUP MONITORING					$3,582,610

TABLE B-5

OPERATION AND MAINTENANCE COSTS
GROUNDWATER EXTRACTION/TREATMENT SYSTEM

RASMUSSEN SITE

Item	*Description*	*Annual Costs* *Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*	*Present Worth*
DIRECT OPERATION AND MAINTENANCE COSTS						
Treatment Plant Operation						
1) Power costs						
a)	Annual costs for equipment for Years 0 to 100	1	LS	$13,600	$13,600	$269,930
2) Operating staff for Years 0 to 100		1	LS	$30,000	$30,000	$595,440
3) Capital replacement (20% of equipment costs)		1	LS	$20,000	$20,000	$396,960
4) Sludge disposal (if required)		1	LS	$24,600	$24,600	$488,260
5) Carbon replacement		1	LS	$50,000	$50,000	$992,400
6) Sampling of extraction system and analysis for TCL VOCs						
a)	Perform quarterly for Years 0 to 100 (4 samples)	4	Round	$1,200	$4,800	$95,270
7) Sampling of discharge system for TCL VOCs						
a)	Perform monthly for Months 0 to 6	6	Round	$300	$1,800	$1,800
b)	Perform quarterly for Months 6 to 12 (1 sample)	2	Round	$300	$600	$570
c)	Perform quarterly for Years 1 to 100 (1 sample)	4	Round	$300	$1,200	$22,680

TABLE B-5

OPERATION AND MAINTENANCE COSTS
GROUNDWATER EXTRACTION/TREATMENT SYSTEM

RASMUSSEN SITE

Item	*Description*	*Annual Costs* *Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*	*Present Worth*
Sampling of Wells						
A.	During Cleanup Operation					
	1) Sampling of downgradient well water and analysis for TCL VOCs					
	a) Perform annually for Years 0 to 100 (3 samples)	1	Round	$2,025	$2,025	$40,190
	b) Perform semi-annually for Years 0 to 100 (3 samples)	1	2 Rounds	$4,095	$4,095	$81,270
	2) Sampling of affected groundwater zone and analysis for TCL VOCs					
	a) Perform semiannually for Years 0 to 100 (2 samples)	2	Round	$1,365	$2,730	$11,820
	3) Sampling of affected groundwater zone perimeter and analysis for TCL VOCs					
	a) Perform annually for Years 0 to 100 (2 samples)	1	Round	$1,350	$1,350	$5,840
B.	Post Cleanup					
	1) Sampling of downgradient well water and analysis for TCL VOCs					
	a) Perform annually for Years 100 to 105 (4 samples)	1	Round	$2,700	$2,700	$9,160
	2) Sampling of affected groundwater zone and analysis for TCL VOCs					
	a) Perform annually for Years 100 to 105 (2 samples)	1	Round	$1,350	$1,350	$4,580

TABLE B-5

OPERATION AND MAINTENANCE COSTS
GROUNDWATER EXTRACTION/TREATMENT SYSTEM

RASMUSSEN SITE

Item	*Description*	*Annual Costs* *Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*	*Present Worth*
Hydraulic Monitoring						
A.	During Cleanup Operation					
	1) *Collection of water levels*					
	a) Biweekly for Month 0 to 3 (11 samples)	6	Round	$1,500	$9,000	$8,570
	b) Monthly for Month 3 to 12 (11 samples)	9	Round	$1,500	$13,500	$12,860
	c) Quarterly for Year 1 to 100 (11 samples)	4	Round	$1,500	$6,000	$20,260
B.	Post Cleanup					
	1) Collection of water levels					
	a) Annually for Years 100 to 105 (5 samples)	1	Round	$1,000	$1,000	$3,390
	Subtotal - Direct Operation and Maintenance Costs					$3,061,250
INDIRECT OPERATION AND MAINTENANCE COSTS						
	Administration and Legal (20% of Subtotal)					$612,250
	Subtotal - Indirect Operation and Maintenance Costs					$612,250
	SUBTOTAL - OPERATION AND MAINTENANCE COSTS					$3,673,500
	CONTINGENCY (25%)					$918,380
	ESTIMATED PRESENT WORTH BASED ON A 5% NET DISCOUNT RATE, OVER A 100 YEAR CLEANUP PERIOD AND 5 YEAR POST-CLEANUP MONITORING					$4,591,880

TABLE B-6

OPERATION AND MAINTENANCE COSTS
GROUNDWATER EXTRACTION/TREATMENT SYSTEM

RASMUSSEN SITE

Item	*Description*	*Annual Costs* *Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*	*Present Worth*
DIRECT OPERATION AND MAINTENANCE COSTS						
Treatment Plant Operation						
1)	Power costs					
a)	Annual costs for equipment for Years 0 to 10	1	LS	$13,600	$13,600	$141,170
2)	Operating staff for Years 0 to 10	1	LS	$30,000	$30,000	$311,400
3)	Capital replacement (20% of equipment costs)	1	LS	$20,000	$20,000	$207,600
4)	Sludge disposal (if required)	1	LS	$24,600	$24,600	$255,350
5)	Carbon replacement	1	LS	$50,000	$50,000	$519,000
6)	Sampling of extraction system and analysis for TCL VOCs					
a)	Perform quarterly for Years 0 to 10 (4 samples)	4	Round	$1,200	$4,800	$49,820
7)	Sampling of discharge system for TCL VOCs					
a)	Perform monthly for Months 0 to 6	6	Round	$300	$1,800	$1,800
b)	Perform quarterly for Months 6 to 12 (1 sample)	2	Round	$300	$600	$570
c)	Perform quarterly for Years 1 to 10 (1 sample)	4	Round	$300	$1,200	$11,310

TABLE B-6

OPERATION AND MAINTENANCE COSTS GROUNDWATER EXTRACTION/TREATMENT SYSTEM

RASMUSSEN SITE

Item	*Description*	*Annual Costs* *Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*	*Present Worth*
Sampling of Wells						
A.	During Cleanup Operation					
	1) Sampling of downgradient well water and analysis for TCL VOCs					
	a) Perform annually for Years 0 to 10 (3 samples)	1	Round	$2,025	$2,025	$21,010
	b) Perform semi-annually for Years 0 to 10 (3 samples)	1	2 Rounds	$4,095	$4,095	$42,500
	2) Sampling of affected groundwater zone and analysis for TCL VOCs					
	a) Perform semiannually for Years 0 to 10 (2 samples)	2	Round	$1,365	$2,730	$11,820
	3) Sampling of affected groundwater zone perimeter and analysis for TCL VOCs					
	a) Perform annually for Years 0 to 10 (2 samples)	1	Round	$1,350	$1,350	$5,840
B.	Post Cleanup					
	1) Sampling of downgradient well water and analysis for TCL VOCs					
	a) Perform annually for Years 10 to 15 (4 samples)	1	Round	$2,700	$2,700	$9,160
	2) Sampling of affected groundwater zone and analysis for TCL VOCs					
	a) Perform annually for Years 10 to 15 (2 samples)	1	Round	$1,350	$1,350	$4,580
Hydraulic Monitoring						
A.	During Cleanup Operation					
	1) Collection of water levels					

TABLE B-6

OPERATION AND MAINTENANCE COSTS
GROUNDWATER EXTRACTION/TREATMENT SYSTEM

RASMUSSEN SITE

Item	*Description*	*Annual Costs* *Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*	*Present Worth*
	a) Biweekly for Month 0 to 3 (11 samples)	6	Round	$1,500	$9,000	$8,570
	b) Monthly for Month 3 to 12 (11 samples)	9	Round	$1,500	$13,500	$12,860
	c) Quarterly for Year 1 to 10 (11 samples)	4	Round	$1,500	$6,000	$20,260
B.	Post Cleanup					
	1) Collection of water levels					
	a) Annually for Years 10 to 15 (5 samples)	1	Round	$1,000	$1,000	$3,390
	Subtotal - Direct Operation and Maintenance Costs					$1,638,010
INDIRECT OPERATION AND MAINTENANCE COSTS						
	Administration and Legal (20% of Subtotal)					$327,600
	Subtotal - Indirect Operation and Maintenance Costs					$327,600
	SUBTOTAL - OPERATION AND MAINTENANCE COSTS					$1,965,610
	CONTINGENCY (25%)					$491,400
	ESTIMATED PRESENT WORTH BASED ON A 5% NET DISCOUNT RATE, OVER A 10 YEAR CLEANUP PERIOD AND 5 YEAR POST-CLEANUP MONITORING					$2,457,010

APPENDIX C

HELP MODEL OUTPUT

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REFERENCE 2433
MDNR PROPOSED DESIGN
SEPTEMBER 26, 1990

**********************************************************************
**********************************************************************




                              GOOD GRASS


                               LAYER 1
                               -------

         VERTICAL PERCOLATION LAYER
         THICKNESS                        =    12.00 INCHES
         EVAPORATION COEFFICIENT          =     4.500 MM/DAY**0.5
         POROSITY                         =     0.5210 VOL/VOL
         FIELD CAPACITY                   =     0.3770 VOL/VOL
         WILTING POINT                    =     0.2210 VOL/VOL
         EFFECTIVE HYDRAULIC CONDUCTIVITY =     0.88199991 INCHES/HR


                               LAYER 2
                               -------

         LATERAL DRAINAGE LAYER
         SLOPE                            =    12.00 PERCENT
         DRAINAGE LENGTH                  =   250.0 FEET
         THICKNESS                        =    12.00 INCHES
         EVAPORATION COEFFICIENT          =     3.400 MM/DAY**0.5
         POROSITY                         =     0.4300 VOL/VOL
         FIELD CAPACITY                   =     0.1610 VOL/VOL
         WILTING POINT                    =     0.0600 VOL/VOL
         EFFECTIVE HYDRAULIC CONDUCTIVITY =     2.77999997 INCHES/HR


                               LAYER 3
                               -------

         BARRIER SOIL LAYER
         THICKNESS                        =    36.00 INCHES
         EVAPORATION COEFFICIENT          =     3.100 MM/DAY**0.5
         POROSITY                         =     0.5200 VOL/VOL
         FIELD CAPACITY                   =     0.4500 VOL/VOL
         WILTING POINT                    =     0.3600 VOL/VOL
         EFFECTIVE HYDRAULIC CONDUCTIVITY =     0.00014200 INCHES/HR
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                         GENERAL SIMULATION DATA
                         -----------------------

         SCS RUNOFF CURVE NUMBER              =      80.59
         TOTAL AREA OF COVER                  =  220000. SQ. FT
         EVAPORATIVE ZONE DEPTH               =      10.00 INCHES
         EFFECTIVE EVAPORATION COEFFICIENT    =       4.500 MM/DAY**0.5
         UPPER LIMIT VEG. STORAGE             =       5.2100 INCHES
         INITIAL VEG. STORAGE                 =       2.9900 INCHES


      CLIMATOLOGIC DATA FOR    E. LANCING         MICHIGAN

                  MONTHLY MEAN TEMPERATURES, DEGREES FAHRENHEIT

   JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
   -------     -------     -------     -------     -------     -------
    23.10       24.95       32.83       44.62       57.15       67.09
    71.75       69.90       62.02       50.23       37.70       27.76

                 MONTHLY MEANS SOLAR RADIATION, LANGLEYS PER DAY

   JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
   -------     -------     -------     -------     -------     -------
   121.19      185.29      286.98      399.01      491.38      539.31
   529.98      465.88      364.19      252.15      159.79      111.85

                            LEAF AREA INDEX TABLE

                              DATE       LAI
                              ----      ----
                                1       0.00
                              126       0.00
                              142       1.23
                              158       2.01
                              173       2.01
                              189       2.01
                              205       2.01
                              221       2.01
                              237       1.81
                              252       1.31
                              268       0.64
                              284       0.34
                              366       0.00

                               GOOD GRASS

                          WINTER COVER FACTOR =     1.20




 ***********************************************************************




     AVERAGE MONTHLY TOTALS FOR    74 THROUGH    78

                              JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                              ------- ------- ------- ------- ------- -------

 PRECIPITATION (INCHES)         2.19    1.67    2.99    2.95    2.34    3.26
                                2.03    3.66    2.81    1.61    2.30    2.20


 RUNOFF (INCHES)               0.000   0.000   0.050   0.145   0.023   0.074
```

```
                                  0.027   0.195   0.000   0.002   0.000   0.000


EVAPOTRANSPIRATION                0.812   1.109   2.273   2.619   2.314   2.338
     (INCHES)                     1.901   2.101   1.956   1.559   1.012   0.799


PERCOLATION FROM BASE             0.0830  0.0376  0.0490  0.1266  0.1238  0.1150
OF COVER (INCHES)                 0.1157  0.1165  0.1119  0.1140  0.1130  0.1139


DRAINAGE FROM BASE OF             0.101   0.013   0.201   1.639   1.224   0.738
COVER (INCHES)                    0.600   0.510   0.692   0.579   0.491   0.428

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   AVERAGE ANNUAL TOTALS FOR   74 THROUGH   78
 ----------------------------------------------------------------------
                                          (INCHES)    (CU. FT.)    PERCENT
                                          --------    ---------    -------
   PRECIPITATION                           30.00        550037.    100.00

   RUNOFF                                   0.516         9453.      1.72

   EVAPOTRANSPIRATION                      20.793       381209.     69.31

   PERCOLATION FROM BASE OF COVER          1.2201        22368.      4.07

   DRAINAGE FROM BASE OF COVER              7.216       132292.     24.05
***********************************************************************








***********************************************************************

           PEAK DAILY VALUES FOR   74 THROUGH   78
    --------------------------------------------------------------
                                             (INCHES)     (CU. FT.)
                                             --------     ---------

      PRECIPITATION                            3.08         56466.7

      RUNOFF                                   0.694        12728.6

      PERCOLATION FROM BASE OF COVER           0.0101         184.5

      DRAINAGE FROM BASE OF COVER              0.123         2246.6

      HEAD ON BASE OF COVER                     19.3

      SNOW WATER                                 6.53      119739.2
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      MAXIMUM VEG. SOIL WATER (VOL/VOL)        0.4578

      MINIMUM VEG. SOIL WATER (VOL/VOL)        0.2210

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***********************************************************************

REFERENCE 2433
RSSC PROPOSED DESIGN UNCOMPACTED
SEPTEMBER 26, 1990

***********************************************************************
***********************************************************************



                              GOOD GRASS


                               LAYER 1
                               -------

         VERTICAL PERCOLATION LAYER
         THICKNESS                         =      6.00 INCHES
         EVAPORATION COEFFICIENT           =      4.500 MM/DAY**0.5
         POROSITY                          =      0.5210 VOL/VOL
         FIELD CAPACITY                    =      0.3770 VOL/VOL
         WILTING POINT                     =      0.2210 VOL/VOL
         EFFECTIVE HYDRAULIC CONDUCTIVITY  =      0.88199991 INCHES/HR


                               LAYER 2
                               -------

         LATERAL DRAINAGE LAYER
         THICKNESS                         =     18.00 INCHES
         EVAPORATION COEFFICIENT           =      3.800 MM/DAY**0.5
         POROSITY                          =      0.4420 VOL/VOL
         FIELD CAPACITY                    =      0.2560 VOL/VOL
         WILTING POINT                     =      0.1330 VOL/VOL
         EFFECTIVE HYDRAULIC CONDUCTIVITY  =      0.67000002 INCHES/HR


                               LAYER 3
                               -------

         LATERAL DRAINAGE LAYER
         SLOPE                             =     12.00 PERCENT
         DRAINAGE LENGTH                   =    250.0 FEET
         THICKNESS                         =      6.00 INCHES
         EVAPORATION COEFFICIENT           =      3.400 MM/DAY**0.5
         POROSITY                          =      0.4300 VOL/VOL
         FIELD CAPACITY                    =      0.1610 VOL/VOL
         WILTING POINT                     =      0.0600 VOL/VOL
         EFFECTIVE HYDRAULIC CONDUCTIVITY  =      2.77999997 INCHES/HR
```

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                              LAYER 4
                              -------

             BARRIER SOIL LAYER
             THICKNESS                         =    24.00 INCHES
             EVAPORATION COEFFICIENT           =     3.100 MM/DAY**0.5
             POROSITY                          =     0.5200 VOL/VOL
             FIELD CAPACITY                    =     0.4500 VOL/VOL
             WILTING POINT                     =     0.3600 VOL/VOL
             EFFECTIVE HYDRAULIC CONDUCTIVITY  =     0.00014200 INCHES/HR


                         GENERAL SIMULATION DATA
                         -----------------------

             SCS RUNOFF CURVE NUMBER           =       80.59
             TOTAL AREA OF COVER               =   220000. SQ. FT
             EVAPORATIVE ZONE DEPTH            =       10.00 INCHES
             EFFECTIVE EVAPORATION COEFFICIENT =        4.449 MM/DAY**0.5
             UPPER LIMIT VEG. STORAGE          =        4.8940 INCHES
             INITIAL VEG. STORAGE              =        2.5720 INCHES


          CLIMATOLOGIC DATA FOR    E. LANCING        MICHIGAN

                 MONTHLY MEAN TEMPERATURES, DEGREES FAHRENHEIT

      JAN/JUL      FEB/AUG      MAR/SEP      APR/OCT      MAY/NOV      JUN/DEC
      -------      -------      -------      -------      -------      -------
       23.10        24.95        32.83        44.62        57.15        67.09
       71.75        69.90        62.02        50.23        37.70        27.76

                 MONTHLY MEANS SOLAR RADIATION, LANGLEYS PER DAY

      JAN/JUL      FEB/AUG      MAR/SEP      APR/OCT      MAY/NOV      JUN/DEC
      -------      -------      -------      -------      -------      -------
      121.19       185.29       286.98       399.01       491.38       539.31
      529.98       465.88       364.19       252.15       159.79       111.85

                            LEAF AREA INDEX TABLE

                              DATE         LAI
                              ----         ----
                                1          0.00
                              126          0.00
                              142          1.23
                              158          2.01
                              173          2.01
                              189          2.01
                              205          2.01
                              221          2.01
                              237          1.81
                              252          1.31
                              268          0.64
                              284          0.34
                              366          0.00

                               GOOD GRASS

                        WINTER COVER FACTOR =     1.20
```

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***********************************************************************

   AVERAGE MONTHLY TOTALS FOR    74 THROUGH    78

                              JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                              ------- ------- ------- ------- ------- -------

PRECIPITATION (INCHES)          2.19    1.67    2.99    2.95    2.34    3.26
                                2.03    3.66    2.81    1.61    2.30    2.20

RUNOFF (INCHES)                0.000   0.000   0.048   0.144   0.022   0.074
                               0.027   0.194   0.000   0.002   0.000   0.000

EVAPOTRANSPIRATION             0.812   1.109   2.274   2.632   2.258   2.386
    (INCHES)                   1.958   2.151   1.952   1.566   1.068   0.800

PERCOLATION FROM BASE         0.0809  0.0363  0.0514  0.1502  0.1464  0.1274
OF COVER (INCHES)             0.1231  0.1189  0.1199  0.1193  0.1163  0.1168

DRAINAGE FROM BASE OF          0.102   0.016   0.197   1.274   1.147   0.891
COVER (INCHES)                 0.690   0.517   0.611   0.601   0.475   0.417

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  AVERAGE ANNUAL TOTALS FOR    74 THROUGH    78
-----------------------------------------------------------------------
                                       (INCHES)      (CU. FT.)    PERCENT
                                       --------      ---------    -------
  PRECIPITATION                         30.00        550037.      100.00

  RUNOFF                                 0.511         9376.        1.70

  EVAPOTRANSPIRATION                    20.967       384388.       69.88

  PERCOLATION FROM BASE OF COVER         1.3069       23960.        4.36

  DRAINAGE FROM BASE OF COVER            6.937       127186.       23.12
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          PEAK DAILY VALUES FOR   74 THROUGH   78
-------------------------------------------------------------
                                       (INCHES)    (CU. FT.)
                                       --------    ---------

   PRECIPITATION                        3.08        56466.7

   RUNOFF                               0.696       12753.4

   PERCOLATION FROM BASE OF COVER       0.0106        194.4

   DRAINAGE FROM BASE OF COVER          0.094        1721.8

   HEAD ON BASE OF COVER                 22.4

   SNOW WATER                             6.53     119739.2


   MAXIMUM VEG. SOIL WATER (VOL/VOL)          0.3662

   MINIMUM VEG. SOIL WATER (VOL/VOL)          0.1858

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APPENDIX D

RSSC OCTOBER 1990 SAMPLING RESULTS

SAMPLING PROGRAM MEMORANDUM

CONESTOGA-ROVERS & ASSOCIATES
MEMORANDUM

TO: Cliff Eng
FROM: Walter Pochron
DATE: October 17, 1990
REF. NO: 2433
RE: Groundwater Sampling and Hydraulic Monitoring
Rasmussen Site
Livingston County, Michigan

Groundwater samples were collected from six monitoring wells within the Rasmussen property and from one monitoring well on the Speilgelberg property immediately west of the Speilgelberg/Rasmussen property boundary. The sampled wells consisted of RA-MW-18D; RA-MW-22, RA-MW-28, RA-MW-32, RA-MW-34, RA-MW-54 and SP-MW-25D. Sampling activities commenced on October 10, 1990 and were completed on October 11, 1990. Oversight of the groundwater sampling activities was performed by the Michigan Department of Natural Resources (MDNR). The groundwater sampling activities consisted of the following activities.

Groundwater Sampling

All sampling and/or purging equipment (i.e.; bailer, submersible pumps, etc.) were precleaned prior to use. Decontamination consisted of a wash with Alconox and distilled water followed by a rinse with methanol and a final rinse with distilled water. The equipment was then wrapped in aluminum foil until needed.

Prior to sample collection, the static water level and well depth were measured and recorded. These measurements were then used to calculate well volumes. Wells RA-MW-18D and SP-MW-25D were purged using a pre-cleaned four-inch Franklin electric pump; all of the remaining wells were purged using pre-cleaned stainless-steel bailers. New nylon rope and latex gloves were used at each well location. A minimum of three well volumes were purged from each well prior to sample collection. Field measurements of pH and conductivity were recorded following removal of each standing well volume. Well purging continued until three consistent and consecutive readings ± 10% for pH and conductivity were achieved or a maximum of five well volumes had been removed. The temperature of the excavated water was recorded at the completion of purging activities. Calibration of the pH and conductivity meter was performed on a daily basis. Water generated during the purging activities were allowed to discharge onto the ground surface.

A summary of the groundwater samples and field parameters is presented in Attachment 1.

Immediately following purging of each well, groundwater samples were collected. Groundwater samples were poured directly from the bailer into precleaned bottles supplied by the analytical laboratory. Dissolved metals samples were field filtered by CRA, utilizing a Cole-Parmer filtration kit and 0.45 micron filter paper. All samples requiring preservation were then preserved. The bottle, handling and preservation requirements for each analytical parameter is presented in Attachment 2. The samples collected were placed in a shipping cooler on ice and shipped under chain-of-custody protocol to the contract laboratories, Radian of Sacramento, California, Radian of Milwaukee, Wisconsin and Ensecon in Cambridge, Massachusetts.

Quality Assurance/Quality Control samples collected during this event consisted of two trip blanks, one rinsate blank, one field water blank, one field duplicate and a matrix spike/matrix spike duplicate.

Hydraulic Monitoring

An attempt was made to collect water levels on all of the monitoring wells within the Rasmussen property and a few selected bordering wells on the Spiegelberg property. Water levels were recorded using a Solinst water level meter precleaned with distilled water between wells. Water level data is presented in Attachment 3. Water levels were not recorded at RA-MW-43, 81-1, and SP-MW-29 because these borings were never completed as monitoring wells. Wells RA-MW-23D, RA-MW-31D, RA-MW-35 and 81-11 were not able to be located in the field. Well SP-MW-15 had recently been washed over by sediments and was unable to be located. Access to well SP-MW-37 was prohibited because CRA was provided with the wrong accessing tool by the MDNR.

WJP/lo/1

Attachments

cc: K. Myers
B. Monteith

ATTACHMENT 1

SUMMARY OF QA/QC GROUNDWATER SAMPLES
RASMUSSEN SITE

Well # RA-MW-28

Well Depth = 47.30 ft.
Water Level = 38.18 ft.

Well Volume = 1.45 Gal.
Sample Date = 10/10/90
Sample Time = 13:31

Sample # W-101090-WP-001

Gallons Removed	*pH*	*Cond. µmos*	*Temp.*	*Clarity*
1.5	6.50	610	13	cloudy
3.0	6.85	710	13	cloudy
4.5	6.90	730	13	cloudy
6.0	6.90	710	13	cloudy

Analyses: VOC, BNA, Total Metals, Dissolved Metals, General Chemistry[1]

Well # RA-MW-34

Well Depth = 100.57 ft.
Water Level = 37.65 ft.

Well Volume = 10.06 Gal.
Sample Date = 10/10/90
Sample Time = 14:30

Sample # W-101090-WP-002

Gallons Removed	*pH*	*Cond. µmos*	*Temp. °C*	*Clarity*
10	6.68	890	12.0	clear, no odor
20	6.70	910	12.0	clear, no odor
30	6.80	920	12.0	clear, no odor

Analyses: VOC, BNA, Total Metals, Dissolved Metals, General Chemistry[1]

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[1] Note: General Chemistry includes: TOC, COD, TDS, TSS, Alkalinity, Bicarbonate, Carbonate, BOC

ATTACHMENT 1

SUMMARY OF GROUNDWATER SAMPLES AND FIELD PARAMETERS
RASMUSSEN SITE

Well # RA-MW-54

Well Depth = 56.93 ft.
Water Level = 50.52 ft.
Well Volume = 1.03 Gal.
Sample Date = 10/10/90
Sample Time = 16:30

Sample # W-101090-WP-003

Gallons Removed	*pH*	*Cond. µmos*	*Temp. °C*	*Clarity*
1	6.56	920	12	cloudy
2	6.67	1020	12	cloudy
3	6.67	1120	12	cloudy
4	6.62	1140	12	cloudy

Analyses: VOC, BNA

Well # RA-MW-22

Well Depth = 54.18 ft.
Water Level = 45.85 ft.
Well Volume = 1.33 Gal.
Sample Date = 10/10/90
Sample Time = 17:10

Sample # W-101090-WP-004

Gallons Removed	*pH*	*Cond. µmos*	*Temp. °C*	*Clarity*
1.4	6.60	840	13	cloudy
2.8	6.73	960	13	cloudy
4.2	6.76	1000	13	cloudy
5.6	6.79	1040	13	cloudy

Analyses: VOC, BNA, Total Metals, Dissolved Metals, General Chemistry[1]

[1] Note: General Chemistry includes: TOC, COD, TDS, TSS, Alkalinity, Bicarbonate, Carbonate, BOC

ATTACHMENT 1

SUMMARY OF GROUNDWATER SAMPLES AND FIELD PARAMETERS RASMUSSEN SITE

Well # RA-MW-18D and MS/MSD

Well Depth = 103.90 ft.
Water Level = 54.85 ft.

Well Volume = 32.0 Gal.
Sample Date = 10/11/90
Sample Time = 12:50

Sample # W-101190-WP-008

Gallons Removed	*pH*	*Cond. µmos*	*Temp. °C*	*Clarity*
32	6.51	680	13	clear
64	6.62	730	13	clear
96	6.64	760	13	clear

Note: MS/MSD sample collected from RA-MW-18D

Analyses: VOC, BNA

Well # SP-MW-25D

Well Depth = 161.03 ft.
Water Level = 57.35 ft.

Well Volume = 68 Gal.
Sample Date = 10/11/90
Sample Time = 14:30

Sample # W-101190-WP-009

Gallons Removed	*pH*	*Cond. µmos*	*Temp. °C*	*Clarity*
68	6.76	570	13	cloudy
136	6.79	660	13	clear
204	6.78	670	13	clear
272	6.80	680	13	clear

Analyses: VOC, BNA, Total Metals, Dissolved Metals, General Chemistry[1]

---

[1] Note: General Chemistry includes: TOC, COD, TDS, TSS, Alkalinity, Bicarbonate, Carbonate, BOC

ATTACHMENT 1

SUMMARY OF QA/QC GROUNDWATER SAMPLES
RASMUSSEN SITE

Duplicate from RA-MW-22

Sample Date = 10/10/90
Sample Time = 17:15

Sample # W-101090-WP-005

Analyses: VOC, BNA, Total Metals, Dissolved Metals, General Chemistry[1]

Rinsate Blank RA-MW-32 Bailer

Sample Date = 10/11/90
Sample Time = 10:35

Sample # W-101190-WP-007

Analyses: VOC, BNA

Field Water Blank

Sample Date = 10/11/90
Sample Time = 15:10

Sample # W-101190-WP-010

Analyses: VOC

Solvent Blank

Sample Date = 10/11/90
Sample Time = 15:15

Sample # W-101190-WP-011

Analyses: VOC

[1] Note: General Chemistry includes: TOC, COD, TDS, TSS, Alkalinity, Bicarbonate, Carbonate, BOC

ATTACHMENT 2

SAMPLE BOTTLE, HANDLING AND PRESERVATION REQUIREMENTS RASMUSSEN SITE

Analysis	*Sample Container*	*Preservation*	*Maximum Holding Time*	*Shipping*
TCL-VOC	2 - 40 m*l* vials	HCL	14 days	Transported Daily
Base/Neutral Acid	2 - 1 liter amber glass bottles	Cool 4°C	7 day extraction 40 days after extraction	Transported Daily
Metals	2 - 1 liter plastic bottles	HNO_3	6 months	Transported Daily
BOD	1 - 500 m*l* amber glass bottle	Cool 4°C	2 days	Transported Daily
TOC/COD	1 - 500 m*l* glass bottle	H_2SO_4	28 days	Transported Daily
Alkalinity, Bicarbonate, Carbonate, TDS TSS	1 - 500 m*l* plastic bottle	Cool 4°C	14 days	Transported Daily

ATTACHMENT 3

HYDRAULIC MONITORING DATA
RASMUSSEN SITE

Well Number	*Casing Elevation Ft AMSL*	*Water Level Ft.*	*Groundwater Elevation Ft. AMSL*
RA-MW-16	906.06	20.96	885.10
RA-MW-17	922.20	37.49	884.71
RA-MW-18D	937.51	54.85	882.66
RA-MW-22	930.06	45.85	884.21
RA-MW23D	933.54	Not Located	N A
RA-MW-27	915.04	30.03	885.01
RA-MW-28	920.92	38.18	882.24
RA-MW-31D	902.84	Not Located	N A
RA-MW-32	916.18	33.52	882.66
RA-MW-33	892.70	9.08	883.63
RA-MW-34	922.26	37.65	884.61
RA-MW-35	907.90	Not Located	N A
RA-MW-36	906.53	25.12	881.41
RA-MW-38	888.96	8.42	880.54
RA-MW-39	888.66	3.01	885.65
RA-MW-41	919.14	44.97	874.14
RA-MW-42	934.93	61.71	873.22
RA-MW-43	N A	Soil Boring	N A
RA-MW-47	920.21	46.90	873.31
RA-MW-53	920.32	35.49	884.83
RA-MW-54	934.23	50.52	883.71
RA-MW-56	915.16	33.25	881.91
RA-MW-58	902.10	20.30	881.80
81-1	N A	Soil Boring	N A
81-2	905.63	20.40	885.23
81-4	912.38	27.75	884.63
81-5	915.79	32.52	883.27
81-6	933.79	60.78	873.01
81-7	926.94	45.09	881.85
81-8	923.95	42.22	881.73
81-9	896.63	14.93	881.70
81-10	915.92	31.18	884.74
81-11	N A	Not Located	N A

ATTACHMENT 3

HYDRAULIC MONITORING DATA
RASMUSSEN SITE

Well Number	*Casing Elevation Ft. AMSL*	*Water Level Ft.*	*Groundwater Elevation Ft. AMSL*
SP-MW-5D	915.22	31.87	883.35
SP-MW-15	890.90	Washed Out	NA
SP-MW-19	897.85	8.45	889.40
SP-MW-25D	930.39	57.35	873.04
SP-MW-29	936.40	Soil Boring	NA
SP-MW-30D	901.55	19.50	882.05
SP-MW-37	927.25	Couldn't Assess	NA
SP-MW-44	918.27	45.36	873.61
SP-MW-49	913.30	37.48	875.82

COMPILED ANALYTICAL DATA

TABLE 1

ORGANIC CHEMICAL CONCENTRATIONS - UPPER AQUIFER
RASMUSSEN SITE

Well Name	***81-8***	***81-8***		***RA-MW-18D***	***RA-MW-18D***		***RA-MW-18D (DUP)***		***RA-MW-18D***	
Sample No.	***RA-GW-63-1***	***RAS-2***		***RA-GW-78-1***	***RAS-3***		***RAS-4***		***W-101190-WP-008***	
Sample Date	***3/17/87***	***5/30/90***		***3/20/87***	***5/31/90***		***5/31/90***		***10/11/90***	
Volatile Organics (VOCs)										ΔΔΔ
Acetone	No compounds found	ND	(5.0)		5.5 *A	(5.0)	6.5 *	(5.0)	ND	(1.2)
Benzene		ND	(2.5)		ND A	(1.0)	ND	(2.5)	2.8	(0.24)
2-Butanone (MEK)		ND	(5.0)		ND A	(2.0)	ND	(5.0)	ND	(12)
Chlorobenzene		ND	(2.5)		ND A	(1.0)	ND	(2.5)	ND	(0.28)
Chloroethane		ND	(5.0)		ND A	(2.0)	ND	(5.0)	ND	(0.40)
Chloroform		ND	(1.0)		ND A	(1.0)	ND	(1.0)	ND	(0.24)
1,1-Dichloroethane		ND	(2.5)		ND A	(1.0)	ND	(2.5)	ND	(0.24)
1,1-Dichloroethene		ND	(1.0)		ND A	(1.0)	ND	(1.0)	ND	(0.20)
1,2-Dichloroethene (total)		ND	(2.5)		ND A	(1.0)	ND	(2.5)	ND	(0.20)
Trans-1,2-Dichloroethene										
Ethylbenzene		ND	(2.5)		ND A	(1.0)	ND	(2.5)	ND	(0.24)
4-Methyl-2-pentanone (MIBK)		ND	(5.0)	300 J	55 E	(5.0)	67 E	(5.0)	53	(2.0)
Methylene Chloride		ND	(2.5)		ND A	(1.0)	ND	(2.5)	1.7 U	(0.20)
Tetrachloroethene		ND	(1.0)		ND A	(1.0)	ND	(1.0)	ND	(0.24)
Toluene		ND	(2.5)		ND A	(1.0)	ND	(2.5)	ND	(0.28)
1,1,1-Trichloroethane		ND	(2.5)		ND A	(1.0)	ND	(2.5)	ND	(0.24)
Trichloroethene		ND	(2.5)		ND A	(1.0)	ND	(2.5)	ND	(0.20)
Vinyl Chloride		ND	(5.0)		ND A	(2.0)	ND	(5.0)	ND	(0.20)
Xylene (Total)		ND	(2.5)		ND	(2.0)	ND	(2.5)	ND R	(0.20)
Base Neutral/Acid Extractables (BNAs)										
Benzo(a)Anthracene		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
Benzoic acid		ND	(25)		17 J	(25)	ND	(25)	ND	(25)
Benzyl Alcohol		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
Butylbenzylphthalate		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
Di-n-Butylphthalate		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
Di-n-Octylphthalate		ND	(5.0)		ND	(5.0)	ND	(5.0)	10	(5.0)
2-Chlorophenol		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
Chrysene		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
2,4-Dimethylphenol		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
bis(2-Ethylhexyl)phthalate		ND	(5.0)		16 *	(5.0)	19 *	(5.0)	64	(5.0)
Isophorone		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
2-Methylphenol		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
4-Methylphenol (p-cresol)		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
N-Nitrosodiphenylamine		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
N-Nitroso-di-n-propylamine		ND	(5.0)		ND	(5.0)	ND	(5.0)	ND	(5.0)
Phenol		ND	(5.0)		ND	(5.0)	ND	(5.0)	5.6	(5.0)

Notes:

For MDNR results (1987)

B Compound detected in laboratory and/or field blank

J Analytical value is approximate

For 1990 Results (Lab qualifiers)

ND None detected at stated detection limits. Stated detection limits are values in parenthesis. These values are PQLs except as otherwise noted by ΔΔΔ for VOCs.

* The analyte result is less than five times the specified detection limit and therefore estimated.

A The associated value is estimated due to outlying surrogate recoveries

E The associated value exceeded the linear calibration range and is therefore estimated

J Detected at less than detection limit

U The parameter was analyzed but not detected above the associated value. The associated value has been adjusted to reflect possible laboratory contamination.

R Data rejected; analyte may or may not be present

ΔΔΔ Reported detection limit is method specified Method Detection Limit (MDL) and does not represent actual sample detection limit achieved for analysis of the VOC sample.. The PQL will at a minimum be 5 times this reported limit.

TABLE 1

ORGANIC CHEMICAL CONCENTRATIONS - UPPER AQUIFER
RASMUSSEN SITE

Well Name	*SP-MW-5D*	*SP-MW-5D*	*81-5*	*81-5*	*RA-MW-27*	*RA-MW-27*
Sample No.	*SP-GW-57-1*	*RAS-6*	*SP-GW-56-1*	*RAS-7*	*RA-GW-81-1*	*RAS-8*
Sample Date	*3/23/87*	*5/31/90*	*3/18/87*	*5/31/90*	*3/20/87*	*5/31/90*
Volatile Organics (VOCs)						
Acetone		ND (5.0)		ND (5.0)		ND R (5.0)
Benzene	5	11 (2.5)		11 (2.5)		ND R (2.5)
2-Butanone (MEK)		ND (5.0)		ND (5.0)		ND (10)
Chlorobenzene		ND (2.5)		ND (2.5)		ND R (2.5)
Chloroethane		6.5 * (5.0)		18 (5.0)		ND R (5.0)
Chloroform		ND (1.0)		ND (1.0)		ND R (2.5)
1,1-Dichloroethane	66	120 (16)	26	38 (2.5)		ND R (2.5)
1,1-Dichloroethene		ND (1.0)		ND (1.0)		ND R (2.5)
1,2-Dichloroethene (total)		12 (2.5)		11 (2.5)		ND R (2.5)
Trans-1,2-Dichloroethene	7		2 J			
Ethylbenzene		ND (2.5)		ND (2.5)		ND R (2.5)
4-Methyl-2-pentanone (MIBK)		ND (5.0)		ND (5.0)		ND R (5.0)
Methylene Chloride	1 J	ND (2.5)		ND (2.5)		ND R (2.5)
Tetrachloroethene		ND (1.0)		ND (1.0)		ND R (2.5)
Toluene		ND (2.5)		ND (2.5)		ND R (2.5)
1,1,1-Trichloroethane	12	31 (2.5)		5.7 (2.5)		ND (5.0)
Trichloroethene		ND (2.5)		ND (2.5)	120	39 H
Vinyl Chloride	1 J	6.6 * (5.0)		32 (5.0)		ND R (5.0)
Xylene (Total)		ND (2.5)		ND (2.5)		ND R (2.5)
Base Neutral/Acid Extractables (BNAs)						
Benzo(a)Anthracene		ND (5.0)		ND (5.0)		
Benzoic acid		ND (25)		ND (25)		
Benzyl Alcohol		ND (5.0)		ND (5.0)		
Butylbenzylphthalate		ND (5.0)		ND (5.0)		
Di-n-Butylphthalate		ND (5.0)		ND (5.0)		
Di-n-Octylphthalate		ND (5.0)		ND (5.0)		
2-Chlorophenol		ND (5.0)		ND (5.0)		
Chrysene		ND (5.0)		ND (5.0)		
2,4-Dimethylphenol		ND (5.0)		ND (5.0)		
bis(2-Ethylhexyl)phthalate		ND (5.0)		9.5 * (5.0)		
Isophorone		ND (5.0)		ND (5.0)		
2-Methylphenol		ND (5.0)		ND (5.0)		
4-Methylphenol (p-cresol)		ND (5.0)		ND (5.0)		
N-Nitrosodiphenylamine		ND (5.0)		ND (5.0)		
N-Nitroso-di-n-propylamine		ND (5.0)		ND (5.0)		
Phenol		ND (5.0)		ND (5.0)		

Notes:

<u>For MDNR results (1987)</u>

B Compound detected in laboratory and/or field blank

J Analytical value is approximate

<u>For 1990 results (Lab qualifiers)</u>

ND None detected at stated detection limits. Stated detection limits are values in parenthesis. These values are PQLs except as otherwise noted by ΔΔΔ for VOCs.

* The analyte result is less than five times the specified detection limit and therefore estimated.

H The associated value is estimated due to holding time exceedances and may indicate a low bias in results.

R The associated value is unusable due to ambient sample temperature.

T The associated value is estimated due to ambient sample temperatures and may indicate a low bias in results.

U The parameter was analyzed but not detected above the associated value. The associated value has been adjusted to reflect possible laboratory contamination.

TABLE 1

ORGANIC CHEMICAL CONCENTRATIONS - UPPER AQUIFER
RASMUSSEN SITE

Well Name	***RA-MW-17***	***RA-MW-17***		***RA-MW-54***	***RA-MW-54***	***RA-MW-54***		***RA-MW-54***	
Sample No.	***RA-GW-72-1***	***RAS-30***		***RA-GW-84-1***	***RA-GW-84A-1***	***RAS-12***		***W-101090-WP-003***	
Sample Date	***3/20/87***	***6/01/90***		***3/20/87***	***3/20/87***	***6/01/90***		***10/10/90***	
Volatile Organics (VOCs)									ΔΔΔ
Acetone	No compounds found	ND R	(20)			ND R	(20)	230 U	(12)
Benzene		ND R	(1.0)	270 J	260 J	100 T	(2.5)	170	(2.4)
2-Butanone (MEK)		ND R	(10)			ND R	(10)	ND	(120)
Chlorobenzene		ND R	(1.0)	1000	1000	320 T	(120)	650	(2.8)
Chloroethane		ND R	(2.0)			170 T	(5.0)	110	(4.0)
Chloroform		ND R	(1.0)			ND R	(1.0)	ND	(2.4)
1,1-Dichloroethane		ND R	(1.0)	300 J	310 J	52 T	(2.5)	67	(2.4)
1,1-Dichloroethene		ND R	(1.0)			ND R	(1.0)	ND	(2.0)
1,2-Dichloroethene (total)		ND R	(1.0)			4.1 T	(2.5)	ND	(2.0)
Trans-1,2-Dichloroethene		ND R	(1.0)	270 J	240 J	ND R	(1.0)		
Ethylbenzene		ND R	(1.0)	510 J	500	120 T	(120)	280	(2.4)
4-Methyl-2-pentanone (MIBK)		ND R	(10)	6900 J	7900 J	ND R	(10)	ND	(20)
Methylene Chloride		ND R	(1.0)			ND R	(1.0)	24 U	(2.0)
Tetrachloroethene		ND R	(1.0)			ND R	(1.0)	ND	(2.4)
Toluene		ND R	(1.0)	18000 B	18000 B	900 T	(120)	30	(2.8)
1,1,1-Trichloroethane		ND R	(5.0)			ND R	(5.0)	ND	(2.4)
Trichloroethene		ND R	(1.0)			ND R	(1.0)	ND	(2.0)
Vinyl Chloride		ND R	(2.0)		96 J	300 ET	(2.0)	130	(2.0)
Xylene (Total)		ND R	(1.0)	3800	3700	460 T	(120)	1300 J	(2.0)
Base Neutral/Acid Extractables (BNAs)									
Benzo(a)Anthracene		ND T	(5.0)			ND T	(5.0)	ND	(26)
Benzoic acid		ND T	(5.0)			ND T	(5.0)	ND	(130)
Benzyl Alcohol		ND T	(10)			ND T	(10)	ND	(26)
Butylbenzylphthalate		ND T	(5.0)			ND T	(5.0)	ND	(26)
Di-n-Butylphthalate				21 J				ND	(26)
Di-n-Octylphthalate		ND	(5.0)			ND	(5.0)	ND	(26)
2-Chlorophenol		ND T	(5.0)			ND T	(5.0)	ND	(26)
Chrysene		ND T	(5.0)			ND T	(5.0)	ND	(26)
2,4-Dimethylphenol		ND T	(5.0)			ND T	(5.0)	ND	(26)
bis(2-Ethylhexyl)phthalate		14 U	(5.0)			6.2 U	(5.0)	ND	(26)
Isophorone		ND T	(5.0)			ND T	(5.0)	ND	(26)
2-Methylphenol				260	270			ND	(26)
4-Methylphenol (p-cresol)		ND T	(5.0)	110		66 T	(5.0)	ND	(26)
N-Nitrosodiphenylamine		ND T	(5.0)			ND T	(5.0)	ND	(26)
N-Nitroso-di-n-propylamine								ND	(26)
Phenol		ND T	(5.0)	21 J	24 J	ND T	(5.0)	ND	(26)

Notes:

<u>For MDNR results (1987)</u>

B Compound detected in laboratory and/or field blank

J Analytical value is approximate

<u>For 1990 results (Lab qualifiers)</u>

ND None detected at stated detection limits. Stated detection limits are values in parenthesis. These values are PQLs except as otherwise noted by ΔΔΔ for VOCs.

E The associated value exceeded the linear calibration range and is therefore estimated.

R The associated value is unusable due to ambient sample temperature.

T The associated value is estimated due to ambient sample temperatures and may indicate a low bias in results.

U The parameter was analyzed but not detected above the associated value. The associated value has been adjusted to reflect possible laboratory contamination.

J Value is an estimate

ΔΔΔ Reported detection limit is method specified Method Detection Limit (MDL) and does not represent actual sample detection limit achieved for analysis of the VOC sample.. The PQL will at a minimum be 5 times this reported limit.

TABLE 1

ORGANIC CHEMICAL CONCENTRATIONS - UPPER AQUIFER
RASMUSSEN SITE

Well Name	*RA-MW-22*	*RA-MW-22*	*RA-MW-22*	*RA-MW-22*		*RA-MW-22 DUP*		*RA-MW-28*
Sample No.	*RA-GW-006-1*	*RA-GW-40-1*	*RA-GW-83-1*	*W-101090-WP-004*		*W-101090-WP-005*		*RA-GW-11-1*
Sample Date	*4/10/86*	*10/31/86*	*3/20/87*	*10/10/90*		*10/10/90*		*4/10/85*
Volatile Organics (VOCs)					ΔΔΔ		ΔΔΔ	
Acetone	26000 B	9500 B		700 U	(60)	700 U	(60)	
Benzene	700	550 J	470 J	51 J	(12)	47 J	(12)	
2-Butanone (MEK)	74000 B	18000 B		ND	(600)	ND	(600)	
Chlorobenzene	3700	3500	3600	890	(14)	850	(14)	
Chloroethane				ND	(20)	ND	(20)	
Chloroform				ND	(12)	ND	(12)	5 J
1,1-Dichloroethane	550		450 J	130	(12)	120	(12)	5.8
1,1-Dichloroethene				ND	(10)	ND	(10)	
1,2-Dichloroethene (total)	500 J		590 J	51	(10)	43 J	(10)	
Trans-1,2-Dichloroethene								
Ethylbenzene	2400	2300 J	2400	680	(12)	650	(12)	
4-Methyl-2-pentanone (MIBK)	30000	9900	4500 J	ND	(100)	ND	(100)	
Methylene Chloride		1100 BJ		130 U	(30)	110 U	(10)	
Tetrachloroethene				ND	(12)	ND	(12)	
Toluene	71000	51000	45000 B	ND	(14)	ND	(14)	
1,1,1-Trichloroethane	500 J		290 J	75	(12)	59 J	(12)	120
Trichloroethene	500 J		230 J	ND	(10)	ND	(10)	8.6
Vinyl Chloride				ND	(10)	ND	(10)	
Xylene (Total)	9100	10000	11000	4100 J	(10)	3800 J	(10)	
Base Neutral/Acid Extractables (BNAs)								
Benzo(a)Anthracene				ND	(50)	ND	(60)	
Benzoic acid		17 J		ND	(250)	ND	(300)	
Benzyl Alcohol	12			ND	(50)	ND	(60)	
Butylbenzylphthalate				ND	(50)	ND	(60)	
Di-n-Butylphthalate				ND	(50)	ND	(60)	
Di-n-Octylphthalate				ND	(50)	ND	(60)	
2-Chlorophenol	12	17		ND	(50)	ND	(60)	
Chrysene				ND	(50)	ND	(60)	
2,4-Dimethylphenol	14	27		50	(50)	ND	(60)	
bis(2-Ethylhexyl)phthalate				ND	(50)	ND	(60)	12 B
Isophorone	440	310	91 J	ND	(50)	ND	(60)	
2-Methylphenol	800	1600	950 J	67	(50)	85	(60)	
4-Methylphenol (*p-cresol*)	70	280	160 J	ND	(50)	ND	(60)	
N-Nitrosodiphenylamine				11	(0.0)	ND	(60)	
N-Nitroso-di-n-propylamine				ND	(50)	ND	(60)	
Phenol	62	17	24 J	ND	(50)	ND	(60)	

Notes:

<u>For MDNR results (1987)</u>

B Compound detected in laboratory and/or field blank

J Analytical value is approximate

<u>For 1990 results (Lab qualifiers)</u>

ND None detected at stated detection limits. Stated detection limits are values in parenthesis. These values are PQLs except as otherwise noted by ΔΔΔ for VOCs.

E The associated value exceeded the linear calibration range and is therefore estimated.

R The associated value is unusable due to ambient sample temperature.

T The associated value is estimated due to ambient sample temperatures and may indicate a low bias in results.

U The parameter was analyzed but not detected above the associated value. The associated value has been adjusted to reflect possible laboratory contamination.

J Value is an estimate

ΔΔΔ Reported detection limit is method specified Method Detection Limit (MDL) and does not represent actual sample detection limit achieved for analysis of the VOC sample.. The PQL will at a minimum be 5 times this reported limit.

TABLE 1

ORGANIC CHEMICAL CONCENTRATIONS - UPPER AQUIFER
RASMUSSEN SITE

Well Name	*RA-MW-28*	*RA-MW-28*	*RA-MW-28*		*RA-MW-32*	*RA-MW-32*	*RA-MW-32*
Sample No.	*RA-GW-44-1*	*RA-GW-88-1*	*W-101090-WP-001*		*RA-GW-22-1*	*RA-GW-33-1*	*RA-GW-56-1*
Sample Date	*10/30/85*	*3/20/87*	*10/10/90*		*7/30/85*	*10/15/85*	*5/13/86*
Volatile Organics (VOCs)				ΔΔΔ			
Acetone			4.2 U	(1.2)			No compounds found
Benzene			ND	(0.24)			
2-Butanone (MEK)			ND	(12)			
Chlorobenzene			ND	(26)			
Chloroethane			ND	(0.40)			
Chloroform	1 J		ND	(0.24)			
1,1-Dichloroethane	8	8	2.1	(0.24)			
1,1-Dichloroethene	2 J		ND	(0.20)			
1,2-Dichloroethene (total)			ND	(0.20)			
Trans-1,2-Dichloroethene							
Ethylbenzene			ND	(0.24)			
4-Methyl-2-pentanone (MIBK)			ND	(2.0)			
Methylene Chloride			4.0 U	(0.20)			
Tetrachloroethene		2 J	ND	(0.24)			
Toluene			ND	(0.20)		3 J	
1,1,1-Trichloroethane	140	99	40	(0.24)			
Trichloroethene	8	9	2.9	(0.20)	23		
Vinyl Chloride			ND	(0.20)			
Xylene (Total)			ND R	(0.20)			
Base Neutral/Acid Extractables (BNAs)							
Benzo(a)Anthracene			ND	(5.0)			
Benzoic acid			ND	(25)			
Benzyl Alcohol			ND	(5.0)			
Butylbenzylphthalate			ND	(5.0)			
Di-n-Butylphthalate			ND	(5.0)			
Di-n-Octylphthalate			ND	(5.0)			
2-Chlorophenol			ND	(5.0)			
Chrysene			ND	(5.0)			
2,4-Dimethylphenol			ND	(5.0)			
bis(2-Ethylhexyl)phthalate			ND	(5.0)			
Isophorone			ND	(5.0)			
2-Methylphenol			ND	(5.0)			
4-Methylphenol (p-cresol)			ND	(5.0)			
N-Nitrosodiphenylamine			ND	(5.0)			
N-Nitroso-di-n-propylamine			8.2	(5.0)			
Phenol			ND	(5.0)			

Notes:

For MDNR results (1987)
- B Compound detected in laboratory and/or field blank
- J Analytical value is approximate

For 1990 results (Lab qualifiers)
- ND None detected at stated detection limits. Stated detection limits are values in parenthesis. These values are PQLs except as otherwise noted by ΔΔΔ for VOCs.
- E The associated value exceeded the linear calibration range and is therefore estimated.
- R The associated value is unusable.
- T The associated value is estimated due to ambient sample temperatures and may indicate a low bias in results.
- U The parameter was analyzed but not detected above the associated value. The associated value has been adjusted to reflect possible laboratory contamination.
- ΔΔΔ Reported detection limit is method specified Method Detection Limit (MDL) and does not represent actual sample detection limit achieved for analysis of the VOC sample.. The PQL will at a minimum be 5 times this reported limit.

TABLE 1

ORGANIC CHEMICAL CONCENTRATIONS - UPPER AQUIFER
RASMUSSEN SITE

Well Name	RA-MW-32	RA-MW-32	RA-MW-32		RA-MW-34	RA-MW-34	RA-MW-34
Sample No.	RA-GW-70-1	RA-GW-70A-1	W-101190-WP-006		RA-GW-24-1	RA-GW-31-1	RA-GW-68-1
Sample Date	3/17/87	3/17/87	10/11/90		7/30/85	10/14/85	5/13/86
Volatile Organics (VOCs)				ΔΔΔ			
Acetone	No compounds found	No compounds found	ND	(1.2)			
Benzene			ND	(0.24)			
2-Butanone (MEK)			ND	(12)			
Chlorobenzene			ND	(0.28)			
Chloroethane			ND	(0.40)			
Chloroform			ND	(0.24)			
1,1-Dichloroethane			ND	(0.24)			
1,1-Dichloroethene			ND	(0.20)			
1,2-Dichloroethene (total)			ND	(0.20)			
Trans-1,2-Dichloroethene							
Ethylbenzene			ND	(0.24)			
4-Methyl-2-pentanone (MIBK)			ND	(2.0)			
Methylene Chloride			1.8 U	(0.20)			
Tetrachloroethene			ND	(0.24)			
Toluene			ND	(0.28)		1 J	
1,1,1-Trichloroethane			ND	(0.24)			
Trichloroethene			ND	(0.20)	2.7 J		
Vinyl Chloride			ND	(0.20)			
Xylene (Total)			ND R	(0.20)			
Base Neutral/Acid Extractables (BNAs)							
Benzo(a)Anthracene			ND	(10)			3 J
Benzoic acid			ND	(52)			
Benzyl Alcohol			ND	(10)			
Butylbenzylphthalate			ND	(10)			3 J
Di-n-Butylphthalate			ND	(10)		5 J	
Di-n-Octylphthalate			ND	[illegible]			
2-Chlorophenol			ND	(10)			
Chrysene			ND	(10)			3 J
2,4-Dimethylphenol			ND	(10)			
bis(2-Ethylhexyl)phthalate			ND	(10)			
Isophorone			ND	(10)			
2-Methylphenol			ND	(10)			
4-Methylphenol (p-cresol)			ND	(10)			
N-Nitrosodiphenylamine			ND	(10)			
N-Nitroso-di-n-propylamine			ND	(10)			
Phenol			ND	(10)			3 J

Notes:

For MDNR results (1987)

B Compound detected in laboratory and/or field blank

J Analytical value is approximate

For 1990 results (Lab qualifiers)

ND None detected at stated detection limits. Stated detection limits are values in parenthesis. These values are PQLs except as otherwise noted by ΔΔΔ for VOCs.

E The associated value exceeded the linear calibration range and is therefore estimated.

R The associated value is unusable.

T The associated value is estimated due to ambient sample temperatures and may indicate a low bias in results.

U The parameter was analyzed but not detected above the associated value. The associated value has been adjusted to reflect possible laboratory contamination.

ΔΔΔ Reported detection limit is method specified Method Detection Limit (MDL) and does not represent *actual sample detection limit achieved for analysis of the VOC sample.. The PQL will at a minimum be 5* times this reported limit.

TABLE 1

ORGANIC CHEMICAL CONCENTRATIONS - UPPER AQUIFER
RASMUSSEN SITE

Well Name	***RA-MW-34***	***RA-MW-34***	
Sample No.	***RA-GW-71-1***	***W-101090-WP-002***	
Sample Date	***3/17/87***	***10/10/90***	
Volatile Organics (VOCs)			ΔΔΔ
Acetone	No compounds found	ND	(0.60)
Benzene		ND	(0.12)
2-Butanone (MEK)		ND	(6.0)
Chlorobenzene		ND	(0.14)
Chloroethane		ND	(0.20)
Chloroform		ND	(0.12)
1,1-Dichloroethane		ND	(0.12)
1,1-Dichloroethene		ND	(0.10)
1,2-Dichloroethene (total)		ND	(0.10)
Trans-1,2-Dichloroethene			
Ethylbenzene		ND	(0.12)
4-Methyl-2-pentanone (MIBK)		ND	(1.0)
Methylene Chloride		0.5 U	(0.10)
Tetrachloroethene		ND	(0.12)
Toluene		ND	(0.14)
1,1,1-Trichloroethane		ND	(0.12)
Trichloroethene		ND	(0.10)
Vinyl Chloride		ND	(0.10)
Xylene (Total)		ND R	(0.10)
Base Neutral/Acid Extractables (BNAs)			
Benzo(a)Anthracene		ND	(5.0)
Benzoic acid		ND	(25)
Benzyl Alcohol		ND	(5.0)
Butylbenzylphthalate		ND	(5.0)
Di-n-Butylphthalate		ND	(5.0)
Di-n-Octylphthalate		ND	(5.0)
2-Chlorophenol		ND	(5.0)
Chrysene		ND	(5.0)
2,4-Dimethylphenol		ND	(5.0)
bis(2-Ethylhexyl)phthalate		13	(5.0)
Isophorone		ND	(5.0)
2-Methylphenol		ND	(5.0)
4-Methylphenol (p-cresol)		ND	(5.0)
N-Nitrosodiphenylamine		ND	(5.0)
N-Nitroso-di-n-propylamine		ND	(5.0)
Phenol		ND	(5.0)

Notes:

For MDNR results (1987)	For 1990 results (Lab qualifiers)
B Compound detected in laboratory and/or field blank	ND None detected at stated detection limits. Stated detection limits are values in parenthesis. These values are PQLs except as otherwise noted by ΔΔΔ for VOCs.
J Analytical value is approximate	E The associated value exceeded the linear calibration range and is therefore estimated.
	R The associated value is unusable.
	T The associated value is estimated due to ambient sample temperatures and may indicate a low bias in results.
	U The parameter was analyzed but not detected above the associated value. The associated value has been adjusted to reflect possible laboratory contamination.
	ΔΔΔ Reported detection limit is method specified Method Detection Limit (MDL) and does not represent actual sample detection limit achieved for analysis of the VOC sample.. The PQL will at a minimum be 5 times this reported limit.

TABLE 2

ORGANIC CHEMICAL CONCENTRATIONS - LOWER AQUIFER
RASMUSSEN SITE

Well Name	*RA-MW-42*	*RA-MW-42*		*RA-MW-41*	*RA-MW-41*		*RA-MW-47*	*RA-MW-47*	
Sample No.	*RA-GW-77-1*	*RAS-1*		*RA-GW-68-1*	*RAS-5*		*RA-GW-79-1*	*RAS-9*	
Sample Date	*3/20/87*	*5/30/90*		*3/19/87*	*5/31/90*		*3/20/87*	*5/31/90*	
Volatile Organics (VOCs)									
Acetone		ND	(5.0)	No compounds found	ND	(5.0)		11	(5.0)
Benzene		ND	(2.5)		ND	(2.5)		ND	(2.5)
2-Butanone (MEK)		ND	(5.0)		ND	(5.0)	11 JB	ND	(5.0)
Chlorobenzene		ND	(2.5)		ND	(2.5)		ND	(2.5)
Chloroethane		ND	(5.0)		ND	(5.0)		ND	(5.0)
1,1-Dichloroethane		ND	(2.5)		ND	(2.5)		ND	(2.5)
1,2-Dichloroethene (total)		ND	(2.5)		ND	(2.5)		ND	(2.5)
Trans-1,2-Dichloroethene									
Ethylbenzene		ND	(2.5)		ND	(2.5)		ND	(2.5)
4-Methyl-2-pentanone (MIBK)		ND	(5.0)		25 D	(5.0)		ND	(5.0)
Methylene Chloride		ND	(2.5)		ND	(2.5)		ND	(2.5)
Toluene		ND	(2.5)		ND	(2.5)		ND	(2.5)
1,1,1-Trichloroethane		ND	(2.5)		ND	(2.5)		ND	(2.5)
Trichloroethene		ND	(2.5)		ND	(2.5)		ND	(2.5)
Vinyl Chloride		ND	(5.0)		ND	(5.0)		ND	(5.0)
Xylene (Total)		ND	(2.5)		ND	(2.5)		ND	(2.5)
Base Neutral/Acid Extractables									
Benzoic acid	51 J	ND	(25)		ND	(25)		ND	(25)
Di-n-Butylphthalate		ND	(5.0)		ND	(5.0)		ND	(5.0)
Di-n-Octylphthalate		ND	(5.0)		ND	(5.0)		ND	(5.0)
bis(2-Ethylhexyl)phthalate		ND	(5.0)		ND D	(5.0)		61	(5.0)
2-Methylphenol		ND	(5.0)		ND	(5.0)		ND	(5.0)
4-Methylphenol (p-cresol)		ND	(5.0)		ND	(5.0)		ND	(5.0)
Phenol		ND	(5.0)		ND	(5.0)		ND	(5.0)

Notes:

For MDNR results (1987)	For 1990 Results (Lab qualifiers)
B Compound detected in laboratory and/or field blank	ND None detected at stated detection limits. Stated detection limits are values in parenthesis. These values are PQLs except as otherwise noted by ΔΔΔ for VOCs.
J Analytical value is approximate.	D The associated data value is estimated due to a variability among the field duplicate data.

TABLE 2

ORGANIC CHEMICAL CONCENTRATIONS - LOWER AQUIFER
RASMUSSEN SITE

Well Name	*SP-MW-25D*	*SP-MW-25D*	*SP-MW-25D*	*SP-MW-25D*	*SP-MW-25D*	*SP-MW-25D*	
Sample No.	*SP-GW-21-1*	*SP-GW-21A-1*	*SP-GW-25-1*	*SP-GW-55-1*	*SP-GW-55A-1*	*W-101190-WP-009*	
Sample Date	*4/23/85*	*4/23/85*	*5/14/85*	*3/18/87*	*3/18/87*	*10/11/90*	
Volatile Organics (VOCs)							ΔΔΔ
Acetone	No compounds found	No compounds found	No compounds found	No compounds found	No compounds found	ND	(0.60)
Benzene						0.3 J	(0.12)
2-Butanone (MEK)						ND	(6.0)
Chlorobenzene						ND	(0.14)
Chloroethane						ND	(0.20)
1,1-Dichloroethane						ND	(0.12)
1,2-Dichloroethene (total)						ND	(0.10)
Trans-1,2-Dichloroethene							
Ethylbenzene						ND	(0.12)
4-Methyl-2-pentanone (MIBK)						ND	(1.0)
Methylene Chloride						0.4 U	(0.10)
Toluene						0.8	(0.14)
1,1,1-Trichloroethane						ND	(0.12)
Trichloroethene						ND	(0.10)
Vinyl Chloride						ND	(0.10)
Xylene (Total)'						ND R	(0.10)
Base Neutral/Acid Extractables							
Benzoic acid						ND	(50)
Di-n-Butylphthalate						ND	(10)
Di-n-Octylphthalate						25	(10)
bis(2-Ethylhexyl)phthalate						87	(10)
2-Methylphenol						ND	(10)
4-Methylphenol (p-cresol)						ND	(10)
Phenol						ND	(10)

Notes:

<u>For MDNR results (1987)</u>

- B Compound detected in laboratory and/or field blank
- J Analytical value is approximate.

<u>For 1990 Results (Lab qualifiers)</u>

- ND None detected at stated detection limits. Stated detection limits are values in parenthesis. These values are PQLs except as otherwise noted by ΔΔΔ for VOCs.
- D The associated data value is estimated due to a variability among the field duplicate data.
- R The associated value is unusable.
- U The parameter was analyzed but not detected above the associated value. The associated value has been adjusted to reflect possible laboratory contamination.
- J Value is an estimate..
- ΔΔΔ Reported detection limit is method specified Method Detection Limit (MDL) and does not represent actual sample detection limit achieved for analysis of the VOC sample.. The PQL will at a minimum be 5 times this reported limit.

TABLE 3

INORGANICS ANALYTICAL DATA - UPPER AQUIFER
RASMUSSEN SITE

Well Name			*81-8*				*RA-MW-18D*				*RA-MW-18D (Dup)*			
Sample No.			*RAS-2*				*RAS-3*				*RAS-4*			
Sample Date			*5/30/90*				*5/31/90*				*5/31/90*			
Parameter	*Detection Limit* +	*Units*	*Total*		*Dissolved*		*Total*		*Dissolved*		*Total*		*Dissolved*	
Aluminum	0.0078	mg/L	2.9		0.015 U		0.14 U		0.018 U		0.14 U		ND	
Antimony	0.0020	mg/L	ND		ND		ND		ND		ND		ND	
Arsenic	0.0020	mg/L	0.014		0.0038		ND		ND		ND		ND	
Barium	0.010	mg/L	0.058		0.044 *		0.092		0.081		0.086		0.080	
Beryllium	0.0020	mg/L	ND		ND		ND		ND		ND		ND	
Cadmium	0.0050	mg/L	0.0055 *		ND		0.014 *		ND		0.011 *		ND	
Calcium	1.0	mg/L	120		91		100		99		97		97	
Chromium	0.010	mg/L	0.010 *		ND		0.013 *		ND		0.011 *		ND	
Cobalt	0.010	mg/L	ND		ND		ND		ND		ND		ND	
Copper	0.020	mg/L	0.047 *		ND		0.043 *		ND		0.035 *		ND	
Iron	0.040	mg/L	8.7		0.12 *		11		0.086 *		9.4		ND	
Lead		mg/L	0.20	(0.015)	0.0040 *	(0.0015)	0.51	(0.060)	0.0048 *	(0.0015)	0.39	(0.030)	0.0097	(0.0015)
Magnesium	1.0	mg/L	38		31		32		33		32		32	
Manganese	0.010	mg/L	0.69		0.49		0.17		0.083		0.15		0.082	
Mercury	0.0002	mg/L	ND		ND		ND		ND		ND		ND	
Nickel	0.020	mg/L	ND		ND		ND		ND		ND		ND	
Potassium	3.0	mg/L	ND		ND		ND		ND		ND		ND	
Selenium	0.0025	mg/L	ND		ND		ND		ND		ND		ND	
Silver	0.010	mg/L	ND		ND		ND		ND		ND		ND	
Sodium	1.0	mg/L	5.1		5.9		8.2		7.3		7.9		7.7	
Thallium	0.0025	mg/L	ND		ND		ND		ND		ND		ND	
Vanadium	0.020	mg/L	ND		ND		ND		ND		ND		ND	
Zinc	0.020	mg/L	16		5.4		45		13		32		14	

Notes

+ Detection limits, when different, are shown in brackets to right of each column
ND None detected at stated Practical Quantitation Limits (PQLs). Values in parenthesis are PQLs.
* The analyte result is less than five times the specified detection limit and therefore estimated.
U The parameter was analyzed but not detected above the associated value. The associated value is the PQL and has been adjusted to reflect possible laboratory contamination.
m Compound exceeded standard calibration range in the original analysis and was rerun with a dilution
G Reporting limit raised due to matrix interference

TABLE 3

INORGANICS ANALYTICAL DATA - UPPER AQUIFER
RASMUSSEN SITE

Well Name			*RA-MW-22 DUP*			*RA-MW-28*				*RA-MW-32*			
Sample No.			*W-101090-WP-005*			*W-101090-WP-001*				*W-101190-WP-006*			
Sample Date			*10/10/90*			*10/10/90*				*10/11/90*			
Parameter	*Detection Limit* +	*Units*	*Total*		*Dissolved*	*Total*		*Dissolved*		*Total*		*Dissolved*	
Aluminum	0.0078	mg/L	3.5	(0.10)	ND	36.0	(0.10)	ND	(0.10)	14.7	(0.10)	ND	(0.10)
Antimony	0.0020	mg/L	ND	(0.050)	ND	ND	(0.050)	ND	(0.050)	ND	(0.050)	0.051	(0.050)
Arsenic	0.0020	mg/L	0.25	(0.050)	0.10	0.0090	(0.0050)	ND	(0.0050)	0.018	(0.0050)	ND	(0.0050)
Barium	0.010	mg/L	0.35		0.33	0.28		0.053		0.15		0.066	
Beryllium	0.0020	mg/L	ND		ND	0.0023		ND		ND		ND	
Cadmium	0.0050	mg/L	0.026 m	(0.00050)	0.0015	0.060 m	(0.00050)	0.001	(0.00050)	0.023	(0.00050)	ND	(0.00050)
Calcium	1.0	mg/L	210	(0.20)	179	352	(0.20)	136	(0.20)	333	(0.20)	220	(0.20)
Chromium	0.010	mg/L	0.10		ND	0.21		ND		0.14		ND	
Cobalt	0.010	mg/L	0.045		0.012	0.045		ND		0.024		ND	
Copper	0.020	mg/L	0.032	(0.010)	ND	0.22	(0.010)	ND	(0.010)	0.12	(0.010)	ND	(0.010)
Iron	0.040	mg/L	31.3	(0.10)	14.7	118	(0.10)	ND	(0.10)	44.1	(0.10)	ND	(0.10)
Lead		mg/L	1.2 m	(0.12)	ND	0.44	(0.050)	ND	(0.050)	0.36 m	(0.050)	ND	(0.050)
Magnesium	1.0	mg/L	34.8	(0.20)	33.6	102	(0.20)	34.3	(0.20)	82.7	(0.20)	52.7	(0.20)
Manganese	0.010	mg/L	0.22		0.12	2.6		0.031		1.1		0.21	
Mercury	0.0002	mg/L	ND		ND	ND		ND		ND		ND	
Nickel *	0.020	mg/L	0.10	(0.040)	ND	0.18	(0.040)	ND	(0.040)	0.13	(0.040)	ND	(0.040)
Potassium	3.0	mg/L	ND	(5.0)	ND	10.7	(5.0)	ND	(5.0)	5.8	(5.0)	ND	(5.0)
Selenium	0.0025	mg/L	ND G	(0.010)	ND G	ND G	(0.010)	ND	(0.010)	ND G	(0.010)	ND	(0.0050)
Silver	0.010	mg/L	ND		ND	ND		ND		ND		ND	
Sodium	1.0	mg/L	ND	(5.0)	ND	6.3	(5.0)	7.8	(5.0)	ND	(5.0)	ND	(5.0)
Thallium	0.0025	mg/L	ND	(0.0050)	ND G	ND G	(0.010)	ND G	(0.010)	ND G	(0.010)	ND G	(0.010)
Vanadium	0.020	mg/L	ND	(0.010)	ND	0.12	(0.010)	ND	(0.010)	0.061	(0.010)	ND	(0.010)
Zinc	0.020	mg/L	72.2		13.9	30.8		4.1		64.9		9.7	

Notes

+ Detection limits, when different, are shown in brackets to right of each column

ND None detected at stated Practical Quantitation Limits (PQLs). Values in parenthesis are PQLs.

* The analyte result is less than five times the specified detection limit and therefore estimated.

U The parameter was analyzed but not detected above the associated value. The associated value is the PQL and has been adjusted to reflect possible laboratory contamination.

m Compound exceeded standard calibration range in the original analysis and was rerun with a dilution

G Reporting limit raised due to matrix interference

TABLE 3

INORGANICS ANALYTICAL DATA - UPPER AQUIFER
RASMUSSEN SITE

Well Name	*RA-MW-34*
Sample No.	*W-101090-WP-002*
Sample Date	*10/10/90*

Parameter	*Detection Limit* +	*Units*	*Total*		*Dissolved*	
Aluminum	0.0078	mg/L	1.8	(0.10)	ND	(0.10)
Antimony	0.0020	mg/L	ND	(0.050)	ND	(0.050)
Arsenic	0.0020	mg/L	ND	(0.0050)	ND	(0.0050)
Barium	*0.010*	mg/L	*0.28*		*0.27*	
Beryllium	0.0020	mg/L	ND		ND	
Cadmium	0.0050	mg/L	0.0022	(0.00050)	0.00060	(0.00050)
Calcium	1.0	mg/L	163	(0.20)	155	(0.20)
Chromium	0.010	mg/L	0.028		ND	
Cobalt	0.010	mg/L	ND		ND	
Copper	0.020	mg/L	0.012	(0.010)	ND	(0.010)
Iron	0.040	mg/L	8.2	(0.10)	2.7	(0.10)
Lead		mg/L	0.055	(0.0050)	ND	(0.0050)
Magnesium	*1.0*	mg/L	*41.7*	*(0.20)*	*40.9*	*(0.20)*
Manganese	0.010	mg/L	0.11		0.037	
Mercury	0.0002	mg/L	ND		ND	
Nickel	0.020	mg/L	ND	(0.040)	ND	(0.040)
Potassium	3.0	mg/L	ND	(5.0)	ND	(5.0)
Selenium	0.0025	mg/L	ND G	(0.010)	ND G	(0.010)
Silver	0.010	mg/L	ND		ND	
Sodium	1.0	mg/L	13.7	(5.0)	15.8	(5.0)
Thallium	0.0025	mg/L	ND G	(0.010)	ND G	(0.010)
Vanadium	*0.020*	mg/L	*ND*	*(0.010)*	*ND*	*(0.010)*
Zinc	0.020	mg/L	7.9	(0.020)	2.9	(0.020)

Notes

+ Detection limits, when different, are shown in brackets to right of each column

ND None detected at stated Practical Quantitation Limits (PQLs). Values in parenthesis are PQLs.

* The analyte result is less than five times the specified detection limit and therefore estimated.

U The parameter was analyzed but not detected above the associated value. The associated value is the PQL and has been adjusted to reflect possible laboratory contamination.

m Compound exceeded standard calibration range in the original analysis and was rerun with a dilution

G Reporting limit raised due to matrix interference

TABLE 3

INORGANICS ANALYTICAL DATA - UPPER AQUIFER
RASMUSSEN SITE

Well Name			*SP-MW-5D*				*81-5*				*RA-MW-27*			
Sample No.			*RAS-6*				*RAS-7*				*RAS-8*			
Sample Date			*5/31/90*				*5/31/90*				*5/31/90*			
Parameter	*Detection Limit* +	*Units*	*Total*		*Dissolved*		*Total*		*Dissolved*		*Total*		*Dissolved*	
Aluminum	0.0078	mg/L	0.12 U		0.16 U		0.79		0.015 U		17		ND	
Antimony	0.0020	mg/L	ND		ND		ND		ND		ND		ND	
Arsenic	0.0020	mg/L	ND		ND		0.002 *		ND		0.042	(0.0080)	ND	
Barium	0.010	mg/L	0.16		0.15		0.075		0.067		0.20		0.048 *	
Beryllium	0.0020	mg/L	ND		ND		ND		ND		ND		ND	
Cadmium	0.0050	mg/L	ND		ND		ND		ND		0.012 *		ND	
Calcium	1.0	mg/L	170		17		170		160		300		220	
Chromium	0.010	mg/L	ND		ND		0.039 *		ND		0.073		ND	
Cobalt	0.010	mg/L	ND		ND		ND		ND		0.018 *		ND	
Copper	0.020	mg/L	ND		ND		0.021 *		ND		0.098 *		ND	
Iron	0.040	mg/L	4.0		3.1		3.1		ND		43		ND	
Lead		mg/L	0.043	(0.0030)	0.0062 *	(0.0015)	0.16	(0.015)	0.0040 *	(0.0015)	0.22	(0.015)	0.0015 *	(0.0015)
Magnesium	1.0	mg/L	47		46		51		50		86		57	
Manganese	0.010	mg/L	0.28		0.28		0.74		0.68		0.66		0.21	
Mercury	0.0002	mg/L	ND		ND		ND		ND		ND		ND	
Nickel	0.020	mg/L	ND		ND		0.035 *		ND		0.076 *		ND	
Potassium	3.0	mg/L	ND		ND		ND		ND		6.0 *		ND	
Selenium	0.0025	mg/L	ND		ND		ND		ND		ND		ND	
Silver	0.010	mg/L	ND		ND		ND		ND		0.013 *		ND	
Sodium	1.0	mg/L	5.0		6.4		6.2		6.4		72		72	
Thallium	0.0025	mg/L	ND		ND		ND		ND		ND		ND	
Vanadium	0.020	mg/L	ND		ND		ND		ND		0.060 *		ND	
Zinc	0.020	mg/L	5.2		3.0		23		5.1		36		6.1	

Notes

+ Detection limits, when different, are shown in brackets to right of each column

ND None detected at stated Practical Quantitation Limits (PQLs). Values in parenthesis are PQLs.

* The analyte result is less than five times the specified detection limit and therefore estimated.

U The parameter was analyzed but not detected above the associated value. The associated value is the PQL and has been adjusted to reflect possible laboratory contamination.

m Compound exceeded standard calibration range in the original analysis and was rerun with a dilution

G Reporting limit raised due to matrix interference

TABLE 3

INORGANICS ANALYTICAL DATA - UPPER AQUIFER
RASMUSSEN SITE

Well Name			***RA-MW-17***				***RA-MW-54***				***RA-MW-22***			
Sample No.			***RAS-10***				***RAS-12***				***W-101090-WP-004***			
Sample Date			***6/01/90***				***6/01/90***				***10/10/90***			
Parameter	***Detection Limit*** +	***Units***	***Total***		***Dissolved***		***Total***		***Dissolved***		***Total***		***Dissolved***	
Aluminum	0.0078	mg/L	0.76		0.78		16		0.039 U		3.1	(0.10)	ND	(0.10)
Antimony	0.0020	mg/L	ND		ND		ND		ND		ND	(0.050)	ND	(0.050)
Arsenic	*0.0020*	*mg/L*	*ND*		*ND*		*0.068*	*(0.010)*	*0.045*	*(0.0080)*	*0.24*	*(0.050)*	*0.11*	*(0.050)*
Barium	0.010	mg/L	0.075		0.059		1.4		1.1		0.34		0.33	
Beryllium	0.0020	mg/L	ND		ND		ND		ND		ND		ND	
Cadmium	0.0050	mg/L	0.0095 *		ND		0.018 *		ND		0.024 m	(0.00050)	0.0014	(0.00050)
Calcium	1.0	mg/L	100		100		300		110		197	(0.20)	181	(0.20)
Chromium	0.010	mg/L	0.030 *		ND		0.094		ND		0.081		ND	
Cobalt	0.010	mg/L	ND		ND		0.020 *		ND		0.039		0.013	
Copper	0.025	mg/L	ND		ND		0.13		ND		0.028	(0.010)	ND	(0.010)
Iron	0.040	mg/L	2.3		0.078 *		80		6.9		29.0	(0.10)	15.2	(0.10)
Lead		mg/L	0.24	(0.030)	0.0038 *	(0.0015)	0.42	(0.060)	0.0038 *	(0.0015)	1.0 m	(0.12)	ND	(0.12)
Magnesium	1.0	mg/L	30		29		84		44		33.3	(0.20)	34.0	(0.20)
Manganese	0.010	mg/L	0.050		0.034 *		1.4		0.049 *		0.2		0.12	
Mercury	0.0002	mg/L	ND		ND		ND		ND		ND		ND	
Nickel	0.020	mg/L	ND		ND		0.099 *		ND		0.092	(0.040)	ND	(0.040)
Potassium	3.0	mg/L	ND		ND		6.4 *		ND		ND	(5.0)	ND	(5.0)
Selenium	0.0025	mg/L	ND		ND		ND	(0.025)	ND		ND G	(0.010)	ND	(0.010)
Silver	0.010	mg/L	ND		ND		0.015 *		ND		ND		ND	
Sodium	*1.0*	*mg/L*	5.5		5.2		12		14		ND	*(5.0)*	ND	(5.0)
Thallium	0.0025	mg/L	ND		ND		ND		ND		ND	(0.0050)	ND G	(0.0050)
Vanadium	0.020	mg/L	ND		ND		0.057 *		ND		ND	(0.010)	ND	(0.010)
Zinc	0.020	mg/L	28		7.1		30		2.2		59.8		14.0	

Notes

\+ Detection limits, when different, are shown in brackets to right of each column

ND None detected at stated Practical Quantitation Limits (PQLs). Values in parenthesis are PQLs.

* The analyte result is less than five times the specified detection limit and therefore estimated.

U The parameter was analyzed but not detected above the associated value. The associated value is the PQL and has been adjusted to reflect possible laboratory contamination.

m Compound exceeded standard calibration range in the original analysis and was rerun with a dilution

G Reporting limit raised due to matrix interference

TABLE 4

INORGANICS ANALYTICAL DATA - LOWER AQUIFER
RASMUSSEN SITE

Well Name			***RA-MW-42***				***RA-MW-41***				***RA-MW-47***			
Sample No.			***RAS-1***				***RAS-5***				***RAS-9***			
Sample Date			***5/30/90***				***5/31/90***				***5/31/90***			
Parameter	***Detection Limit*** +	***Units***	***Total***		***Dissolved***		***Total***		***Dissolved***		***Total***		***Dissolved***	
Aluminum	0.0078	mg/L	1.2		0.016 U		0.91		0.074 U		0.067 U		0.18 U	
Antimony	0.0020	mg/L	ND		ND		ND		ND		ND		ND	
Arsenic	0.0020	mg/L	0.026		0.018		0.015		0.011		ND		ND	
Barium	0.010	mg/L	0.27		0.24		0.31		0.29		0.019 *		0.016 *	
Beryllium	0.0020	mg/L	ND		ND		ND		ND		ND		ND	
Cadmium	0.0050	mg/L	ND		ND		ND		ND		ND		ND	
Calcium	1.00	mg/L	84		76		69		69		9.1		7.6	
Chromium	0.010	mg/L	ND		ND		ND		ND		ND		ND	
Cobalt	0.010	mg/L	ND		ND		ND		ND		0.012 *		ND	
Copper	0.020	mg/L	0.031 *		ND		ND		ND		0.53		ND	
Iron	0.040	mg/L	5.2		0.36		3.0		0.058 *		16		0.44	
Lead		mg/L	0.057	(0.0030)	0.0030 *	(0.0015)	0.023	(0.0015)	0.0050 *	(0.0015)	0.015	(0.0015)	0.0038	(0.0015)
Magnesium	1.0	mg/L	27		25		22		23		ND		16	
Manganese	0.010	mg/L	0.062		0.017 *		0.030 *		0.018 *		ND		ND	
Mercury	0.0002	mg/L	ND		ND		ND		ND		ND		ND	
Nickel	0.020	mg/L	ND		ND		ND		ND		ND		ND	
Potassium	3.0	mg/L	ND		ND		ND		ND		ND		ND	
Selenium	0.0025	mg/L	ND		ND		ND		ND		ND		ND	
Silver	0.010	mg/L	ND		ND		ND		ND		ND		ND	
Sodium	1.0	mg/L	19		20		23		23		8.9		9.4	
Thallium	0.0025	mg/L	ND		ND		ND		ND		ND		ND	
Vanadium	0.020	mg/L	ND		ND		ND		ND		ND		ND	
Zinc	0.020	mg/L	17		2.1		7.1		0.61		5.8		0.14	

Notes
+ Detection limits, when different, are shown in brackets to the right of each column
ND None detected at stated Practical Quantitation Limits (PQLs). Values in parenthesis are PQLs.
* Est. result less than 5 times detection limit.
U The parameter was analyzed but not detected above the associated value. The associated value is the PQL and has been adjusted to reflect possible laboratory contamination.
m Compound exceeded standard calibration range in the original analysis and was rerun with a dilution.
G Reporting limit raised due to matrix interference.

TABLE 4

INORGANICS ANALYTICAL DATA - LOWER AQUIFER
RASMUSSEN SITE

Well Name	***SP-MW-25D***
Sample No.	***W-101190-WP-009***
Sample Date	***10/11/90***

Parameter	*Detection Limit* +	*Units*	*Total*		*Dissolved*	
Aluminum	0.0078	mg/L	0.23	(0.10)	ND	(0.10)
Antimony	0.0020	mg/L	ND	(0.050)	ND	(0.050)
Arsenic	0.0020	mg/L	ND	(0.0050)	ND	(0.0050)
Barium	0.010	mg/L	0.048		0.017	
Beryllium	0.0020	mg/L	ND		ND	
Cadmium	0.0050	mg/L	0.010	(0.00050)	ND	(0.00050)
Calcium	1.00	mg/L	17.4	(0.20)	13.3	(0.20)
Chromium	0.010	mg/L	0.027		ND	
Cobalt	0.010	mg/L	ND		ND	
Copper	0.020	mg/L	0.031	(0.010)	ND	(0.010)
Iron	0.040	mg/L	14.2	(0.10)	ND	(0.10)
Lead		mg/L	0.43 m	(0.050)	ND	(0.050)
Magnesium	1.0	mg/L	16.8	(0.20)	16.3	(0.20)
Manganese	0.010	mg/L	0.13		ND	
Mercury	0.0002	mg/L	ND		ND	
Nickel	0.020	mg/L	ND	(0.040)	ND	(0.040)
Potassium	3.0	mg/L	ND	(5.0)	ND	(5.0)
Selenium	0.0025	mg/L	ND	(0.0050)	ND	(0.010)
Silver	0.010	mg/L	ND		ND	
Sodium	1.0	mg/L	6.1	(5.0)	9.2	(5.0)
Thallium	0.0025	mg/L	ND	(0.0050)	ND G	(0.0050)
Vanadium	0.020	mg/L	ND	(0.010)	ND	(0.010)
Zinc	0.020	mg/L	71.0		0.068 U	

Notes

+ Detection limits, when different, are shown in brackets to the right of each column
ND None detected at stated Practical Quantitation Limits (PQLs). Values in parenthesis are PQLs.
* Est. result less than 5 times detection limit
U The parameter was analyzed but not detected above the associated value. The associated value is the PQL and has been adjusted to reflect possible laboratory contamination.
m Compound exceeded standard calibration range in the original analysis and was rerun with a dilution.
G Reporting limit raised due to matrix interference.

TABLE 5

GENERAL CHEMISTRY - UPPER AQUIFER
RASMUSSEN SITE

Well Name			*81-8*	*RA-MW-18D*	*RA-MW-18D (Dup.)*	*SP-MW-5D*	*81-5*
Sample No.			*RAS-2*	*RAS-3*	*RAS-4*	*RAS-6*	*RAS-7*
Sample Date			*5/30/90*	*5/31/90*	*5/31/90*	*5/31/90*	*5/31/90*
Parameter	*Detection Limit*	*Unit*					
Alkalinity							
Bicarbonate	1.0	mg/L	370	370	390	560	590
Carbonate	1.0	mg/L	ND	ND	ND	ND	ND
Total Alkalinity	1.0	mg/L	370	370	390	560	590
Other Parameters							
BOD 5	1.0	mg/L	15 H	20 H	15 H	9	14
Chemical Oxygen Demand	5.0	mg/L	21 *	46	25	6.7 *	30
Specific conductance	1.0	umhos/cm	670	690	750	1100	1100
pH		pH units	7.4	7.5	7.4	6.9	7.0
Total dissolved solids	9.0	mg/L	390 H	420 H	410 H	710 H	700
Total organic carbon	1.0	mg/L	23	32	17	11	22
Total suspended solids	3.0	mg/L	360	160	120	20	80

Notes:

ND None detected at stated Practical Quantitation Limits (PQLs). Values in parenthesis are PQLs.

* Estimated result less than 5 times detection limit.

H The associated value is estimated due to holding time exceedances and may indicate a low bias in results.

NA Parameter not sampled.

TABLE 5

GENERAL CHEMISTRY - UPPER AQUIFER
RASMUSSEN SITE

Well Name			*RA-MW-27*	*RA-MW-17*	*RA-MW-54*	*RA-MW-22*	*RA-MW-22 DUP*
Sample No.			*RAS-8*	*RAS-10*	*RAS-12*	*W-101090-WP-004*	*W-101090-WP-005*
Sample Date			*5/31/90*	*6/01/90*	*6/01/90*	*10/10/90*	*10/10/90*
Parameter	*Detection Limit*	*Unit*					
Alkalinity							
Bicarbonate	1.0	mg/L	420	380	440		
Carbonate	1.0	mg/L	ND	ND	ND		
Total Alkalinity	1.0	mg/L	420	380	440	780 J	730 J
Other Parameters							
BOD 5	1.0	mg/L	15	17	36	57 J	35 J
Chemical Oxygen Demand	5.0	mg/L	32	60	100	160 J	100 J
Specific conductance	1.0	umhos/cm	1600	620 H	670 H	NA	NA
pH		pH units	7.1	7.4	6.9	NA	NA
Total dissolved solids	9.0	mg/L H	1200 H	430 H	570 H	690 J	950 J
Total organic carbon	1.0	mg/L	11	16	26	83 J	11 J
Total suspended solids	3.0	mg/L	1400	130	2100	670 J	450 J

<u>Notes:</u>

ND None detected at stated Practical Quantitation Limits (PQLs). Values in parenthesis are PQLs.

* Estimated result less than 5 times detection limit.

H The associated value is estimated due to holding time exceedances and may indicate a low bias in results.

NA Parameter not sampled.

J Value is an estimate.

TABLE 5

GENERAL CHEMISTRY - UPPER AQUIFER
RASMUSSEN SITE

Well Name			*RA-MW-28*	*RA-MW-32*	*RA-MW-34*
Sample No.			*W-101090-WP-001*	*W-101190-WP-006*	*W-101090-WP-002*
Sample Date			*10/10/90*	*10/11/90*	*10/10/90*
Parameter	*Detection Limit*	*Unit*			
Alkalinity					
Bicarbonate	1.0	mg/L			
Carbonate	1.0	mg/L			
Total Alkalinity	1.0	mg/L	860 J	890 J	520 J
Other Parameters					
BOD 5	1.0	mg/L	13 J	8 J	6 J
Chemical Oxygen Demand	5.0	mg/L	12 J	110 J	33 J
Specific conductance	1.0	umhos/cm	NA	NA	NA
pH		pH units	NA	NA	NA
Total dissolved solids	9.0	mg/L	970 J	2100 J	760 J
Total organic carbon	1.0	mg/L	23 J	13 J	11 J
Total suspended solids	3.0	mg/L	3400 J	1400 J	300 J

Notes:

ND None detected at stated Practical Quantitation Limits (PQLs). Values in parenthesis are PQLs.

* Estimated result less than 5 times detection limit.

H The associated value is estimated due to holding time exceedances and may indicate a low bias in results.

NA Parameter not sampled.

J Value is an estimate.

TABLE 6

GENERAL CHEMISTRY - LOWER AQUIFER
RASMUSSEN SITE

Well Name			***RA-MW-42***	***RA-MW-41***	***RA-MW-47***	***SP-MW-25D***
Sample No.			***RAS-1***	***RAS-5***	***RAS-9***	***W-101190-WP-009***
Sample Date			***5/30/90***	***5/31/90***	***5/31/90***	***10/11/90***
Parameter	***Detection Limit***	***Unit***				
Alkalinity						
Bicarbonate	1.0	mg/L	330	300	84	
Carbonate	1.0	mg/L	ND	ND	10	
Total Alkalinity	1.0	mg/L	330	300	94	100 J
Other Parameters						
BOD 5	1.0	mg/L	15 H	12	24	36 J
Chemical Oxygen Demand	5.0	mg/L	ND	8.7 *	60	81 J
Specific conductance	1.0	umhos/cm	620	580	190	NA
pH		pH units	7.7	7.6	9.2	NA
Total dissolved solids	9.0	mg/L	370 H	340 H	100 H	450 J
Total organic carbon	1.0	mg/L	10	8.4	19	20 J
Total suspended solids	3.0	mg/L	110	40	30	190 J

<u>Notes:</u>

ND None detected at stated Practical Quantitation Limits (PQLs). Values in parenthesis are PQLs.

* Est. result less than 5 times detection limit.

H The associated value is estimated due to holding time exceedances and may indicate a low bias in results.

NA Parameter not sampled.

J Value is an estimate.

LABORATORY REPORTS

Enseco
A CORNING Company

Rec'd CRA
OCT 24 90

October 23, 1990

Mr. David Dempsey
Conestoga-Rovers Associates
382 West County Road D
St. Paul, MN 55112

Dear David:

Enclosed are the results of the analyses for Rasmussen (10/11/90). This project was received at Enseco - Erco Laboratory on October 11, 1990, and was processed for a 14 day turnaround time.

This report is presented in three sections. The first section consists of the Sample Description Information page and Analytical Test Requests summary. The second section contains the analytical results and method references. The third section briefly describes the elements of Enseco's quality assurance/quality control (QA/QC) program and contains the QA/QC results. This letter authorizes the release of the analytical results and should be considered an integral part of this report.

Please refer to this project by the Enseco project number 007299 to expedite any further discussions. I will be happy to address any questions or concerns that you may have.

Sincerely,

Catherine M. Flaherty
Program Administrator

Encl.

Enseco Incorporated
205 Alewife Brook Parkway
Cambridge, MA 02138
617/661-3111 617/354-5258

October 23, 1990

Project Narrative

Client: Conestoga-Rovers Associates
Project Name: 10/11/90
Erco Project No.: 007299

1. This project consists of the results for samples received at Enseco - Erco Laboratory on October 11, 1990. Please see the sample description information sheet for a list of samples.

2. Temperature of cooler upon receipt was 8.7 C.
   Bottles were not broken in transit.
   Bottles were properly labeled.
   Samples agree with chain of custody.
   Samples were properly preserved.

3. Samples 003 - 005 required additional dilutions for semivolatile analysis due to high concentrations of unknowns.

- ANALYTICAL RESULTS -

ANALYTICAL RESULTS

The method number provided on each data report sheet refers to a publication originating from a regulatory or standard-setting organization. In general, the methods employed are those specified by the U.S. Environmental Protection Agency and other state and federal agencies. In cases where an approved regulatory method does not exist, a method developed by Enseco will be employed to meet the specific needs of the client. The methods commonly employed by Enseco are based on methods from the following references.

U.S. Environmental Protection Agency. 1983. Methods for chemical analysis of water and wastes. EPA-600/4-79-020. Cincinnati, OH, March.

U.S. Environmental Protection Agency. 1984. Test methods for evaluating solid waste, physical/chemical methods. (SW-846); Washington, D.C. April.

U.S. Environmental Protection Agency. 1986. Methods for determination of organic compounds in finished drinking water and raw source water. Cincinnati, OH, March.

"Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act," 40 CFR, Part 136; Federal Register, Vol. 49, No. 209.

American Public Health Association, American Water Works Association, Water Pollution Control Federation. 1985. Standard methods for the examination of water and wastewater, 16th edition. Washington, D.C., April.

Current EPA Contract Laboratory Program (CLP) protocols for the analysis of organic and inorganic hazardous substances including chlorinated dioxins and furans.

SAMPLE DESCRIPTION INFORMATION
for
Conestoga-Rovers Associates

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
007299-0001-SA	W-101090-WP-001	AQUEOUS	10 OCT 90	13:31	11 OCT 90
007299-0002-SA	W-101090-WP-002	AQUEOUS	10 OCT 90	14:30	11 OCT 90
007299-0003-SA	W-101090-WP-003	AQUEOUS	10 OCT 90	16:30	11 OCT 90
007299-0004-SA	W-101090-WP-004	AQUEOUS	10 OCT 90	17:10	11 OCT 90
007299-0005-SA	W-101090-WP-005	AQUEOUS	10 OCT 90	17:15	11 OCT 90
007299-0006-SA	W-101090-WP-001-dissolved	AQUEOUS	10 OCT 90	13:31	11 OCT 90
007299-0007-SA	W-101090-WP-002-dissolved	AQUEOUS	10 OCT 90	14:30	11 OCT 90
007299-0008-SA	W-101090-WP-004-dissolved	AQUEOUS	10 OCT 90	17:10	11 OCT 90
007299-0009-SA	W-101090-WP-005-dissolved	AQUEOUS	10 OCT 90	17:15	11 OCT 90

ANALYTICAL TEST REQUESTS
for
Conestoga-Rovers Associates

Lab ID: 007299	Group Code	Analysis Description	Custom Test?
0001 - 0002, 0004 - 0005	A	Method 625 - TCL Semivolatile Organics	N
		Prep - Method 625	N
		TAL Total Metals	
		Prep - Total Metals, ICP	N
		Arsenic, FAA (Total)	N
		Prep - Total Metals, FAA	N
		Lead, FAA (Total)	N
		Mercury, CVAA (Total)	N
		Prep - Mercury, CVAA	N
		Selenium, FAA (Total)	N
		Thallium, FAA (Total)	N
		Cadmium, FAA (Total)	N
0006 - 0009	B	TAL Dissolved Metals	
		Arsenic, FAA (Diss.)	N
		Lead, FAA (Diss.)	N
		Mercury, CVAA (Diss.)	N
		Selenium, FAA (Diss.)	N
		Thallium, FAA (Diss.)	N
		Cadmium, FAA (Diss.)	N
0003	C	Method 625 - TCL Semivolatile Organics	N
		Prep - Method 625	N

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-001
Lab ID: 007299-0001-SA Enseco ID: 2048565
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: 16 OCT 90 Analyzed: 18 OCT 90

Parameter	Result	Units	Reporting Limit
Phenol	ND	ug/L	5.0
bis(2-Chloroethyl) ether	ND	ug/L	5.0
2-Chlorophenol	ND	ug/L	5.0
1,3-Dichlorobenzene	ND	ug/L	5.0
1,4-Dichlorobenzene	ND	ug/L	5.0
Benzyl alcohol	ND	ug/L	5.0
1,2-Dichlorobenzene	ND	ug/L	5.0
2-Methylphenol	ND	ug/L	5.0
bis(2-Chloroisopropyl) ether	ND	ug/L	5.0
4-Methylphenol	ND	ug/L	5.0
N-Nitroso-di-n-propylamine	8.2	ug/L	5.0
Hexachloroethane	ND	ug/L	5.0
Nitrobenzene	ND	ug/L	5.0
Isophorone	ND	ug/L	5.0
2-Nitrophenol	ND	ug/L	5.0
2,4-Dimethylphenol	ND	ug/L	5.0
Benzoic acid	ND	ug/L	25
bis(2-Chloroethoxy)-methane	ND	ug/L	5.0
2,4-Dichlorophenol	ND	ug/L	5.0
1,2,4-Trichlorobenzene	ND	ug/L	5.0
Naphthalene	ND	ug/L	5.0
4-Chloroaniline	ND	ug/L	5.0
Hexachlorobutadiene	ND	ug/L	5.0
4-Chloro-3-methylphenol	ND	ug/L	5.0
2-Methylnaphthalene	ND	ug/L	5.0
Hexachlorocyclopentadiene	ND	ug/L	5.0
2,4,6-Trichlorophenol	ND	ug/L	5.0
2,4,5-Trichlorophenol	ND	ug/L	25
2-Chloronaphthalene	ND	ug/L	5.0
2-Nitroaniline	ND	ug/L	25
Dimethyl phthalate	ND	ug/L	5.0
Acenaphthylene	ND	ug/L	5.0
3-Nitroaniline	ND	ug/L	25
Acenaphthene	ND	ug/L	5.0
2,4-Dinitrophenol	ND	ug/L	25
4-Nitrophenol	ND	ug/L	25
Dibenzofuran	ND	ug/L	5.0
2,4-Dinitrotoluene	ND	ug/L	5.0

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS (CONT.)
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-001
Lab ID: 007299-0001-SA Enseco ID: 2048565
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: 16 OCT 90 Analyzed: 18 OCT 90

Parameter	Result	Units	Reporting Limit	
2,6-Dinitrotoluene	ND	ug/L	5.0	
Diethyl phthalate	ND	ug/L	5.0	
4-Chlorophenyl phenyl ether	ND	ug/L	5.0	
Fluorene	ND	ug/L	5.0	
4-Nitroaniline	ND	ug/L	25	
4,6-Dinitro-2-methylphenol	ND	ug/L	25	
N-Nitrosodiphenylamine	ND	ug/L	5.0	
4-Bromophenyl phenyl ether	ND	ug/L	5.0	
Hexachlorobenzene	ND	ug/L	5.0	
Pentachlorophenol	ND	ug/L	25	
Phenanthrene	ND	ug/L	5.0	
Anthracene	ND	ug/L	5.0	
Di-n-butyl phthalate	ND	ug/L	5.0	
Fluoranthene	ND	ug/L	5.0	
Pyrene	ND	ug/L	5.0	
Butyl benzyl phthalate	ND	ug/L	5.0	
3,3'-Dichlorobenzidine	ND	ug/L	10	
Benzo(a)anthracene	ND	ug/L	5.0	
bis(2-Ethylhexyl) phthalate	ND	ug/L	5.0	
Chrysene	ND	ug/L	5.0	
Di-n-octyl phthalate	ND	ug/L	5.0	
Benzo(b)fluoranthene	ND	ug/L	5.0	
Benzo(k)fluoranthene	ND	ug/L	5.0	
Benzo(a)pyrene	ND	ug/L	5.0	
Indeno(1,2,3-cd)pyrene	ND	ug/L	5.0	
Dibenz(a,h)anthracene	ND	ug/L	5.0	
Benzo(g,h,i)perylene	ND	ug/L	5.0	
Nitrobenzene-d5	46	%	--	
2-Fluorobiphenyl	41	%	--	&
Terphenyl-d14	49	%	--	
Phenol-d5	10	%	--	
2-Fluorophenol	12	%	--	&
2,4,6-Tribromophenol	18	%	--	

Note & : Surrogate recovery is outside of control limits.

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-002
Lab ID: 007299-0002-SA Enseco ID: 2048566
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: 16 OCT 90 Analyzed: 18 OCT 90

Parameter	Result	Units	Reporting Limit
Phenol	ND	ug/L	5.0
bis(2-Chloroethyl) ether	ND	ug/L	5.0
2-Chlorophenol	ND	ug/L	5.0
1,3-Dichlorobenzene	ND	ug/L	5.0
1,4-Dichlorobenzene	ND	ug/L	5.0
Benzyl alcohol	ND	ug/L	5.0
1,2-Dichlorobenzene	ND	ug/L	5.0
2-Methylphenol	ND	ug/L	5.0
bis(2-Chloroisopropyl) ether	ND	ug/L	5.0
4-Methylphenol	ND	ug/L	5.0
N-Nitroso-di-n-propylamine	ND	ug/L	5.0
Hexachloroethane	ND	ug/L	5.0
Nitrobenzene	ND	ug/L	5.0
Isophorone	ND	ug/L	5.0
2-Nitrophenol	ND	ug/L	5.0
2,4-Dimethylphenol	ND	ug/L	5.0
Benzoic acid	ND	ug/L	25
bis(2-Chloroethoxy)-methane	ND	ug/L	5.0
2,4-Dichlorophenol	ND	ug/L	5.0
1,2,4-Trichlorobenzene	ND	ug/L	5.0
Naphthalene	ND	ug/L	5.0
4-Chloroaniline	ND	ug/L	5.0
Hexachlorobutadiene	ND	ug/L	5.0
4-Chloro-3-methylphenol	ND	ug/L	5.0
2-Methylnaphthalene	ND	ug/L	5.0
Hexachlorocyclopentadiene	ND	ug/L	5.0
2,4,6-Trichlorophenol	ND	ug/L	5.0
2,4,5-Trichlorophenol	ND	ug/L	25
2-Chloronaphthalene	ND	ug/L	5.0
2-Nitroaniline	ND	ug/L	25
Dimethyl phthalate	ND	ug/L	5.0
Acenaphthylene	ND	ug/L	5.0
3-Nitroaniline	ND	ug/L	25
Acenaphthene	ND	ug/L	5.0
2,4-Dinitrophenol	ND	ug/L	25
4-Nitrophenol	ND	ug/L	25
Dibenzofuran	ND	ug/L	5.0
2,4-Dinitrotoluene	ND	ug/L	5.0

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS (CONT.)
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-002
Lab ID: 007299-0002-SA Enseco ID: 2048566
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: 16 OCT 90 Analyzed: 18 OCT 90

Parameter	Result	Units	Reporting Limit	
2,6-Dinitrotoluene	ND	ug/L	5.0	
Diethyl phthalate	ND	ug/L	5.0	
4-Chlorophenyl phenyl ether	ND	ug/L	5.0	
Fluorene	ND	ug/L	5.0	
4-Nitroaniline	ND	ug/L	25	
4,6-Dinitro-2-methylphenol	ND	ug/L	25	
N-Nitrosodiphenylamine	ND	ug/L	5.0	
4-Bromophenyl phenyl ether	ND	ug/L	5.0	
Hexachlorobenzene	ND	ug/L	5.0	
Pentachlorophenol	ND	ug/L	25	
Phenanthrene	ND	ug/L	5.0	
Anthracene	ND	ug/L	5.0	
Di-n-butyl phthalate	ND	ug/L	5.0	
Fluoranthene	ND	ug/L	5.0	
Pyrene	ND	ug/L	5.0	
Butyl benzyl phthalate	ND	ug/L	5.0	
3,3'-Dichlorobenzidine	ND	ug/L	10	
Benzo(a)anthracene	ND	ug/L	5.0	
bis(2-Ethylhexyl) phthalate	13	ug/L	5.0	
Chrysene	ND	ug/L	5.0	
Di-n-octyl phthalate	ND	ug/L	5.0	
Benzo(b)fluoranthene	ND	ug/L	5.0	
Benzo(k)fluoranthene	ND	ug/L	5.0	
Benzo(a)pyrene	ND	ug/L	5.0	
Indeno(1,2,3-cd)pyrene	ND	ug/L	5.0	
Dibenz(a,h)anthracene	ND	ug/L	5.0	
Benzo(g,h,i)perylene	ND	ug/L	5.0	
Nitrobenzene-d5	42	%	--	
2-Fluorobiphenyl	37	%	--	&
Terphenyl-d14	47	%	--	
Phenol-d5	16	%	--	
2-Fluorophenol	25	%	--	
2,4,6-Tribromophenol	43	%	--	

Note & : Surrogate recovery is outside of control limits.

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-003
Lab ID: 007299-0003-SA Enseco ID: 2048567
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: 16 OCT 90 Analyzed: 18 OCT 90

Parameter	Result	Units	Reporting Limit
Phenol	ND	ug/L	26
bis(2-Chloroethyl) ether	ND	ug/L	26
2-Chlorophenol	ND	ug/L	26
1,3-Dichlorobenzene	ND	ug/L	26
1,4-Dichlorobenzene	ND	ug/L	26
Benzyl alcohol	ND	ug/L	26
1,2-Dichlorobenzene	ND	ug/L	26
2-Methylphenol	ND	ug/L	26
bis(2-Chloroisopropyl) ether	ND	ug/L	26
4-Methylphenol	ND	ug/L	26
N-Nitroso-di-n-propylamine	ND	ug/L	26
Hexachloroethane	ND	ug/L	26
Nitrobenzene	ND	ug/L	26
Isophorone	ND	ug/L	26
2-Nitrophenol	ND	ug/L	26
2,4-Dimethylphenol	ND	ug/L	26
Benzoic acid	ND	ug/L	130
bis(2-Chloroethoxy)-methane	ND	ug/L	26
2,4-Dichlorophenol	ND	ug/L	26
1,2,4-Trichlorobenzene	ND	ug/L	26
Naphthalene	ND	ug/L	26
4-Chloroaniline	ND	ug/L	26
Hexachlorobutadiene	ND	ug/L	26
4-Chloro-3-methylphenol	ND	ug/L	26
2-Methylnaphthalene	ND	ug/L	26
Hexachlorocyclopentadiene	ND	ug/L	26
2,4,6-Trichlorophenol	ND	ug/L	26
2,4,5-Trichlorophenol	ND	ug/L	130
2-Chloronaphthalene	ND	ug/L	26
2-Nitroaniline	ND	ug/L	130
Dimethyl phthalate	ND	ug/L	26
Acenaphthylene	ND	ug/L	26
3-Nitroaniline	ND	ug/L	130
Acenaphthene	ND	ug/L	26
2,4-Dinitrophenol	ND	ug/L	130
4-Nitrophenol	ND	ug/L	130
Dibenzofuran	ND	ug/L	26
2,4-Dinitrotoluene	ND	ug/L	26

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS (CONT.)
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-003
Lab ID: 007299-0003-SA Enseco ID: 2048567
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: 16 OCT 90 Analyzed: 18 OCT 90

Parameter	Result	Units	Reporting Limit
2,6-Dinitrotoluene	ND	ug/L	26
Diethyl phthalate	ND	ug/L	26
4-Chlorophenyl phenyl ether	ND	ug/L	26
Fluorene	ND	ug/L	26
4-Nitroaniline	ND	ug/L	130
4,6-Dinitro-2-methylphenol	ND	ug/L	130
N-Nitrosodiphenylamine	ND	ug/L	26
4-Bromophenyl phenyl ether	ND	ug/L	26
Hexachlorobenzene	ND	ug/L	26
Pentachlorophenol	ND	ug/L	130
Phenanthrene	ND	ug/L	26
Anthracene	ND	ug/L	26
Di-n-butyl phthalate	ND	ug/L	26
Fluoranthene	ND	ug/L	26
Pyrene	ND	ug/L	26
Butyl benzyl phthalate	ND	ug/L	26
3,3'-Dichlorobenzidine	ND	ug/L	52
Benzo(a)anthracene	ND	ug/L	26
bis(2-Ethylhexyl) phthalate	ND	ug/L	26
Chrysene	ND	ug/L	26
Di-n-octyl phthalate	ND	ug/L	26
Benzo(b)fluoranthene	ND	ug/L	26
Benzo(k)fluoranthene	ND	ug/L	26
Benzo(a)pyrene	ND	ug/L	26
Indeno(1,2,3-cd)pyrene	ND	ug/L	26
Dibenz(a,h)anthracene	ND	ug/L	26
Benzo(g,h,i)perylene	ND	ug/L	26
Nitrobenzene-d5	47	%	--
2-Fluorobiphenyl	43	%	--
Terphenyl-d14	50	%	--
Phenol-d5	20	%	--
2-Fluorophenol	24	%	--
2,4,6-Tribromophenol	43	%	--

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-004
Lab ID: 007299-0004-SA Enseco ID: 2048568
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: 16 OCT 90 Analyzed: 19 OCT 90

Parameter	Result	Units	Reporting Limit
Phenol	ND	ug/L	50
bis(2-Chloroethyl) ether	ND	ug/L	50
2-Chlorophenol	ND	ug/L	50
1,3-Dichlorobenzene	ND	ug/L	50
1,4-Dichlorobenzene	ND	ug/L	50
Benzyl alcohol	ND	ug/L	50
1,2-Dichlorobenzene	ND	ug/L	50
2-Methylphenol	67	ug/L	50
bis(2-Chloroisopropyl) ether	ND	ug/L	50
4-Methylphenol	ND	ug/L	50
N-Nitroso-di-n-propylamine	ND	ug/L	50
Hexachloroethane	ND	ug/L	50
Nitrobenzene	ND	ug/L	50
Isophorone	ND	ug/L	50
2-Nitrophenol	ND	ug/L	50
2,4-Dimethylphenol	50	ug/L	50
Benzoic acid	ND	ug/L	250
bis(2-Chloroethoxy)-methane	ND	ug/L	50
2,4-Dichlorophenol	ND	ug/L	50
1,2,4-Trichlorobenzene	ND	ug/L	50
Naphthalene	ND	ug/L	50
4-Chloroaniline	ND	ug/L	50
Hexachlorobutadiene	ND	ug/L	50
4-Chloro-3-methylphenol	ND	ug/L	50
2-Methylnaphthalene	ND	ug/L	50
Hexachlorocyclopentadiene	ND	ug/L	50
2,4,6-Trichlorophenol	ND	ug/L	50
2,4,5-Trichlorophenol	ND	ug/L	250
2-Chloronaphthalene	ND	ug/L	50
2-Nitroaniline	ND	ug/L	250
Dimethyl phthalate	ND	ug/L	50
Acenaphthylene	ND	ug/L	50
3-Nitroaniline	ND	ug/L	250
Acenaphthene	ND	ug/L	50
2,4-Dinitrophenol	ND	ug/L	250
4-Nitrophenol	ND	ug/L	250
Dibenzofuran	ND	ug/L	50
2,4-Dinitrotoluene	ND	ug/L	50

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS (CONT.)
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-004
Lab ID: 007299-0004-SA   Enseco ID: 2048568
Matrix: AQUEOUS   Sampled: 10 OCT 90   Received: 11 OCT 90
Authorized: 11 OCT 90   Prepared: 16 OCT 90   Analyzed: 19 OCT 90

Parameter	Result	Units	Reporting Limit	
2,6-Dinitrotoluene	ND	ug/L	50	
Diethyl phthalate	ND	ug/L	50	
4-Chlorophenyl phenyl ether	ND	ug/L	50	
Fluorene	ND	ug/L	50	
4-Nitroaniline	ND	ug/L	250	
4,6-Dinitro-2-methylphenol	ND	ug/L	250	
N-Nitrosodiphenylamine	11	ug/L	0.0	
4-Bromophenyl phenyl ether	ND	ug/L	50	
Hexachlorobenzene	ND	ug/L	50	
Pentachlorophenol	ND	ug/L	250	
Phenanthrene	ND	ug/L	50	
Anthracene	ND	ug/L	50	
Di-n-butyl phthalate	ND	ug/L	50	
Fluoranthene	ND	ug/L	50	
Pyrene	ND	ug/L	50	
Butyl benzyl phthalate	ND	ug/L	50	
3,3'-Dichlorobenzidine	ND	ug/L	100	
Benzo(a)anthracene	ND	ug/L	50	
bis(2-Ethylhexyl) phthalate	ND	ug/L	50	
Chrysene	ND	ug/L	50	
Di-n-octyl phthalate	ND	ug/L	50	
Benzo(b)fluoranthene	ND	ug/L	50	
Benzo(k)fluoranthene	ND	ug/L	50	
Benzo(a)pyrene	ND	ug/L	50	
Indeno(1,2,3-cd)pyrene	ND	ug/L	50	
Dibenz(a,h)anthracene	ND	ug/L	50	
Benzo(g,h,i)perylene	ND	ug/L	50	
Nitrobenzene-d5	55	%	--	
2-Fluorobiphenyl	49	%	--	
Terphenyl-d14	57	%	--	
Phenol-d5	21	%	--	
2-Fluorophenol	18	%	--	&
2,4,6-Tribromophenol	46	%	--	

Note & : Surrogate recovery is outside of control limits.

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile   Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-005
Lab ID: 007299-0005-SA Enseco ID: 2048569
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: 16 OCT 90 Analyzed: 19 OCT 90

Parameter	Result	Units	Reporting Limit
Phenol	ND	ug/L	60
bis(2-Chloroethyl) ether	ND	ug/L	60
2-Chlorophenol	ND	ug/L	60
1,3-Dichlorobenzene	ND	ug/L	60
1,4-Dichlorobenzene	ND	ug/L	60
Benzyl alcohol	ND	ug/L	60
1,2-Dichlorobenzene	ND	ug/L	60
2-Methylphenol	85	ug/L	60
bis(2-Chloroisopropyl) ether	ND	ug/L	60
4-Methylphenol	ND	ug/L	60
N-Nitroso-di-n-propylamine	ND	ug/L	60
Hexachloroethane	ND	ug/L	60
Nitrobenzene	ND	ug/L	60
Isophorone	ND	ug/L	60
2-Nitrophenol	ND	ug/L	60
2,4-Dimethylphenol	ND	ug/L	60
Benzoic acid	ND	ug/L	300
bis(2-Chloroethoxy)-methane	ND	ug/L	60
2,4-Dichlorophenol	ND	ug/L	60
1,2,4-Trichlorobenzene	ND	ug/L	60
Naphthalene	ND	ug/L	60
4-Chloroaniline	ND	ug/L	60
Hexachlorobutadiene	ND	ug/L	60
4-Chloro-3-methylphenol	ND	ug/L	60
2-Methylnaphthalene	ND	ug/L	60
Hexachlorocyclopentadiene	ND	ug/L	60
2,4,6-Trichlorophenol	ND	ug/L	60
2,4,5-Trichlorophenol	ND	ug/L	300
2-Chloronaphthalene	ND	ug/L	60
2-Nitroaniline	ND	ug/L	300
Dimethyl phthalate	ND	ug/L	60
Acenaphthylene	ND	ug/L	60
3-Nitroaniline	ND	ug/L	300
Acenaphthene	ND	ug/L	60
2,4-Dinitrophenol	ND	ug/L	300
4-Nitrophenol	ND	ug/L	300
Dibenzofuran	ND	ug/L	60
2,4-Dinitrotoluene	ND	ug/L	60

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS (CONT.)
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-005
Lab ID: 007299-0005-SA   Enseco ID: 2048569
Matrix: AQUEOUS   Sampled: 10 OCT 90   Received: 11 OCT 90
Authorized: 11 OCT 90   Prepared: 16 OCT 90   Analyzed: 19 OCT 90

Parameter	Result	Units	Reporting Limit
2,6-Dinitrotoluene	ND	ug/L	60
Diethyl phthalate	ND	ug/L	60
4-Chlorophenyl phenyl ether	ND	ug/L	60
Fluorene	ND	ug/L	60
4-Nitroaniline	ND	ug/L	300
4,6-Dinitro-2-methylphenol	ND	ug/L	300
N-Nitrosodiphenylamine	ND	ug/L	60
4-Bromophenyl phenyl ether	ND	ug/L	60
Hexachlorobenzene	ND	ug/L	60
Pentachlorophenol	ND	ug/L	300
Phenanthrene	ND	ug/L	60
Anthracene	ND	ug/L	60
Di-n-butyl phthalate	ND	ug/L	60
Fluoranthene	ND	ug/L	60
Pyrene	ND	ug/L	60
Butyl benzyl phthalate	ND	ug/L	60
3,3′-Dichlorobenzidine	ND	ug/L	120
Benzo(a)anthracene	ND	ug/L	60
bis(2-Ethylhexyl) phthalate	ND	ug/L	60
Chrysene	ND	ug/L	60
Di-n-octyl phthalate	ND	ug/L	60
Benzo(b)fluoranthene	ND	ug/L	60
Benzo(k)fluoranthene	ND	ug/L	60
Benzo(a)pyrene	ND	ug/L	60
Indeno(1,2,3-cd)pyrene	ND	ug/L	60
Dibenz(a,h)anthracene	ND	ug/L	60
Benzo(g,h,i)perylene	ND	ug/L	60
Nitrobenzene-d5	61	%	--
2-Fluorobiphenyl	59	%	--
Terphenyl-d14	60	%	--
Phenol-d5	25	%	--
2-Fluorophenol	32	%	--
2,4,6-Tribromophenol	54	%	--

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile   Approved By: Kerylynn Hemmerle

METALS

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-001
Lab ID: 007299-0001-SA Enseco ID: 2048565
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date	
Aluminum	36.0	mg/L	0.10	200.7	12 OCT 90	15 OCT 90	
Antimony	ND	mg/L	0.050	200.7	12 OCT 90	15 OCT 90	
Arsenic	0.0090	mg/L	0.0050	206.2	12 OCT 90	15 OCT 90	
Barium	0.28	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Beryllium	0.0023	mg/L	0.0020	200.7	12 OCT 90	15 OCT 90	
Cadmium	0.060	mg/L	0.00050	213.2	12 OCT 90	15 OCT 90	m
Calcium	352	mg/L	0.20	200.7	12 OCT 90	15 OCT 90	
Chromium	0.21	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Cobalt	0.045	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Copper	0.22	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Iron	118	mg/L	0.10	200.7	12 OCT 90	15 OCT 90	
Lead	0.44	mg/L	0.050	239.2	12 OCT 90	15 OCT 90	
Magnesium	102	mg/L	0.20	200.7	12 OCT 90	15 OCT 90	
Manganese	2.6	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Mercury	ND	mg/L	0.00020	245.1	12 OCT 90	16 OCT 90	
Nickel	0.18	mg/L	0.040	200.7	12 OCT 90	15 OCT 90	
Potassium	10.7	mg/L	5.0	200.7	12 OCT 90	15 OCT 90	
Selenium	ND	mg/L	0.010	270.2	12 OCT 90	16 OCT 90	G
Silver	ND	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Sodium	6.3	mg/L	5.0	200.7	12 OCT 90	15 OCT 90	
Thallium	ND	mg/L	0.010	279.2	12 OCT 90	15 OCT 90	G
Vanadium	0.12	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Zinc	30.8	mg/L	0.020	200.7	12 OCT 90	15 OCT 90	

Note m : Compound exceeded standard calibration range in the original analysis and was rerun with a dilution.

Note G : Reporting limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Tony Noce Approved By: Vaughn Pusey

METALS

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-002
Lab ID: 007299-0002-SA Enseco ID: 2048566
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date	
Aluminum	1.8	mg/L	0.10	200.7	12 OCT 90	15 OCT 90	
Antimony	ND	mg/L	0.050	200.7	12 OCT 90	15 OCT 90	
Arsenic	ND	mg/L	0.0050	206.2	12 OCT 90	15 OCT 90	
Barium	0.28	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Beryllium	ND	mg/L	0.0020	200.7	12 OCT 90	15 OCT 90	
Cadmium	0.0022	mg/L	0.00050	213.2	12 OCT 90	15 OCT 90	
Calcium	163	mg/L	0.20	200.7	12 OCT 90	15 OCT 90	
Chromium	0.028	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Cobalt	ND	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Copper	0.012	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Iron	8.2	mg/L	0.10	200.7	12 OCT 90	15 OCT 90	
Lead	0.055	mg/L	0.0050	239.2	12 OCT 90	15 OCT 90	
Magnesium	41.7	mg/L	0.20	200.7	12 OCT 90	15 OCT 90	
Manganese	0.11	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Mercury	ND	mg/L	0.00020	245.1	12 OCT 90	16 OCT 90	
Nickel	ND	mg/L	0.040	200.7	12 OCT 90	15 OCT 90	
Potassium	ND	mg/L	5.0	200.7	12 OCT 90	15 OCT 90	
Selenium	ND	mg/L	0.010	270.2	12 OCT 90	16 OCT 90	G
Silver	ND	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Sodium	13.7	mg/L	5.0	200.7	12 OCT 90	15 OCT 90	
Thallium	ND	mg/L	0.010	279.2	12 OCT 90	15 OCT 90	G
Vanadium	ND	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Zinc	7.9	mg/L	0.020	200.7	12 OCT 90	15 OCT 90	

Note G : Reporting limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Tony Noce Approved By: Vaughn Pusey

METALS

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-004
Lab ID: 007299-0004-SA Enseco ID: 2048568
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date	
Aluminum	3.1	mg/L	0.10	200.7	12 OCT 90	15 OCT 90	
Antimony	ND	mg/L	0.050	200.7	12 OCT 90	15 OCT 90	
Arsenic	0.24	mg/L	0.050	206.2	12 OCT 90	15 OCT 90	
Barium	0.34	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Beryllium	ND	mg/L	0.0020	200.7	12 OCT 90	15 OCT 90	
Cadmium	0.024	mg/L	0.00050	213.2	12 OCT 90	15 OCT 90	m
Calcium	197	mg/L	0.20	200.7	12 OCT 90	15 OCT 90	
Chromium	0.081	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Cobalt	0.039	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Copper	0.028	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Iron	29.0	mg/L	0.10	200.7	12 OCT 90	15 OCT 90	
Lead	1.0	mg/L	0.12	239.2	12 OCT 90	15 OCT 90	m
Magnesium	33.3	mg/L	0.20	200.7	12 OCT 90	15 OCT 90	
Manganese	0.20	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Mercury	ND	mg/L	0.00020	245.1	12 OCT 90	16 OCT 90	
Nickel	0.092	mg/L	0.040	200.7	12 OCT 90	15 OCT 90	
Potassium	ND	mg/L	5.0	200.7	12 OCT 90	15 OCT 90	
Selenium	ND	mg/L	0.010	270.2	12 OCT 90	16 OCT 90	G
Silver	ND	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Sodium	ND	mg/L	5.0	200.7	12 OCT 90	15 OCT 90	
Thallium	ND	mg/L	0.0050	279.2	12 OCT 90	15 OCT 90	
Vanadium	ND	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Zinc	59.8	mg/L	0.020	200.7	12 OCT 90	15 OCT 90	

Note m : Compound exceeded standard calibration range in the original analysis and was rerun with a dilution.

Note G : Reporting limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Tony Noce Approved By: Vaughn Pusey

METALS

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-005
Lab ID: 007299-0005-SA Enseco ID: 2048569
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date	
Aluminum	3.5	mg/L	0.10	200.7	12 OCT 90	15 OCT 90	
Antimony	ND	mg/L	0.050	200.7	12 OCT 90	15 OCT 90	
Arsenic	0.25	mg/L	0.050	206.2	12 OCT 90	15 OCT 90	
Barium	0.35	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Beryllium	ND	mg/L	0.0020	200.7	12 OCT 90	15 OCT 90	
Cadmium	0.026	mg/L	0.00050	213.2	12 OCT 90	15 OCT 90	m
Calcium	210	mg/L	0.20	200.7	12 OCT 90	15 OCT 90	
Chromium	0.10	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Cobalt	0.045	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Copper	0.032	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Iron	31.3	mg/L	0.10	200.7	12 OCT 90	15 OCT 90	
Lead	1.2	mg/L	0.12	239.2	12 OCT 90	15 OCT 90	m
Magnesium	34.8	mg/L	0.20	200.7	12 OCT 90	15 OCT 90	
Manganese	0.22	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Mercury	ND	mg/L	0.00020	245.1	12 OCT 90	16 OCT 90	
Nickel	0.10	mg/L	0.040	200.7	12 OCT 90	15 OCT 90	
Potassium	ND	mg/L	5.0	200.7	12 OCT 90	15 OCT 90	
Selenium	ND	mg/L	0.010	270.2	12 OCT 90	16 OCT 90	G
Silver	ND	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Sodium	ND	mg/L	5.0	200.7	12 OCT 90	15 OCT 90	
Thallium	ND	mg/L	0.0050	279.2	12 OCT 90	15 OCT 90	
Vanadium	ND	mg/L	0.010	200.7	12 OCT 90	15 OCT 90	
Zinc	72.2	mg/L	0.020	200.7	12 OCT 90	15 OCT 90	

Note m : Compound exceeded standard calibration range in the original analysis and was rerun with a dilution.

Note G : Reporting limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Tony Noce Approved By: Vaughn Pusey

METALS
(DISSOLVED)

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-001-dissolved
Lab ID: 007299-0006-SA Enseco ID: 2048570
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Aluminum	ND	mg/L	0.10	200.7	NA	15 OCT 90
Antimony	ND	mg/L	0.050	200.7	NA	15 OCT 90
Arsenic	ND	mg/L	0.0050	206.2	NA	15 OCT 90
Barium	0.053	mg/L	0.010	200.7	NA	15 OCT 90
Beryllium	ND	mg/L	0.0020	200.7	NA	15 OCT 90
Cadmium	0.0010	mg/L	0.00050	213.2	NA	15 OCT 90
Calcium	136	mg/L	0.20	200.7	NA	15 OCT 90
Chromium	ND	mg/L	0.010	200.7	NA	15 OCT 90
Cobalt	ND	mg/L	0.010	200.7	NA	15 OCT 90
Copper	ND	mg/L	0.010	200.7	NA	15 OCT 90
Iron	ND	mg/L	0.10	200.7	NA	15 OCT 90
Lead	ND	mg/L	0.0050	239.2	NA	15 OCT 90
Magnesium	34.3	mg/L	0.20	200.7	NA	15 OCT 90
Manganese	0.031	mg/L	0.010	200.7	NA	15 OCT 90
Mercury	ND	mg/L	0.00020	245.1	NA	16 OCT 90
Nickel	ND	mg/L	0.040	200.7	NA	15 OCT 90
Potassium	ND	mg/L	5.0	200.7	NA	15 OCT 90
Selenium	ND	mg/L	0.0050	270.2	NA	15 OCT 90
Silver	ND	mg/L	0.010	200.7	NA	15 OCT 90
Sodium	7.8	mg/L	5.0	200.7	NA	15 OCT 90
Thallium	ND	mg/L	0.010	279.2	NA	15 OCT 90 G
Vanadium	ND	mg/L	0.010	200.7	NA	15 OCT 90
Zinc	4.1	mg/L	0.020	200.7	NA	15 OCT 90

Note G : Reporting limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Tony Noce Approved By: Vaughn Pusey

METALS
(DISSOLVED)

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-002-dissolved
Lab ID: 007299-0007-SA Enseco ID: 2048571
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date	
Aluminum	ND	mg/L	0.10	200.7	NA	15 OCT 90	
Antimony	ND	mg/L	0.050	200.7	NA	15 OCT 90	
Arsenic	ND	mg/L	0.0050	206.2	NA	15 OCT 90	
Barium	0.27	mg/L	0.010	200.7	NA	15 OCT 90	
Beryllium	ND	mg/L	0.0020	200.7	NA	15 OCT 90	
Cadmium	0.00060	mg/L	0.00050	213.2	NA	15 OCT 90	
Calcium	155	mg/L	0.20	200.7	NA	15 OCT 90	
Chromium	ND	mg/L	0.010	200.7	NA	15 OCT 90	
Cobalt	ND	mg/L	0.010	200.7	NA	15 OCT 90	
Copper	ND	mg/L	0.010	200.7	NA	15 OCT 90	
Iron	2.7	mg/L	0.10	200.7	NA	15 OCT 90	
Lead	ND	mg/L	0.0050	239.2	NA	15 OCT 90	
Magnesium	40.9	mg/L	0.20	200.7	NA	15 OCT 90	
Manganese	0.037	mg/L	0.010	200.7	NA	15 OCT 90	
Mercury	ND	mg/L	0.00020	245.1	NA	16 OCT 90	
Nickel	ND	mg/L	0.040	200.7	NA	15 OCT 90	
Potassium	ND	mg/L	5.0	200.7	NA	15 OCT 90	
Selenium	ND	mg/L	0.010	270.2	NA	15 OCT 90	G
Silver	ND	mg/L	0.010	200.7	NA	15 OCT 90	
Sodium	15.8	mg/L	5.0	200.7	NA	15 OCT 90	
Thallium	ND	mg/L	0.010	279.2	NA	15 OCT 90	G
Vanadium	ND	mg/L	0.010	200.7	NA	15 OCT 90	
Zinc	2.9	mg/L	0.020	200.7	NA	15 OCT 90	

Note G : Reporting limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Tony Noce Approved By: Vaughn Pusey

METALS
(DISSOLVED)

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-004-dissolved
Lab ID: 007299-0008-SA Enseco ID: 2048572
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Aluminum	ND	mg/L	0.10	200.7	NA	15 OCT 90
Antimony	ND	mg/L	0.050	200.7	NA	15 OCT 90
Arsenic	0.11	mg/L	0.025	206.2	NA	15 OCT 90
Barium	0.33	mg/L	0.010	200.7	NA	15 OCT 90
Beryllium	ND	mg/L	0.0020	200.7	NA	15 OCT 90
Cadmium	0.0014	mg/L	0.00050	213.2	NA	15 OCT 90
Calcium	181	mg/L	0.20	200.7	NA	15 OCT 90
Chromium	ND	mg/L	0.010	200.7	NA	15 OCT 90
Cobalt	0.013	mg/L	0.010	200.7	NA	15 OCT 90
Copper	ND	mg/L	0.010	200.7	NA	15 OCT 90
Iron	15.2	mg/L	0.10	200.7	NA	15 OCT 90
Lead	ND	mg/L	0.0050	239.2	NA	15 OCT 90
Magnesium	34.0	mg/L	0.20	200.7	NA	15 OCT 90
Manganese	0.12	mg/L	0.010	200.7	NA	15 OCT 90
Mercury	ND	mg/L	0.00020	245.1	NA	16 OCT 90
Nickel	ND	mg/L	0.040	200.7	NA	15 OCT 90
Potassium	ND	mg/L	5.0	200.7	NA	15 OCT 90
Selenium	ND	mg/L	0.0050	270.2	NA	15 OCT 90
Silver	ND	mg/L	0.010	200.7	NA	15 OCT 90
Sodium	ND	mg/L	5.0	200.7	NA	15 OCT 90
Thallium	ND	mg/L	0.010	279.2	NA	15 OCT 90 G
Vanadium	ND	mg/L	0.010	200.7	NA	15 OCT 90
Zinc	14.0	mg/L	0.020	200.7	NA	15 OCT 90

Note G : Reporting limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Tony Noce Approved By: Vaughn Pusey

METALS
(DISSOLVED)

Client Name: Conestoga-Rovers Associates
Client ID: W-101090-WP-005-dissolved
Lab ID: 007299-0009-SA Enseco ID: 2048573
Matrix: AQUEOUS Sampled: 10 OCT 90 Received: 11 OCT 90
Authorized: 11 OCT 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Aluminum	ND	mg/L	0.10	200.7	NA	15 OCT 90
Antimony	ND	mg/L	0.050	200.7	NA	15 OCT 90
Arsenic	0.10	mg/L	0.0050	206.2	NA	15 OCT 90
Barium	0.33	mg/L	0.010	200.7	NA	15 OCT 90
Beryllium	ND	mg/L	0.0020	200.7	NA	15 OCT 90
Cadmium	0.0015	mg/L	0.00050	213.2	NA	15 OCT 90
Calcium	179	mg/L	0.20	200.7	NA	15 OCT 90
Chromium	ND	mg/L	0.010	200.7	NA	15 OCT 90
Cobalt	0.012	mg/L	0.010	200.7	NA	15 OCT 90
Copper	ND	mg/L	0.010	200.7	NA	15 OCT 90
Iron	14.7	mg/L	0.10	200.7	NA	15 OCT 90
Lead	ND	mg/L	0.0050	239.2	NA	15 OCT 90
Magnesium	33.6	mg/L	0.20	200.7	NA	15 OCT 90
Manganese	0.12	mg/L	0.010	200.7	NA	15 OCT 90
Mercury	ND	mg/L	0.00020	245.1	NA	16 OCT 90
Nickel	ND	mg/L	0.040	200.7	NA	15 OCT 90
Potassium	ND	mg/L	5.0	200.7	NA	15 OCT 90
Selenium	ND	mg/L	0.010	270.2	NA	15 OCT 90 G
Silver	ND	mg/L	0.010	200.7	NA	15 OCT 90
Sodium	ND	mg/L	5.0	200.7	NA	15 OCT 90
Thallium	ND	mg/L	0.010	279.2	NA	15 OCT 90 G
Vanadium	ND	mg/L	0.010	200.7	NA	15 OCT 90
Zinc	13.9	mg/L	0.020	200.7	NA	15 OCT 90

Note G : Reporting limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Tony Noce Approved By: Vaughn Pusey

- QUALITY ASSURANCE/QUALITY CONTROL -

QUALITY ASSURANCE/QUALITY CONTROL

As an indication of the overall quality of the data generated by Enseco - Erco Laboratory for this report, the following controls have been provided (when applicable).

Method blanks are analyzed to assess the level of contamination which exists in the analytical system. A method blank, analyzed with every batch of samples, consists of reagents specific to the method. This blank is carried through every aspect of the procedure, including preparation, cleanup, and analysis. Ideally, the concentration of an analyte in the blank is below the reporting limit for that analyte. However, some common laboratory solvents and metals are difficult to eliminate to the part-per-billion levels commonly reported in environmental analyses. Therefore, all method blank data is reported to the client. Data are not blank-corrected.

Duplicate control samples (DCS) are used to monitor the laboratory's day-to-day performance of routine analytical methods. A DCS consists of a standard, control matrix which is spiked with a group of target compounds representative of the method analytes. The DCS is analyzed with environmental samples to provide evidence that the laboratory is performing the method within accepted QC guidelines.

A DCS has been established for most routine analytical methods. Reagent water is used as the control matrix for the analysis of aqueous samples. The DCS compounds are spiked into reagent water and carried through the appropriate steps of the analysis. As stated in SW-846 (third edition), a universal blank matrix does not exist for solid samples and therefore no matrix is used. The DCS for solid samples consists of the DCS compounds spiked into a reagent blank and carried through the appropriate steps of the analysis. The data thus obtained are used to set the DCS control limits. As sufficient laboratory data become available, the control limits are redefined based upon the most recent six months of DCS data. Control limits for accuracy are based on the historical average recovery of the DCS plus or minus three standard deviation units, or alternatively on established control limits defined in the methodology.

Surrogates are organic compounds that are similar to the analytes of interest in chemical behavior but which are not normally found in environmental samples. Enseco routinely adds surrogates to samples requiring GC/MS and most GC analysis and reports these surrogate recoveries to the client. These surrogates are added to samples to monitor the effect of the matrix on the accuracy of the analysis. Results are reported in terms of percent recovery.

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC/MS

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
007299-0001-SA	AQUEOUS	625-A	16 OCT 90-FA	16 OCT 90-F12
007299-0002-SA	AQUEOUS	625-A	16 OCT 90-FA	16 OCT 90-F12
007299-0003-SA	AQUEOUS	625-A	16 OCT 90-FA	16 OCT 90-F12
007299-0004-SA	AQUEOUS	625-A	16 OCT 90-FA	16 OCT 90-F12
007299-0005-SA	AQUEOUS	625-A	16 OCT 90-FA	16 OCT 90-F12

METHOD BLANK REPORT
Semivolatile Organics by GC/MS (cont.)

Test: 625-TCL-A
Matrix: AQUEOUS
QC Lot: 16 OCT 90-FA QC Run: 16 OCT 90-F12

Analyte	Result	Units	Reporting Limit
2,6-Dinitrotoluene	ND	ug/L	10
Diethyl phthalate	ND	ug/L	10
4-Chlorophenyl phenyl ether	ND	ug/L	10
Fluorene	ND	ug/L	10
4-Nitroaniline	ND	ug/L	50
4,6-Dinitro-2-methylphenol	ND	ug/L	50
N-Nitrosodiphenylamine	ND	ug/L	10
4-Bromophenyl phenyl ether	ND	ug/L	10
Hexachlorobenzene	ND	ug/L	10
Pentachlorophenol	ND	ug/L	50
Phenanthrene	ND	ug/L	10
Anthracene	ND	ug/L	10
Di-n-butyl phthalate	ND	ug/L	10
Fluoranthene	ND	ug/L	10
Pyrene	ND	ug/L	10
Butyl benzyl phthalate	ND	ug/L	10
3,3′-Dichlorobenzidine	ND	ug/L	20
Benzo(a)anthracene	ND	ug/L	10
bis(2-Ethylhexyl) phthalate	ND	ug/L	10
Chrysene	ND	ug/L	10
Di-n-octyl phthalate	ND	ug/L	10
Benzo(b)fluoranthene	ND	ug/L	10
Benzo(k)fluoranthene	ND	ug/L	10
Benzo(a)pyrene	ND	ug/L	10
Indeno(1,2,3-cd)pyrene	ND	ug/L	10
Dibenz(a,h)anthracene	ND	ug/L	10
Benzo(g,h,i)perylene	ND	ug/L	10

METHOD BLANK REPORT
Semivolatile Organics by GC/MS

Test: 625-TCL-A
Matrix: AQUEOUS
QC Lot: 16 OCT 90-FA QC Run: 16 OCT 90-F12

Analyte	Result	Units	Reporting Limit
Phenol	ND	ug/L	10
bis(2-Chloroethyl) ether	ND	ug/L	10
2-Chlorophenol	ND	ug/L	10
1,3-Dichlorobenzene	ND	ug/L	10
1,4-Dichlorobenzene	ND	ug/L	10
Benzyl alcohol	ND	ug/L	10
1,2-Dichlorobenzene	ND	ug/L	10
2-Methylphenol	ND	ug/L	10
bis(2-Chloroisopropyl) ether	ND	ug/L	10
4-Methylphenol	ND	ug/L	10
N-Nitroso-di-n-propylamine	ND	ug/L	10
Hexachloroethane	ND	ug/L	10
Nitrobenzene	ND	ug/L	10
Isophorone	ND	ug/L	10
2-Nitrophenol	ND	ug/L	10
2,4-Dimethylphenol	ND	ug/L	10
Benzoic acid	ND	ug/L	50
bis(2-Chloroethoxy)-methane	ND	ug/L	10
2,4-Dichlorophenol	ND	ug/L	10
1,2,4-Trichlorobenzene	ND	ug/L	10
Naphthalene	ND	ug/L	10
4-Chloroaniline	ND	ug/L	10
Hexachlorobutadiene	ND	ug/L	10
4-Chloro-3-methylphenol	ND	ug/L	10
2-Methylnaphthalene	ND	ug/L	10
Hexachlorocyclopentadiene	ND	ug/L	10
2,4,6-Trichlorophenol	ND	ug/L	10
2,4,5-Trichlorophenol	ND	ug/L	50
2-Chloronaphthalene	ND	ug/L	10
2-Nitroaniline	ND	ug/L	50
Dimethyl phthalate	ND	ug/L	10
Acenaphthylene	ND	ug/L	10
3-Nitroaniline	ND	ug/L	50
Acenaphthene	ND	ug/L	10
2,4-Dinitrophenol	ND	ug/L	50
4-Nitrophenol	ND	ug/L	50
Dibenzofuran	ND	ug/L	10
2,4-Dinitrotoluene	ND	ug/L	10

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC/MS

Category: 625-A
Matrix: AQUEOUS
QC Lot: 16 OCT 90-FA QC Run: 16 OCT 90-F12
Concentration Units: ug/L

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	SCS	Limits
Phenol-d5	200	27.1	14	10- 94
2-Fluorophenol	200	46.5	23	21-100
2,4,6-Tribromophenol	200	81.3	41	10-123
Nitrobenzene-d5	100	50.7	51	35-114
2-Fluorobiphenyl	100	44.5	44	43-116
Terphenyl-d14	100	56.4	56	33-141

Calculations are performed before rounding to avoid round-off errors in calculated results.

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC/MS

Category: 625-A
Matrix: AQUEOUS
QC Lot: 16 OCT 90-FA
Concentration Units: ug/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Pentachlorophenol	**200**	31.2	51.9	41.6	21	9-103	50	50
Phenol	**200**	62.2	50.5	56.4	28	12- 89	21	42
2-Chlorophenol	**200**	110	118	114	57	27-123	7.9	40
4-Chloro-3-methylphenol	**200**	106	120	113	56	23- 97	12	42
4-Nitrophenol	**200**	49.6	40.1	44.9	22	10- 80	21	50
1,2,4-Trichlorobenzene	**100**	56.2	66.2	61.2	61	39- 98	16	28
Acenaphthene	**100**	47.8	50.8	49.3	49	46-118	6.0	31
2,4-Dinitrotoluene	**100**	68.4	76.8	72.6	73	24- 96	12	38
Pyrene	**100**	58.1	68.0	63.0	63	26-127	16	31
N-Nitroso-di-n-propylamine	**100**	61.0	64.3	62.6	63	41-116	5.3	38
1,4-Dichlorobenzene	**100**	43.3	51.9	47.6	48	36- 97	18	28

Calculations are performed before **rounding** to avoid round-off errors in calculated results.

QC LOT ASSIGNMENT REPORT
Metals Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
007299-0001-SA	AQUEOUS	ICP-AT	12 OCT 90-545	12 OCT 90-545
007299-0001-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0001-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0001-SA	AQUEOUS	HG-CVAA-AT	12 OCT 90-545	12 OCT 90-545
007299-0001-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0001-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0001-SA	AQUEOUS	FAA2-AT	12 OCT 90-545	12 OCT 90-545
007299-0002-SA	AQUEOUS	ICP-AT	12 OCT 90-545	12 OCT 90-545
007299-0002-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0002-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0002-SA	AQUEOUS	HG-CVAA-AT	12 OCT 90-545	12 OCT 90-545
007299-0002-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0002-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0002-SA	AQUEOUS	FAA2-AT	12 OCT 90-545	12 OCT 90-545
007299-0004-SA	AQUEOUS	ICP-AT	12 OCT 90-545	12 OCT 90-545
007299-0004-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0004-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0004-SA	AQUEOUS	HG-CVAA-AT	12 OCT 90-545	12 OCT 90-545
007299-0004-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0004-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0004-SA	AQUEOUS	FAA2-AT	12 OCT 90-545	12 OCT 90-545
007299-0005-SA	AQUEOUS	ICP-AT	12 OCT 90-545	12 OCT 90-545
007299-0005-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0005-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0005-SA	AQUEOUS	HG-CVAA-AT	12 OCT 90-545	12 OCT 90-545
007299-0005-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0005-SA	AQUEOUS	FAA1-AT	12 OCT 90-545	12 OCT 90-545
007299-0005-SA	AQUEOUS	FAA2-AT	12 OCT 90-545	12 OCT 90-545
007299-0006-SA	AQUEOUS	ICP-AD	12 OCT 90-546	12 OCT 90-546
007299-0006-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0006-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0006-SA	AQUEOUS	HG-CVAA-AD	12 OCT 90-546	12 OCT 90-546
007299-0006-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0006-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0006-SA	AQUEOUS	FAA2-AD	12 OCT 90-546	12 OCT 90-546
007299-0007-SA	AQUEOUS	ICP-AD	12 OCT 90-546	12 OCT 90-546
007299-0007-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0007-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0007-SA	AQUEOUS	HG-CVAA-AD	12 OCT 90-546	12 OCT 90-546
007299-0007-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0007-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0007-SA	AQUEOUS	FAA2-AD	12 OCT 90-546	12 OCT 90-546
007299-0008-SA	AQUEOUS	ICP-AD	12 OCT 90-546	12 OCT 90-546
007299-0008-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0008-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0008-SA	AQUEOUS	HG-CVAA-AD	12 OCT 90-546	12 OCT 90-546
007299-0008-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546

QC LOT ASSIGNMENT REPORT
Metals Analysis and Preparation (cont.)

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
007299-0008-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0008-SA	AQUEOUS	FAA2-AD	12 OCT 90-546	12 OCT 90-546
007299-0009-SA	AQUEOUS	ICP-AD	12 OCT 90-546	12 OCT 90-546
007299-0009-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0009-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0009-SA	AQUEOUS	HG-CVAA-AD	12 OCT 90-546	12 OCT 90-546
007299-0009-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0009-SA	AQUEOUS	FAA1-AD	12 OCT 90-546	12 OCT 90-546
007299-0009-SA	AQUEOUS	FAA2-AD	12 OCT 90-546	12 OCT 90-546

METHOD BLANK REPORT
Metals Analysis and Preparation

Analyte	Result	Units	Reporting Limit
Test: ICP-TAL-AT Matrix: AQUEOUS QC Lot: 12 OCT 90-545 QC Run: 12 OCT 90-545			
Aluminum	ND	mg/L	0.10
Antimony	ND	mg/L	0.050
Barium	ND	mg/L	0.010
Beryllium	ND	mg/L	0.0020
Calcium	ND	mg/L	0.20
Chromium	ND	mg/L	0.010
Cobalt	ND	mg/L	0.010
Copper	ND	mg/L	0.010
Iron	ND	mg/L	0.10
Magnesium	ND	mg/L	0.20
Manganese	ND	mg/L	0.010
Nickel	ND	mg/L	0.040
Potassium	ND	mg/L	5.0
Silver	ND	mg/L	0.010
Sodium	ND	mg/L	5.0
Vanadium	ND	mg/L	0.010
Zinc	ND	mg/L	0.020
Test: AS-FAA-AT Matrix: AQUEOUS QC Lot: 12 OCT 90-545 QC Run: 12 OCT 90-545			
Arsenic	ND	mg/L	0.0050
Test: PB-FAA-AT Matrix: AQUEOUS QC Lot: 12 OCT 90-545 QC Run: 12 OCT 90-545			
Lead	ND	mg/L	0.0050
Test: HG-CVAA-AT Matrix: AQUEOUS QC Lot: 12 OCT 90-545 QC Run: 12 OCT 90-545			
Mercury	ND	mg/L	0.00020

METHOD BLANK REPORT
Metals Analysis and Preparation (cont.)

Analyte	Result	Units	Reporting Limit
Test: SE-FAA-AT Matrix: AQUEOUS QC Lot: 12 OCT 90-545 QC Run: 12 OCT 90-545			
Selenium	ND	mg/L	0.0050
Test: TL-FAA-AT Matrix: AQUEOUS QC Lot: 12 OCT 90-545 QC Run: 12 OCT 90-545			
Thallium	ND	mg/L	0.0050
Test: CD-FAA-AT Matrix: AQUEOUS QC Lot: 12 OCT 90-545 QC Run: 12 OCT 90-545			
Cadmium	ND	mg/L	0.00050
Test: ICP-TAL-AD Matrix: AQUEOUS QC Lot: 12 OCT 90-546 QC Run: 12 OCT 90-546			
Aluminum	ND	mg/L	0.10
Antimony	ND	mg/L	0.050
Barium	ND	mg/L	0.010
Beryllium	ND	mg/L	0.0020
Calcium	ND	mg/L	0.20
Chromium	ND	mg/L	0.010
Cobalt	ND	mg/L	0.010
Copper	ND	mg/L	0.010
Iron	ND	mg/L	0.10
Magnesium	ND	mg/L	0.20
Manganese	ND	mg/L	0.010
Nickel	ND	mg/L	0.040
Potassium	ND	mg/L	5.0
Silver	ND	mg/L	0.010
Sodium	ND	mg/L	5.0
Vanadium	ND	mg/L	0.010
Zinc	ND	mg/L	0.020

METHOD BLANK REPORT
Metals Analysis and Preparation (cont.)

Analyte	Result	Units	Reporting Limit
Test: AS-FAA-AD Matrix: AQUEOUS QC Lot: 12 OCT 90-546 QC Run: 12 OCT 90-546			
Arsenic	ND	mg/L	0.0050
Test: PB-FAA-AD Matrix: AQUEOUS QC Lot: 12 OCT 90-546 QC Run: 12 OCT 90-546			
Lead	ND	mg/L	0.0050
Test: HG-CVAA-AD Matrix: AQUEOUS QC Lot: 12 OCT 90-546 QC Run: 12 OCT 90-546			
Mercury	ND	mg/L	0.00020
Test: SE-FAA-AD Matrix: AQUEOUS QC Lot: 12 OCT 90-546 QC Run: 12 OCT 90-546			
Selenium	ND	mg/L	0.0050
Test: TL-FAA-AD Matrix: AQUEOUS QC Lot: 12 OCT 90-546 QC Run: 12 OCT 90-546			
Thallium	ND	mg/L	0.0050
Test: CD-FAA-AD Matrix: AQUEOUS QC Lot: 12 OCT 90-546 QC Run: 12 OCT 90-546			
Cadmium	ND	mg/L	0.00050

DUPLICATE CONTROL SAMPLE REPORT
Metals Analysis and Preparation

Category: ICP-AT
Matrix: AQUEOUS
QC Lot: 12 OCT 90-545
Concentration Units: mg/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision (RPD) Limit
Aluminum	2.0	2.09	2.07	2.08	104	80-120	1.0	20
Antimony	0.5	0.510	0.522	0.516	103	80-120	2.3	20
Arsenic	0.5	0.519	0.515	0.517	103	80-120	0.7	20
Barium	2.0	2.08	2.06	2.07	104	80-120	1.1	20
Beryllium	0.05	0.0504	0.0497	0.0501	100	80-120	1.4	20
Cadmium	0.05	0.0487	0.0464	0.0476	95	80-120	4.9	20
Calcium	100	101	99.5	100	100	80-120	1.5	20
Chromium	0.2	0.206	0.203	0.204	102	80-120	1.4	20
Cobalt	0.5	0.494	0.487	0.491	98	80-120	1.4	20
Copper	0.25	0.261	0.260	0.260	104	80-120	0.7	20
Iron	1.0	0.971	0.951	0.961	96	80-120	2.1	20
Lead	0.5	0.520	0.497	0.509	102	80-120	4.6	20
Magnesium	50	49.3	48.6	48.9	98	80-120	1.4	20
Manganese	0.5	0.491	0.485	0.488	98	80-120	1.2	20
Nickel	0.5	0.490	0.483	0.486	97	80-120	1.5	20
Potassium	50	53.2	52.1	52.6	105	80-120	2.0	20
Silver	0.05	0.0482	0.0462	0.0472	94	80-120	4.2	20
Sodium	100	107	106	107	107	80-120	1.4	20
Tin	0.4	0.321	0.273	0.297	74	80-120	16	20
Vanadium	0.5	0.484	0.481	0.482	96	80-120	0.5	20
Zinc	0.5	0.493	0.488	0.490	98	80-120	0.9	20

Category: FAA1-AT
Matrix: AQUEOUS
QC Lot: 12 OCT 90-545
Concentration Units: mg/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision (RPD) Limit
Arsenic	0.04	0.0401	0.0410	0.0406	101	80-120	2.2	20
Lead	0.02	0.0198	0.0199	0.0198	99	80-120	0.5	20
Selenium	0.01	0.00920	0.00850	0.00885	89	80-120	7.9	20
Thallium	0.05	0.0470	0.0440	0.0455	91	80-120	6.6	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

DUPLICATE CONTROL SAMPLE REPORT
Metals Analysis and Preparation (cont.)

Category: HG-CVAA-AT
Matrix: AQUEOUS
QC Lot: 12 OCT 90-545
Concentration Units: mg/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision (RPD) Lim
Mercury	0.001	0.00103	0.00106	0.00104	105	80-120	2.9	20

Category: FAA2-AT
Matrix: AQUEOUS
QC Lot: 12 OCT 90-545
Concentration Units: mg/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision (RPD) Lim
Antimony	0.002	NA	NA	NC	NC	80-120	NC	20
Cadmium	0.002	0.00189	0.00207	0.00198	99	80-120	9.1	[illegible]
Chromium	0.05	NA	NA	NC	NC	80-120	NC	[illegible]
Copper	0.05	NA	NA	NC	NC	80-120	NC	20
Nickel	0.05	NA	NA	NC	NC	80-120	NC	20
Silver	0.002	NA	NA	NC	NC	80-120	NC	[illegible]

Category: ICP-AD
Matrix: AQUEOUS
QC Lot: 12 OCT 90-546
Concentration Units: mg/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision (RPD) Lim
Aluminum	2.0	2.02	2.02	2.02	101	80-120	0.1	[illegible]
Antimony	0.5	0.503	0.500	0.502	100	80-120	0.5	20
Arsenic	0.5	0.545	0.490	0.518	104	80-120	11	20
Barium	2.0	1.99	1.98	1.99	99	80-120	0.4	[illegible]
Beryllium	0.05	0.0487	0.0488	0.0488	98	80-120	0.3	[illegible]
Cadmium	0.05	0.0434	0.0467	0.0450	90	80-120	7.3	20
Calcium	100	96.6	96.5	96.6	97	80-120	0.2	[illegible]
Chromium	0.2	0.197	0.199	0.198	99	80-120	0.7	[illegible]
Cobalt	0.5	0.476	0.477	0.477	95	80-120	0.4	20
Copper	0.25	0.251	0.252	0.251	101	80-120	0.5	20
Iron	1.0	0.946	0.944	0.945	95	80-120	0.3	[illegible]
Lead	0.5	0.466	0.495	0.481	96	80-120	5.9	[illegible]
Magnesium	50	46.8	46.8	46.8	94	80-120	0.1	20
Manganese	0.5	0.471	0.471	0.471	94	80-120	0.1	20
Nickel	0.5	0.480	0.472	0.476	95	80-120	1.8	[illegible]
Potassium	50	49.9	50.1	50.0	100	80-120	0.6	[illegible]
Silver	0.05	0.0470	0.0487	0.0479	96	80-120	3.7	20
Sodium	100	102	102	102	102	80-120	0.5	20
Tin	0.4	0.370	0.369	0.369	92	80-120	0.3	[illegible]

ND = Not detected
NC = Not calculated, calculation not applicable.
NA = Not applicable

Calculations are performed before rounding to avoid round-off errors in calculated results

DUPLICATE CONTROL SAMPLE REPORT
Metals Analysis and Preparation (cont.)

	Concentration				Accuracy		Precision	
Analyte	Spiked		Measured		Average(%)		(RPD)	
		DCS1	DCS2	AVG	DCS	Limits	DCS	Limit
Category: ICP-AD Matrix: AQUEOUS QC Lot: 12 OCT 90-546 Concentration Units: mg/L								
Vanadium	0.5	0.468	0.466	0.467	93	80-120	0.4	20
Zinc	0.5	0.480	0.467	0.474	95	80-120	2.7	20
Category: FAA1-AD Matrix: AQUEOUS QC Lot: 12 OCT 90-546 Concentration Units: mg/L								
Arsenic	0.05	0.0477	0.0478	0.0478	96	80-120	0.2	20
Lead	0.05	0.0480	0.0490	0.0485	97	80-120	2.1	20
Selenium	0.05	0.0513	0.0504	0.0508	102	80-120	1.8	20
Thallium	0.05	0.0480	0.0480	0.0480	96	80-120	0.0	20
Category: HG-CVAA-AD Matrix: AQUEOUS QC Lot: 12 OCT 90-546 Concentration Units: mg/L								
Mercury	0.001	0.00103	0.00106	0.00104	105	80-120	2.9	20
Category: FAA2-AD Matrix: AQUEOUS QC Lot: 12 OCT 90-546 Concentration Units: mg/L								
Antimony	0.002	NA	NA	NC	NC	80-120	NC	20
Cadmium	0.005	0.00487	0.00499	0.00493	99	80-120	2.4	20
Chromium	0.05	NA	NA	NC	NC	80-120	NC	20
Copper	0.05	NA	NA	NC	NC	80-120	NC	20
Nickel	0.05	NA	NA	NC	NC	80-120	NC	20
Silver	0.002	NA	NA	NC	NC	80-120	NC	20

ND = Not detected
NC = Not calculated, calculation not applicable.
NA = Not applicable

Calculations are performed before rounding to avoid round-off errors in calculated results.

Enseco
A CORNING Company

Rec'd CRA
OCT 25 90

October 24, 1990

Mr. David Dempsey
Conestoga-Rovers Associates
382 West County Road D
St. Paul, MN 55112

Dear David:

Enclosed are the results of the analyses for Rasmussen (10/12/90). This project was received at Enseco - Erco Laboratory on October 12, 1990, and was processed for a 14 day turnaround time.

This report is presented in three sections. The first section consists of the Sample Description Information page and Analytical Test Requests summary. The second section contains the analytical results and method references. The third section briefly describes the elements of Enseco's quality assurance/quality control (QA/QC) program and contains the QA/QC results. This letter authorizes the release of the analytical results and should be considered an integral part of this report.

Please refer to this project by the Enseco project number 007352 to expedite any further discussions. I will be happy to address any questions or concerns that you may have.

Sincerely,

Catherine M. Flaherty
Program Administrator

Encl.

Enseco Incorporated
205 Alewife Brook Parkway
Cambridge, MA 02138
617/661-3111 617/354-5258

October 24, 1990

Project Narrative

Client: Conestoga-Rovers Associates
Project Name: 10/12/90
Erco Project No.: 007352

1. This project consists of the results for samples received at Enseco - Erco Laboratory on October 12, 1990. Please see the sample description information sheet for a list of samples.

2. Temperature of coolers upon receipt was 15.5,16.1 C respectively.
   Bottles were not broken in transit.
   Bottles were properly labeled.
   Samples agree with chain of custody.
   Samples were properly preserved.

3. Per telephone conversation with Dave Dempsey on October 12, 1990, only analyze the matrix spike aliquot for BNA analysis. Not enough volume of sample W-101190-WP-08 was provided to perform both a matrix spike and a matrix spike duplicate for BNA analysis. A matrix spike and duplicate was assigned to W-101190-WP-06 for both total and dissolved metals.

4. Sample 01 and 02 required additional dilutions due to high concentration of unknowns (ester of alkanoic acid).

Enseco
A Corning Company

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101190-WP-06
Lab ID: 007352-0001-SA Enseco ID: 2048657
Matrix: AQUEOUS Sampled: 11 OCT 90 Received: 12 OCT 90
Authorized: 12 OCT 90 Prepared: 16 OCT 90 Analyzed: 19 OCT 90

Parameter	Result	Units	Reporting Limit
Phenol	ND	ug/L	10
bis(2-Chloroethyl) ether	ND	ug/L	10
2-Chlorophenol	ND	ug/L	10
1,3-Dichlorobenzene	ND	ug/L	10
1,4-Dichlorobenzene	ND	ug/L	10
Benzyl alcohol	ND	ug/L	10
1,2-Dichlorobenzene	ND	ug/L	10
2-Methylphenol	ND	ug/L	10
bis(2-Chloroisopropyl) ether	ND	ug/L	10
4-Methylphenol	ND	ug/L	10
N-Nitroso-di-n-propylamine	ND	ug/L	10
Hexachloroethane	ND	ug/L	10
Nitrobenzene	ND	ug/L	10
Isophorone	ND	ug/L	10
2-Nitrophenol	ND	ug/L	10
2,4-Dimethylphenol	ND	ug/L	10
Benzoic acid	ND	ug/L	52
bis(2-Chloroethoxy)-methane	ND	ug/L	10
2,4-Dichlorophenol	ND	ug/L	10
1,2,4-Trichlorobenzene	ND	ug/L	10
Naphthalene	ND	ug/L	10
4-Chloroaniline	ND	ug/L	10
Hexachlorobutadiene	ND	ug/L	10
4-Chloro-3-methylphenol	ND	ug/L	10
2-Methylnaphthalene	ND	ug/L	10
Hexachlorocyclopentadiene	ND	ug/L	10
2,4,6-Trichlorophenol	ND	ug/L	10
2,4,5-Trichlorophenol	ND	ug/L	52
2-Chloronaphthalene	ND	ug/L	10
2-Nitroaniline	ND	ug/L	52
Dimethyl phthalate	ND	ug/L	10
Acenaphthylene	ND	ug/L	10
3-Nitroaniline	ND	ug/L	52
Acenaphthene	ND	ug/L	10
2,4-Dinitrophenol	ND	ug/L	52
4-Nitrophenol	ND	ug/L	52
Dibenzofuran	ND	ug/L	10
2,4-Dinitrotoluene	ND	ug/L	10

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS (CONT.)
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101190-WP-06
Lab ID: 007352-0001-SA Enseco ID: 2048657
Matrix: AQUEOUS Sampled: 11 OCT 90 Received: 12 OCT 90
Authorized: 12 OCT 90 Prepared: 16 OCT 90 Analyzed: 19 OCT 90

Parameter	Result	Units	Reporting Limit
2,6-Dinitrotoluene	ND	ug/L	10
Diethyl phthalate	ND	ug/L	10
4-Chlorophenyl phenyl ether	ND	ug/L	10
Fluorene	ND	ug/L	10
4-Nitroaniline	ND	ug/L	52
4,6-Dinitro-2-methylphenol	ND	ug/L	52
N-Nitrosodiphenylamine	ND	ug/L	10
4-Bromophenyl phenyl ether	ND	ug/L	10
Hexachlorobenzene	ND	ug/L	10
Pentachlorophenol	ND	ug/L	52
Phenanthrene	ND	ug/L	10
Anthracene	ND	ug/L	10
Di-n-butyl phthalate	ND	ug/L	10
Fluoranthene	ND	ug/L	10
Pyrene	ND	ug/L	10
Butyl benzyl phthalate	ND	ug/L	10
3,3'-Dichlorobenzidine	ND	ug/L	21
Benzo(a)anthracene	ND	ug/L	10
bis(2-Ethylhexyl) phthalate	ND	ug/L	10
Chrysene	ND	ug/L	10
Di-n-octyl phthalate	ND	ug/L	10
Benzo(b)fluoranthene	ND	ug/L	10
Benzo(k)fluoranthene	ND	ug/L	10
Benzo(a)pyrene	ND	ug/L	10
Indeno(1,2,3-cd)pyrene	ND	ug/L	10
Dibenz(a,h)anthracene	ND	ug/L	10
Benzo(g,h,i)perylene	ND	ug/L	10
Nitrobenzene-d5	51	%	--
2-Fluorobiphenyl	45	%	--
Terphenyl-d14	60	%	--
Phenol-d5	21	%	--
2-Fluorophenol	31	%	--
2,4,6-Tribromophenol	50	%	--

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101190-WP-07
Lab ID: 007352-0005-SA Enseco ID: 2048670
Matrix: AQUEOUS Sampled: 11 OCT 90 Received: 12 OCT 90
Authorized: 12 OCT 90 Prepared: 16 OCT 90 Analyzed: 19 OCT 90

Parameter	Result	Units	Reporting Limit
Phenol	ND	ug/L	5.4
bis(2-Chloroethyl) ether	ND	ug/L	5.4
2-Chlorophenol	ND	ug/L	5.4
1,3-Dichlorobenzene	ND	ug/L	5.4
1,4-Dichlorobenzene	ND	ug/L	5.4
Benzyl alcohol	ND	ug/L	5.4
1,2-Dichlorobenzene	ND	ug/L	5.4
2-Methylphenol	ND	ug/L	5.4
bis(2-Chloroisopropyl) ether	ND	ug/L	5.4
4-Methylphenol	ND	ug/L	5.4
N-Nitroso-di-n-propylamine	ND	ug/L	5.4
Hexachloroethane	ND	ug/L	5.4
Nitrobenzene	ND	ug/L	5.4
Isophorone	ND	ug/L	5.4
2-Nitrophenol	ND	ug/L	5.4
2,4-Dimethylphenol	ND	ug/L	5.4
Benzoic acid	ND	ug/L	27
bis(2-Chloroethoxy)-methane	ND	ug/L	5.4
2,4-Dichlorophenol	ND	ug/L	5.4
1,2,4-Trichlorobenzene	ND	ug/L	5.4
Naphthalene	ND	ug/L	5.4
4-Chloroaniline	ND	ug/L	5.4
Hexachlorobutadiene	ND	ug/L	5.4
4-Chloro-3-methylphenol	ND	ug/L	5.4
2-Methylnaphthalene	ND	ug/L	5.4
Hexachlorocyclopentadiene	ND	ug/L	5.4
2,4,6-Trichlorophenol	ND	ug/L	5.4
2,4,5-Trichlorophenol	ND	ug/L	27
2-Chloronaphthalene	ND	ug/L	5.4
2-Nitroaniline	ND	ug/L	27
Dimethyl phthalate	ND	ug/L	5.4
Acenaphthylene	ND	ug/L	5.4
3-Nitroaniline	ND	ug/L	27
Acenaphthene	ND	ug/L	5.4
2,4-Dinitrophenol	ND	ug/L	27
4-Nitrophenol	ND	ug/L	27
Dibenzofuran	ND	ug/L	5.4
2,4-Dinitrotoluene	ND	ug/L	5.4

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Karylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS (CONT.)
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101190-WP-07
Lab ID: 007352-0005-SA Enseco ID: 2048670
Matrix: AQUEOUS Sampled: 11 OCT 90 Received: 12 OCT 90
Authorized: 12 OCT 90 Prepared: 16 OCT 90 Analyzed: 19 OCT 90

Parameter	Result	Units	Reporting Limit
2,6-Dinitrotoluene	ND	ug/L	5.4
Diethyl phthalate	ND	ug/L	5.4
4-Chlorophenyl phenyl ether	ND	ug/L	5.4
Fluorene	ND	ug/L	5.4
4-Nitroaniline	ND	ug/L	27
4,6-Dinitro-2-methylphenol	ND	ug/L	27
N-Nitrosodiphenylamine	ND	ug/L	5.4
4-Bromophenyl phenyl ether	ND	ug/L	5.4
Hexachlorobenzene	ND	ug/L	5.4
Pentachlorophenol	ND	ug/L	27
Phenanthrene	ND	ug/L	5.4
Anthracene	ND	ug/L	5.4
Di-n-butyl phthalate	ND	ug/L	5.4
Fluoranthene	ND	ug/L	5.4
Pyrene	ND	ug/L	5.4
Butyl benzyl phthalate	ND	ug/L	5.4
3,3'-Dichlorobenzidine	ND	ug/L	11
Benzo(a)anthracene	ND	ug/L	5.4
bis(2-Ethylhexyl) phthalate	ND	ug/L	5.4
Chrysene	ND	ug/L	5.4
Di-n-octyl phthalate	ND	ug/L	5.4
Benzo(b)fluoranthene	ND	ug/L	5.4
Benzo(k)fluoranthene	ND	ug/L	5.4
Benzo(a)pyrene	ND	ug/L	5.4
Indeno(1,2,3-cd)pyrene	ND	ug/L	5.4
Dibenz(a,h)anthracene	ND	ug/L	5.4
Benzo(g,h,i)perylene	ND	ug/L	5.4
Nitrobenzene-d5	50	%	--
2-Fluorobiphenyl	43	%	--
Terphenyl-d14	57	%	--
Phenol-d5	13	%	--
2-Fluorophenol	25	%	--
2,4,6-Tribromophenol	35	%	--

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS
Method 625

Client Name:	Conestoga-Rovers Associates				
Client ID:	W-101190-WP-08				
Lab ID:	007352-0006-SA	Enseco ID:	2048671		
Matrix:	AQUEOUS	Sampled:	11 OCT 90	Received:	12 OCT 90
Authorized:	12 OCT 90	Prepared:	16 OCT 90	Analyzed:	19 OCT 90

Parameter	Result	Units	Reporting Limit
Phenol	5.6	ug/L	5.0
bis(2-Chloroethyl) ether	ND	ug/L	5.0
2-Chlorophenol	ND	ug/L	5.0
1,3-Dichlorobenzene	ND	ug/L	5.0
1,4-Dichlorobenzene	ND	ug/L	5.0
Benzyl alcohol	ND	ug/L	5.0
1,2-Dichlorobenzene	ND	ug/L	5.0
2-Methylphenol	ND	ug/L	5.0
bis(2-Chloroisopropyl) ether	ND	ug/L	5.0
4-Methylphenol	ND	ug/L	5.0
N-Nitroso-di-n-propylamine	ND	ug/L	5.0
Hexachloroethane	ND	ug/L	5.0
Nitrobenzene	ND	ug/L	5.0
Isophorone	ND	ug/L	5.0
2-Nitrophenol	ND	ug/L	5.0
2,4-Dimethylphenol	ND	ug/L	5.0
Benzoic acid	ND	ug/L	25
bis(2-Chloroethoxy)-methane	ND	ug/L	5.0
2,4-Dichlorophenol	ND	ug/L	5.0
1,2,4-Trichlorobenzene	ND	ug/L	5.0
Naphthalene	ND	ug/L	5.0
4-Chloroaniline	ND	ug/L	5.0
Hexachlorobutadiene	ND	ug/L	5.0
4-Chloro-3-methylphenol	ND	ug/L	5.0
2-Methylnaphthalene	ND	ug/L	5.0
Hexachlorocyclopentadiene	ND	ug/L	5.0
2,4,6-Trichlorophenol	ND	ug/L	5.0
2,4,5-Trichlorophenol	ND	ug/L	25
2-Chloronaphthalene	ND	ug/L	5.0
2-Nitroaniline	ND	ug/L	25
Dimethyl phthalate	ND	ug/L	5.0
Acenaphthylene	ND	ug/L	5.0
3-Nitroaniline	ND	ug/L	25
Acenaphthene	ND	ug/L	5.0
2,4-Dinitrophenol	ND	ug/L	25
4-Nitrophenol	ND	ug/L	25
Dibenzofuran	ND	ug/L	5.0
2,4-Dinitrotoluene	ND	ug/L	5.0

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile

Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS (CONT.)
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101190-WP-08
Lab ID: 007352-0006-SA
Enseco ID: 2048671
Matrix: AQUEOUS
Sampled: 11 OCT 90
Received: 12 OCT 90
Authorized: 12 OCT 90
Prepared: 16 OCT 90
Analyzed: 19 OCT 90

Parameter	Result	Units	Reporting Limit
2,6-Dinitrotoluene	ND	ug/L	5.0
Diethyl phthalate	ND	ug/L	5.0
4-Chlorophenyl phenyl ether	ND	ug/L	5.0
Fluorene	ND	ug/L	5.0
4-Nitroaniline	ND	ug/L	25
4,6-Dinitro-2-methylphenol	ND	ug/L	25
N-Nitrosodiphenylamine	ND	ug/L	5.0
4-Bromophenyl phenyl ether	ND	ug/L	5.0
Hexachlorobenzene	ND	ug/L	5.0
Pentachlorophenol	ND	ug/L	25
Phenanthrene	ND	ug/L	5.0
Anthracene	ND	ug/L	5.0
Di-n-butyl phthalate	ND	ug/L	5.0
Fluoranthene	ND	ug/L	5.0
Pyrene	ND	ug/L	5.0
Butyl benzyl phthalate	ND	ug/L	5.0
3,3'-Dichlorobenzidine	ND	ug/L	10
Benzo(a)anthracene	ND	ug/L	5.0
bis(2-Ethylhexyl) phthalate	64	ug/L	5.0
Chrysene	ND	ug/L	5.0
Di-n-octyl phthalate	10	ug/L	5.0
Benzo(b)fluoranthene	ND	ug/L	5.0
Benzo(k)fluoranthene	ND	ug/L	5.0
Benzo(a)pyrene	ND	ug/L	5.0
Indeno(1,2,3-cd)pyrene	ND	ug/L	5.0
Dibenz(a,h)anthracene	ND	ug/L	5.0
Benzo(g,h,i)perylene	ND	ug/L	5.0
Nitrobenzene-d5	55	%	--
2-Fluorobiphenyl	49	%	--
Terphenyl-d14	55	%	--
Phenol-d5	19	%	--
2-Fluorophenol	26	%	--
2,4,6-Tribromophenol	52	%	--

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile

Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101190-WP-09
Lab ID: 007352-0002-SA Enseco ID: 2048658
Matrix: AQUEOUS Sampled: 11 OCT 90 Received: 12 OCT 90
Authorized: 12 OCT 90 Prepared: 16 OCT 90 Analyzed: 19 OCT 90

Parameter	Result	Units	Reporting Limit
Phenol	ND	ug/L	10
bis(2-Chloroethyl) ether	ND	ug/L	10
2-Chlorophenol	ND	ug/L	10
1,3-Dichlorobenzene	ND	ug/L	10
1,4-Dichlorobenzene	ND	ug/L	10
Benzyl alcohol	ND	ug/L	10
1,2-Dichlorobenzene	ND	ug/L	10
2-Methylphenol	ND	ug/L	10
bis(2-Chloroisopropyl) ether	ND	ug/L	10
4-Methylphenol	ND	ug/L	10
N-Nitroso-di-n-propylamine	ND	ug/L	10
Hexachloroethane	ND	ug/L	10
Nitrobenzene	ND	ug/L	10
Isophorone	ND	ug/L	10
2-Nitrophenol	ND	ug/L	10
2,4-Dimethylphenol	ND	ug/L	10
Benzoic acid	ND	ug/L	50
bis(2-Chloroethoxy)-methane	ND	ug/L	10
2,4-Dichlorophenol	ND	ug/L	10
1,2,4-Trichlorobenzene	ND	ug/L	10
Naphthalene	ND	ug/L	10
4-Chloroaniline	ND	ug/L	10
Hexachlorobutadiene	ND	ug/L	10
4-Chloro-3-methylphenol	ND	ug/L	10
2-Methylnaphthalene	ND	ug/L	10
Hexachlorocyclopentadiene	ND	ug/L	10
2,4,6-Trichlorophenol	ND	ug/L	10
2,4,5-Trichlorophenol	ND	ug/L	50
2-Chloronaphthalene	ND	ug/L	10
2-Nitroaniline	ND	ug/L	50
Dimethyl phthalate	ND	ug/L	10
Acenaphthylene	ND	ug/L	10
3-Nitroaniline	ND	ug/L	50
Acenaphthene	ND	ug/L	10
2,4-Dinitrophenol	ND	ug/L	50
4-Nitrophenol	ND	ug/L	50
Dibenzofuran	ND	ug/L	10
2,4-Dinitrotoluene	ND	ug/L	10

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile Approved By: Kerylynn Hemmerle

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANICS (CONT.)
Method 625

Client Name: Conestoga-Rovers Associates
Client ID: W-101190-WP-09
Lab ID: 007352-0002-SA
Enseco ID: 2048658
Matrix: AQUEOUS
Sampled: 11 OCT 90
Received: 12 OCT 90
Authorized: 12 OCT 90
Prepared: 16 OCT 90
Analyzed: 19 OCT 90

Parameter	Result	Units	Reporting Limit
2,6-Dinitrotoluene	ND	ug/L	10
Diethyl phthalate	ND	ug/L	10
4-Chlorophenyl phenyl ether	ND	ug/L	10
Fluorene	ND	ug/L	10
4-Nitroaniline	ND	ug/L	50
4,6-Dinitro-2-methylphenol	ND	ug/L	50
N-Nitrosodiphenylamine	ND	ug/L	10
4-Bromophenyl phenyl ether	ND	ug/L	10
Hexachlorobenzene	ND	ug/L	10
Pentachlorophenol	ND	ug/L	50
Phenanthrene	ND	ug/L	10
Anthracene	ND	ug/L	10
Di-n-butyl phthalate	ND	ug/L	10
Fluoranthene	ND	ug/L	10
Pyrene	ND	ug/L	10
Butyl benzyl phthalate	ND	ug/L	10
3,3'-Dichlorobenzidine	ND	ug/L	20
Benzo(a)anthracene	ND	ug/L	10
bis(2-Ethylhexyl) phthalate	87	ug/L	10
Chrysene	ND	ug/L	10
Di-n-octyl phthalate	25	ug/L	10
Benzo(b)fluoranthene	ND	ug/L	10
Benzo(k)fluoranthene	ND	ug/L	10
Benzo(a)pyrene	ND	ug/L	10
Indeno(1,2,3-cd)pyrene	ND	ug/L	10
Dibenz(a,h)anthracene	ND	ug/L	10
Benzo(g,h,i)perylene	ND	ug/L	10
Nitrobenzene-d5	50	%	--
2-Fluorobiphenyl	45	%	--
Terphenyl-d14	50	%	--
Phenol-d5	15	%	--
2-Fluorophenol	21	%	--
2,4,6-Tribromophenol	45	%	--

ND = Not detected
NA = Not applicable

Reported By: Marbela Bazile

Approved By: Kerylynn Hemmerle

METALS

Client Name: Conestoga-Rovers Associates
Client ID: W-101190-WP-06
Lab ID: 007352-0001-SA Enseco ID: 2048657
Matrix: AQUEOUS Sampled: 11 OCT 90 Received: 12 OCT 90
Authorized: 12 OCT 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date	
Aluminum	14.7	mg/L	0.10	200.7	17 OCT 90	17 OCT 90	
Antimony	ND	mg/L	0.050	200.7	17 OCT 90	17 OCT 90	
Arsenic	0.018	mg/L	0.0050	206.2	17 OCT 90	17 OCT 90	
Barium	0.15	mg/L	0.010	200.7	17 OCT 90	17 OCT 90	
Beryllium	ND	mg/L	0.0020	200.7	17 OCT 90	17 OCT 90	
Cadmium	0.023	mg/L	0.00050	213.2	17 OCT 90	19 OCT 90	
Calcium	333	mg/L	0.20	200.7	17 OCT 90	17 OCT 90	
Chromium	0.14	mg/L	0.010	200.7	17 OCT 90	17 OCT 90	
Cobalt	0.024	mg/L	0.010	200.7	17 OCT 90	17 OCT 90	
Copper	0.12	mg/L	0.010	200.7	17 OCT 90	17 OCT 90	
Iron	44.1	mg/L	0.10	200.7	17 OCT 90	17 OCT 90	
Lead	0.36	mg/L	0.050	239.2	17 OCT 90	18 OCT 90	m
Magnesium	82.7	mg/L	0.20	200.7	17 OCT 90	17 OCT 90	
Manganese	1.1	mg/L	0.010	200.7	17 OCT 90	17 OCT 90	
Mercury	ND	mg/L	0.00020	245.1	17 OCT 90	16 OCT 90	
Nickel	0.13	mg/L	0.040	200.7	17 OCT 90	17 OCT 90	
Potassium	5.8	mg/L	5.0	200.7	17 OCT 90	17 OCT 90	
Selenium	ND	mg/L	0.010	270.2	17 OCT 90	17 OCT 90	G
Silver	ND	mg/L	0.010	200.7	17 OCT 90	17 OCT 90	
Sodium	ND	mg/L	5.0	200.7	17 OCT 90	17 OCT 90	
Thallium	ND	mg/L	0.010	279.2	17 OCT 90	18 OCT 90	G
Vanadium	0.061	mg/L	0.010	200.7	17 OCT 90	17 OCT 90	
Zinc	64.9	mg/L	0.020	200.7	17 OCT 90	17 OCT 90	

Note m : Compound exceeded standard calibration range in the original analysis and was rerun with a dilution.

Note G : Reporting limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Vinora Nicholls Approved By: Vaughn Pusey

METALS

Client Name: Conestoga-Rovers Associates
Client ID: W-101190-WP-09
Lab ID: 007352-0002-SA   Enseco ID: 2048658
Matrix: AQUEOUS   Sampled: 11 OCT 90   Received: 12 OCT 90
Authorized: 12 OCT 90   Prepared: See Below   Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Aluminum	0.23	mg/L	0.10	200.7	17 OCT 90	17 OCT 90
Antimony	ND	mg/L	0.050	200.7	17 OCT 90	17 OCT 90
Arsenic	ND	mg/L	0.0050	206.2	17 OCT 90	17 OCT 90
Barium	0.048	mg/L	0.010	200.7	17 OCT 90	17 OCT 90
Beryllium	ND	mg/L	0.0020	200.7	17 OCT 90	17 OCT 90
Cadmium	0.010	mg/L	0.00050	213.2	17 OCT 90	19 OCT 90
Calcium	17.4	mg/L	0.20	200.7	17 OCT 90	17 OCT 90
Chromium	0.027	mg/L	0.010	200.7	17 OCT 90	17 OCT 90
Cobalt	ND	mg/L	0.010	200.7	17 OCT 90	17 OCT 90
Copper	0.031	mg/L	0.010	200.7	17 OCT 90	17 OCT 90
Iron	14.2	mg/L	0.10	200.7	17 OCT 90	17 OCT 90
Lead	0.43	mg/L	0.050	239.2	17 OCT 90	18 OCT 90 m
Magnesium	16.8	mg/L	0.20	200.7	17 OCT 90	17 OCT 90
Manganese	0.13	mg/L	0.010	200.7	17 OCT 90	17 OCT 90
Mercury	ND	mg/L	0.00020	245.1	17 OCT 90	16 OCT 90
Nickel	ND	mg/L	0.040	200.7	17 OCT 90	17 OCT 90
Potassium	ND	mg/L	5.0	200.7	17 OCT 90	17 OCT 90
Selenium	ND	mg/L	0.0050	270.2	17 OCT 90	17 OCT 90
Silver	ND	mg/L	0.010	200.7	17 OCT 90	17 OCT 90
Sodium	6.1	mg/L	5.0	200.7	17 OCT 90	17 OCT 90
Thallium	ND	mg/L	0.0050	279.2	17 OCT 90	18 OCT 90
Vanadium	ND	mg/L	0.010	200.7	17 OCT 90	17 OCT 90
Zinc	71.0	mg/L	0.020	200.7	17 OCT 90	17 OCT 90

Note m : Compound exceeded standard calibration range in the original analysis and was rerun with a dilution.

ND = Not detected
NA = Not applicable

Reported By: Vinora Nicholls   Approved By: Vaughn Pusey

METALS
(DISSOLVED)

Client Name: Conestoga-Rovers Associates
Client ID: W-101190-WP-06 dissolved
Lab ID: 007352-0003-SA Enseco ID: 2048659
Matrix: AQUEOUS Sampled: 11 OCT 90 Received: 12 OCT 90
Authorized: 12 OCT 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Aluminum	ND	mg/L	0.10	200.7	NA	17 OCT 90
Antimony	0.051	mg/L	0.050	200.7	NA	17 OCT 90
Arsenic	ND	mg/L	0.0050	206.2	NA	18 OCT 90
Barium	0.066	mg/L	0.010	200.7	NA	17 OCT 90
Beryllium	ND	mg/L	0.0020	200.7	NA	17 OCT 90
Cadmium	ND	mg/L	0.00050	213.2	NA	19 OCT 90
Calcium	220	mg/L	0.20	200.7	NA	17 OCT 90
Chromium	ND	mg/L	0.010	200.7	NA	17 OCT 90
Cobalt	ND	mg/L	0.010	200.7	NA	17 OCT 90
Copper	ND	mg/L	0.010	200.7	NA	17 OCT 90
Iron	ND	mg/L	0.10	200.7	NA	17 OCT 90
Lead	ND	mg/L	0.0050	239.2	NA	18 OCT 90
Magnesium	52.7	mg/L	0.20	200.7	NA	17 OCT 90
Manganese	0.21	mg/L	0.010	200.7	NA	17 OCT 90
Mercury	ND	mg/L	0.00020	245.1	NA	17 OCT 90
Nickel	ND	mg/L	0.040	200.7	NA	17 OCT 90
Potassium	ND	mg/L	5.0	200.7	NA	17 OCT 90
Selenium	ND	mg/L	0.0050	270.2	NA	18 OCT 90
Silver	ND	mg/L	0.010	200.7	NA	17 OCT 90
Sodium	ND	mg/L	5.0	200.7	NA	17 OCT 90
Thallium	ND	mg/L	0.010	279.2	NA	18 OCT 90 G
Vanadium	ND	mg/L	0.010	200.7	NA	17 OCT 90
Zinc	9.7	mg/L	0.020	200.7	NA	17 OCT 90

Note G : Reporting limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Vinora Nicholls Approved By: Vaughn Pusey

METALS
(DISSOLVED)

Client Name: Conestoga-Rovers Associates
Client ID: W-101190-WP-09 dissolved
Lab ID: 007352-0004-SA Enseco ID: 2048669
Matrix: AQUEOUS Sampled: 11 OCT 90 Received: 12 OCT 90
Authorized: 12 OCT 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Aluminum	ND	mg/L	0.10	200.7	NA	17 OCT 90
Antimony	ND	mg/L	0.050	200.7	NA	17 OCT 90
Arsenic	ND	mg/L	0.0050	206.2	NA	18 OCT 90
Barium	0.017	mg/L	0.010	200.7	NA	17 OCT 90
Beryllium	ND	mg/L	0.0020	200.7	NA	17 OCT 90
Cadmium	ND	mg/L	0.00050	213.2	NA	19 OCT 90
Calcium	13.3	mg/L	0.20	200.7	NA	17 OCT 90
Chromium	ND	mg/L	0.010	200.7	NA	17 OCT 90
Cobalt	ND	mg/L	0.010	200.7	NA	17 OCT 90
Copper	ND	mg/L	0.010	200.7	NA	17 OCT 90
Iron	ND	mg/L	0.10	200.7	NA	17 OCT 90
Lead	ND	mg/L	0.0050	239.2	NA	18 OCT 90
Magnesium	16.3	mg/L	0.20	200.7	NA	17 OCT 90
Manganese	ND	mg/L	0.010	200.7	NA	17 OCT 90
Mercury	ND	mg/L	0.00020	245.1	NA	17 OCT 90
Nickel	ND	mg/L	0.040	200.7	NA	17 OCT 90
Potassium	ND	mg/L	5.0	200.7	NA	17 OCT 90
Selenium	ND	mg/L	0.0050	270.2	NA	18 OCT 90
Silver	ND	mg/L	0.010	200.7	NA	17 OCT 90
Sodium	9.2	mg/L	5.0	200.7	NA	17 OCT 90
Thallium	ND	mg/L	0.010	279.2	NA	19 OCT 90 G
Vanadium	ND	mg/L	0.010	200.7	NA	17 OCT 90
Zinc	0.068	mg/L	0.020	200.7	NA	17 OCT 90

Note G : Reporting limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Vinora Nicholls Approved By: Vaughn Pusey

QUALITY ASSURANCE/QUALITY CONTROL

As an indication of the overall quality of the data generated by Enseco - Erco Laboratory for this report, the following controls have been provided (when applicable).

Method blanks are analyzed to assess the level of contamination which exists in the analytical system. A method blank, analyzed with every batch of samples, consists of reagents specific to the method. This blank is carried through every aspect of the procedure, including preparation, cleanup, and analysis. Ideally, the concentration of an analyte in the blank is below the reporting limit for that analyte. However, some common laboratory solvents and metals are difficult to eliminate to the part-per-billion levels commonly reported in environmental analyses. Therefore, all method blank data is reported to the client. Data are not blank-corrected.

Duplicate control samples (DCS) are used to monitor the laboratory's day-to-day performance of routine analytical methods. A DCS consists of a standard, control matrix which is spiked with a group of target compounds representative of the method analytes. The DCS is analyzed with environmental samples to provide evidence that the laboratory is performing the method within accepted QC guidelines.

A DCS has been established for most routine analytical methods. Reagent water is used as the control matrix for the analysis of aqueous samples. The DCS compounds are spiked into reagent water and carried through the appropriate steps of the analysis. As stated in SW-846 (third edition), a universal blank matrix does not exist for solid samples and therefore no matrix is used. The DCS for solid samples consists of the DCS compounds spiked into a reagent blank and carried through the appropriate steps of the analysis. The data thus obtained are used to set the DCS control limits. As sufficient laboratory data become available, the control limits are redefined based upon the most recent six months of DCS data. Control limits for accuracy are based on the historical average recovery of the DCS plus or minus three standard deviation units, or alternatively on established control limits defined in the methodology.

Surrogates are organic compounds that are similar to the analytes of interest in chemical behavior but which are not normally found in environmental samples. Enseco routinely adds surrogates to samples requiring GC/MS and most GC analysis and reports these surrogate recoveries to the client. These surrogates are added to samples to monitor the effect of the matrix on the accuracy of the analysis. Results are reported in terms of percent recovery.

QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC/MS

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
007352-0001-SA	AQUEOUS	625-A	16 OCT 90-FA	16 OCT 90-F12
007352-0002-SA	AQUEOUS	625-A	16 OCT 90-FA	16 OCT 90-F12
007352-0005-SA	AQUEOUS	625-A	16 OCT 90-FA	16 OCT 90-F12
007352-0006-SA	AQUEOUS	625-A	16 OCT 90-FA	16 OCT 90-F12
007352-0006-MS	AQUEOUS	625-A	16 OCT 90-FA	16 OCT 90-F12

METHOD BLANK REPORT
Semivolatile Organics by GC/MS

Test: 625-TCL-A
Matrix: AQUEOUS
QC Lot: 16 OCT 90-FA QC Run: 16 OCT 90-F12

Analyte	Result	Units	Reporting Limit
Phenol	ND	ug/L	10
bis(2-Chloroethyl) ether	ND	ug/L	10
2-Chlorophenol	ND	ug/L	10
1,3-Dichlorobenzene	ND	ug/L	10
1,4-Dichlorobenzene	ND	ug/L	10
Benzyl alcohol	ND	ug/L	10
1,2-Dichlorobenzene	ND	ug/L	10
2-Methylphenol	ND	ug/L	10
bis(2-Chloroisopropyl) ether	ND	ug/L	10
4-Methylphenol	ND	ug/L	10
N-Nitroso-di-n-propylamine	ND	ug/L	10
Hexachloroethane	ND	ug/L	10
Nitrobenzene	ND	ug/L	10
Isophorone	ND	ug/L	10
2-Nitrophenol	ND	ug/L	10
2,4-Dimethylphenol	ND	ug/L	10
Benzoic acid	ND	ug/L	50
bis(2-Chloroethoxy)-methane	ND	ug/L	10
2,4-Dichlorophenol	ND	ug/L	10
1,2,4-Trichlorobenzene	ND	ug/L	10
Naphthalene	ND	ug/L	10
4-Chloroaniline	ND	ug/L	10
Hexachlorobutadiene	ND	ug/L	10
4-Chloro-3-methylphenol	ND	ug/L	10
2-Methylnaphthalene	ND	ug/L	10
Hexachlorocyclopentadiene	ND	ug/L	10
2,4,6-Trichlorophenol	ND	ug/L	10
2,4,5-Trichlorophenol	ND	ug/L	50
2-Chloronaphthalene	ND	ug/L	10
2-Nitroaniline	ND	ug/L	50
Dimethyl phthalate	ND	ug/L	10
Acenaphthylene	ND	ug/L	10
3-Nitroaniline	ND	ug/L	50
Acenaphthene	ND	ug/L	10
2,4-Dinitrophenol	ND	ug/L	50
4-Nitrophenol	ND	ug/L	50
Dibenzofuran	ND	ug/L	10
2,4-Dinitrotoluene	ND	ug/L	10

METHOD BLANK REPORT
Semivolatile Organics by GC/MS (cont.)

Test: 625-TCL-A
Matrix: AQUEOUS
QC Lot: 16 OCT 90-FA QC Run: 16 OCT 90-F12

Analyte	Result	Units	Reporting Limit
2,6-Dinitrotoluene	ND	ug/L	10
Diethyl phthalate	ND	ug/L	10
4-Chlorophenyl phenyl ether	ND	ug/L	10
Fluorene	ND	ug/L	10
4-Nitroaniline	ND	ug/L	50
4,6-Dinitro-2-methylphenol	ND	ug/L	50
N-Nitrosodiphenylamine	ND	ug/L	10
4-Bromophenyl phenyl ether	ND	ug/L	10
Hexachlorobenzene	ND	ug/L	10
Pentachlorophenol	ND	ug/L	50
Phenanthrene	ND	ug/L	10
Anthracene	ND	ug/L	10
Di-n-butyl phthalate	ND	ug/L	10
Fluoranthene	ND	ug/L	10
Pyrene	ND	ug/L	10
Butyl benzyl phthalate	ND	ug/L	10
3,3'-Dichlorobenzidine	ND	ug/L	20
Benzo(a)anthracene	ND	ug/L	10
bis(2-Ethylhexyl) phthalate	ND	ug/L	10
Chrysene	ND	ug/L	10
Di-n-octyl phthalate	ND	ug/L	10
Benzo(b)fluoranthene	ND	ug/L	10
Benzo(k)fluoranthene	ND	ug/L	10
Benzo(a)pyrene	ND	ug/L	10
Indeno(1,2,3-cd)pyrene	ND	ug/L	10
Dibenz(a,h)anthracene	ND	ug/L	10
Benzo(g,h,i)perylene	ND	ug/L	10

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC/MS

Category: 625-A
Matrix: AQUEOUS
QC Lot: 16 OCT 90-FA QC Run: 16 OCT 90-F12
Concentration Units: ug/L

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Phenol-d5	200	27.1	14	10- 94
2-Fluorophenol	200	46.5	23	21-100
2,4,6-Tribromophenol	200	81.3	41	10-123
Nitrobenzene-d5	100	50.7	51	35-114
2-Fluorobiphenyl	100	44.5	44	43-116
Terphenyl-d14	100	56.4	56	33-141

Calculations are performed before rounding to avoid round-off errors in calculated results.

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC/MS

Category: 625-A
Matrix: AQUEOUS
QC Lot: 16 OCT 90-FA
Concentration Units: ug/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Pentachlorophenol	200	31.2	51.9	41.6	21	9-103	50	50
Phenol	200	62.2	50.5	56.4	28	12- 89	21	42
2-Chlorophenol	200	110	118	114	57	27-123	7.9	40
4-Chloro-3-methylphenol	200	106	120	113	56	23- 97	12	42
4-Nitrophenol	200	49.6	40.1	44.9	22	10- 80	21	50
1,2,4-Trichlorobenzene	100	56.2	66.2	61.2	61	39- 98	16	28
Acenaphthene	100	47.8	50.8	49.3	49	46-118	6.0	31
2,4-Dinitrotoluene	100	68.4	76.8	72.6	73	24- 96	12	38
Pyrene	100	58.1	68.0	63.0	63	26-127	16	31
N-Nitroso-di-n-propylamine	100	61.0	64.3	62.6	63	41-116	5.3	36
1,4-Dichlorobenzene	100	43.3	51.9	47.6	48	36- 97	18	28

Calculations are performed before rounding to avoid round-off errors in calculated results.

QC LOT ASSIGNMENT REPORT
Metals Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
007352-0001-SA	AQUEOUS	ICP-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-SA	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-SA	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-SA	AQUEOUS	HG-CVAA-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-SA	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-SA	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-SA	AQUEOUS	FAA2-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-MS	AQUEOUS	ICP-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-MS	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-MS	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-MS	AQUEOUS	HG-CVAA-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-MS	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-MS	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-MS	AQUEOUS	FAA2-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-DU	AQUEOUS	ICP-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-DU	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-DU	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-DU	AQUEOUS	HG-CVAA-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-DU	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-DU	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0001-DU	AQUEOUS	FAA2-AT	16 OCT 90-555	16 OCT 90-555
007352-0002-SA	AQUEOUS	ICP-AT	16 OCT 90-555	16 OCT 90-555
007352-0002-SA	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0002-SA	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0002-SA	AQUEOUS	HG-CVAA-AT	16 OCT 90-555	16 OCT 90-555
007352-0002-SA	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0002-SA	AQUEOUS	FAA1-AT	16 OCT 90-555	16 OCT 90-555
007352-0002-SA	AQUEOUS	FAA2-AT	16 OCT 90-555	16 OCT 90-555
007352-0003-SA	AQUEOUS	FAA2-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-SA	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-SA	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-SA	AQUEOUS	HG-CVAA-AD	16 OCT 90-557	16 OCT 90-557
007352-0003-SA	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-SA	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-SA	AQUEOUS	ICP-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-MS	AQUEOUS	ICP-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-MS	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-MS	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-MS	AQUEOUS	HG-CVAA-AD	16 OCT 90-557	16 OCT 90-557
007352-0003-MS	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-MS	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-MS	AQUEOUS	FAA2-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-DU	AQUEOUS	ICP-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-DU	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-DU	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-DU	AQUEOUS	HG-CVAA-AD	16 OCT 90-557	16 OCT 90-557
007352-0003-DU	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557

QC LOT ASSIGNMENT REPORT
Metals Analysis and Preparation (cont.)

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
007352-0003-DU	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0003-DU	AQUEOUS	FAA2-AD	18 OCT 90-557	18 OCT 90-557
007352-0004-SA	AQUEOUS	ICP-AD	18 OCT 90-557	18 OCT 90-557
007352-0004-SA	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0004-SA	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0004-SA	AQUEOUS	HG-CVAA-AD	16 OCT 90-557	16 OCT 90-557
007352-0004-SA	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0004-SA	AQUEOUS	FAA1-AD	18 OCT 90-557	18 OCT 90-557
007352-0004-SA	AQUEOUS	FAA2-AD	18 OCT 90-557	18 OCT 90-557

METHOD BLANK REPORT
Metals Analysis and Preparation

Test: ICP-TAL-AT
Matrix: AQUEOUS
QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555

Analyte	Result	Units	Reporting Limit
Aluminum	ND	mg/L	0.10
Antimony	ND	mg/L	0.050
Barium	ND	mg/L	0.010
Beryllium	ND	mg/L	0.0020
Calcium	ND	mg/L	0.20
Chromium	ND	mg/L	0.010
Cobalt	ND	mg/L	0.010
Copper	ND	mg/L	0.010
Iron	ND	mg/L	0.10
Magnesium	ND	mg/L	0.20
Manganese	ND	mg/L	0.010
Nickel	ND	mg/L	0.040
Potassium	ND	mg/L	5.0
Silver	ND	mg/L	0.010
Sodium	ND	mg/L	5.0
Vanadium	ND	mg/L	0.010
Zinc	0.022	mg/L	0.020

Test: AS-FAA-AT
Matrix: AQUEOUS
QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555

Analyte	Result	Units	Reporting Limit
Arsenic	ND	mg/L	0.0050

Test: PB-FAA-AT
Matrix: AQUEOUS
QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555

Analyte	Result	Units	Reporting Limit
Lead	ND	mg/L	0.0050

Test: HG-CVAA-AT
Matrix: AQUEOUS
QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555

Analyte	Result	Units	Reporting Limit
Mercury	ND	mg/L	0.00020

METHOD BLANK REPORT
Metals Analysis and Preparation (cont.)

Analyte	Result	Units	Reporting Limit
Test: SE-FAA-AT Matrix: AQUEOUS QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555			
Selenium	ND	mg/L	0.0050
Test: TL-FAA-AT Matrix: AQUEOUS QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555			
Thallium	ND	mg/L	0.0050
Test: CD-FAA-AT Matrix: AQUEOUS QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555			
Cadmium	ND	mg/L	0.00050
Test: ICP-TAL-AT Matrix: AQUEOUS QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555			
Aluminum	ND	mg/L	0.10
Antimony	ND	mg/L	0.050
Barium	ND	mg/L	0.010
Beryllium	ND	mg/L	0.0020
Calcium	ND	mg/L	0.20
Chromium	ND	mg/L	0.010
Cobalt	ND	mg/L	0.010
Copper	ND	mg/L	0.010
Iron	ND	mg/L	0.10
Magnesium	ND	mg/L	0.20
Manganese	ND	mg/L	0.010
Nickel	ND	mg/L	0.040
Potassium	ND	mg/L	5.0
Silver	ND	mg/L	0.010
Sodium	ND	mg/L	5.0
Vanadium	ND	mg/L	0.010
Zinc	0.022	mg/L	0.020

METHOD BLANK REPORT
Metals Analysis and Preparation (cont.)

Analyte	Result	Units	Reporting Limit
Test: AS-FAA-AT Matrix: AQUEOUS QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555			
Arsenic	ND	mg/L	0.0050
Test: PB-FAA-AT Matrix: AQUEOUS QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555			
Lead	ND	mg/L	0.0050
Test: HG-CVAA-AT Matrix: AQUEOUS QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555			
Mercury	ND	mg/L	0.00020
Test: SE-FAA-AT Matrix: AQUEOUS QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555			
Selenium	ND	mg/L	0.0050
Test: TL-FAA-AT Matrix: AQUEOUS QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555			
Thallium	ND	mg/L	0.0050
Test: CD-FAA-AT Matrix: AQUEOUS QC Lot: 16 OCT 90-555 QC Run: 16 OCT 90-555			
Cadmium	ND	mg/L	0.00050

METHOD BLANK REPORT
Metals Analysis and Preparation (cont.)

Analyte	Result	Units	Reporting Limit
Test: CD-FAA-AD Matrix: AQUEOUS QC Lot: 18 OCT 90-557 QC Run: 18 OCT 90-557			
Cadmium	ND	mg/L	0.00050
Test: TL-FAA-AD Matrix: AQUEOUS QC Lot: 18 OCT 90-557 QC Run: 18 OCT 90-557			
Thallium	ND	mg/L	0.0050
Test: SE-FAA-AD Matrix: AQUEOUS QC Lot: 18 OCT 90-557 QC Run: 18 OCT 90-557			
Selenium	ND	mg/L	0.0050
Test: HG-CVAA-AD Matrix: AQUEOUS QC Lot: 16 OCT 90-557 QC Run: 16 OCT 90-557			
Mercury	ND	mg/L	0.00020
Test: PB-FAA-AD Matrix: AQUEOUS QC Lot: 18 OCT 90-557 QC Run: 18 OCT 90-557			
Lead	ND	mg/L	0.0050
Test: AS-FAA-AD Matrix: AQUEOUS QC Lot: 18 OCT 90-557 QC Run: 18 OCT 90-557			
Arsenic	ND	mg/L	0.0050

METHOD BLANK REPORT
Metals Analysis and Preparation (cont.)

Test: ICP-TAL-AD
Matrix: AQUEOUS
QC Lot: 18 OCT 90-557 QC Run: 18 OCT 90-557

Analyte	Result	Units	Reporting Limit
Aluminum	ND	mg/L	0.10
Antimony	ND	mg/L	0.050
Barium	ND	mg/L	0.010
Beryllium	ND	mg/L	0.0020
Calcium	ND	mg/L	0.20
Chromium	ND	mg/L	0.010
Cobalt	ND	mg/L	0.010
Copper	ND	mg/L	0.010
Iron	ND	mg/L	0.10
Magnesium	ND	mg/L	0.20
Manganese	ND	mg/L	0.010
Nickel	ND	mg/L	0.040
Potassium	ND	mg/L	5.0
Silver	ND	mg/L	0.010
Sodium	ND	mg/L	5.0
Vanadium	ND	mg/L	0.010
Zinc	ND	mg/L	0.020

DUPLICATE CONTROL SAMPLE REPORT
Metals Analysis and Preparation

Category: ICP-AT
Matrix: AQUEOUS
QC Lot: 16 OCT 90-555
Concentration Units: mg/L

Analyte	Concentration				Accuracy		Precision	
	Spiked	Measured			Average(%)		(RPD)	
		DCS1	DCS2	AVG	DCS	Limits	DCS	Limit
Aluminum	2.0	2.17	2.27	2.22	111	80-120	4.5	20
Antimony	0.5	0.573	0.602	0.588	118	80-120	4.9	20
Arsenic	0.5	0.537	0.586	0.561	112	80-120	8.8	20
Barium	2.0	2.20	2.31	2.25	113	80-120	5.1	20
Beryllium	0.05	0.0541	0.0567	0.0554	111	80-120	4.7	20
Cadmium	0.05	0.0490	0.0543	0.0516	103	80-120	10	20
Calcium	100	103	109	106	106	80-120	5.7	20
Chromium	0.2	0.214	0.225	0.220	110	80-120	5.2	20
Cobalt	0.5	0.511	0.540	0.525	105	80-120	5.4	20
Copper	0.25	0.273	0.287	0.280	112	80-120	5.2	20
Iron	1.0	1.01	1.08	1.04	104	80-120	5.8	20
Lead	0.5	0.525	0.568	0.547	109	80-120	7.9	20
Magnesium	50	49.9	52.7	51.3	103	80-120	5.3	20
Manganese	0.5	0.504	0.534	0.519	104	80-120	5.8	20
Nickel	0.5	0.496	0.522	0.509	102	80-120	5.1	20
Potassium	50	51.6	54.6	53.1	106	80-120	5.7	20
Silver	0.05	0.0507	0.0525	0.0516	103	80-120	3.6	20
Sodium	100	112	118	115	115	80-120	5.0	20
Tin	0.4	0.424	0.440	0.432	108	80-120	3.7	20
Vanadium	0.5	0.518	0.545	0.532	106	80-120	5.1	20
Zinc	0.5	0.532	0.553	0.543	109	80-120	3.9	20

Category: FAA1-AT
Matrix: AQUEOUS
QC Lot: 16 OCT 90-555
Concentration Units: mg/L

Analyte	Concentration				Accuracy		Precision	
	Spiked	Measured			Average(%)		(RPD)	
		DCS1	DCS2	AVG	DCS	Limits	DCS	Limit
Arsenic	0.04	0.0410	0.0440	0.0425	106	80-120	7.1	20
Lead	0.02	0.0214	0.0214	0.0214	107	80-120	0.0	20
Selenium	0.01	0.00980	0.00980	0.00980	98	80-120	0.0	20
Thallium	0.05	0.0477	0.0489	0.0483	97	80-120	2.5	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

DUPLICATE CONTROL SAMPLE REPORT
Metals Analysis and Preparation (cont.)

Category: HG-CVAA-AD
Matrix: AQUEOUS
QC Lot: 16 OCT 90-557
Concentration Units: mg/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Mercury	0.001	0.00110	0.00120	0.00115	115	80-120	8.7	20

Category: ICP-AD
Matrix: AQUEOUS
QC Lot: 18 OCT 90-557
Concentration Units: mg/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	Measured AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Aluminum	2.0	2.09	2.08	2.09	104	80-120	0.6	20
Antimony	0.5	0.571	0.557	0.564	113	80-120	2.5	20
Arsenic	0.5	0.530	0.541	0.535	107	80-120	2.2	20
Barium	2.0	2.11	2.10	2.11	105	80-120	0.5	20
Beryllium	0.05	0.0514	0.0507	0.0511	102	80-120	1.3	20
Cadmium	0.05	0.0520	0.0483	0.0501	100	80-120	7.4	20
Calcium	100	102	101	102	102	80-120	0.9	20
Chromium	0.2	0.211	0.208	0.209	105	80-120	1.1	20
Cobalt	0.5	0.505	0.501	0.503	101	80-120	0.8	20
Copper	0.25	0.267	0.266	0.266	106	80-120	0.4	20
Iron	1.0	0.990	0.985	0.988	99	80-120	0.5	20
Lead	0.5	0.531	0.513	0.522	104	80-120	3.6	20
Magnesium	50	49.1	48.8	49.0	98	80-120	0.6	20
Manganese	0.5	0.494	0.491	0.493	99	80-120	0.6	20
Nickel	0.5	0.489	0.496	0.493	99	80-120	1.5	20
Potassium	50	51.3	50.9	51.1	102	80-120	0.8	20
Silver	0.05	0.0520	0.0523	0.0521	104	80-120	0.7	20
Sodium	100	108	107	107	107	80-120	0.8	20
Tin	0.4	0.399	0.386	0.393	98	80-120	3.2	20
Vanadium	0.5	0.505	0.502	0.503	101	80-120	0.6	20
Zinc	0.5	0.506	0.517	0.511	102	80-120	2.1	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Metals Analysis and Preparation

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX DUPLICATE	ICP-TAL-AT	007352-0001-DU	16 OCT 90-555
MATRIX DUPLICATE	AS-FAA-AT	007352-0001-DU	16 OCT 90-555
MATRIX DUPLICATE	PB-FAA-AT	007352-0001-DU	16 OCT 90-555
MATRIX DUPLICATE	HG-CVAA-AT	007352-0001-DU	16 OCT 90-555
MATRIX DUPLICATE	SE-FAA-AT	007352-0001-DU	16 OCT 90-555
MATRIX DUPLICATE	TL-FAA-AT	007352-0001-DU	16 OCT 90-555
MATRIX DUPLICATE	CD-FAA-AT	007352-0001-DU	16 OCT 90-555
MATRIX DUPLICATE	ICP-TAL-AD	007352-0003-DU	18 OCT 90-557
MATRIX DUPLICATE	AS-FAA-AD	007352-0003-DU	18 OCT 90-557
MATRIX DUPLICATE	PB-FAA-AD	007352-0003-DU	18 OCT 90-557
MATRIX DUPLICATE	HG-CVAA-AD	007352-0003-DU	16 OCT 90-557
MATRIX DUPLICATE	SE-FAA-AD	007352-0003-DU	18 OCT 90-557
MATRIX DUPLICATE	TL-FAA-AD	007352-0003-DU	18 OCT 90-557
MATRIX DUPLICATE	CD-FAA-AD	007352-0003-DU	18 OCT 90-557
MATRIX SPIKE	ICP-TAL-AT	007352-0001-MS	16 OCT 90-555
MATRIX SPIKE	ICP-TAL-AD	007352-0003-MS	18 OCT 90-557
MATRIX SPIKE	AS-FAA-AD	007352-0003-MS	18 OCT 90-557

MATRIX SPECIFIC QC
ASSIGNMENT REPORT
Metals Analysis and Preparation (cont.)

QC SAMPLE TYPE	TEST	LABORATORY SAMPLE NUMBER	QC LOT
MATRIX SPIKE	PB-FAA-AD	007352-0003-MS	18 OCT 90-557
MATRIX SPIKE	HG-CVAA-AD	007352-0003-MS	16 OCT 90-557
MATRIX SPIKE	SE-FAA-AD	007352-0003-MS	18 OCT 90-557
MATRIX SPIKE	TL-FAA-AD	007352-0003-MS	18 OCT 90-557
MATRIX SPIKE	CD-FAA-AD	007352-0003-MS	18 OCT 90-557

MATRIX DUPLICATE REPORT
Metals Analysis and Preparation

Analyte	Concentration Sample	Concentration Matrix Duplicate	% RPD
Test: ICP-TAL-AT			
Matrix AQUEOUS			
Sample: 007352-0001			
Units: mg/L			
Aluminum	14.7	13.7	6.6
Antimony	ND	ND	NC
Barium	0.15	0.15	0.0
Beryllium	ND	ND	NC
Calcium	333	355	6.2
Chromium	0.14	0.13	2.1
Cobalt	0.024	0.026	8.0
Copper	0.12	0.12	4.7
Iron	44.1	45.8	4.0
Magnesium	82.7	87.6	5.8
Manganese	1.1	1.1	5.2
Nickel	0.13	0.13	2.6
Potassium	5.8	5.5	5.7
Silver	ND	ND	NC
Sodium	ND	ND	NC
Vanadium	0.061	0.055	11
Zinc	64.9	68.6	5.4
Test: AS-FAA-AT			
Matrix AQUEOUS			
Sample: 007352-0001			
Units: mg/L			
Arsenic	0.018	0.018	5.0
Test: PB-FAA-AT			
Matrix AQUEOUS			
Sample: 007352-0001			
Units: mg/L			
Lead	0.36	0.37	1.9

ND = Not detected
NC = Not calculated, calculation not applicable.

All calculations are performed before rounding to avoid round-orf errors in calculated results.

MATRIX DUPLICATE REPORT
Metals Analysis and Preparation (cont.)

	Concentration		
Analyte	Sample	Matrix Duplicate	% RPD
Test: HG-CVAA-AT Matrix AQUEOUS Sample: 007352-0001 Units: mg/L			
Mercury	ND	ND	NC
Test: SE-FAA-AT Matrix AQUEOUS Sample: 007352-0001 Units: mg/L			
Selenium	ND	ND	NC
Test: TL-FAA-AT Matrix AQUEOUS Sample: 007352-0001 Units: mg/L			
Thallium	ND	ND	NC
Test: CD-FAA-AT Matrix AQUEOUS Sample: 007352-0001 Units: mg/L			
Cadmium	0.023	0.024	3.8
Test: ICP-TAL-AD Matrix AQUEOUS Sample: 007352-0003 Units: mg/L			
Aluminum	ND	ND	NC
Antimony	0.051	ND	NC
Barium	0.066	0.063	3.7
Beryllium	ND	ND	NC
Calcium	220	213	3.2
Chromium	ND	ND	NC
Cobalt	ND	ND	NC

ND = Not detected
NC = Not calculated, calculation not applicable.

All calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX DUPLICATE REPORT
Metals Analysis and Preparation (cont.)

Analyte	Concentration Sample	 Matrix Duplicate	% RPD
Copper	ND	ND	NC
Iron	ND	ND	NC
Magnesium	52.7	51.0	3.3
Manganese	0.21	0.21	2.9
Nickel	ND	ND	NC
Potassium	ND	ND	NC
Silver	ND	ND	NC
Sodium	ND	ND	NC
Vanadium	ND	ND	NC
Zinc	9.7	9.4	3.4

Test: AS-FAA-AD
Matrix AQUEOUS
Sample: 007352-0003
Units: mg/L

Arsenic	ND	ND	NC

Test: PB-FAA-AD
Matrix AQUEOUS
Sample: 007352-0003
Units: mg/L

Lead	ND	ND	NC

Test: HG-CVAA-AD
Matrix AQUEOUS
Sample: 007352-0003
Units: mg/L

Mercury	ND	ND	NC

Test: SE-FAA-AD
Matrix AQUEOUS
Sample: 007352-0003
Units: mg/L

Selenium	ND	ND	NC

ND = Not detected
NC = Not calculated, calculation not applicable.

All calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX DUPLICATE REPORT
Metals Analysis and Preparation (cont.)

Analyte	Concentration Sample	Concentration Matrix Duplicate	% RPD
Test: TL-FAA-AD Matrix AQUEOUS Sample: 007352-0003 Units: mg/L			
Thallium	ND	ND	NC
Test: CD-FAA-AD Matrix AQUEOUS Sample: 007352-0003 Units: mg/L			
Cadmium	ND	ND	NC

ND = Not detected
NC = Not calculated, calculation not applicable.

All calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE REPORT
Metals Analysis and Preparation

Test: ICP-TAL-AT
Matrix AQUEOUS
Sample: 007352-0001
Units: mg/L

Analyte	Sample	Concentration Matrix Spike	Amount Spiked	% Rec
Aluminum	14.7	14.0	4.0	NC
Antimony	ND	0.90	1.0	90
Barium	0.15	4.0	4.0	97
Beryllium	ND	0.096	0.10	96
Calcium	333	515	200	91
Chromium	0.14	0.47	0.40	84
Cobalt	0.024	0.91	1.0	88
Copper	0.12	0.59	0.50	95
Iron	44.1	41.1	2.0	NC
Magnesium	82.7	171	100	88
Manganese	1.1	1.9	1.0	80
Nickel	0.13	0.96	1.0	84
Potassium	5.8	98.3	100	93
Silver	ND	0.091	0.10	91
Sodium	ND	208	200	104
Vanadium	0.061	0.97	1.0	90
Zinc	64.9	60.1	1.0	NC

ND = Not detected
NC = Not calculated, calculation not applicable.

All calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE REPORT
Metals Analysis and Preparation (cont.)

Test: HG-CVAA-AT
Matrix AQUEOUS
Sample: 007352-0001
Units: mg/L

Analyte	Sample	Concentration Matrix Spike	Concentration Amount Spiked	% Rec
Mercury	ND	0.0010	0.0010	105

Test: ICP-TAL-AD
Matrix AQUEOUS
Sample: 007352-0003
Units: mg/L

Analyte	Sample	Concentration Matrix Spike	Concentration Amount Spiked	% Rec
Aluminum	ND	2.0	2.0	101
Antimony	0.051	0.54	0.50	98
Barium	0.066	2.1	2.0	103
Beryllium	ND	0.049	0.050	98
Calcium	220	305	100	NC
Chromium	ND	0.20	0.20	100
Cobalt	ND	0.48	0.50	95

ND = Not detected
NC = Not calculated, calculation not applicable.

All calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE REPORT
Metals Analysis and Preparation (cont.)

		Concentration		
		Matrix	Amount	%
Analyte	Sample	Spike	Spiked	Rec
Copper	ND	0.26	0.25	102
Iron	ND	0.93	1.0	93
Magnesium	52.7	98.2	50.0	91
Manganese	0.21	0.67	0.50	91
Nickel	ND	0.46	0.50	93
Potassium	ND	52.3	50.0	105
Silver	ND	0.047	0.050	93
Sodium	ND	111	100	111
Vanadium	ND	0.48	0.50	97
Zinc	9.7	9.1	0.50	NC

Test: AS-FAA-AD
Matrix AQUEOUS
Sample: 007352-0003
Units: mg/L

Arsenic	ND	0.038	0.040	95

Test: PB-FAA-AD
Matrix AQUEOUS
Sample: 007352-0003
Units: mg/L

Lead	ND	0.018	0.020	92

Test: HG-CVAA-AD
Matrix AQUEOUS
Sample: 007352-0003
Units: mg/L

Mercury	ND	0.0011	0.0010	110

Test: SE-FAA-AD
Matrix AQUEOUS
Sample: 007352-0003
Units: mg/L

Selenium	ND	0.012	0.010	120

ND = Not detected
NC = Not calculated, calculation not applicable.

All calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE REPORT
Metals Analysis and Preparation (cont.)

Analyte	Sample	Concentration Matrix Spike	Concentration Amount Spiked	% Rec
Test: TL-FAA-AD Matrix AQUEOUS Sample: 007352-0003 Units: mg/L				
Thallium	ND	0.037	0.050	75
Test: CD-FAA-AD Matrix AQUEOUS Sample: 007352-0003 Units: mg/L				
Cadmium	ND	0.0025	0.0020	125

ND = Not detected
NC = Not calculated, calculation not applicable.

All calculations are performed before rounding to avoid round-off errors in calculated results.

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): Radian (Milwaukee WI)

CHAIN OF CUSTODY RECORD

PROJECT Nº: 2433

PROJECT NAME: Rasmussen

SAMPLER'S SIGNATURE Walter J. Parker (SIGN)

SEQ. Nº	SAMPLE Nº	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	# OF CONTAINERS	REMARKS
W-10	190-WP06	10/11/90	1100		WATER	3	TOC, COD, TDS, TSS
W-10	190-WP-09	10/11/90	1430		↓	3	Alkalinity, Carbonate
							Bicarbonate, BOD
				TOTAL NUMBER OF CONTAINERS		6	

Grab

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY: ① Walter J. Parker (SIGN)	DATE/TIME 10/11/90 / 1730	RECEIVED BY: ② (SIGN)
RELINQUISHED BY: ② (SIGN)	DATE/TIME	RECEIVED BY: ③ (SIGN)
RELINQUISHED BY: ③ (SIGN)	DATE/TIME	RECEIVED BY: ④ (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

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CRA Consulting Engineers CONESTOGA-ROVERS & ASSOCIATES 651 Colby Drive, Waterloo, Ontario Canada N2V 1C2	SHIPPED TO (Laboratory name): Radian (Milwaukee WI)

CHAIN OF CUSTODY RECORD	PROJECT Nº: 2433	PROJECT NAME: Rasmussen

SAMPLER'S SIGNATURE Walter J (SIGN)

SEQ. Nº	SAMPLE Nº	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
W-10	1190-WP-06	10/11/90	1100		WATER	3	TOC, COD, TDS, TSS
W-10	1190-WP-09	10/11/90	1430		↓	3	Alkalinity, Carbonate
							Bicarbonate, BOD
				TOTAL NUMBER OF CONTAINERS		6	

Grab

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY: 1 Walter J (SIGN)	DATE/TIME 10/11/90 / 1730	RECEIVED BY: ② (SIGN)
RELINQUISHED BY: 2 (SIGN)	DATE/TIME	RECEIVED BY: ③ (SIGN)
RELINQUISHED BY: 3 (SIGN)	DATE/TIME	RECEIVED BY: ④ (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: OVERNIGHT	SHIPPED BY: FED-X	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME
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CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): ENSECO (Cambridge)

CHAIN OF CUSTODY RECORD

PROJECT Nº: 2433

PROJECT NAME: Rasmussen

SAMPLER'S SIGNATURE Walter J. Pick (SIGN)

SEQ. Nº	SAMPLE Nº	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
	W-101190-WP-06	10/11/90	1100		WATER	4	BNA, Total Metals
	W-101190-WP-09	10/11/90	1430		WATER	4	Dissolved Metals
	W-101190-WP-07		1035		WATER	2	BNA
	W-101190-WP-08		1250	MS/MSD	WATER	4	BNA/MS/MSD
				TOTAL NUMBER OF CONTAINERS		14	

Group

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY: ① Walter J. Pick (SIGN)	DATE/TIME 10/11/90 / 1730	RECEIVED BY: ② (SIGN)
RELINQUISHED BY: ② (SIGN)	DATE/TIME	RECEIVED BY: ③ (SIGN)
RELINQUISHED BY: ③ (SIGN)	DATE/TIME	RECEIVED BY: ④ (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: OVERNIGHT	SHIPPED BY: FED-X	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN)	DATE/TIME

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Nº 011602

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CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (laboratory name): Enseco (Cambridge)

CHAIN OF CUSTODY RECORD

PROJECT Nº: 2433

PROJECT NAME: Rasmussen

SAMPLER'S SIGNATURE Walter J. Pochron (SIGN)

SEQ. Nº	SAMPLE Nº	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
W-10	1090-WP-001	10/10/90	1331			4	BNA
W-10	1090-WP-002	10/10/90	1430			4	Total Metals
W-10	1090-WP-004	10/10/90	1710			4	Dissolved Metals
W-10	1090-WP-005	10/10/90	1715			4	
W-10	1090-WP-003	10/10/90	1630			2	BNA's
				TOTAL NUMBER OF CONTAINERS		18	

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To Dave Dempsey	From W. Pochron
Co. CRA	Co. CRA
Dept. CHEM	Phone # 313-665-4444
Fax # 612-639-0923	Fax # 313-665-5558

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY: ① Walter J. Pochron (SIGN)	DATE/TIME 10/10/90/1900	RECEIVED BY: ② (SIGN)
RELINQUISHED BY: ② (SIGN)	DATE/TIME	RECEIVED BY: ③ (SIGN)
RELINQUISHED BY: ③ (SIGN)	DATE/TIME	RECEIVED BY: ④ (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: OVERNIGHT	SHIPPED BY: FED-X	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME
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651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): Radian Sacramento CA

CHAIN OF CUSTODY RECORD

PROJECT Nº: 2433

PROJECT NAME: Rasmussen

SAMPLER'S SIGNATURE (SIGN)

SEQ. Nº.	SAMPLE Nº.	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
	W-101090-WP-001	10/10/90	1331		WATER	2	VOC
	W-101090-WP-002	10/10/90	1430		↓	2	VOC
	W-101090-WP-003	10/10/90	1630		↓	2	VOC
	W-101090-WP-004	10/10/90	1710		↓	2	VOC
	W-101090-WP-005	10/10/90	1715		↓	2	VOC
	TRIP BLANK	10/10/90	—		Water	1	VOC
				TOTAL NUMBER OF CONTAINERS		11	

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY: ① (SIGN)	DATE/TIME 10/10/90 / 1900	RECEIVED BY: ② (SIGN)
RELINQUISHED BY: ② (SIGN)	DATE/TIME	RECEIVED BY: ③ (SIGN)
RELINQUISHED BY: ③ (SIGN)	DATE/TIME	RECEIVED BY: ④ (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: FED-X overnight	SHIPPED BY: FED-X	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER ~~OPENED~~ BY: (SIGN)	DATE/TIME 10/11/90 11:00 AM

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To Dave Dompson	From W. Pochron
Co. CRA	Co.
Dept. 5198840325	Phone #
Fax # ~~[illegible]~~	Fax #

SHIPPED TO (Laboratory name): Radian Sacramento CA

Nº: 3

PROJECT NAME: Rasmussen

SAMPLER'S SIGNATURE

SEQ. Nº	SAMPLE Nº.	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	# OF CONTAINERS	REMARKS
W-10	1190-WR 06	10/11/90	1100		WATER	2	VOC
W-10	1190-WR 07	↓	1035		↓	2	VOC
W-10	1190 WR 08		1250	MS/MSD		4	VOC MS/MSD
W-10	1190-WR 09		1430			2	VOC
W-10	1190-WR 10		1510			2	VOC
W-10	1190-WR 11		1515			2	VOC
	TRIP BLANK	—	—			1	VOC
				TOTAL NUMBER OF CONTAINERS		15	

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY: ① (SIGN)	DATE/TIME 10/11/90 / 1730	RECEIVED BY: ② (SIGN)
RELINQUISHED BY: ② (SIGN)	DATE/TIME	RECEIVED BY: ③ (SIGN)
RELINQUISHED BY: ③ (SIGN)	DATE/TIME	RECEIVED BY: ④ (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: OVERNIGHT	SHIPPED BY: FED-X	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN)	DATE/TIME

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Rad[illegible]
Sacramento CA

CHAIN OF CUSTODY RECORD

PROJECT Nº: 2433

PROJECT NAME: Rasmussen

SAMPLER'S SIGNATURE Walter J. (SIGN)

SEQ. Nº	SAMPLE Nº	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
	W-101090-WP-001	10/10/90	1331		WATER	2	VOC
	W-101090-WP-002	10/10/90	1430		↓	2	VOC
	W-101090-WP-003	10/10/90	1630			2	VOC
	W-101090-WP-004	10/10/90	1710			2	VOC
	W-101090-WP-005	10/10/90	1715			2	VOC
	Trip BLANK	10/10/90	—		Water	1	VOC
				TOTAL NUMBER OF CONTAINERS		11	

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY: 1 Walter J. (SIGN)	DATE/TIME 10/10/90 / 1900	RECEIVED BY: ② (SIGN)
RELINQUISHED BY: 2 (SIGN)	DATE/TIME	RECEIVED BY: ③ (SIGN)
RELINQUISHED BY: 3 (SIGN)	DATE/TIME	RECEIVED BY: ④ (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: FED-X overnight

SHIPPED BY: FED-X

RECEIVED FOR LABORATORY BY: (SIGN)

DATE/TIME

CONDITION OF SEAL UPON RECEIPT:

GENERAL CONDITION OF COOLER:

COOLER OPENED BY: (SIGN)

DATE/TIME

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CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): Rudrax Milwaukee WI.

CHAIN OF CUSTODY RECORD

PROJECT Nº: 2433

PROJECT NAME: Rasmussen

SAMPLER'S SIGNATURE Walter J. (SIGN)

SEQ. Nº.	SAMPLE Nº.	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
	W-101090-WP-001	10/10/90	1331		Water	3	TDS, TSS, Alkalinity,
	W-101090-WP-002	↓	1430		↓	3	Bicarbonate, TOC
	W-101090-WP-004		1710			3	Carbonate, COD
	W-101090-WP-005	↓	1715		↓	3	BOD,
				TOTAL NUMBER OF CONTAINERS:		12	

Gr
Gr

ANTICIPATED CHEMICAL HAZARDS:
Note: TDS, TSS, Alk, Bicarb, Carb, TOC, COD, BOD collected for each Sample #

RELINQUISHED BY: ① Walter J. (SIGN)	DATE/TIME 10/10/90 1900	RECEIVED BY: ② (SIGN)
RELINQUISHED BY: ② (SIGN)	DATE/TIME	RECEIVED BY: ③ (SIGN)
RELINQUISHED BY: ③ (SIGN)	DATE/TIME	RECEIVED BY: ④ (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: OVERNIGHT	SHIPPED BY: FED-X	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN)	DATE/TIME

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GOLDEN ROD - SHIPPERS

Nº 006214

RADIAN
CORPORATION

Radian Work Order MO-10-067

Rec'd CRA

OCT 30 1990

Analytical Report
10/23/90

CRA

CRA
CRA
382 WEST COUNTY ROAD "D"
ST. PAUL, MN 55112
DAVE DEMPSEY

Customer Work Identification RASMUSSEN
Purchase Order Number 2433

Contents:

Radian Corporation
5103 West Beloit Road
Milwaukee, WI 53214

414-643-2719

Client Services Coordinator: WLBROWN

Certified by:

CRA
Radian Work Order: M0-10-067

Method/Analyte	Sample Identifications					
	W-101090-WP-0- 01 01		W-101090-WP-0- 02 02		W-101090-WP-0- 05 03	
Matrix	water		water		water	
	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Alkalinity						
Alkalinity	860 mg/L	1.0	520 mg/L	1.0	730 mg/L	1.0
BOD 5 day						
BOD 5	13 mg/L	1.0	6 mg/L	1.0	35 mg/L	1.0
Chemical oxygen demand						
Chemical Oxygen Demand	12 @ mg/L	5.0	33 mg/L	5.0	100 mg/L	5.0
Total dissolved solids						
Total dissolved solids	970 mg/L	9.0	760 mg/L	9.0	950 mg/L	9.0
Total organic carbon						
Total organic carbon	23 mg/L	1.0	11 mg/L	1.0	11 mg/L	1.0
Total suspended solids,						
Total suspended solids	3400 mg/L	3.0	300 mg/L	3.0	450 mg/L	3.0

@ Est. result less that 5 times detection limit

(1) For a detailed description of flags and technical terms in this report refer to the glossary.

CRA
Radian Work Order: M0-10-067

Method/Analyte	Sample Identifications								
	W-101090-WP-0- 04			METHOD BLANK			MATRIX SPIKE		
	04			05			06		
Matrix	water			water			water		
	Result		Det. Limit	Result		Det. Limit	Result		Det. Limit
Alkalinity									
Alkalinity	780	mg/L	1.0						
BOD 5 day									
BOD 5	57	mg/L	1.0						
Chemical oxygen demand									
Chemical Oxygen Demand	160	mg/L	5.0	ND	mg/L	5.0	96	%	
otal dissolved solids									
Total dissolved solids	690	mg/L	9.0						
Total organic carbon									
Total organic carbon	8.3	mg/L	1.0	ND	mg/L	1.0	102	%	
Total suspended solids,									
Total suspended solids	670	mg/L	3.0						

ND Not detected at specified detection limit

(1) For a detailed description of flags and technical terms in this report refer to the glossary.

Sample Identifications

Method/Analyte	MATRIX SPIKE DUPLICATE 07			
Matrix	water			
	Result	Det. Limit		
Chemical oxygen demand				
Chemical Oxygen Demand	103 %			
Total organic carbon				
Total organic carbon	102 %			

(1) For a detailed description of flags and technical terms in this report refer to the glossary.

CRA
Radian Work Order: M0-10-067

Sample Identifications and Dates

Sample ID	W-101090-WP-0-01	W-101090-WP-0-02	W-101090-WP-0-05	W-101090-WP-0-04	METHOD BLANK	MATRIX SPIKE
Date Sampled	10/10/90	10/10/90	10/10/90	10/10/90		
Date Received	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90
Matrix	water	water	water	water	water	water
	01	02	03	04	05	06
Alkalinity						
Prepared	10/13/90	10/13/90	10/13/90	10/13/90		
Analyzed	10/13/90	10/13/90	10/13/90	10/13/90		
Analyst	MJB	MJB	MJB	MJB		
File ID	23843-9	23843-9	23843-9	23843-9		
Blank ID	23843-9	23843-9	23843-9	23843-9		
Instrument	NA	NA	NA	NA		
Report as	received	received	received	received		
BOD 5 day						
Prepared	10/11/90	10/11/90	10/11/90	10/11/90		
Analyzed	10/11/90	10/11/90	10/11/90	10/11/90		
Analyst	RAF	RAF	RAF	RAF		
File ID	23527-37	23527-37	23527-37	23527-37		
Blank ID	23527-37	23527-37	23527-37	23527-37		
Instrument	ysi	ysi	ysi	ysi		
Report as	received	received	received	received		
Chemical oxygen demand						
Prepared	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90
Analyzed	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90
Analyst	MJB	MJB	MJB	MJB	MJB	MJB
File ID	23843-7	23843-7	23843-7	23843-7	23843-7	23843-7
Blank ID	23843-7	23843-7	23843-7	23843-7	23843-7	23843-7
Instrument	HOCH	HOCH	HOCH	HOCH	HOCH	HOCH
Report as	received	received	received	received	received	received
Total dissolved solids						
Prepared	10/13/90	10/13/90	10/13/90	10/13/90		
Analyzed	10/13/90	10/13/90	10/13/90	10/13/90		
Analyst	MJB	MJB	MJB	MJB		
File ID	23843-10	23843-10	23843-10	23843-10		
Blank ID	23843-10	23843-10	23843-10	23843-10		
Instrument	NA	NA	NA	NA		
Report as	received	received	received	received		
Total organic carbon						
Prepared	10/15/90	10/15/90	10/15/90	10/15/90	10/15/90	10/15/90
Analyzed	10/15/90	10/15/90	10/15/90	10/15/90	10/15/90	10/15/90
Analyst	RAF	RAF	RAF	RAF	RAF	RAF
File ID	23532-40	23532-40	23532-40	23532-40	23532-40	23532-40
Blank ID	23532-40	23532-40	23532-40	23532-40	23532-40	23532-40
Instrument	DOHRMANN	DOHRMANN	DOHRMANN	DOHRMANN	DOHRMANN	DOHRMANN
Report as	received	received	received	received	received	received

CRA
Radian Work Order: M0-10-067

Sample Identifications and Dates

Sample ID	W-101090-WP-0-01	W-101090-WP-0-02	W-101090-WP-0-05	W-101090-WP-0-04	METHOD BLANK	MATRIX SPIKE
Date Sampled	10/10/90	10/10/90	10/10/90	10/10/90		
Date Received	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90
Matrix	water	water	water	water		
	01	02	03	04	05	06
Total suspended solids,						
Prepared	10/13/90	10/13/90	10/13/90	10/13/90		
Analyzed	10/13/90	10/13/90	10/13/90	10/13/90		
Analyst	MJB	MJB	MJB	MJB		
File ID	23843-10	23843-10	23843-10	23843-10		
Blank ID	23843-10	23843-10	23843-10	23843-10		
Instrument	NA	NA	NA	NA		
Report as	received	received	received	received		

CRA
Radian Work Order: NO-10-067

Sample Identifications and Dates

Sample ID	MATRIX SPIKE DUPLICATE
Date Sampled	
Date Received	10/11/90
Matrix	water
	07
Chemical oxygen demand	
Prepared	10/11/90
Analyzed	10/11/90
Analyst	MJB
File ID	23843-7
Blank ID	23843-7
Instrument	HOCH
Report as	received
Total organic carbon	
Prepared	10/15/90
Analyzed	10/15/90
Analyst	RAF
File ID	23532-40
Blank ID	23532-40
Instrument	DOHRMANN
Report as	receivec

Appendix A

Comments, Notes and Definitions

CRA
Radian Work Order: M0-10-067

a ALL METHODS EXCEPT CLP
The results which are less than five times the method specified detection limit.
EXPLANATION
Uncertainty of the analysis will increase as the method detection limit is approached. These results should be considered approximate.

ND ALL METHODS EXCEPT CLP
This flag is used to denote analytes which are not detected at or above the specified detection limit.
EXPLANATION
The value to the right of the < symbol is the method specified detection limit for the analyte.

TERMS USED IN THIS REPORT:
Analyte - A chemical for which a sample is to be analyzed. The analysis will meet EPA method and QC specifications.

Compound - See Analyte.

Detection Limit - The method specified detection limit, which is the lower limit of quantitation specified by EPA for a method. Radian staff regularly assess their laboratories' method detection limits to verify that they meet or are lower than those specified by EPA. Detection limits which are higher than method limits are based on experimental values at the 99% confidence level. The detection limits for EPA CLP (Contract Laboratory Program) methods are CRQLs (contract required quantitation limits) for organics and CRDLs (contract required detection limits) for inorganics. Note, the detection limit may vary from that specified by EPA based on sample size, dilution or cleanup. (Refer to Factor, below)

EPA Method - The EPA specified method used to perform an analysis. EPA has specified standard methods for analysis of environmental samples. Radian will perform its analyses and accompanying QC tests in conformance with EPA methods unless otherwise specified.

Factor - Default method detection limits are based on analysis of clean water samples. A factor is required to calculate sample specific detection limits based on alternate matrices (soil or water), reporting units, use of cleanup procedures, or dilution of extracts/ digestates. For example, extraction or digestion of 10 grams of soil in contrast to 1 liter of water will result in a factor of 100.

Matrix - The sample material. Generally, it will be soil, water, air, oil, or solid waste.

Radian Work Order - The unique Radian identification code assigned to the samples reported in the analytical summary.

Units -	ug/L	micrograms per liter (parts per billion);liquids/water
	ug/kg	micrograms per kilogram (parts per billion); soils/solids
	ug/M3	micrograms per cubic meter; air samples
	mg/L	milligrams per liter (parts per million);liquids/water
	mg/kg	milligrams per kilogram (parts per million);soils/solids
	%	percent; usually used for percent recovery of QC standards
	uS/cm	conductance unit; microSiemans/centimeter
	mL/hr	milliliters per hour; rate of settlement of matter in water
	NTU	turbidity unit; nephelometric turbidity unit
	CU	color unit; equal to 1 mg/L of chloroplatinate salt

Appendix A

Comments, Notes and Definitions

General Comments

SAMPLE 11 WAS ANALYZED TWICE. SEVERE MATRIX EFFECTS REDUCED INTERNAL STANDARD RECOVERIES TO NEARLY ZERO. NO USEFUL DATA COULD BE RETRIEVED FROM THE DATA.

Notes and Definitions

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: S0-10-128

@ ALL METHODS EXCEPT CLP
The results which are less than five times the method specified detection limit.
EXPLANATION
Uncertainty of the analysis will increase as the method detection limit is approached. These results should be considered approximate.

B *INORGANIC CLP*
This flag incdicates that a reported value is less than the Contract Required Detection Limit (CRDL), but greater than the Instrument Detection Limit (IDL).
ORGANIC METHODS
This flag indicates that an analyte is found in the associated blank, but the sample results are not corrected for the amount in the blank.

ND ALL METHODS EXCEPT CLP
This flag is used to denote analytes which are not detected at or above the specified detection limit.
EXPLANATION
The value to the right of the < symbol is the method specified detection limit for the analyte.

Q ALL METHODS EXCEPT CLP
This quality control standard is outside method or laboratory specified control limits.
EXPLANATION
This flag is applied to matrix spike, analytical QC spike, and surrogate recoveries; and to RPD(relative percent difference) values for duplicate analyses and matrix spike/matrix spike duplicate result.

TERMS USED IN THIS REPORT:

Analyte - A chemical for which a sample is to be analyzed. The analysis will meet EPA method and QC specifications.

Compound - See Analyte.

Detection Limit - The method specified detection limit, which is the lower limit of quantitation specified by EPA for a method. Radian staff regularly assess their laboratories' method detection limits to verify that they meet or are lower than those specified by EPA. Detection limits which are higher than method limits are based on experimental values at the 99% confidence level. The detection limits for EPA CLP (Contract Laboratory Program) methods are CRQLs (contract required quantitation limits) for organics and CRDLs (contract required detection limits) for inorganics. Note, the detection limit may vary from that specified by EPA based on sample size, dilution or cleanup. (Refer to Factor, below)

EPA Method - The EPA specified method used to perform an analysis. EPA has specified standard methods for analysis of environmental samples. Radian will perform its analyses and accompanying QC tests in conformance with EPA methods unless otherwise specified.

Factor - Default method detection limits are based on analysis of clean water samples. A factor is required to calculate sample specific detection limits based on alternate matrices (soil or water), reporting units, use of cleanup procedures, or dilution of extracts/digestates. For example, extraction or digestion of 10 grams of soil in contrast to 1 liter of water will result in a factor of 100.

Matrix - The sample material. Generally, it will be soil, water, air, oil, or solid waste.

Radian Work Order - The unique Radian identification code assigned to the samples reported in the analytical summary.

Units -	ug/L	micrograms per liter (parts per billion);liquids/water
	ug/kg	micrograms per kilogram (parts per billion); soils/solids
	ug/M3	micrograms per cubic meter; air samples
	mg/L	milligrams per liter (parts per million);liquids/water
	mg/kg	milligrams per kilogram (parts per million);soils/solids
	%	percent; usually used for percent recovery of QC standards
	uS/cm	conductance unit; microSiemans/centimeter
	mL/hr	milliliters per hour; rate of settlement of matter in water
	NTU	turbidity unit; nephelometric turbidity unit
	CU	color unit; equal to 1 mg/L of chloroplatinate salt

Sample Identifications and Dates

Sample ID	W-101190-WP-06	W-101190-WP-07	W-101190-WP-08	W-101190-WP-09	W-101190-WP-10	W-101190-WP-0-8 MS
Date Sampled	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90
Date Received	10/12/90	10/12/90	10/12/90	10/12/90	10/12/90	10/12/90
Matrix	water	water	water	water	water	water
	01	02	03	04	05	07
Volatiles by SW8240 (25mL)						
Prepared						
Analyzed						10/24/90
Analyst						RY
File ID						1012807A
Blank ID						1010607A
Instrument						F3
Report as						received
Volatiles by SW8240 (25mL)						
Prepared						
Analyzed						10/24/90
Analyst						RY
File ID						1012807B
Blank ID						1010607A
Instrument						F3
Report as						received
Volatiles by SW8240 (25mL)						
Prepared						
Analyzed	10/24/90	10/23/90	10/24/90	10/23/90	10/23/90	
Analyst	RY	RY	RY	RY	RY	
File ID	1012801R	1012802A	1012803R	1012804A	1012805A	
Blank ID	1010607B	1010607A	1010607B	1010607A	1010607A	
Instrument	F3	F3	F3	F3	F3	
Report as	received	received	received	received	received	

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: S0-10-128

Sample Identifications and Dates

Sample ID	TRIP BLANK	REAGENT BLANK
Date Sampled	10/11/90	
Date Received	10/12/90	10/12/90
Matrix	water	water
	08	09
Volatiles by SW8240 (25mL)		
Prepared		
Analyzed	10/24/90	10/23/90
Analyst	RY	RY
File ID	1012808A	1010607A
Blank ID	1010607A	
Instrument	F3	F3
Report as	received	received
Volatiles by SW8240 (25mL)		
Prepared		
Analyzed		10/24/90
Analyst		RY
File ID		1010607B
Blank ID		
Instrument		F3
Report as		received

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: SO-10-128

Method:Volatiles by SW8240 (25mL) (1)
List:Target compound list

Sample ID:	W-101190-WP-10	TRIP BLANK	REAGENT BLANK	REAGENT BLANK
Factor:	0.200	0.200	0.200	0.200
Results in:	ug/L	ug/L	ug/L	ug/L
	05A	08A	09A	09B
Matrix:	water	water	water	water

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Acetone	ND	0.60	4.5	0.60	ND	0.60	3.0	0.60
Benzene	ND	0.12	ND	0.12	ND	0.12	ND	0.12
Bromodichloromethane	ND	0.14	ND	0.14	ND	0.14	ND	0.14
Bromoform	ND	0.10	ND	0.10	ND	0.10	ND	0.10
Bromomethane	ND	0.10	ND	0.10	ND	0.10	ND	0.10
2-Butanone	ND	6.0	ND	6.0	ND	6.0	ND	6.0
Carbon disulfide	ND	0.10	2.3	0.10	ND	0.10	ND	0.10
Carbon tetrachloride	ND	0.12	ND	0.12	ND	0.12	ND	0.12
Chlorobenzene	ND	0.14	ND	0.14	ND	0.14	ND	0.14
Chloroethane	ND	0.20	ND	0.20	ND	0.20	ND	0.20
Chloroform	0.9	0.12	ND	0.12	ND	0.12	ND	0.12
Chloromethane	ND	0.10	ND	0.10	ND	0.10	ND	0.10
Dibromochloromethane	ND	0.12	ND	0.12	ND	0.12	ND	0.12
1,1-Dichloroethane	ND	0.12	ND	0.12	ND	0.12	ND	0.12
1,2-Dichloroethane	ND	0.12	ND	0.12	ND	0.12	ND	0.12
1,2-Dichloroethene (total)	ND	0.10	ND	0.10	ND	0.10	ND	0.10
1,1-Dichloroethene	ND	0.10	ND	0.10	ND	0.10	ND	0.10
1,2-Dichloropropane	ND	0.10	ND	0.10	ND	0.10	ND	0.10
cis-1,3-Dichloropropene	ND	0.16	ND	0.16	ND	0.16	ND	0.16
trans-1,3-Dichloropropene	ND	0.12	ND	0.12	ND	0.12	ND	0.12
Ethylbenzene	ND	0.12	ND	0.12	ND	0.12	ND	0.12
2-Hexanone	ND	0.24	ND	0.24	ND	0.24	ND	0.24
4-Methyl-2-pentanone	ND	1.0	ND	1.0	ND	1.0	ND	1.0
Methylene chloride	ND	0.10	0.4 Ba	0.10	0.6	0.10	0.5	0.10
Styrene	ND	0.12	ND	0.12	ND	0.12	ND	0.12
1,1,2,2-Tetrachloroethane	ND	0.10	ND	0.10	ND	0.10	ND	0.10
Tetrachloroethene	ND	0.12	ND	0.12	ND	0.12	ND	0.12
Toluene	ND	0.14	ND	0.14	ND	0.14	ND	0.14
Total Xylenes	ND	0.10	ND	0.10	ND	0.10	ND	0.10
1,1,1-Trichloroethane	ND	0.12	ND	0.12	ND	0.12	ND	0.12

ND Not detected at specified detection limit

B Inorg-result < CRDL but > than IDL/Org-detected in blank

a Est. result less that 5 times detection limit

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: SO-10-128

Method:Volatiles by SW8240 (25mL) (1)
List:Target compound list

Sample ID:	W-101190-WP-10		TRIP BLANK		REAGENT BLANK		REAGENT BLANK	
Factor:	0.200		0.200		0.200		0.200	
Results in:	ug/L		ug/L		ug/L		ug/L	
	05A		08A		09A		09B	
Matrix:	water		water		water		water	
	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
1,1,2-Trichloroethane	ND	0.14	ND	0.14	ND	0.14	ND	0.14
Trichloroethene	ND	0.10	ND	0.10	ND	0.10	ND	0.10
Vinyl acetate	ND	0.20	ND	0.20	ND	0.20	ND	0.20
Vinyl chloride	ND	0.10	ND	0.10	ND	0.10	ND	0.10
Surrogate Recovery(%)								
1,4-Bromofluorobenzene	98		100		96		94	
Control Limits: 86 to 115								
1,2-Dichloroethane-d4	102		110		102		120 Q	
Control Limits: 76 to 114								
Toluene-d8	101		101		100		98	
Control Limits: 88 to 110								

ND Not detected at specified detection limit Q Outside control limits

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: S0-10-128

Method:Volatiles by SW8240 (25mL) (1)
List:Target compound list

Sample ID:	W-101190-WP-06	W-101190-WP-07	W-101190-WP-08	W-101190-WP-09
Factor:	0.400	0.200	0.400	0.200
Results in:	ug/L	ug/L	ug/L	ug/L
	01A	02A	03A	04A
Matrix:	water	water	water	water

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Acetone	ND	1.2	ND	0.60	ND	1.2	ND	0.60
Benzene	ND	0.24	ND	0.12	2.8	0.24	0.3 a	0.12
Bromodichloromethane	ND	0.28	ND	0.14	ND	0.28	ND	0.14
Bromoform	ND	0.20	ND	0.10	ND	0.20	ND	0.10
Bromomethane	ND	0.20	ND	0.10	ND	0.20	ND	0.10
2-Butanone	ND	12	ND	6.0	ND	12	ND	6.0
Carbon disulfide	ND	0.20	ND	0.10	ND	0.20	ND	0.10
Carbon tetrachloride	ND	0.24	ND	0.12	ND	0.24	ND	0.12
Chlorobenzene	ND	0.28	ND	0.14	ND	0.28	ND	0.14
Chloroethane	ND	0.40	ND	0.20	ND	0.40	ND	0.20
Chloroform	ND	0.24	0.9	0.12	ND	0.24	ND	0.12
Chloromethane	ND	0.20	ND	0.10	ND	0.20	ND	0.10
Dibromochloromethane	ND	0.24	ND	0.12	ND	0.24	ND	0.12
1,1-Dichloroethane	ND	0.24	ND	0.12	ND	0.24	ND	0.12
1,2-Dichloroethane	ND	0.24	ND	0.12	ND	0.24	ND	0.12
1,2-Dichloroethene (total)	ND	0.20	ND	0.10	ND	0.20	ND	0.10
1,1-Dichloroethene	ND	0.20	ND	0.10	ND	0.20	ND	0.10
1,2-Dichloropropane	ND	0.20	ND	0.10	ND	0.20	ND	0.10
cis-1,3-Dichloropropene	ND	0.32	ND	0.16	ND	0.32	ND	0.16
trans-1,3-Dichloropropene	ND	0.24	ND	0.12	ND	0.24	ND	0.12
Ethylbenzene	ND	0.24	ND	0.12	ND	0.24	ND	0.12
2-Hexanone	ND	0.48	ND	0.24	ND	0.48	ND	0.24
4-Methyl-2-pentanone	ND	2.0	ND	1.0	53	2.0	ND	1.0
Methylene chloride	1.8 B	0.20	0.5 B	0.10	1.7	0.20	0.4 Ba	0.10
Styrene	ND	0.24	ND	0.12	ND	0.24	ND	0.12
1,1,2,2-Tetrachloroethane	ND	0.20	ND	0.10	ND	0.20	ND	0.10
Tetrachloroethene	ND	0.24	ND	0.12	ND	0.24	ND	0.12
Toluene	ND	0.28	ND	0.14	ND	0.28	0.8	0.14
Total Xylenes	ND	0.20	ND	0.10	ND	0.20	ND	0.10
1,1,1-Trichloroethane	ND	0.24	ND	0.12	ND	0.24	ND	0.12

ND Not detected at specified detection limit
a Est. result less that 5 times detection limit
B Inorg-result < CRDL but > than IDL/Org-detected in blank

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

Method:Volatiles by SW8240 (25mL) (1)
List:Target compound list

Sample ID:	W-101190-WP-06		W-101190-WP-07		W-101190-WP-08		W-101190-WP-09	
Factor:	0.400		0.200		0.400		0.200	
Results in:	ug/L		ug/L		ug/L		ug/L	
	01A		02A		03A		04A	
Matrix:	water		water		water		water	
	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
1,1,2-Trichloroethane	ND	0.28	ND	0.14	ND	0.28	ND	0.14
Trichloroethene	ND	0.20	ND	0.10	ND	0.20	ND	0.10
Vinyl acetate	ND	0.40	ND	0.20	ND	0.40	ND	0.20
Vinyl chloride	ND	0.20	ND	0.10	ND	0.20	ND	0.10
Surrogate Recovery(%)								
1,4-Bromofluorobenzene	98		101		99		99	
Control Limits: 86 to 115								
1,2-Dichloroethane-d4	110		102		109		104	
Control Limits: 76 to 114								
Toluene-d8	101		101		101		100	
Control Limits: 88 to 110								

ND Not detected at specified detection limit

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

Rec'd CRA

OCT 30 1990

RADIAN CORPORATION

Radian Work Order S0-10-128

Analytical Report
10/29/90

CONESTOGA ROVERS & ASSOCIATES

CONESTOGA ROVERS & ASSOCIATES
382 WEST COUNTY RD "D"
ST. PAUL, MN 55112

DAVE DEMPSEY

Customer Work Identification RASMUSSEN
Purchase Order Number EXTERNAL

Contents:

Radian Analytical Services
10395 Old Placerville Road
Sacramento, CA 95827

916-362-5332

Client Services Coordinator: WLBROWN

Certified by: Marilyn Melton

Method:Volatiles by SW8240 (25mL) (1)
List:Matrix spike analyte list

Sample ID:	W-101190-WP-0- 8 MS		W-101190-WP-0- 8 MSD	
Factor:	2.000		2.000	
Results in:	% RECOV. 07A		% RECOV. 07B	
Matrix:	water		water	
	Result	Det. Limit	Result	Det. Limit
Benzene	137 Q		130 Q	
Chlorobenzene	92		88	
1,1-Dichloroethene	107		99	
Toluene	100		97	
Trichloroethene	98		93	
Surrogate Recovery(%)				
1,4-Bromofluorobenzene	92		103	
Control Limits: 86 to 115				
1,2-Dichloroethane-d4	102		103	
Control Limits: 76 to 114				
Toluene-d8	101		100	
Control Limits: 88 to 110				

Q Outside control limits

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

a ALL METHODS EXCEPT CLP
The results which are less than five times the method specified detection limit.
EXPLANATION
Uncertainty of the analysis will increase as the method detection limit is approached. These results should be considered approximate.

B INORGANIC CLP
This flag incdicates that a reported value is less than the Contract Required Detection Limit (CRDL), but greater than the Instrument Detection Limit (IDL).
ORGANIC METHODS
This flag indicates that an analyte is found in the associated blank, but the sample results are not corrected for the amount in the blank.

ND ALL METHODS EXCEPT CLP
This flag is used to denote analytes which are not detected at or above the specified detection limit.
EXPLANATION
The value to the right of the < symbol is the method specified detection limit for the analyte.

N\A ALL METHODS EXCEPT CLP
A result or value is not available for this parameter, usually a detection limit.

Q ALL METHODS EXCEPT CLP
This quality control standard is outside method or laboratory specified control limits.
EXPLANATION
This flag is applied to matrix spike, analytical QC spike, and surrogate recoveries; and to RPD(relative percent difference) values for duplicate analyses and matrix spike/matrix spike duplicate result.

TERMS USED IN THIS REPORT:

Analyte - A chemical for which a sample is to be analyzed. The analysis will meet EPA method and QC specifications.

Compound - See Analyte.

Detection Limit - The method specified detection limit, which is the lower limit of quantitation specified by EPA for a method. Radian staff regularly assess their laboratories' method detection limits to verify that they meet or are lower than those specified by EPA. Detection limits which are higher than method limits are based on experimental values at the 99% confidence level. The detection limits for EPA CLP (Contract Laboratory Program) methods are CRQLs (contract required quantitation limits) for organics and CRDLs (contract required detection limits) for inorganics. Note, the detection limit may vary from that specified by EPA based on sample size, dilution or cleanup. (Refer to Factor, below)

EPA Method - The EPA specified method used to perform an analysis. EPA has specified standard methods for analysis of environmental samples. Radian will perform its analyses and accompanying QC tests in conformance with EPA methods unless otherwise specified.

Factor - Default method detection limits are based on analysis of clean water samples. A factor is required to calculate sample specific detection limits based on alternate matrices (soil or water), reporting units, use of cleanup procedures, or dilution of extracts/ digestates. For example, extraction or digestion of 10 grams of soil in contrast to 1 liter of water will result in a factor of 100.

Matrix - The sample material. Generally, it will be soil, water, air, oil, or solid waste.

Radian Work Order - The unique Radian identification code assigned to the samples reported in the analytical summary.

Units -	ug/L	micrograms per liter (parts per billion);liquids/water
	ug/kg	micrograms per kilogram (parts per billion); soils/solids
	ug/M3	micrograms per cubic meter; air samples
	mg/L	milligrams per liter (parts per million);liquids/water
	mg/kg	milligrams per kilogram (parts per million);soils/solids
	%	percent; usually used for percent recovery of QC standards
	uS/cm	conductance unit; microSiemans/centimeter
	mL/hr	milliliters per hour; rate of settlement of matter in water
	NTU	turbidity unit; nephelometric turbidity unit
	CU	color unit; equal to 1 mg/L of chloroplatinate salt

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: S0-10-106

Sample Identifications and Dates

Sample ID	REAGENT BLANK					
Date Sampled						
Date Received	10/11/90					
Matrix	water					
	07					
volatiles by SW8240 (25mL)						
Prepared						
Analyzed	10/23/90					
Analyst	RY					
File ID	1010607A					
Blank ID						
Instrument	F3					
Report as	received					
Volatiles by SW8240 (25mL)						
Prepared						
Analyzed	10/24/90					
Analyst	RY					
File ID	1010607B					
Blank ID						
Instrument	F3					
Report as	received					

Appendix A

Comments, Notes and Definitions

Method:Volatiles by SW8240 (25mL) (1)
List:Target compound list

Sample ID:	REAGENT BLANK
Factor:	0.20
Results in:	ug/L
	07B
Matrix:	water

	Result	Det. Limit			
1,1,2-Trichloroethane	ND	0.14			
Trichloroethene	ND	0.10			
Vinyl acetate	ND	0.20			
Vinyl chloride	ND	0.10			
Surrogate Recovery(%)					
1,4-Bromofluorobenzene	94				
Control Limits: 86 to 115					
1,2-Dichloroethane-d4	120 Q				
Control Limits: 76 to 114					
Toluene-d8	98				
Control Limits: 88 to 110					

ND Not detected at specified detection limit

Q Outside control limits

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: S0-10-106

Sample Identifications and Dates

Sample ID	W-101090-WP-0-01	W-101090-WP-0-02	W-101090-WP-0-03	W-101090-WP-0-04	W-101090-WP-0-05	TRIP BLANK
Date Sampled	10/10/90	10/10/90	10/10/90	10/10/90	10/10/90	10/10/90
Date Received	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90	10/11/90
Matrix	water	water	water	water	water	water
	01	02	03	04	05	06
Volatiles by SW8240 (25mL)						
Prepared						
Analyzed	10/24/90	10/23/90	10/23/90	10/23/90	10/23/90	10/23/90
Analyst	RY	RY	RY	RY	RY	RY
File ID	1010601R	1010602A	1010603A	1010604A	1010605A	1010606A
Blank ID	1010607B	1010607A	1010607A	1010607A	1010607A	1010607A
Instrument	F3	F3	F3	F3	F3	F3
Report as	received	received	received	received	received	received
Volatiles by SW8240 (25mL)						
Prepared						
Analyzed					10/23/90	
Analyst					RY	
File ID					1010605C	
Blank ID						
Instrument					F3	
Report as					received	

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: S0-10-106

Method:Volatiles by SW8240 (25mL) (1)
List:Target compound list

Sample ID:	W-101090-WP-0-05		METHOD SPIKE		TRIP BLANK		REAGENT BLANK	
Factor:	20.000		2.000		0.200		0.200	
Results in:	ug/L		% RECOV.		ug/L		ug/L	
	05A		05C		06A		07A	
Matrix:	water		water		water		water	
	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
1,1,2-Trichloroethane	ND	14	N/A		ND	0.14	ND	0.14
Trichloroethene	ND	10	95		ND	0.10	ND	0.10
Vinyl acetate	ND	20	N/A		ND	0.20	ND	0.20
Vinyl chloride	ND	10	112		ND	0.10	ND	0.10
<u>Surrogate Recovery(%)</u>								
1,4-Bromofluorobenzene	102		102		108		96	
Control Limits: 86 to 115								
1,2-Dichloroethane-d4	102		102		106		102	
Control Limits: 76 to 114								
Toluene-d8	101		100		101		100	
Control Limits: 88 to 110								

ND Not detected at specified detection limit N\A Not available

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: S0-10-106

Method:Volatiles by SW8240 (25mL) (1)
List:Target compound list

Sample ID:	*REAGENT BLANK*
Factor:	0.20
Results in:	ug/L
	078
Matrix:	water

	Result	Det. Limit
Acetone	3.0	0.60
Benzene	ND	0.12
Bromodichloromethane	ND	0.14
Bromoform	ND	0.10
Bromomethane	ND	0.10
2-Butanone	ND	6.0
Carbon disulfide	ND	0.10
Carbon tetrachloride	ND	0.12
Chlorobenzene	ND	0.14
Chloroethane	ND	0.20
Chloroform	ND	0.12
Chloromethane	ND	0.10
Dibromochloromethane	ND	0.12
1.1-Dichloroethane	ND	0.12
1,2-Dichloroethane	ND	0.12
1,2-Dichloroethene (total)	ND	0.10
1,1-Dichloroethene	ND	0.10
1,2-Dichloropropane	ND	0.10
cis-1,3-Dichloropropene	ND	0.16
trans-1,3-Dichloropropene	ND	0.12
Ethylbenzene	ND	0.12
2-Hexanone	ND	0.24
4-Methyl-2-pentanone	ND	1.0
Methylene chloride	0.5	0.10
Styrene	ND	0.12
1,1,2,2-Tetrachloroethane	ND	0.10
Tetrachloroethene	ND	0.12
Toluene	ND	0.14
Total Xylenes	ND	0.10
1,1,1-Trichloroethane	ND	0.12

ND Not detected at specified detection limit

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

Analytical Data Summary

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: S0-10-106

Method:Volatiles by SW8240 (25mL) (1)
List:Target compound list

Sample ID:	W-101090-WP-0-01	W-101090-WP-0-02	W-101090-WP-0-03	W-101090-WP-0-04
Factor:	0.400	0.200	4.000	20.000
Results in:	ug/L	ug/L	ug/L	ug/L
	01A	02A	03A	04A
Matrix:	water	water	water	water

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
1,1,2-Trichloroethane	ND	0.28	ND	0.14	ND	2.8	ND	14
Trichloroethene	2.9	0.20	ND	0.10	ND	2.0	ND	10
Vinyl acetate	ND	0.40	ND	0.20	ND	4.0	ND	20
Vinyl chloride	ND	0.20	ND	0.10	130	2.0	ND	10
Surrogate Recovery(%)								
1,4-Bromofluorobenzene	94		97		96		97	
Control Limits: 86 to 115								
1,2-Dichloroethane-d4	108		92		117 Q		115 Q	
Control Limits: 76 to 114								
Toluene-d8	98		101		101		101	
Control Limits: 88 to 110								

ND Not detected at specified detection limit

Q Outside control limits

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: S0-10-106

Method:Volatiles by SW8240 (25mL) (1)
List:Target compound list

Sample ID:	W-101090-WP-0-05	METHOD SPIKE	TRIP BLANK	REAGENT BLANK
Factor:	20.000	2.000	0.200	0.200
Results in:	ug/L	% RECOV.	ug/L	ug/L
	05A	05C	06A	07A
Matrix:	water	water	water	water

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Acetone	700	60	86		ND	0.60	ND	0.60
Benzene	47 @	12	92		ND	0.12	ND	0.12
Bromodichloromethane	ND	14	106		ND	0.14	ND	0.14
Bromoform	ND	10	100		0.6	0.10	ND	0.10
Bromomethane	ND	10	53		ND	0.10	ND	0.10
2-Butanone	ND	600	N/A		14 @	6.0	ND	6.0
Carbon disulfide	ND	10	N/A		1.8	0.10	ND	0.10
Carbon tetrachloride	ND	12	90		ND	0.12	ND	0.12
Chlorobenzene	850	14	89		0.2 @	0.14	ND	0.14
Chloroethane	ND	20	77		ND	0.20	ND	0.20
Chloroform	ND	12	96		ND	0.12	ND	0.12
Chloromethane	ND	10	99		ND	0.10	ND	0.10
Dibromochloromethane	ND	12	95		ND	0.12	ND	0.12
1,1-Dichloroethane	120	12	96		ND	0.12	ND	0.12
1,2-Dichloroethane	ND	12	98		ND	0.12	ND	0.12
1,2-Dichloroethene (total)	43 @	10	N/A		ND	0.10	ND	0.10
1,1-Dichloroethene	ND	10	99		ND	0.10	ND	0.10
1,2-Dichloropropane	ND	10	93		ND	0.10	ND	0.10
cis-1,3-Dichloropropene	ND	16	161		ND	0.16	ND	0.16
trans-1,3-Dichloropropene	ND	12	73		ND	0.12	ND	0.12
Ethylbenzene	650	12	97		0.2 @	0.12	ND	0.12
2-Hexanone	ND	24	N/A		ND	0.24	ND	0.24
4-Methyl-2-pentanone	ND	100	N/A		ND	1.0	ND	1.0
Methylene chloride	110 B	10	98 B		0.4 B@	0.10	0.6	0.10
Styrene	ND	12	N/A		ND	0.12	ND	0.12
1,1,2,2-Tetrachloroethane	ND	10	112		1.4	0.10	ND	0.10
Tetrachloroethene	ND	12	N/A		ND	0.12	ND	0.12
Toluene	ND	14	97		ND	0.14	ND	0.14
Total Xylenes	3800	10	0.3		ND	0.10	ND	0.10
1,1,1-Trichloroethane	59 @	12	84		ND	0.12	ND	0.12

@ Est. result less that 5 times detection limit
B Inorg-result < CRDL but > than IDL/Org-detected in blank
ND Not detected at specified detection limit
N\A Not available

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

RADIAN
CORPORATION

Rec'd CRA
OCT 30 1990

Radian Work Order S0-10-106

Analytical Report
10/26/90

CONESTOGA ROVERS & ASSOCIATES

CONESTOGA ROVERS & ASSOCIATES
382 WEST COUNTY RD "D"
ST. PAUL, MN 55112

DAVE DEMPSEY

Customer Work Identification RASMUSSEN
Purchase Order Number EXTERNAL

Contents:

Radian Analytical Services
10395 Old Placerville Road
Sacramento, CA 95827

916-362-5332

Client Services Coordinator: WLBROWN

Certified by: Marilyn Melton

CONESTOGA ROVERS & ASSOCIATES
Radian Work Order: S0-10-106

Method:Volatiles by SW8240 (25mL) (1)
List:Target compound list

Sample ID:	W-101090-WP-0-01	W-101090-WP-0-02	W-101090-WP-0-03	W-101090-WP-0-04
Factor:	0.400	0.200	4.000	20.000
Results in:	ug/L	ug/L	ug/L	ug/L
	01A	02A	03A	04A
Matrix:	water	water	water	water

	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit	Result	Det. Limit
Acetone	4.2 B@	1.2	ND	0.60	230	12	700	60
Benzene	ND	0.24	ND	0.12	170	2.4	51 @	12
Bromodichloromethane	ND	0.28	ND	0.14	ND	2.8	ND	14
Bromoform	ND	0.20	ND	0.10	ND	2.0	ND	10
Bromomethane	ND	0.20	ND	0.10	ND	2.0	ND	10
2-Butanone	ND	12	ND	6.0	ND	120	ND	600
Carbon disulfide	ND	0.20	ND	0.10	ND	2.0	ND	10
Carbon tetrachloride	ND	0.24	ND	0.12	ND	2.4	ND	12
Chlorobenzene	ND	0.28	ND	0.14	650	2.8	890	14
Chloroethane	ND	0.40	ND	0.20	110	4.0	ND	20
Chloroform	ND	0.24	ND	0.12	ND	2.4	ND	12
Chloromethane	ND	0.20	ND	0.10	ND	2.0	ND	10
Dibromochloromethane	ND	0.24	ND	0.12	ND	2.4	ND	12
1,1-Dichloroethane	2.1	0.24	ND	0.12	67	2.4	130	12
1,2-Dichloroethane	ND	0.24	ND	0.12	ND	2.4	ND	12
1,2-Dichloroethene (total)	ND	0.20	ND	0.10	ND	2.0	51	10
1,1-Dichloroethene	ND	0.20	ND	0.10	ND	2.0	ND	10
1,2-Dichloropropane	ND	0.20	ND	0.10	ND	2.0	ND	10
cis-1,3-Dichloropropene	ND	0.32	ND	0.16	ND	3.2	ND	16
trans-1,3-Dichloropropene	ND	0.24	ND	0.12	ND	2.4	ND	12
Ethylbenzene	ND	0.24	ND	0.12	280	2.4	680	12
2-Hexanone	ND	0.48	ND	0.24	ND	4.8	ND	24
4-Methyl-2-pentanone	ND	2.0	ND	1.0	ND	20	ND	100
Methylene chloride	4.0 B	0.20	0.5 B	0.10	24 B	2.0	130 B	10
Styrene	ND	0.24	ND	0.12	ND	2.4	ND	12
1,1,2,2-Tetrachloroethane	ND	0.20	ND	0.10	ND	2.0	ND	10
Tetrachloroethene	ND	0.24	ND	0.12	ND	2.4	ND	12
Toluene	ND	0.28	ND	0.14	30	2.8	ND	14
Total Xylenes	ND	0.20	ND	0.10	1300	2.0	4100	10
1,1,1-Trichloroethane	40	0.24	ND	0.12	ND	2.4	75	12

B Inorg-result < CRDL but > than IDL/Org-detected in blank
@ Est. result less that 5 times detection limit
ND Not detected at specified detection limit

(1) For a detailed description of flags and technical terms in this report refer to Appendix A in this report.

ND ALL METHODS EXCEPT CLP

This flag is used to denote analytes which are not detected at or above the specified detection limit.

EXPLANATION

The value to the right of the < symbol is the method specified detection limit for the analyte.

CRA
Radian Work Order: M0-10-070

TERMS USED IN THIS REPORT:

Analyte - A chemical for which a sample is to be analyzed. The analysis will meet EPA method and QC specifications.

Compound - See Analyte.

Detection Limit - The method specified detection limit, which is the lower limit of quantitation specified by EPA for a method. Radian staff regularly assess their laboratories' method detection limits to verify that they meet or are lower than those specified by EPA. Detection limits which are higher than method limits are based on experimental values at the 99% confidence level. The detection limits for EPA CLP (Contract Laboratory Program) methods are CRQLs (contract required quantitation limits) for organics and CRDLs (contract required detection limits) for inorganics. Note, the detection limit may vary from that specified by EPA based on sample size, dilution or cleanup. (Refer to Factor, below)

EPA Method - The EPA specified method used to perform an analysis. EPA has specified standard methods for analysis of environmental samples. Radian will perform its analyses and accompanying QC tests in conformance with EPA methods unless otherwise specified.

Factor - Default method detection limits are based on analysis of clean water samples. A factor is required to calculate sample specific detection limits based on alternate matrices (soil or water), reporting units, use of cleanup procedures, or dilution of extracts/digestates. For example, extraction or digestion of 10 grams of soil in contrast to 1 liter of water will result in a factor of 100.

Matrix - The sample material. Generally, it will be soil, water, air, oil, or solid waste.

Radian Work Order - The unique Radian identification code assigned to the samples reported in the analytical summary.

Units -	ug/L	micrograms per liter (parts per billion);liquids/water
	ug/kg	micrograms per kilogram (parts per billion); soils/solids
	ug/M3	micrograms per cubic meter; air samples
	mg/L	milligrams per liter (parts per million);liquids/water
	mg/kg	milligrams per kilogram (parts per million);soils/solids
	%	percent; usually used for percent recovery of QC standards
	uS/cm	conductance unit; microSiemens/centimeter
	mL/hr	milliliters per hour; rate of settlement of matter in water
	NTU	turbidity unit; nephelometric turbidity unit
	CU	color unit; equal to 1 mg/L of chloroplatinate salt

CRA
Radian Work Order: M0-10-070

Sample Identifications and Dates

Sample ID	W-101190-WP-06	W-101190-WP-09	METHOD BLANK
Date Sampled	10/11/90	10/11/90	
Date Received	10/12/90	10/12/90	10/12/90
Matrix	water	water	
	01	02	03

Total suspended solids,						
Prepared	10/13/90	10/13/90				
Analyzed	10/13/90	10/13/90				
Analyst	MJB	MJB				
File ID	23843-10	23843-10				
Blank ID	23843-10	23843-10				
Instrument	NA	NA				
Report as	received	received				

Appendix A

Comments, Notes and Definitions

RADIAN
CORPORATION

Rec'd CRA

OCT 30 1990

Radian Work Order M0-10-070

Analytical Report
10/23/90

CRA

CRA
CRA
382 WEST COUNTY ROAD "D"
ST. PAUL, MN 55112
DAVE DEMPSEY

Customer Work Identification RASMUSSEN
Purchase Order Number 2433

Contents:

Radian Corporation
5103 West Beloit Road
Milwaukee, WI 53214

414-643-2719

Client Services Coordinator: WLBROWN

Certified by:

CRA
Radian Work Order: M0-10-070

Method/Analyte	Sample Identifications								
	W-101190-WP-06			W-101190-WP-09			METHOD BLANK		
	01			02			03		
Matrix	water			water			water		
	Result		Det. Limit	Result		Det. Limit	Result		Det. Limit
Alkalinity									
Alkalinity	890	mg/L	1.0	100	mg/L	1.0			
BOD 5 day									
BOD 5	8	mg/L	1.0	36	mg/L	1.0			
Chemical oxygen demand									
Chemical Oxygen Demand	110	mg/L	5.0	81	mg/L	5.0	ND	mg/L	5.0
Total dissolved solids									
Total dissolved solids	2100	mg/L	9.0	450	mg/L	9.0			
Total organic carbon									
Total organic carbon	13	mg/L	1.0	20	mg/L	1.0	ND	mg/L	1.0
Total suspended solids,									
Total suspended solids	1400	mg/L	3.0	190	mg/L	3.0			

ND Not detected at specified detection limit

(1) For a detailed description of flags and technical terms in this report refer to the glossary.

Sample History

CRA
Radian Work Order: M0-10-070

Sample Identifications and Dates

Sample ID	W-101190-WP-06	W-101190-WP-09	METHOD BLANK
Date Sampled	10/11/90	10/11/90	
Date Received	10/12/90	10/12/90	10/12/90
Matrix	water	water	water
	01	02	03

	01	02	03			
Alkalinity						
Prepared	10/13/90	10/13/90				
Analyzed	10/13/90	10/13/90				
Analyst	MJB	MJB				
File ID	23843-9	23843-9				
Blank ID	23843-9	23843-9				
Instrument	NA	NA				
Report as	received	received				
BOD 5 day						
Prepared	10/12/90	10/12/90				
Analyzed	10/12/90	10/12/90				
Analyst	RAF	RAF				
File ID	23527-39	23527-39				
Blank ID	23527-39	23527-39				
Instrument	YSI	YSI				
Report as	received	received				
Chemical oxygen demand						
Prepared	10/12/90	10/12/90	10/12/90			
Analyzed	10/12/90	10/12/90	10/12/90			
Analyst	MJB	MJB	MJB			
File ID	23843-8	23843-8	23843-8			
Blank ID	23843-8	23843-8	23843-8			
Instrument	HOCH	HOCH	HOCH			
Report as	received	received	received			
Total dissolved solids						
Prepared	10/13/90	10/13/90				
Analyzed	10/13/90	10/13/90				
Analyst	MJB	MJB				
File ID	23843-10	23843-10				
Blank ID	23843-10	23843-10				
Instrument	NA	NA				
Report as	received	received				
Total organic carbon						
Prepared	10/15/90	10/15/90	10/15/90			
Analyzed	10/15/90	10/15/90	10/15/90			
Analyst	RAF	RAF	RAF			
File ID	23532-40	23532-40	23532-40			
Blank ID	23532-40	23532-40	23532-40			
Instrument	DOHRMANN	DOHRMANN	DOHRMANN			
Report as	received	received	received			