4.0 REVIEW OF MONITORING WELLS SURROUNDING THE LANDFILL

4.1 Introduction

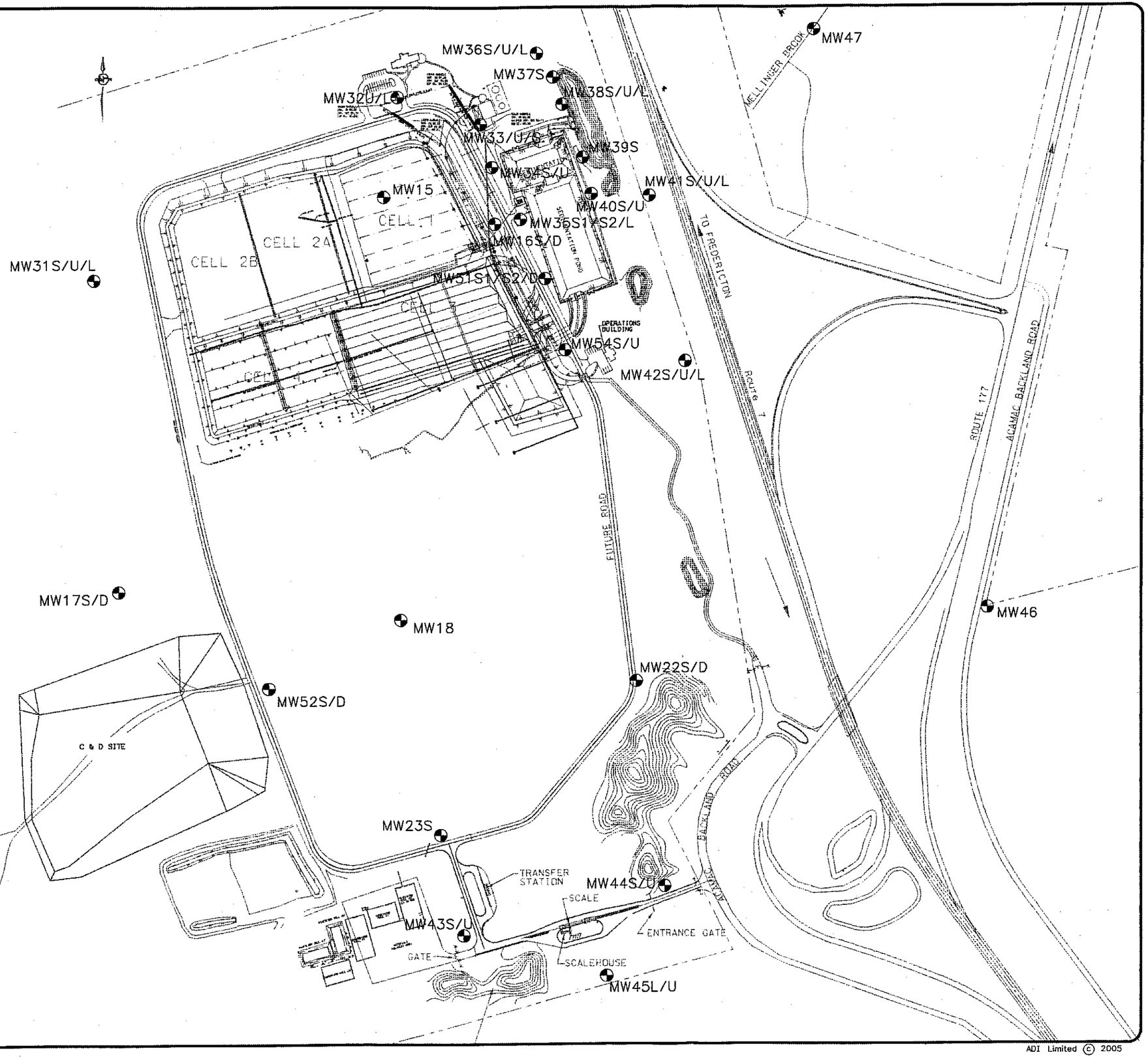
The Crane Mountain Landfill is surrounded by over 50 monitoring wells. Samples from the monitoring wells are analyzed to check for any impacts of the landfill on the quality of the surrounding groundwater. This chapter provides a Review of Monitoring Wells Surrounding the Landfill as per Specification 3.2, which includes the following:

- *Adequacy of location, design, and number of onsite monitoring wells, given the hydrogeological characteristics of the site.*
- *Analytical database of monitoring well data.*
- *Adequacy of background data with respect to scope and variability.*
- *Identification of analytical anomalies with particular attention to leachate indicator parameters.*
- *Adequacy of sampling and testing: quality control, frequency, and scope.*
- *Adequacy of analysis of data from testing.*
- *Adequacy of emergency response plans relative to findings in onsite monitoring wells.*

4.2 Adequacy of On-site Monitoring Wells

The existing groundwater monitoring network is comprised of over fifty groundwater monitoring wells installed at approximately twenty discrete locations. Most of the wells included in the existing well network were installed during the fall of 1997 (50 wells installed), and results of this work were summarized in the report entitles *"Monitoring Well Installation Program Crane Mountain Regional Sanitary Landfill Saint John, New Brunswick", (Gemtec Limited, file: 658.17, April 1998).* Subsequent to completion of this main network of wells, based on documentation provided six additional wells (51D, 51S1, 51S2, 52S, 52D, and 53D) at three new locations were established during 2002 to monitor the construction and demolition debris disposal cell area. Results of this work were provided in a letter report to the Commission dated April 23, 2002 (*Gemtec file: 658.52).* Figure 4-1 shows the location of the monitoring wells.

Regarding the main monitoring system installed in 1997, the network includes two angled boreholes (MW37A and MW39A) which were outfitted with multi-level groundwater monitoring installations. It is understood that the original monitoring network was designed



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No.	Revision	Ckd. By	Date

PRELIMINARY

Const. North

Drawn By:

Dwg. Standards Ckd. By:

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Project Title

INDEPENDENT EXTERNAL REVIEW OF CRANE MOUNTAIN LANDFILL

Dwg. Title

MONITORING WELL LOCATIONS

Project No.	5668-001.1
Dwg. No.	FIGURE 4-1
Rev. No.	0
Scale	1:5000

This drawing is not to be scaled

Offices located in:
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in a tiered manner. Tier 1 wells (MW32 through MW40) were installed closest to the area of original cell construction and the site sedimentation ponds. The Tier 1 wells are generally within 20 to 30 m of the larger potential source areas (e.g. landfill cells, pond(s)). Tier 2 wells (MW41 through MW47) were established further to the east of the original cell area (generally within the range of 100 to 200 m from the landfill cell area), and south of the Tier 1 wells adjacent to the area of future cell development. Finally, the Tier 3 wells (MW48, MW49 and MW50) were established at relatively remote (e.g. > 1km) locations relative to the landfill, with these wells intended to serve as "long range" monitoring locations. These off-site wells are shown on Figure 6-3. Most wells were installed with a geo-environmental type drilling rig, but a few wells were installed with an air rotary drilling rig.

As discussed in **section 2.2** site stratigraphy includes a variable depth of overburden sediments (mainly glacial till) overlying fractured bedrock. Typically, monitoring well networks for solid waste disposal sites should include nested wells to monitor each distinct hydrostratigraphic unit (e.g. overburden deposits, shallow bedrock, "intermediate" bedrock, and "deeper" bedrock). The Crane Mountain monitoring network has generally been completed in this manner. Based on a review of the background information provided related to the site groundwater monitoring network, it appears that the existing network is similar to those installed at other regional landfill facilities in the province, and is considered adequate with respect to location, design and number of on-site monitoring wells given the hydrogeological characteristics of the site.

It is recommended that further characterization of the hydrogeological system be made as it relates to flow pathways within the bedrock and geochemical evolution of groundwater in the context of water supply usage by downgradient domestic wells.

4.3 Analytical Database of Monitoring Data

The Fall, 1997 baseline monitoring data and the most recent monitoring results for the Fall, 2004 monitoring round were reviewed. For this review, the groundwater monitoring data were compared with the Guidelines for the Protection of Canadian Drinking Water Quality (GPCDWQ) established by Health Canada. Related discussion on analytical anomalies is provided in **section 4.5**.

Regarding groundwater quality, concentrations of iron and manganese in excess of their respective guideline values were observed at many monitoring locations. However, it is

noted that the guideline values for these parameters have been established on the basis of aesthetic considerations such as the control of staining and encrustation of pipeworks. Naturally occurring concentrations of iron and manganese in excess of the guideline values are frequently found in New Brunswick groundwater and, as such, the above noted observations pertaining to the Crane Mountain background groundwater quality data are quite typical of New Brunswick conditions.

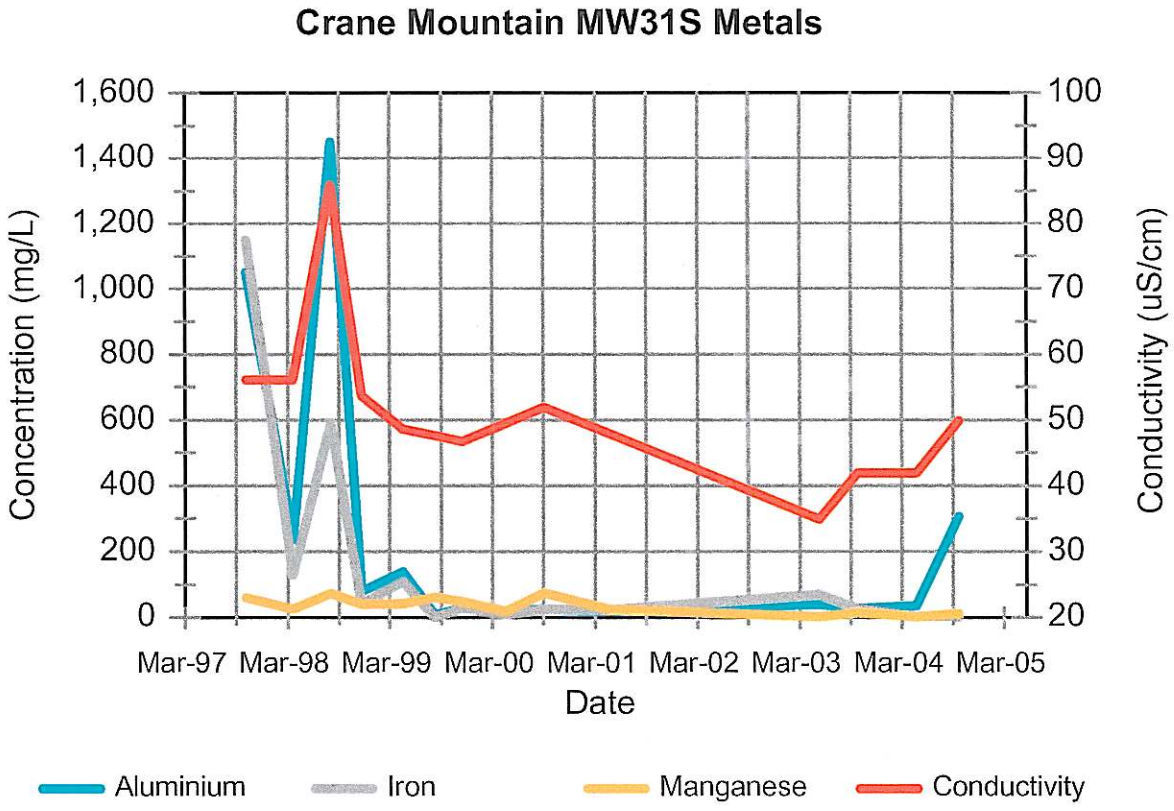
Elevated pH levels outside the recommended range were also identified for selected monitoring locations. Turbidity levels in excess of the guideline value were observed at most monitoring locations. However, it is noted that the guideline values for pH and turbidity have also been established primarily on the basis of aesthetic considerations. Elevated turbidity levels are commonly identified in groundwater samples from 50 mm monitoring wells and are most likely attributable to a lack of well development and the riling of drill cuttings (i.e. disturbance of rock or soil cuttings left over from the drilling process) during sample collection. In addition to the above, concentrations of the trace metal parameters arsenic and antimony in excess of their respective guideline values were observed at a few monitoring locations. The elevated concentrations of these parameters in the background data is most likely reflective of the natural hydrogeological setting of the study area. Naturally occurring minerals in an aquifer can dissolve in the groundwater and result in elevated concentrations of the mineral parameter.

4.4 Adequacy of Background Data

Baseline groundwater and surface water quality data was collected immediately prior to the commissioning of the Crane Mountain facility in the Fall of 1997. The level of effort in this regard was similar to that employed at other regional landfill facilities in the Province and, in general, is considered to be adequate. The background data related to environmental protection was collected during the Environmental Impact Assessment (EIA) of the proposed use of either the Crane Mountain or Paddy's Hill sites for the new solid waste management facility for the Fundy region.

4.5 Identification of Analytical Anomalies

Although most of the fall 2004 monitoring results were similar to the baseline data with no obvious indication of leachate impacts, elevated concentrations of chloride and conductivity were observed for the lower bedrock monitoring well MW46L. It is recommended that



Sample Monitoring Well Results
Figure 4-2

future monitoring results from this location be closely monitored for any increase in parameter concentrations.

Regarding the elevated concentrations of iron and manganese, as previously mentioned naturally elevated concentrations of these parameters in groundwater are quite common in New Brunswick including the Crane Mountain area. Although elevated levels of iron and manganese occur in municipal solid waste landfill leachate, leachate impacted groundwater would be expected to display elevated concentrations of other parameters in addition to iron and manganese (e.g. chloride, conductivity, others).

Some examples of analytical plots (trend plots) that would be useful in identifying analytical anomalies are shown in Figure 4-2. Such plots should be developed and maintained on an ongoing basis.

4.6 Adequacy of Sampling and Testing

We have reviewed the Approval to Operate and find that the stipulated monitoring schedules and analytical suites are similar to the requirements outlined for other Provincial regional landfill facilities. Due the presence of potable water supply wells downgradient and in relatively close proximity to the landfill, the Approval for Crane Mountain includes domestic well monitoring which is not a requirement at many sites due to the absence of nearby wells or other factors.

On the basis of our review, it is our opinion that the compliance monitoring requirements outlined in the Approval are adequate. However, consideration of additional parameters should be completed in the context of the work directed toward identification of "trigger" parameters referenced in the Environmental Management Plan (EMP) for the landfill. The EMP is a document which provides a framework for the administration of environmental issues at the site including environmental compliance monitoring in addition to environmental protection/emergency response planning and environmental training. The emergency response plans (ERP's) included in the EMP outline general corrective actions to be taken in the event that a problem is encountered such as potential leachate impacts on downgradient domestic wells.

4.7 Adequacy of Analysis of Test Data

It is our understanding that analytical testing services for groundwater and surface water compliance monitoring at the landfill site have been provided by Saint John Laboratory Services Ltd. of Saint John, NB. It is our understanding that this laboratory is currently certified by the Canadian Association for Environmental Analytical Laboratories (CAEAL) for selected tests. The mandate of CAEAL is to promote the delivery of high quality analytical services and, therefore, ideally the analytical laboratory charged with analyzing samples from the landfill would be CAEAL certified. However, Section D.77 of the Approval requires only that the laboratory be "approved by the Department" (i.e. New Brunswick Department of the Environment and Local Government). It is unknown whether or not Saint John Laboratory Services is an NBDELG approved laboratory.

4.8 Monitoring Wells Emergency Response Plans

The Emergency Response Plans in the Environmental Management Plan (EMP) outline remedial measures which may be taken in the event that "trigger" concentrations are exceeded for key parameters in the groundwater monitoring data or the domestic well water quality data. The "trigger" concentrations are not defined and it is stated in the EMP that they will be established based on an analysis of background water quality data. Remedial action will only be taken if the results of a more detailed analysis on the water quality data (ASTM PS 64-96 - now ASTM D6312-98 (2005)) indicate that the trigger exceedances are not related to natural background variation.

A trigger concentration may be defined as an upper limit on the expected range of the concentration of a given parameter on the basis of an analysis of the existing water quality database. Trigger concentrations may be defined by a statistical analysis of the existing analytical database or other means such as the adoption of regulatory guideline values. They are in effect action levels whereby if the concentration is exceeded, investigation into the cause of the elevated parameter value is warranted, although not necessarily a problem.

If impacts are detected in the groundwater monitoring data, suggested remedial measures in the EMP include plume delineation; containment of groundwater and remediation by "pump and treat"; and containment of affected groundwater by slurry cut-off or reaction walls or in-situ groundwater remediation by biological and/or chemical means. In general, the suggested remedial approaches are vague and lacking in details. However, a similar level

of effort has been expended in developing remedial measures for other potential environmental liabilities for other landfills in the Province.

Suggested remedial options in the event of the identification of parameter concentrations in domestic well water in excess of "trigger" concentrations include developing alternate water supplies and treating the affected water. Again, the proposed remedial measures are vague but it is acknowledged that conceptual remedial approaches are probably acceptable for EMP purposes.

Consideration should be given to identifying the "trigger" concentrations described above.