Reducing or Terminating Groundwater Monitoring at Solid Waste Landfills

PUB-WA 1013

Revised 2014

Waste & Materials Management
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Summary: This guidance is for people or municipalities who want to reduce or stop groundwater sampling at a solid waste landfill. It describes how you should prepare and submit your request and how the Department of Natural Resources will review your request.

If you have been sampling groundwater around a landfill four times a year ("quarterly") and there are no problems, it is likely the DNR will allow you to cut back to sampling twice a year ("semi-annually") instead. Sampling less often than semi-annual is possible in certain situations. We will make the decision based on how big your landfill is, what the local geology is like, how long you have been sampling groundwater, what the sampling results show and other factors.

This guidance (Publication WA1013, revised 2014) replaces previous guidance dated 1997, 2003 and 2006, on reducing monitoring frequency near landfills.

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- For additional information on landfill monitoring or any contacts you can go to the DNR website at: http://dnr.wi.gov/topic/Landfills/Monitor.html
- To see relevant Wisconsin administrative codes and statutes, including NR 500 and NR 140, go to: http://dnr.wi.gov/topic/Waste/Laws.html

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Table of Contents: (Click on headers below to jump to each section.) **Page number**

Introduction

(Click on **blue** headers in the document to return to Table of Contents.)

The Department of Natural Resources (DNR) requires landfill owners to sample groundwater to assure the safety of those who drink that water now or in the future. Although it can be expensive to gather and analyze water samples, our goal is to protect human health and the environment. At the same time, we do not want you to have to collect more information than is necessary to assure groundwater quality.

How often groundwater around a landfill is sampled depends on the landfill's DNR approval, which is a legally enforceable document. This could be an approval of a plan of operation, closure plan or groundwater monitoring plan. The approval requires the landfill owner to take samples periodically to look for possible problems. This is called "detection monitoring." Sampling carried out to assess the degree of impacts of a landfill known to have polluted groundwater is called "assessment monitoring."

Before 1996, the department normally required detection monitoring every 3 months (that is, 4 times a year or "quarterly"). Since 1996, when the department upgraded its landfill design standards, the normal sampling frequency for new landfills has been every 6 months (that is, "semi-annually"). Sampling for older landfills remained as approved, however, because most of them did not have design features, such as clay liners, to protect water quality.

As a landfill owner, if you want to sample your landfill less often or not at all, you must first ask the department to modify your approval in writing. You may ask DNR to allow you to:

- Change the sampling from 4 times a year to 2 times a year ,
- Change the sampling to anything less than twice a year , or
- Stop sampling altogether.

Generally speaking:

- If you are doing quarterly detection monitoring and the substances being found in the water samples are not increasing, the department is likely to allow you to reduce the monitoring frequency from quarterly to semi-annual. This is possible at most solid waste landfills.
- If detection monitoring over many years indicates that the landfill is unlikely to contaminate groundwater, it may be possible to reduce the sampling frequency to less than semi-annual.
- If the volume and type of waste, hydrogeologic conditions and long term groundwater monitoring have shown that the facility does not, and is not expected to, pose a threat to human health or the environment, the department may allow you to stop monitoring the landfill. This situation is rare, but possible.

This guidance only addresses how to propose changes in groundwater monitoring frequency. It does not address how to ask for changes in what you are sampling for, how the samples are taken, adding or replacing wells, how you monitor leachate or gas, or other things landfill owners must do, such as taking care of the landfill cap. If you are considering any of these changes, we recommend you contact the DNR early in the process to discuss them. We may be able to suggest things that will save you money in the long run.

Applicability to General Categories of Landfills

Different types of landfills may have differing monitoring requirements, depending on which laws apply. As a result, this guidance DOES NOT apply to:

- Subtitle D Landfills with semi-annual monitoring. These are landfills that accepted municipal solid waste on or after October 9, 1993. (However, if a landfill received less than 100 tons per day on an annual basis, it is not a Subtitle D landfill unless it accepted municipal solid waste on or after April 9, 1994.) Subtitle D landfills are subject to Wisconsin rules consistent with federal solid waste landfill regulations (see RCRA Subtitle D, 40 CFR, Parts 257 and 258, and chapters NR 504, NR 506 and NR 507, Wis. Adm. Code). The minimum groundwater monitoring frequency for active or closed Subtitle D landfills is semi-annual (NR 507, Appendix I, Table 1, Wis. Adm. Code). 40 CFR Part 258.54 does provide for alternate sampling frequencies that are less often than semiannual for operating Subtitle D landfills, but this guidance document does not address all of the items that could pertain to such a request. Subtitle D landfills that are conducting quarterly detection monitoring and are not required to do assessment monitoring can use this guidance to reduce groundwater monitoring frequency to semi-annual.
- Landfills under "assessment monitoring" (see ch. NR 508, Wis. Adm. Code). This guidance does not apply to sites under assessment monitoring because of impacts to groundwater.
- Landfills undergoing remediation. Although the principles in this guidance may apply to landfills undergoing remediation, the department will take other factors into consideration in reviewing the monitoring programs at such sites; this guidance is not intended for use in establishing monitoring programs for sites undergoing remediation.

This guidance DOES apply to detection monitoring at:

- Small Size Construction and Demolition (C & D) Waste landfills which are landfills designed for disposal of no more than 50,000 cubic yards of C & D waste. These are monitored under s. NR 503.09, Wis. Adm. Code.
- Intermediate Size C & D waste landfills which are designed for disposal of more than 50,000 cubic yards but no more than 250,000 cubic yards of C & D waste. These are monitored under s. NR 503.10, Wis. Adm. Code.
- Large size C & D waste landfills which are designed for disposal of more than 250,000 cubic yards of C & D waste. These are monitored under ss. NR 507.15(1) and NR 507.19, Wis. Adm. Code.
- Industrial waste landfills. These are monitored under ss. NR 507.15(1) and NR 507.19, Wis. Adm. Code.
- Municipal waste landfills that ceased accepting municipal solid waste prior to October 9, 1993, including both approved and non-approved landfills. These are monitored under ss. NR 507.15(1) and NR 507.19, Wis. Adm. Code.
- Municipal waste landfills which received less than 100 tons per day on an annual basis and which ceased accepting solid waste prior to April 9, 1994. These are monitored under ss. NR 507.15(1) and NR 507.19, Wis. Adm. Code.
- Subtitle D landfills that are monitoring quarterly because of a DNR approval requirement that goes beyond the federal rules.

Department Recommendations about Monitoring Frequency

The standard monitoring frequency for solid waste landfills is semi-annual. However, the department may approve other sampling frequencies in writing in accordance with ss. NR 503.09(6)(f), NR 503.10(7)(e) and NR 507.19(2), Wis. Adm. Code.

NOTE: While this guidance is about sampling LESS often, the department may require landfill owners to sample groundwater MORE often depending on waste type(s), landfill size and design, the physical environment or existing groundwater contamination conditions (see s. NR 507.19(2), Wis. Adm. Code).

The DNR technical staff recommends the following groundwater monitoring frequencies at landfills (see Appendix A.)

1. **At most closed landfills, groundwater should be sampled at twice a year (semi-annually**). Sampling twice a year gives the best picture of how groundwater quality changes over time.

2. **At some closed landfills, it may be possible to cut sampling back to once a year**. These would include sites with many years of groundwater monitoring data and that meet the general criteria for reducing monitoring (see next section).

3. **Termination of groundwater monitoring for closed landfills is appropriate only where future groundwater contamination is extremely unlikely**. Here are site conditions that would indicate future groundwater contamination is unlikely:
    - There are at least 5 years of groundwater monitoring data from one or more wells that are located down gradient from the closed landfill and screened at an appropriate depth.
    - No wells currently show increasing concentrations of substances in groundwater. This applies to substances which have Public Health or Public Welfare groundwater quality standards or indicator parameter preventive action limits (PALs) under NR 140, Wis. Adm. Code, as well as other substances. An increasing concentration trend of an indicator parameter that does not have an NR 140 standard, such as specific conductance, may also indicate an increasing concentration of one or more parameters that do have an NR 140 groundwater standard.
    - The landfill has an active leachate extraction and/or an active gas extraction system, but they are not operating due to no or low volumes of leachate and gas in the landfill.
    - The landfill owner has performed all remedial actions that the department has required at the site.
    - There are no exceedances of NR 140, Wis. Adm. Code public health or public welfare PALs or Enforcement Standards (ES) attributed to the landfill in the past 5 years.
    - The landfill volume is very small.
    - The landfill has a good cap that is well maintained.
    - The types of waste received by the landfill were limited in variability and known with some certainty.
    - Wastes accepted did not include significant amounts of liquid or industrial waste.
    - Wastes at the landfill were periodically burned, thereby destroying generally mobile contaminants such as volatile organic compounds (VOCs). (Note: metals may still be a concern.)
    - There are few private wells near the landfill and it is unlikely that private wells will be installed near the landfill in the future.
    - The geologic and hydrogeologic conditions near the landfill would be suitable to support natural attenuation or restrict contamination migration (for example, groundwater is far removed from waste, soils are finer-grained and would inhibit contaminant movement, etc.).
    - Down gradient and up gradient groundwater monitoring wells have similar chemistry.
    - Groundwater sampling results demonstrate that any concentration exceeding an NR 140 ES is due to background conditions, or that contaminant levels have decreased or stabilized at a low level and do not pose a threat to human health or the environment.
    - The DNR concurs with technical rationale provided by the landfill owner or consultant that NR 140 groundwater standards will not be exceeded beyond the Design Management Zone (defined in s. NR 140.22(3), Wis. Adm. Code) in the future.

4. **The DNR will evaluate proposals to terminate monitoring with particular caution**. If monitoring stops and wells are removed, it becomes much harder to tell if a closed landfill is contaminating groundwater later. If there are any questions about whether the landfill is contaminating groundwater in the future, the DNR can ask the landfill owner to reinstall the wells and begin sampling again. Furthermore, older landfills may be more likely to pollute groundwater if they don't have liners and leachate collection systems, if they are located close to the groundwater table, or if soils

are sandy (which allows contaminants to infiltrate more readily. A landfill owner may be required to resume groundwater monitoring even after termination is approved if there is a later indication of groundwater contamination.

Note that the DNR will approve an annual sampling frequency or will terminate sampling, but will not reduce monitoring at a closed landfill to less than once a year. Reasons include: (1) it may take too long to detect groundwater contamination, especially if one or more samples are skipped or determined to be unreliable, (2) Landfill owners might forget or fail to sample if funds for sampling aren't included in their budgets every year, (3) Sample quality can decline if the well is sampled less often than annually, and (4) Wells may fall into disrepair or be lost when monitoring wells are sampled less than annually.

General Guidelines for Reducing or Terminating Monitoring

If you want to reduce or stop monitoring, you should be prepared to show all of the following:

1. That a reduction or termination of monitoring does not present a threat to public health and welfare or the environment. A DNR hydrogeologist will review the landfill history, hydrogeology, and monitoring data.
2. That the facility has an adequate monitoring network. This means that a sufficient number of wells are in locations and at depths needed to detect groundwater contamination near the landfill and the wells were constructed properly and are in good condition. If this is not the case at your landfill, you should upgrade and repair the wells before submitting your request to reduce monitoring. If you are unsure, ask for a preliminary review (see "How to Propose Changes in Monitoring Frequency," below).
3. That the data submitted to the DNR are reliable and complete. This includes maps, well locations, well construction logs, groundwater monitoring data and other information. In particular, DNR staff will carefully evaluate data on VOCs to determine data reliability (see Appendix D, "Quality Assurance Considerations for VOCs"). If data are unreliable, you may need to take more samples before the DNR can review your request.
4. That the landfill is not a significant source of ongoing groundwater contamination. Any of the following would be evidence of significant groundwater contamination:
   - Increasing concentrations of a contaminant which exceeds PALs defined in NR 140 for public health or public welfare standards. Note that the DNR hydrogeologist may require analysis for select health and welfare based parameters (such as VOCs and metals) prior to reducing or terminating groundwater monitoring at a landfill.
   - Significant detection of VOCs in the groundwater after the landfill has been closed for a minimum of five years. This time limit may be increased if an analysis of the flow system shows that groundwater moves very slowly and therefore contaminants may not have reached the monitoring wells yet.
   - Significant current differences in water quality when comparing up gradient or background wells with down gradient wells, where the difference cannot be reasonably attributed to other factors, such as soil/rock type, natural variability or other sources of groundwater contamination.

Following these guidelines will help the department evaluate a request for reducing terminating monitoring, and will increase the likelihood that the DNR will approve the changes you propose.

Be aware that a request to reduce monitoring may lead to increased monitoring!

The process of preparing and reviewing a request to reduce or terminate monitoring may disclose unanticipated conditions, such as groundwater contamination or an inadequate well network. These conditions may lead to increased monitoring requirements, an environmental investigation or remediation of the landfill. This potential is more likely to be realized at landfills that have not been complying with routine monitoring requirements.

How to Propose Changes in Monitoring Frequency

The DNR must approve changes in monitoring before you implement them. Here are some things you should know about proposing changes in monitoring frequency.

Preliminary Reviews The DNR strongly recommends that you contact the department hydrogeologist assigned to your facility for a preliminary review of your proposal before spending time and money compiling the information needed for a formal plan modification request. To find out which department staff member is assigned to your landfill, locate your DNR regional office at:
http://dnr.wi.gov/staffdir/_newsearch/contactsearchext.aspx?exp=waste+facility+environmental+monitoring

You may already have much of the necessary information in reports previously prepared for the site. However, for some closed sites, records are incomplete or outdated, and you should provide the information in Appendix B for the department to review. The department will provide a preliminary review and opinion. There is no fee for the preliminary review.

Plan Modifications If your plan of operation, groundwater monitoring plan or closure plan specifies a monitoring frequency, you must obtain written DNR approval before you implement any change in monitoring. To initiate the approval process, you must submit a formal plan modification request to the department for approval to amend this plan.

All submittals should follow the general submittal requirements detailed in s. NR 500.05, Wis. Adm. Code, regarding the contents, format, number of copies, size of visuals, etc. For a detailed listing of the information to be submitted with your plan modification request, please refer to Appendix C.

Upon receiving your plan modification proposal, the department will send an invoice to cover the cost of reviewing the plan, based on the plan review fees listed in s. NR 520, Wis. Adm. Code, Table 3. See
http://www.legis.state.wi.us/rsb/code/nr/nr520.pdf.

Expedited Plan Modifications Wisconsin's solid waste rules outline a process by which certain relatively simple plan modifications may be submitted to the department. If the department does not object within thirty days after it receives the expedited proposal, the proposed modifications are considered to be approved automatically (see s. NR 514.09, Wis. Adm. Code). These expedited plan modifications are subject to reduced plan review fees.

Except as noted below, the expedited plan modification process may apply to reductions of monitoring frequency from quarterly to semi-annually at a closed landfill where the department determines there is low potential risk of adverse impacts on public health or the environment. The information to be submitted under the expedited plan modification process is the same as for a formal plan modification and is listed in Appendix C.

The expedited plan modification does not apply to the following proposals:

- A proposal to change monitoring at a small or intermediate size construction and demolition waste landfill, because these landfills are regulated under ch. NR 503, not ch. NR 514, Wis. Adm. Code.
- A change that would result in a violation of a statute or administrative rule, or an existing written condition (other than the condition specifying monitoring frequency) contained in a department approval document.
- A proposal that would require the DNR more than 8 hours to review.
- A proposal that would require the DNR to issue an exemption.
- A proposal that poses a potential risk to public health or the environment under s. NR 514.09(1)(a)13., Wis. Adm. Code.
- A proposal that would reduce monitoring frequency to less than the minimum required by Wis. Adm. Code (i.e., semiannually).

- A proposal to terminate monitoring.
- A single proposed plan modification which includes multiple requests. For example, a proposal to change the monitoring parameters, approve PALs, grant exemptions to groundwater standards, or change other aspects of sampling and landfill operation at the same time you request a reduction in monitoring frequency. These more complicated proposals take longer to review and should be submitted as formal plan modifications rather than expedited plan modifications.

Based on s. NR 514.09(1)(a)13, Wis. Adm. Code, the department would object to the above proposals for expedited plan reviews. If in doubt, please contact the department staff assigned to your landfill before submitting the proposal. If the department objects to your request for an expedited review, you will have the option of requesting a formal plan modification and the department would send an invoice for the appropriate plan review fee before reviewing your proposal.

In any case, you should contact the department hydrogeologist assigned to your facility prior to submitting a proposed expedited plan modification.

Appendix A

Table 1: Groundwater Monitoring Frequencies for Various Landfill Categories

Landfill Type	Applicable Code Provisions	Minimum Monitoring Frequencies	Expedited Plan Review may be used to reduce:
Subtitle D Municipal landfills	NR 507.15(2), and NR 507.19, Wis. Adm. Code	Semi-Annually. Federal Subtitle D regulations specify semi-annual.	From quarterly to semi-annually
Small Size Construction & Demolition Waste landfills (less than or equal to 50,000 c.y.)	NR 503.09(5), Wis. Adm. Code	Semi-annually. DNR may approve other frequencies.	Not Allowed
Intermediate Size Construction & Demolition Waste landfills (more than 50,000 c.y. but less than or equal to 250,000 c.y.)	NR 503.10(7), Wis. Adm. Code	Semi-annually. DNR may approve other frequencies.	Not Allowed
Large Size Construction & Demolition Waste landfills (more than 250,000 c.y.)	NR 507.15(1), and NR 507.19, Wis. Adm. Code	Semi-annually. DNR may approve other frequencies.	From quarterly to semi-annually
Operating Industrial landfills	NR 507.15(1), and NR 507.19, Wis. Adm. Code	Semi-annually. DNR may approve other frequencies.	From quarterly to semi-annually
Closed Industrial landfills	NR 507.15(1), and NR 507.19, Wis. Adm. Code	Semi-annually. DNR may approve other frequencies.	From quarterly to semi-annually
Closed Non-Subtitle D Municipal landfills (see "Applicability" for description)	NR 507.15(1), and NR 507.19, Wis. Adm. Code	Semi-annually. DNR may approve other frequencies.	From quarterly to semi-annually

In some cases, where the landfill meets the criteria in this guidance, annual monitoring may be appropriate. In some cases, monitoring may be terminated.

Appendix B

Information to Provide With a Request for a Preliminary Review

The DNR recognizes that many landfill owners may not have readily available all the information suggested below to support a request to reduce or terminate groundwater monitoring. We suggest you plan ahead before requesting monitoring reductions to spread out the workload and costs to obtain this information over a time frame that is manageable within your needs. This may include:

- Sampling for the additional suggested parameters when you currently have your wells sampled, such as once a year, will spread out the added laboratory costs. Note that if you currently sample for chemical oxygen demand (COD), contact the hydrogeologist assigned to your facility to see if you can terminate COD monitoring in exchange for VOC monitoring, which will help minimize costs.

  Note: While still required in the administrative code and many existing groundwater monitoring plans, COD may be less useful for detection monitoring than other parameters such as VOCs and dissolved organic carbon (DOC). The analytical results for COD may be highly variable and the analysis method itself generates a mercury laden hazardous waste. If COD does not appear to be a useful parameter at your landfill the department will drop COD from your list of required monitoring parameters and substitute VOCs (for municipal solid waste landfills or industrial landfills with wastes containing VOCs) or DOC. If you are already sampling for VOCs, the DNR may allow you to drop COD monitoring without adding another parameter.

- Finding or having prepared ground water elevation contour maps.
- Preparing a history of the landfill, such as year opened and closed, types of waste accepted, estimated volume of waste disposed, whether waste was permitted to be burned and if so during which years.

The DNR will base its opinion on the likelihood of reducing or terminating groundwater monitoring on the information you submit, current code and statute requirements, and information in the department's file including previously submitted monitoring results.

Requests for Preliminary Review to Reduce Quarterly to Semiannual Monitoring

When you ask the DNR for a preliminary opinion on the potential to reduce monitoring from quarterly to semiannual at your facility, we suggest you submit the following information for department review:[1] If information is not available or is an estimate, this should be indicated in the submittal.

1. A description of your proposed monitoring program (wells to be sampled and for which parameters) and how it differs from your existing monitoring program and the minimum requirements in administrative code. Presentation in a table is preferred.

2. A list of any DNR-approved conditions related to the existing monitoring program and a request to modify them (if applicable).

3. An evaluation of the monitoring network at the site, with specific attention given to:
   a. the locations of the up-gradient and down-gradient wells and direction of groundwater flow;
   b. the condition of the wells; and

[1] These are not legal requirements, but are listed here because they will assist the DNR in evaluating requests for reduction or termination of monitoring frequency and in most cases increase the probability they can be granted.

c. an identification of any repairs or improvements needed to ensure that the monitoring network is capable of accurately characterizing groundwater quality as it might be affected by the facility.

4. An evaluation of any monitoring for VOCs or other public health or public welfare parameters at the landfill, including the most recent results and noting values exceeding groundwater PAL or ES standards. Note that annual analysis of VOCs will be included as part of the sampling plan for municipal solid waste landfill sites performing semiannual sampling. Other parameters, such as those listed in Table 2 below, may be added.

5. Any other information that you believe is relevant to your request or that may provide an update to the information in the DNR's files. All monitoring data not already sent to the department must be submitted in proper uploadable format for the GEMS database. Note: The department may request additional information, such as items listed in Appendix C, if the reviewer determines that it is needed.

Requests for Preliminary Review to Reduce to Less than Semiannual Monitoring

When you ask the DNR for a preliminary opinion on the potential to reduce monitoring from semiannual to annual monitoring, or to terminate monitoring at your facility, we suggest you submit the following information, in addition to that indicated for reducing from quarterly to semiannual monitoring, for department review:

1. A current, adequately-scaled map (or aerial photo or other mapping applications, such as Google™ Maps, MapQuest™ or Bing™ Maps) that accurately depicts all of the following:
   a. the limits of waste and property boundaries of the landfill;
   b. the location of all monitoring wells, gas monitoring probes and leachate head wells;
   c. the location of all private water supply wells within 1,200 feet of the landfill;
   d. the location of all public water supply wells and high-capacity wells within one-half mile of the landfill;
   e. the location of any structures on or near (within 300 feet of) the landfill;
   f. the zoning of land within 1,200 feet of the landfill and a key describing allowed uses under the current zoning ordinance; and
   g. the location of surface water features such as wetlands within 300 ft. and navigable waters (e.g., streams, ponds and lakes) within 1,000 ft.

2. A summary of well conditions including heaved well or protective casings, broken or bent well casings, damaged surface seals or sediment observed in well samples.

3. Any information on monitoring of public health and public welfare parameters at the landfill should be provided, such as the last time such testing was performed, how often samples were analyzed, and all results of VOC testing and quality assurance information. If public health and public welfare parameters have been monitored routinely, summarize the historical trends, list values exceeding groundwater standards, and for VOCs, discuss how the samples meet the quality assurance considerations in Appendix D.

To help support a future reduction in groundwater monitoring to less than semiannual, the DNR will request that you conduct groundwater monitoring for select public health and public welfare parameters (in Table 2 below) to document the concentrations of or lack of these parameters in groundwater at the facility. Some landfills may already be monitoring for some of these parameters or may have had them added to a plan modification that reduces monitoring from quarterly to semi-annual or annual. For parameters with only 2 rounds of sampling suggested, please conduct 4 additional rounds if one of the first two rounds has a result exceeding the chapter NR 140 preventive action limit (PAL) for that parameter. Monitoring of public health parameters provides a direct measurement of representative toxic compounds that may be released by a landfill. Appendix D outlines quality assurance considerations for VOC samples.

Table 2: Additional Parameters

	Landfill Type					
Parameter, filtered, except unfiltered for VOCs	**Municipal Solid Waste Landfill**		**Construction and Demolition Waste Landfill**		**Industrial Landfill**	
	suggested minimum number of rounds to support frequency					
	annual	termination	annual	termination	annual	termination
VOCs[1]	2	4	2	4	2[2]	2[2]
sulfate, arsenic, cadmium, chromium (total), lead	2	4	2	4	4	4
mercury	0	2	0	2	2	2
boron, strontium, molybdenum	0	0	0	0	2	4

Footnotes:

1. Annual analysis of VOCs will be added to a plan modification that reduces monitoring from quarterly to semi-annually or annually. Likewise, annual or semi-annual analysis of those respective parameters listed in Table 2 may be added to C&D and industrial landfills.

2. VOCs would be required if they are used as a part of industrial processes or if additional other wastes were disposed at the industrial landfill, otherwise they would not be required at industrial landfills. For example, VOCs would not be expected in coal ash, and analysis for VOCs in groundwater would not generally be necessary.

Appendix C

Information to Include in a Plan Modification Request to Reduce or Terminate Monitoring

Requests to reduce monitoring to annual should be discussed with the DNR regional hydrogeologist before they are prepared. Requests to terminate monitoring should not be made if evidence of groundwater contamination is shown by ES exceedances, increasing PAL exceedances, or a history of VOCs being detected.

Requests to Reduce to Semiannual or Annual Monitoring

If you choose to pursue a formal plan modification or expedited plan review to reduce the sampling frequency from quarterly to semiannual at your facility, you should prepare the plan according to the general submittal requirements in s. NR 500.05, Wis. Adm. Code, and this appendix. The information to be provided is listed above in "Requests for Preliminary Review to Reduce Quarterly to Semiannual Monitoring" in Appendix B. The department will send you an invoice for the plan modification review fee, in accordance with s. NR 520, Wis. Adm. Code, Table 3.

Requests to Terminate Monitoring

If you choose to pursue a formal plan modification to terminate groundwater monitoring at your facility, you should prepare the plan according to the general submittal requirements in s. NR 500.05, Wis. Adm. Code, and this appendix.

Please submit all of the following information with your request to terminate monitoring. Including these will assist the department in evaluating requests for reduction or termination of monitoring frequency and in most cases increase the probability they can be granted. If any of the information is included in past reports you have already submitted to the department, you may refer to those reports. However, if any referenced report does not accurately reflect current conditions, you should describe the current conditions and update plan sheets, if necessary.

1. All of the information and maps requested in Appendix B above.

2. A description of the landfill, including:
   a. landfill size, that is, the number of acres filled;
   b. depth of waste below ground surface;
   c. volume of waste disposed (including daily cover);
   d. waste types;
   e. years of operation;
   f. history of operation and ownership;
   g. whether or not waste was burned at the site;
   h. landfill design, including any liner, cap, and leachate and gas collection systems;
   i. time since closure;
   j. type and thickness of final cover;
   k. depth to groundwater;
   l. soil types (for landfill cover soils and soils expected to be beneath the base of the landfill);

3. Up-to-date, adequately scaled groundwater table contour maps of the site, showing all of the following:
   a. the elevation of the static water table;
   b. groundwater contours (equipotential lines);
   c. perpendicular streamlines indicating groundwater flow direction;
   d. the high water table;

e. the low water table;
f. maximum variance in ground water flow direction, based on the historical groundwater elevation data collected at the site, and show the flow direction at the high and low water table elevations; and
g. An analysis of the 3-dimensional groundwater flow system at the site (i.e., horizontal and vertical flow directions and gradients), including an estimate of vertical and horizontal groundwater velocity. Show your calculations.

4. Copies of well and boring logs for the monitoring wells on the site, indicating the geologic characteristics and the depth and screened interval of each well.

5. An analysis of all historic groundwater monitoring data to characterize groundwater quality and identify any trends.
   a. Describe the monitoring history, including the number of samples collected to date, how the samples were collected for various parameters, detection limits used, compliance with monitoring requirements, what quality assurance/quality control (QA/QC) samples were taken and an interpretation of QA/QC results. See also Appendices D and E.
   b. Assess landfill impacts by comparing background or up-gradient groundwater conditions to down-gradient conditions and by plotting concentrations vs. time for the wells. Please note that an increasing trend in concentration is not the only indicator of groundwater contamination. Most computer spreadsheet programs offer simple graphing and least-squares regression routines to determine whether a statistical trend exists in a data set. Outliers in the dataset should be determined and removed before any analysis is performed.
   c. Answer these questions: Is the landfill contaminating groundwater (yes, no or maybe)? If maybe, what information is needed to determine if it is or isn't? Note: a contamination evaluation should not be limited to only public health parameters; public welfare and indicator parameters can also be used to determine if a landfill is contaminating groundwater. If indicator parameter PALs have been established for the landfill, please compare the analytical results to the established PALs.

6. The department strongly suggests you submit analytical data from all groundwater monitoring wells for the public health and public welfare parameters as indicated in Appendix B to support and conduct a more thorough groundwater quality evaluation of the facility. In addition, to help support your proposal, we suggest you consider sampling each down-gradient or side-gradient private, high capacity, and public water supply well within 1,200 feet of the landfill at least once for the parameters listed the table in Appendix B. The groundwater monitoring wells should be sampled at least three to six months apart to account for seasonal variations. All analytical data must be submitted in electronic format acceptable to the department.

7. A copy of an affidavit of site registry (Form #4400-67, available from the department's Bureau of Waste and Materials Management at 608-266-2111) showing that the landfill's existence has been recorded in the county Registrar of Deeds' office. This is an official deed notice to inform future property owners of the existence of the solid waste landfill.

8. Certification that a professional geologist or engineer has prepared the report according to s. NR 500.05(4)(b), Wis. Adm. Code.

9. Results of available hydraulic conductivity testing to support your estimate of groundwater flow velocity and travel time to the nearest down-gradient well.

10. A discussion of the potential for development of, and new water supply well installations on, land within 1,200 feet of the landfill.

Appendix D

Quality Control and Quality Assurance Considerations for Volatile Organic Compounds (VOCs)

Your landfill's groundwater monitoring program may have been approved before the importance of VOC sampling was recognized. Therefore, there may be little or no VOC data for the department to review along with your request to reduce or terminate monitoring. Depending on the type of reduction desired, you may need to gather more VOC samples before you submit your plan modification to the department. Given the very limited amount of VOC data being requested and the importance of the decision being made, it is essential that both the VOC sampling and the analyses be reliable. If samples are collected improperly or the quality of sampling results is poor, the data may be unusable and could falsely show you have or don't have a problem. If so, the DNR will ask you to take more samples before considering your request to reduce or terminate monitoring.

We strongly encourage you to incorporate data quality expectations into your contracts for services. This appendix will guide you in your selection of laboratories and consultants.

Sampling

The preferred sample collection method is low flow pumping; however, other methods may be acceptable. Using bailers for collecting samples is not an appropriate choice of sampling method for VOCs because of the high probability that VOCs will be lost in the sampling process. The DNR *Groundwater Sampling Desk Reference* (PUBL-DG-037-96) [available at http://dnr.wi.gov/topic/Groundwater/publications.html] describes various methods for collecting groundwater samples with their advantages and limitations. Flawed sampling techniques may mean that the sample results obtained are not representative. Additional sampling and analyses may be necessary to make a defensible decision.

Laboratories typically supply sample bottles, preservatives and shipping instructions. For VOC samples to be valid, the bottle must be filled completely with no air space remaining. The samples must be cooled immediately to below 6 degrees C utilizing cubed ice. "Blue ice" or other ice/cold packs are strongly discouraged, since they do not cool samples below 4 degrees Celsius. If samples are not sufficiently cooled, the analysis may be invalid and additional sampling may be needed. Remember to include one trip blank per cooler.

The department recommends collecting and analyzing duplicate samples at a rate of one duplicate for every ten samples collected (if you have three wells a duplicate sample should be obtained every three or four sampling events). The best wells to collect duplicate samples from would be a down gradient well with detections of the parameters being analyzed for.

Analyses

In selecting a laboratory for these analyses, consider the following credentials and capabilities:

- Currently certified or registered for volatile organics under ch. NR 149, Wis. Adm. Code;
- The methods used are capable of detecting VOCs at or below the ch. NR 140, Wis. Adm. Code, PALs, where possible. It will not be possible to achieve the PAL detection level for all of the compounds with NR 140 PALs. See the discussion below;
- Blanks demonstrate that laboratory contamination is under control;

- Ability to report quality control data (surrogates, lab control spikes, matrix spikes, duplicates, blanks); and
- Quality control recoveries are generally within 70 to 130%. Recovery rates are affected by the responsiveness of the specific compounds, as well as the matrix (soil, water) and analytical method.

Certification

Laboratories should be able to provide a copy of their certificate that lists their certifications.

Method Detection Limits for VOCs

As you select a laboratory, consider whether their VOC method is capable of detecting the target substances at or below their respective PALs, when possible. Laboratories should be able to provide a list of their method detection limits (MDLs). Note that MDLs are the result of a statistical calculation and are not the same as a measure of the accuracy of a result. The following substances have PALs that are usually below laboratory MDLs:

Table 3: Substances with PALs that are usually below laboratory MDLs:

Substance	CAS Number	PAL (µg/L)	Target MDL (µg/L)
Bromodichloromethane	75-27-4	0.06	0.15
Bromoform	75-25-2	0.44	0.15
Chloroform	67–66–3	0.6	0.15
1,2-Dibromoethane	106–93–4	0.005	0.15
1,2-Dibromo-3-Chloropropane	96–12–8	0.02	0.15
1,3-Dichloropropene(cis & trans)	10061-01-5 10061-02-6	0.02	0.15
1,1,2,2-Tetrachloroethane	79-34-5	0.02	0.15
Vinyl chloride	75-01-4	0.02	0.15

DNR recognizes that few laboratories are capable of achieving detection limits below the PALs for these substances. Remember that s. NR 507.26, Wis. Adm. Code, requires all results be reported to the laboratory's method detection limit, even in cases where the laboratory's method detection limit is lower than the PAL.

Blanks

Field, trip and laboratory method blanks provide an indication of whether sampling and analysis have contaminated the samples. Several of the volatiles found in contaminated groundwater are common laboratory contaminants. Ideally, the method blanks that laboratories analyze with samples should be free of contaminants; however, in reality laboratories have varying degrees of success in their efforts to control contamination. Methylene chloride is one of the most problematic contaminants; if detected in a blank, its detection in samples should be evaluated to determine the validity of the sample results for methylene chloride. Additional samples may need to be collected. Less commonly found contaminants include benzene, acetone, methyl ethyl ketone, ethyl benzene, toluene and xylenes. The laboratory certification code, s.NR 149.14(3)(d), Wis. Adm. Code, provides guidelines on acceptable levels of contamination. Contamination in excess of 10% of the sample concentration or 5% of the PAL significantly reduces the reliability of the result and may make the result unusable.

Quality Control Results

As a routine quality control practice, laboratories monitor the recoveries of surrogate standards in each sample. The recovery of the surrogates is an indicator of the reliability of the results for the target compounds. When reviewing laboratory results, the department recommends closely examining the quality control limits. For groundwater, recoveries for surrogates and matrix spikes should generally range between 70% and 130%. Although results outside of this guideline may be acceptable, the decreased reliability may mean that additional samples beyond the recommended number of rounds may be necessary to make a determination. Ask the laboratory to report quality control results along with the sample results.

Appendix E

Table 4:VOCs and Dissolved Substances Associated with Landfill Leachate

Common name	GEMS Param. No.	CAS RN	Synonyms
Acetone	81552	67–64–1	2–Propanone
Benzene	34030	71–43–2	Benzol, benzen, benzole
Bromodichloromethane	32101	75–27–4	Dichlorobromomethane
Bromoform	32104	75–25–2	Tribromomethane
Carbon disulfide	77041	75–15–0	Dithiocarbonic Anhydride
Carbon tetrachloride	32102	56–23–5	Tetrachloromethane
Chlorobenzene	34301	108–90–7	Monochlorobenzene
Chloroethane	34311	75–00–3	Ethyl chloride
Chloroform	32106	67–66–3	Trichloromethane
Dibromochloromethane	32105	124–48–1	Chlorodibromomethane
1,2–Dibromo–3–chloropropane	38437	96–12–8	DBCP
1,2–Dibromoethane	77651	106–93–4	EDB; Ethylene dibromide
o–Dichlorobenzene	34536	95–50–1	1,2–Dichlorobenzene
m–Dichlorobenzene	34566	541–73–1	1,3–Dichlorobenzene
p–Dichlorobenzene	34571	106–46–7	1,4–Dichlorobenzene 8021, 8260
Dichlorodifluoromethane	34668	75–71–8	Freon 12, Difluorodichloromethane
1,1–Dichloroethane	34496	75–34–3	
1,2–Dichloroethane	32103	107–06–2	Ethylene dichloride
1,1–Dichloroethylene	34501	75–35–4	Vinylidene chloride
cis–1,2–Dichloroethylene	77093	156–59–2	cis–1,2–Dichloroethene
Trans–1,2–Dichloroethylene	34546	156–60–5	trans–1,2–Dichloroethene
1,2–Dichloropropane	34541	78–87–5	
cis–1,3–Dichloropropylene	34704	10061–01–5	cis–1,3–Dichloropropene, Z–Dichloropropylene
Trans–1,3–Dichloropropylene	34699	10061–02–6	trans–1,3–Dichloropropene, E–Dichloropropylene
Ethylbenzene	78113	100–41–4	Phenylethane
Methyl bromide	34413	74–83–9	Bromomethane
Methyl chloride	34418	74–87–3	Chloromethane
Methylene bromide	77596	74-95-3	Dibromomethane
Methylene chloride	34423	75–09–2	Dichloromethane
Methyl ethyl ketone	81595	78–93–3	2–Butanone; MEK
Methyl tert–butyl ether	78032	1634–04–4	MTBE
Naphthalene	34696	91–20–3	Camphor Tar, Naphthalin
Styrene	77128	100–42–5	Ethenylbenzene
Tetrachloroethylene	34475	127–18–4	Tetrachloroethene; Perchloroethylene; PCE; Perc
Tetrahydrofuran	81607	109–99–9	THF
Toluene	78131	108–88–3	Methylbenzene
1,1,1–Trichloroethane	34506	71–55–6	Methylchloroform
1,1,2–Trichloroethane	34511	79–00–5	
Trichloroethylene	39180	79–01–6	Trichloroethene; TCE
Trichlorofluoromethane	34488	75–69–4	Fluorotrichloromethane, Freon 11

Common name	GEMS Param. No.	CAS RN	Synonyms
Vinyl chloride	39175	75–01–4	Chloroethene
Xylenes (total)	81551	1330–20–7	Dimethylbenzene
Sulfate, dissolved	00946	14808-79-8	
Arsenic, dissolved	01000	7440-38-2	
Cadmium, dissolved	01025	7440-43-9	
Chromium, dissolved	01030	7440-47-3	Chrome
Lead, dissolved	01049	7439-92-1	Plumbum
Mercury, dissolved	71890	7439-97-6	Quick silver
Boron, dissolved	01020	7440-42-8	
Strontium, dissolved	01080	7440-24-6	
Molybdenum, dissolved	01060	7439-98-7	

Note: Xylenes (total): This entry includes o–xylene (CAS RN 96–47–6), m–xylene (CAS RN 108–38–3), p–xylene (CAS RN 106–42–3), and unspecified xylenes (dimethylbenzenes) (CAS RN 1330–20–7).

Source: s. NR 507, Wis. Adm. Code, Appendices III and IV

Appendix F
Example Proposals for Groundwater Monitoring

Table 5: Example of semi-annual monitoring at a closed municipal solid waste (MSW) landfill:

Closed Municipal Solid Waste Landfill – License # 0000B Semiannual Groundwater Monitoring Requirements as of date		
Monitoring Well (Point ID #)	**Frequency**	**Parameters (Parameter #s)**
MW-1 (001) MW-2 (002) MW-3 (003)	Semiannual (April & October) *(pick your months)*	00010 Temperature, Field 00094 Specific Conductance (umhos/cm @ 25 C), Field 00400 pH, Field 04189 Groundwater Elevation (ft above MSL) 00940 Chloride, Total or Dissolved 22413 Hardness, Total Filtered 39036 Alkalinity, Total Filtered
	Annual (October) *(pick your month)*	VOCs Using an EPA SW-846 or s. NR 219.04, Wis. Adm. Code method that otherwise meets s. NR 507.17(4), Wis. Adm. Code
Note sample odor (00001), color (00002) and turbidity (00003), if present. Note well broken (00004), well frozen (00005), and groundwater monitoring well dry (00006) if applicable. Unless approved otherwise, sample collection and handling should be conducted in accordance with the Department's "Groundwater Sampling Desk Reference" and "Groundwater Sampling Field Manual", publication numbers PUBL-DG-037 96, and PUBL-DG-038 96 respectively.		

(Note: It may be possible to reduce monitoring of up-gradient and side-gradient wells to less than semi-annual.)

Table 6: Example of annual monitoring at a MSW landfill:

Closed Municipal Solid Waste Landfill – License # 0000C Annual Groundwater Monitoring Requirements as of date		
Monitoring Well (Point ID #)	**Frequency**	**Parameters (Parameter #s)**
MW-1 (001) MW-2 (002) MW-3 (003)	Annual (October) *(pick your month)*	00010 Temperature, Field 00094 Specific Conductance (umhos/cm @ 25 C), Field 00400 pH, Field 04189 Groundwater Elevation (ft above MSL) 00940 Chloride, Total or Dissolved 22413 Hardness, Total Filtered 39036 Alkalinity, Total Filtered 01000 Arsenic, Dissolved 01025 Cadmium, Dissolved 01030 Chromium, Dissolved 01049 Lead, Dissolved 71890 Mercury, Dissolved 00946 Sulfate, Dissolved VOCs Using an EPA SW-846 or s. NR 219.04, Wis. Adm. Code method that otherwise meets s. NR 507.17(4), Wis. Adm. Code
Note sample odor (00001), color (00002) and turbidity (00003), if present. Note well broken (00004), well frozen (00005), and groundwater monitoring well dry (00006) if applicable. Unless approved otherwise, sample collection and handling should be conducted in accordance with the Department's "Groundwater Sampling Desk Reference" and "Groundwater Sampling Field Manual", publication numbers PUBL-DG-037 96, and PUBL-DG-038 96 respectively. Arsenic, cadmium, chromium, lead, mercury, and sulfate can be removed from the monitoring requirements if no PAL exceedances occur for that parameter in 4 consecutive sampling events. The DNR may request that monitoring be resumed for these parameters prior to termination of monitoring.		

Table 7: Example of semi-annual monitoring at a construction and demolition (C&D) landfill:

Small Sized C&D Landfill, – Monitoring ID # 0000E Annual Groundwater Monitoring Requirements as of Date		
Monitoring Well (Point ID #)	**Frequency**	**Parameters (Parameter #s)**
MW-1 (001) MW-2 (002) MW-3 (003)	Annual (April) *(pick your month)*	00094 Field Specific Conductance (umhos/cm @ 25 C) 00400 Field pH 04189 Groundwater Elevation (ft above MSL) 00941 Chloride, Dissolved 22413 Hardness, Total Filtered 39036 Alkalinity, Total Filtered 00946 Sulfate, Dissolved 01000 Arsenic, Dissolved 01025 Cadmium, Dissolved 01030 Chromium, Dissolved 01049 Lead, Dissolved 71890 Mercury, Dissolved VOCs Using an EPA SW-846 or s. NR 219.04, Wis. Adm. Code method that otherwise meets s. NR 507.17(4), Wis. Adm. Code
Note sample odor (00001), color (00002) and turbidity (00003), if present. Note well broken (00004), well frozen (00005), and groundwater monitoring well dry (00006) if applicable. Unless approved otherwise, sample collection and handling should be conducted in accordance with the Department's "Groundwater Sampling Desk Reference" and "Groundwater Sampling Field Manual", publication numbers PUBL-DG-037 96, and PUBL-DG-038 96 respectively. Arsenic, cadmium, chromium, lead, mercury, and sulfate can be removed from the monitoring requirements if no PAL exceedances occur for that parameter in 4 consecutive sampling events. The DNR may request that monitoring be resumed for these parameters prior to termination of monitoring.		

Table 8: Example of annual monitoring at a C&D landfill:

Small Sized C&D Landfill, – Monitoring ID # 0000D Semiannual Groundwater Monitoring Requirements as of Date		
Monitoring Well (Point ID #) (WUWN)	**Frequency**	**Parameters (Parameter #s)**
MW-1 (001) MW-2 (002) MW-3 (003)	Semiannual (April & October) *(pick your months)*	00094 Field Specific Conductance (umhos/cm @ 25 C) 00400 Field pH 04189 Groundwater Elevation (ft above MSL) 00941 Chloride, Dissolved 22413 Hardness, Total Filtered 39036 Alkalinity, Total Filtered 00946 Sulfate, Dissolved
	Annual (April) *(pick your month)*	VOCs Using an EPA SW-846 or s. NR 219.04, Wis. Adm. Code method that otherwise meets s. NR 507.17(4), Wis. Adm. Code
Note sample odor (00001), color (00002) and turbidity (00003), if present. Note well broken (00004), well frozen (00005), and groundwater monitoring well dry (00006) if applicable. Unless approved otherwise, sample collection and handling should be conducted in accordance with the Department's "Groundwater Sampling Desk Reference" and "Groundwater Sampling Field Manual", publication numbers PUBL-DG-037 96, and PUBL-DG-038 96 respectively.		

Appendix G

Other considerations regarding environmental monitoring associated with some closed landfills:

1. The Department has the authority to reduce leachate head well monitoring and sampling, if such a change is justified. These measures of landfill performance have significance both for measuring impacts and for assessing the internal behavior of the waste mass. Discuss this topic with the hydrogeologist or engineer assigned to the site prior to requesting a change to leachate monitoring.

2. The Department has the authority to reduce landfill gas monitoring, if such change is justified. A reduction to landfill gas probe monitoring may be considered if there are not current or historical gas migration issues at the landfill. Discuss this topic with the hydrogeologist or engineer assigned to the site prior to requesting a change in gas monitoring.