

How To Read and Interpret a Lab Report

*What You Don't Know
CAN hurt You.*

“Environment '09”
Session # 03-B 1:15 PM
Tuesday 10/20/2009

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- No two are a like.
- Similar, yes...but also quite different.
- NR 149 (Lab certification Admin. Code) offers flexibility in meeting requirements.
- NR149 specifies what information must be presented....
- ...but not how it is presented.



Lab Reports are like DNA

- What are the Code Requirements for reports?
- Is the lab properly certified for the analyte, technology, and matrix involved?
- Are subcontracted results properly noted?
- Are the lab's LODs/LOQ adequate
- Are you on the same page in terms of "lists"?
- What resources are available to assist you?



Questions to answer

- (1)(a)** The results of each test must be reported in accordance with any requirements in approved methods or by the department.
- (1)(c)** If testing is done for internal clients, or under a written client agreement, lab reports do not have to contain all the info specified in this section. However, lab must still these records.
- (1)(d)** • Labs operated by a facility required to submit compliance data for covered programs must keep records that include all "Required Report" items.

Exemptions from report requirements

- Lab reports do not have to include all "Required Report" items if:

1. The lab prepares reports in a DNR specified format (ex. DMRs, TAD)
2. The lab provides data to someone else in the facility who prepares and submits reports in a DNR specified format (ex. DMRs).



Code Requirements for lab reports

Laboratory test reports (NR 149.47)

(1)(e) Unless otherwise specified by DNR, [or as exempted by^{5 of 90}
(1)(c) and (d), **lab reports must include at least:**

1. Name, address, phone#, and contact of the lab that did the testing.
2. The lab's certification or registration ID #.
3. Name and address of the client/entity.
4. The sample codes or IDs provided by the client or collector.
5. Methods used for analysis.
6. The collection date of the samples.
7. The date of receipt of the samples.
8. For samples submitted to analytical preparation steps, such as digestions or extractions, with identified holding times in department regulations, the date in which such steps were performed.
9. The date of analysis.
10. Results of analyses and reporting units.

- a. Dilution factors (if samples required dilution).
- b. If reported on a dry weight basis, the solids content and a note that results have been adjusted for the solids content.



Required elements for lab reports

Laboratory test reports (NR 149.47)

(1)(e) **Unless otherwise specified by DNR, [or as exempted by (1)(c) and (d)], lab reports must include at least:**

11. IF reporting to the LOD is required: LOD and LOQ for each sample.

- a. If a sample is diluted, note whether LOD & LOQ have been adjusted by the dilution factor.
- b. If reported on a dry weight basis, the solids content and note whether LOD and LOQ have been adjusted for the solids content.

12. Names and signatures of parties authorizing results.

13. Any deviations from NR149 or method requirements, when the deviations affect the validity/ defensibility of results

- a. Can be described by narratives, flags or qualifiers.
- b. If use flags or qualifiers, a key to flag's meaning must be provided.

14. The date of the test report.



Required elements for lab reports

NR 149.47 - "Required Lab Report Items"

(2) Amended Lab Reports

(a) **Must clearly specify**

- what was amended,
- reason for the change, and
- must reference the original lab test report.

(b) Must comply with all other report requirements.

(3) Reporting results from subcontract labs.

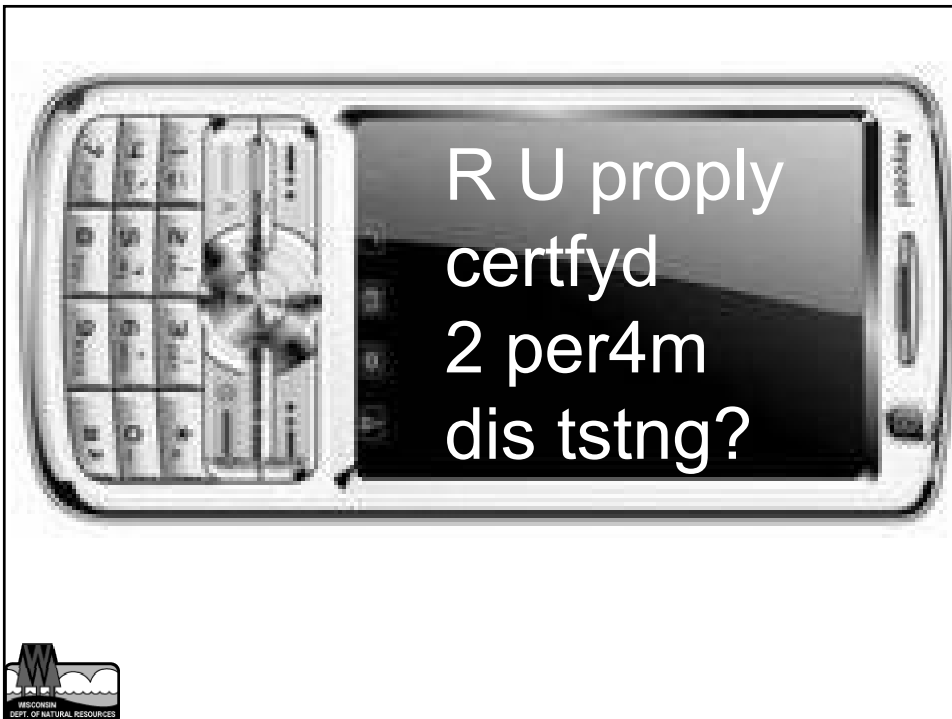
(a) If report any results from a subcontract lab, must...

- include any qualifiers reported by the subcontractor,
- include subcontractor's lab ID

(b) Upon request by the lab or the DNR subcontractor labs must provide all the "Required Report Items".



NR 149.47-"Amended & Subcontract Lab Reports"



Report Date 14-Jul-09

Project Name
 Project #
 Lab Code 5019217A
 Sample ID 7-1-09-E
 Sample Matrix soil
 Sample Date 7/1/2009

If a lab reports any results from a subcontract lab, the report must include the subcontractor's lab ID


	Result	Unit	LOD	LOQ	Dil	Method	Ext Date	Run Date	Analyst	Code
Pesticides 8081										
Chlordane	< 0.003	mg/kg	0.003	0.2	1	8081A	?	7/9/2009	ESC	1

"J" Flag: Analyte detected between LOD and LOQ LOD Limit of Detection LOQ Limit of Quantitation

Code	Comment
1	Laboratory QC within limits.

ESC denotes sub contract lab - Certification #998093910

All solid sample results reported on a dry weight basis unless otherwise indicated. All LOD's and LOQ's are adjusted for dilutions but not dry weight.



Example: Notation of subcontract lab


Parameter	Result	Units	Dil	LOD	LOQ	Method	Analyst	Date Analyzed
Sample Number: 120676			Date Collected: 7/2/2009		Composite			
Sample Description: 002								
Copper - low level	36.6	ug/L	EMT	6.25	8.12	24.4	EPA 200.8	7/14/2009
Metals Digestion (Low Level)	DONE		EMT				SW 301S	7/13/2009
Ammonia Nitrogen	0.44*	mg/L	1	0.25	0.8		SM 4500 NH3-D	NMB 7/13/2009
Ammonia Nitrogen (prep)	Done						SM 4500 NH3-B	NMB 7/9/2009
Biochemical Oxygen Demand	6.5	mg/L	1.5	2.01	6.4		SM 5210 B	HDW 7/2/2009
Chloride, Total	295	mg/L	20	21	67		SM 4500 CL B	DRL 7/10/2009
Total Suspended Solids	<2.0	mg/L	2	2	64		SM 2540 D	HDW 7/2/2009

LOD = Limit of Detection LOQ = Limit of Quantitation * = Result falls between LOD and LOQ
 All LOD and LOQs have been adjusted to reflect dilution.
 All LOD and LOQs are reported on a "wet weight basis".
 "SM" Methods refer to the 19th edition of Standard Methods for the Examination of Water and Wastewater

EMT Analyzed by Environmental Monitoring Technologies, WI Lab certification #999888890. Results are based on Practical Quantitation Limits (PQL).

Comments:

If a lab reports any results from a subcontract lab, the report must include the subcontractor's lab ID



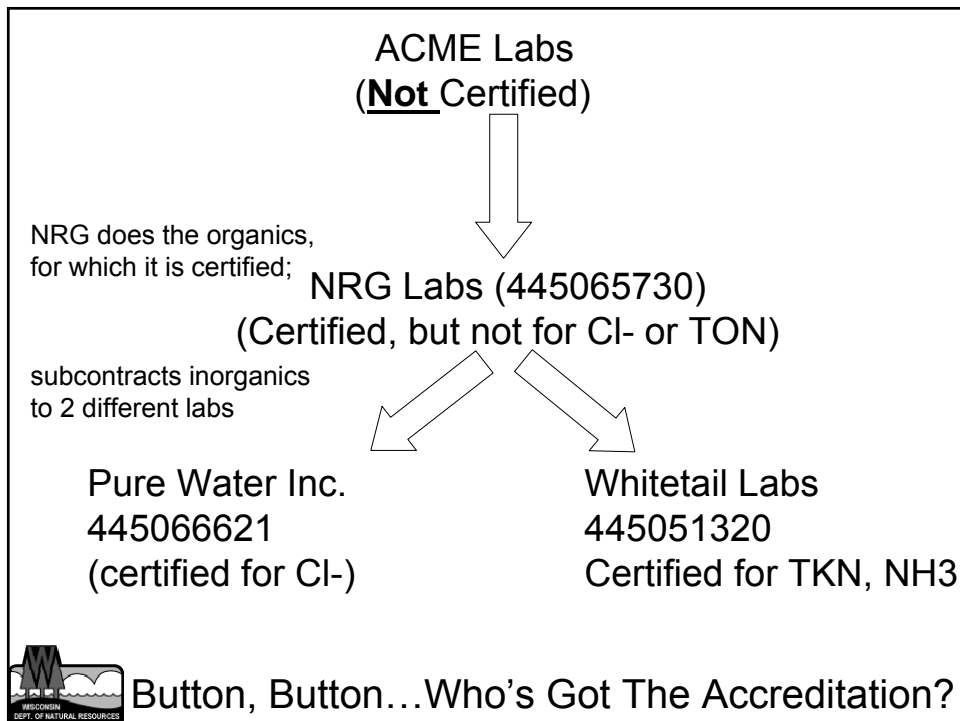
Subcontracting – another example

Let's suppose...

- Data comes in from an out-of-state lab that is not certified in Wisconsin...let's call them ACME Labs
- ACME Labs reports that the LabCert certification number for the testing performed is 445888000. Tests analyzed are Nitrogen; Organic Dissolved, Chloride and other parameters
- The number 445888000 belongs to a lab (NRG Labs) that is certified by WI, but not for the tests performed.
- Who is on the hook? The out-of-state lab (ACME)? The lab identified (NRG)? The client?
- Or maybe there's more to the story.



Sub-Sub Contracting



- Be aware of the certifications held by your contract lab.
- Understand what analyses they might subcontract.
- Familiarize yourself with how subcontracted results are reported.
- Know that the DNR programs are checking each reported analysis against our certification database.



Moral of the story

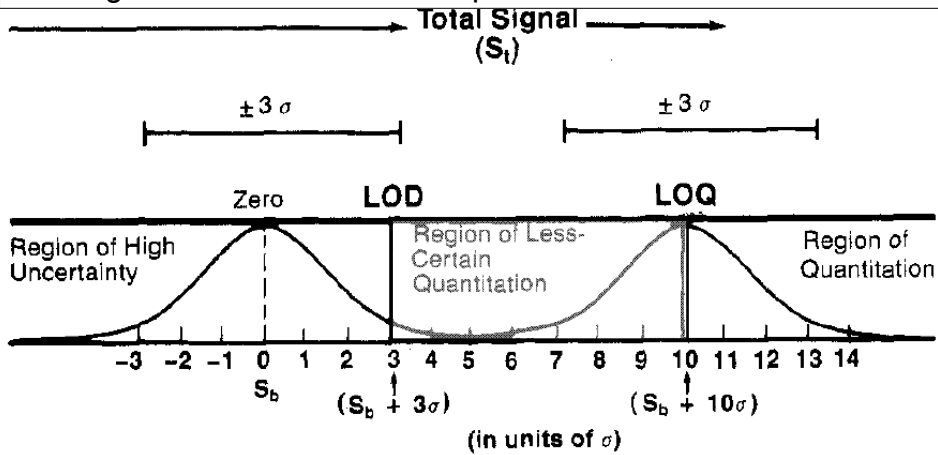
THE
OUTER
LIMITS

Classic paper

LOD defined as 3 standard deviations of replicate blank analysis

LOQ defined as 10 standard deviations of replicate blank analysis

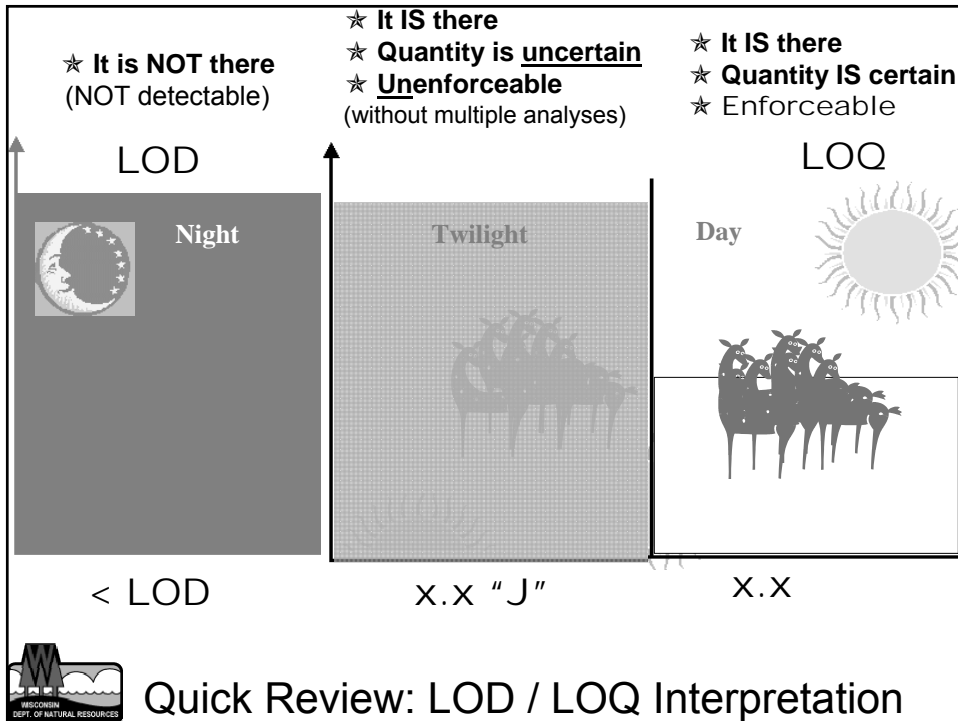
Leading to the classic relationship that the LOQ = 10/3 LOD



"Principles of Environmental Analysis", Analytical Chemistry, volume 55, 1983.



What's That Mean?



So...LOD is the point at which an analyte is detectable.
But the LOQ is the point at which quantitation is accurate.

NR 149.03 (71) “Reporting limit” means a concentration or amount of analyte required by the department or client above which numerical results must be reported. **Reporting limits may be LODs, LOQs, PQLs, or other concentrations, and may be specific to a project or investigation.**

NR 149.44 (5)(e)

Laboratories reporting results at levels at or near the LOD of an analysis shall include in initial calibrations a standard at a concentration near the LOQ of the analysis.

NR 149.48 (2)(f) Laboratories shall establish procedures to relate LODs to LOQs.



NR149 RE: LOD, LOQ, Report Limits

PALs and LODs and
LODs... Oh My!



NR140.16

(2) The laboratory shall select the analytical methodology which:

(a) Is specified in rules or approved by the regulatory agency, and

(b) Is appropriate for the concentration of the sample, and

(c) Is one of the following:

1. Has a LOD and LOQ below the PAL, or
2. Produces the lowest available LOD and LOQ if the LOD and LOQ are above the PAL.



NR140 Groundwater Rules

- NR140.14 (1) and (2) tell what happens if a PAL or Enforcement Standard is exceeded.
- NR140(3) says that the following apply when the PAL or Enf. Std are below the LOQ
 - (a) says that if the lab reports < LOD, we cannot say the PAL/ES have been attained/exceeded
 - (b) says that if the PAL or ES is < LOD and a compound is reported between the LOD and LOQ then the PAL (or ES) is attained/exceeded IF:
 - 1. the compounds have been confirmed by an equally sensitive method or the same method, AND
 - 2. the compound has been statistically determined to be present (based on multiple analyses and statistical tests)
 - (c) says that if the PAL/ES is between the LOD and LOQ, then the PAL/ES is exceeded if the compound is reported above the LOQ.

Strategy: set the LOQ as high as possible????



NR 140 Groundwater Rules

NO Violation IF

- Substance reported: $< \text{LOD}$

Possible Violation IF

- PAL/Enf. Std is $< \text{LOD}$ and
 - $\text{LOD} < \text{Substance reported} < \text{LOQ}$
 - *Requires analytical and statistical confirmation*

Violation IF



- $\text{LOD} < \text{PAL/Enf. Std} < \text{LOQ}$
 - Substance reported: $> \text{LOQ}$



Translation: if PAL/ Enf. Std $< \text{LOQ}$

Substance	Enforcement Standard also =the SDWA MCL (all units ug/L)	PAL (Preventive Action Limit)
Antimony	6	1.2
Arsenic	10	1
Cadmium	5	0.5
Lead	15	1.5
Thallium	2	0.4
<hr/>		
Benzene	5	0.5
1,2-Dibromoethane (EDB)	0.05	0.005
1,1,2,2-Tetrachloroethane	0.2	0.02
Vinyl chloride	0.2	0.02
<hr/>		
Benzo(a)pyrene	0.2	0.02
Di (2-ethylhexyl) phthalate	6	0.6
2,4-Dinitrotoluene	0.05	0.005
Pentachlorophenol (PCP)	1	0.1



Analytes with **low** NR 140 PALs

Some School District				Home Owner		A School				
Lab #				Well ID/Address		CUSTODIAN CLOSET SAMP				
Sample Type				Well City						
Drinking Water										
Sample Date										
10/19/2006										
Report Date										
20-Oct-06										
Analyte	Result	Units	LOD	LOQ	Vol	Run Date	Method	Analyst	QC Code	
Antimony - ICP	< 32.7	ug/L	32.7	104	1	0/19/2006	200.7	NMP	1	
This is not a certified method for this element, and is for informational purposes only. If a certified result with a lower detection limit is necessary please contact the laboratory for more information.										
Arsenic - ICP	< 6.3	ug/L	6.3	20	1	0/19/2006	200.7	NMP	1	
This is not a certified method for drinking water, and is for informational purposes only. If a certified result with a lower detection limit is necessary please contact the laboratory for more information.										
Cadmium	< 0.3	ug/l	0.3	1.1	1	0/19/2006	200.7	NMP	1	
(as total Cd) Maximum Contaminant Limit is 10 ug/L (ppb).										
Lead - ICP	7.164	ug/L	1.3	4.1	1	0/19/2006	200.7	NMP	1	
This is not a certified method for this element, and is for informational purposes only. If a certified result with a lower detection limit is necessary please contact the laboratory for more information.										
Selenium - ICP	8.879	ug/L	4.4	14.1	1	0/19/2006	200.7	NMP	1	
This is not a certified method for drinking water, and is for informational purposes only. If a certified result with a lower detection limit is necessary please contact the laboratory for more information.										
Thallium - ICP	< 4.3	ug/L	4.3	13.5	1	0/19/2006	200.7	NMP	1	
This is not a certified method for this element, and is for informational purposes only. If a certified result with a lower detection limit is necessary please contact the laboratory for more information.										

Example: Are the LODs/LOQs sufficient?

Analyte Lists - Getting on the same page

You order “VOCs” from your contract lab...

- EPA 624 lists 31 analytes
- The “Priority Pollutant” list includes 35 VOCs
- The “Appendix IX” list includes 55 VOCs
- WI DNR has identified 61 VOCs ‘of interest’
- SW-846 8260A lists 97 VOC analytes
- SW-846 8260B lists 108 VOC analytes
- SW-846 8260C lists 111 VOC analytes

So...what VOCs does your lab report?



Make a list. Check it twice

- Verify your contract lab’s list of contaminants!
- The term ‘VOC’ means different “lists” to different labs.
- What ‘list’ of analytes do YOU require?
- WI has identified 62 VOCs ‘of interest’. This should serve as a framework for any lab’s “list”.
- Know which ones you need....and more importantly, check with your lab to be sure their ‘list’ covers YOUR list.



there is no universal “list” of contaminants



RESOURCES

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<http://www.dnr.state.wi.us/org/es/science/lc/>
Laboratory Certification & Registration Program

[Link to NR149 revisions information page](#)
[Link to printable Analyte Group lists](#) ←


About Wisconsin's Certification Program
The Department of Natural Resources certifies and registers laboratories to perform soil, water and waste testing for many of the agency's environmental programs. Certified and registered laboratories must meet all the criteria outlined in Ch. NR 149, Wis. Adm. Code. Certification, registration or acceptance of a laboratory by the State of Wisconsin is not a guarantee of the quality of data generated by that laboratory. Instead, the certification and registration program insures that laboratories have the appropriate systems in place to generate reliable data. For more information about the program, see the [Program Overview](#).

[What's new](#) in the Laboratory Certification & Registration Program?

Recognition of Other Certification Programs
The Department is not a National Environmental Laboratory Accreditation Program (NELAP) Accrediting Authority and does not recognize NELAP accreditation issued by other state or federal agencies in lieu of certification under Ch. NR 149, Wis. Adm. Code.

The DNR maintains [reciprocity agreements](#) with several other states for specific regulatory programs.

QuickLink: <http://tinyurl.com/WI-LabCert>

 **DNR LabCert Main web page**

<http://www.dnr.state.wi.us/org/es/science/lc/INFO/analyteGRP.htm>

- LabCert Program
- Current News Briefs
- Frequently Asked Questions (FAQ)
- Program Information
 - Newletter (LabNotes)
 - Lab-of-the-Year Award
 - Program Background
 - Reciprocity Agreements
 - Is Certification Required?
 - DNR Programs Requiring Certification
 - Certifications Offered
 - Required LODs
 - Low Level Mercury
- Water Testing
- Program Contacts
- Administrative Rules

Analyte Groups Explained

"Analyte group" is defined in s. 149.03 (5) as: "Analyte group" means a set of analytes that can be determined using the same method or technology and that constitute a unit, acknowledged by the department, of the third tier of certification or registration.

The selection of an analyte group for certification or registration means that your certification/registration for the group extends to all analytes that make up that group.

Examples of "analyte groups" which have been established for certification are listed below. Each of these groups is available for either the Aqueous or Solid matrices.

- [BNA Analyte Group](#) (Technology = GC/MS) [Rev. 1, Nov.2008 PDF 36KB]
- [VOC Analyte Group](#) (Technology = GC) [Rev. 1, Nov.2008 PDF 24KB]
- [VOC Analyte Group](#) (Technology = GC/MS) [Rev. 1, Nov.2008 PDF 24KB]
- [PAH Analyte Group](#) (Technology = GC/MS) [Rev. 0, Sep.2008 PDF 20KB]
- [PAH Analyte Group](#) (Technology = HPLC or GC) [Rev. 0, Sep.2008 PDF 20KB]
- [Pesticides, Organochlorine Analyte Group](#) (Technology = GC) [Rev. 0, Sep.2008 PDF 52KB]
- [Pesticides, Organochlorine Analyte Group](#) (Technology = GC/MS) [Rev. 0, Sep.2008 PDF 52KB]
- [PCB as Aroclors Analyte Group](#) (Technology = GC or GC/MS) [Rev. 0, Sep.2008 PDF 20KB]
- [PCB Congeners Analyte Group](#) (Technology = GC, GC/MS, or HRGC/MS) [Rev. 0, Sep.2008 PDF 28KB]



Analyte Groups

Wisconsin Department of Natural Resources

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<http://www.dnr.state.wi.us/org/es/science/lc/LABS/Lablists.htm>

Wisconsin Certified Lab Lists

LabCert Program

Outreach

Science Services

Lists of Certified and Registered Laboratories

Commercial Laboratories

 [updated 2/27/2009; PDF 658 KB]

This list includes all commercial laboratories currently certified or accepted under reciprocity. This list does not include public laboratories or noncommercial private labs. Contains testing parameter information.

NON-Commercial CERTIFIED Laboratories

 [updated 2/27/2009; PDF 198 KB]

This list includes all NON-commercial laboratories currently certified to perform testing for facilities other than their own. This list basically includes public laboratories, industrial labs, and small municipal wastewater labs. Contains testing parameter information.

Safe Drinking Water Chemistry Testing Labs

 [updated 2/27/2009; PDF 157 KB]

This list includes all of the laboratories currently certified or accepted under reciprocity to analyze safe drinking water samples for Wisconsin compliance. Contains testing parameter information.

Safe Drinking Water Arsenic Testing Labs

 [updated 2/27/2009; PDF 76 KB]

This list includes all of the laboratories currently certified or accepted under reciprocity to analyze Arsenic in safe drinking water samples for Wisconsin compliance.

Lists of Labs Certified for Specific Parameters

Low-Level Mercury Capability Labs

 [updated 2/27/2009; PDF 72 KB]

This list includes laboratories that are certified or registered to perform low-level mercury determinations in aqueous or solid matrices.

Pesticide and Herbicide Labs

 [updated 2/27/2009; PDF 170 KB]

This list includes laboratories that are certified to perform analytical testing for pesticides and herbicides in all sample matrices. Some of the labs on this list are certified to analyze for pesticides in drinking water.

LabCert "Lists" of specific certified labs

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LabCert Program

Wisconsin Certified Lab Lists

List of All Laboratories by Certification Type

Registered Labs [updated 2/27/2009; PDF 143 KB]
 This list includes all of the currently registered laboratories in the program. These labs are not able to contract for analytical work. Contains testing parameter information.

Certified and Reciprocity Labs [updated 2/27/2009; PDF 320 KB]
 This list includes all of the labs currently certified or accepted under reciprocity. These labs are able to contract for analytical chemistry work. Contains testing parameter information.

Laboratory Lists From Other Certifying Agencies

Safe Drinking Water Bacti Testing Labs (exit DNR)
 These are approved by the Department of Agriculture to perform bacti testing on drinking water for Wisconsin compliance.

Approved Radiological Testing Labs
 The Department lacks the authority to certify labs for radiological testing but accepts results generated by any laboratory accepted, approved, or accredited by the EPA.

More "Lists" available

Pure Water Inc.
 ID: 445066621
 Any Address
 Any City WI 55555
 Phone: (800) PUREH2O
 Contact: Joe the Lab Guy

 TYPE: Commercial Environmental Lab

Matrix: Aqueous

Colorimetric or Nephelometric (turbidimetric)

- Nitrate + Nitrite

Ion Chromatography (IC)

- Chloride
- Sulfate

Cold Vapor Atomic Absorption or Hydride Spectrometry

- Mercury

Graphite Furnace Atomic Absorption Spectrometry

- Antimony
- Arsenic
- Copper
- Lead
- Selenium
- Thallium

Inductively Coupled Plasma Emission Spectrometry (ICP)

- Aluminum
- Antimony
- Arsenic
- Barium

- Beryllium
- Boron
- Cadmium
- Calcium
- Chromium (Total)
- Cobalt
- Copper
- Hardness, Total as CaCO3
- Iron
- Lead
- Magnesium
- Manganese
- Molybdenum
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Strontium
- Thallium
- Vanadium
- Zinc

Matrix: Drinking Water

Primary Inorganic Contaminants (Non-Metals)

- Fluoride - EPA 300.0
- Nitrate - Std Methods 4500-NO3-F (18, 19 or 20)
- Nitrate + Nitrite - Std Methods 4500-NO3-F (18, 19, or 20)
- Nitrite - Std Methods 4500-NO2-B (18, 19 or 20)

Primary Inorganic Contaminants (Metals)

- Antimony - Std Methods 3113B (18 or 19)
- Arsenic - Std Methods 3113B (18 or 19)
- Barium - EPA 200.7
- Beryllium - EPA 200.7
- Cadmium - EPA 200.7
- Chromium - EPA 200.7
- Copper - EPA 200.7
- Copper - SM 3113B (18 or 19)
- Lead - Std Methods 3113B (18 or 19)
- Mercury - EPA 245.1
- Nickel - EPA 200.7
- Selenium - Std Methods 3113B (18 or 19)
- Thallium - EPA 200.9

Secondary Contaminants (Non-Metals)

- Sulfate - EPA 300.0

Secondary Contaminants (Metals)

- Sodium - EPA 200.7

Matrix: Solid

Cold Vapor Atomic Absorption or Hydride Spectrometry

- Mercury

Inductively Coupled Plasma Emission Spectrometry (ICP)

- Arsenic
- Barium
- Cadmium
- Chromium (Total)
- Lead
- Selenium
- Silver

Sample LabCert web certification list

1. Be aware of a lab's accreditations.
2. Be on the same page with your lab regarding analyte "lists" for multi-analyte methods.
3. Be aware of a lab's LODs and LOQs and how they relate to action levels such as PALs and MCLs.
4. Use the resources on the DNR LabCert website to assist you in evaluating a lab's capabilities.



4 Things for you to take away



Thank YOU!