



How Well Do You Know Lab Reports? Making Sense Out of Seemingly Simple Lab Reports

Railroad Environmental Conference

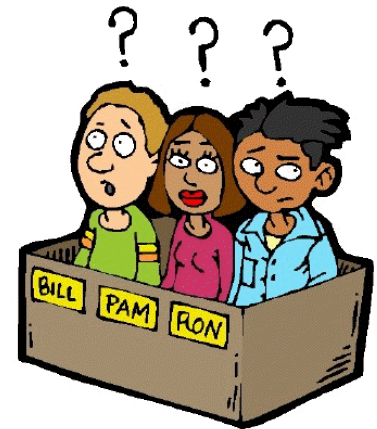
University of Illinois at Urbana-Champaign
November 1 and 2, 2016

Erin E. Rodgers – Environmental Standards, Inc.
Lester J. Dupes, CEAC – Environmental Standards, Inc.
L. Christopher Oakes – Norfolk Southern Company



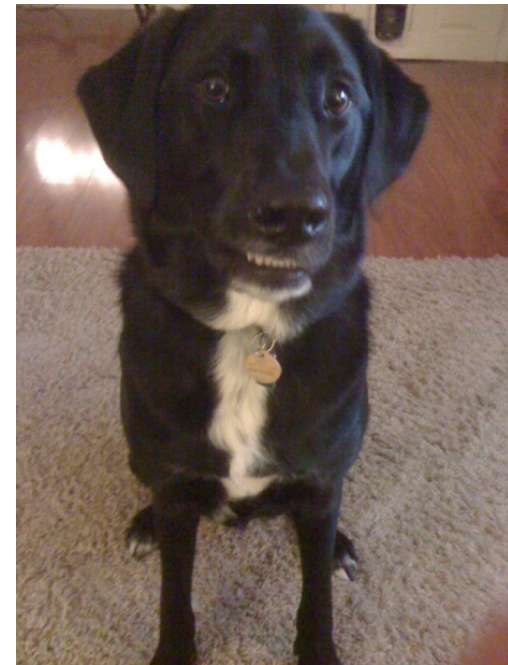
Agenda

- Introduction
- Example Lab Report
- Pop Quiz
- Summary
- Conclusions



Can we agree that...

- Environmental laboratory reports can be confusing.
- Idiosyncrasies, nuances, and “members only” language appear on every page.
- Remediation and capital improvement decisions are made using results from lab reports.



Analytical Results Summary

ANALYTICAL RESULTS									
Project:	XYZ SITE								
Trace Project No.:	123456789								
Sample:	MW	Lab ID:	123456789001	Collected:	02/29/16 14:05	Received:	02/29/16 17:40	Matrix:	Water
Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8315 W HPLC	Analytical Method: EPA 8315 Preparation Method: EPA 8315								
Formaldehyde	25.2	ug/L	0.10	0.027	1	03/02/16 14:30	03/02/16 21:16	50-00-0	N2
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3010A								
Aluminum	1780	ug/L	100	50.0	1	03/02/16 18:00	03/03/16 20:07	7429-90-5	
Antimony	ND	ug/L	5.0	3.9	1	03/02/16 18:00	03/03/16 20:07	7440-36-0	
Chromium	4.2J	ug/L	5.0	2.5	1	03/02/16 18:00	03/03/16 20:07	7440-47-3	
Cobalt	ND	ug/L	5.0	2.5	1	03/02/16 18:00	03/03/16 20:07	7440-48-4	
Lead	ND	ug/L	5.0	2.5	1	03/02/16 18:00	03/03/16 20:07	7439-92-1	
Manganese	34.6	ug/L	5.0	2.5	1	03/02/16 18:00	03/03/16 20:07	7439-96-5	
Nickel	2.5J	ug/L	5.0	2.5	1	03/02/16 18:00	03/03/16 20:07	7440-02-0	
8260 MSV Low Level	Analytical Method: EPA 8260								
Naphthalene Surrogates	ND	ug/L	1.0	0.24	1		03/02/16 02:51	91-20-3	
4-Bromofluorobenzene (S)	96	%	70-130		1		03/02/16 02:51	460-00-4	
1,2-Dichloroethane-d4 (S)	101	%	70-130		1		03/02/16 02:51	17060-07-0	
Toluene-d8 (S)	100	%	70-130		1		03/02/16 02:51	2037-26-5	
8260 MSV SIM	Analytical Method: EPA 8260B Mod.								
1,4-Dioxane (p-Dioxane) Surrogates	ND	ug/L	2.0	1.9	1		03/11/16 14:09	123-91-1	
1,2-Dichloroethane-d4 (S)	107	%	50-150		1		03/11/16 14:09	17060-07-0	
Toluene-d8 (S)	105	%	50-150		1		03/11/16 14:09	2037-26-5	
9040 pH	Analytical Method: EPA 9040								
pH	6.6	Std. Units	0.10	0.10	1		03/03/16 12:15		H6
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Fluoride	0.26J	mg/L	0.50	0.25	1		03/02/16 15:31	16994-48-8	
350.1 Ammonia	Analytical Method: EPA 350.1								
Nitrogen, Ammonia	0.055J	mg/L	0.10	0.050	1		03/04/16 17:13	7664-41-7	
353.2 Nitrogen, NO2/NO3 unpres	Analytical Method: EPA 353.2								
Nitrogen, Nitrate	0.012J	mg/L	0.020	0.010	1		03/01/16 22:26		
385.1 Phosphorus, Total	Analytical Method: EPA 385.1								
Phosphorus	0.042J	mg/L	0.050	0.025	1		03/05/16 05:41	7723-14-0	

1. Client Site ID
2. Lab SDG ID
3. Client Sample ID
4. Lab Sample ID
5. Date Collected
6. Date Received
7. Matrix (lab)
8. Parameters Analyzed
9. Sample Results
10. Units

11. Methods – Prep/Analytical
12. Dilution Factor
13. Date Prepared
14. Date Analyzed
15. “J” Flagged Result
16. Surrogates
17. Laboratory Qualifiers
18. “ND” Result



Quality Control Summary

QUALITY CONTROL DATA

Project: XYZ Site
 Pace Project No.: 92305100

QC Batch: 321455 Analysis Method: EPA 7471
 QC Batch Method: EPA 7471 Analysis Description: 7471 Mercury
 Associated Lab Samples: 92305100001, 92305100002, 92305100003, 92305100004, 92305100005, 92305100006, 92305100007, 92305100008

METHOD BLANK: 1781578 Matrix: Solid
 Associated Lab Samples: 92305100001, 92305100002, 92305100003, 92305100004, 92305100005, 92305100006, 92305100007, 92305100008

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Mercury	mg/kg	ND	0.0050	0.00010	07/20/16 03:44	

LABORATORY CONTROL SAMPLE: 1781579

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mercury	mg/kg	.083	0.079	95	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1781580 1781581

Parameter	Units	92305051001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	Max RPD	RPD	Qual
Mercury	mg/kg	ND	.068	.076	ND	ND	0	0	75-125			M1

Pop Quiz

Laboratory Report #1 - Soil

Client Sample ID:	SB-11 (0'-2')	Lab Sample ID:	Z1235
Matrix:	Soil	Date Sampled:	3/26/16
Method:	SW846 8260B	Date Received:	3/27/16
Project:	ALW #4567	Percent Solids:	92.5%

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch	Purge Volume
Run #1	Z123456-2	1	4/1/16	AW	3/27/16	XYZ	AL1569	5.0 mL
Run #2	Z123456-3	5	4/10/16	AW	3/27/16	XYZ	AL1570	5.0 mL

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	1320	5.0	1.0	ug/kg	
108-88-3	Toluene	1.9	2.1	0.54	ug/kg	J
100-41-4	Ethylbenzene	13.5	2.1	0.43	ug/kg	
1330-20-7	Xylene (Total)	2.0	6.5	2.2	ug/kg	J

CAS No.	Surrogate Recoveries	Run #1	Run #2	Limits
1868-53-7	Dibromofluoromethane	92%	99%	87-116%
17060-07-0	1,2-Dichloroethane-D4	98%	85%	76-127%
2037-26-5	Toluene-D8	100%	96%	86-112%

> = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

MDL = Method Detection Limit

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Soil Question #1

- Which result may not be dry-weight corrected?

Laboratory Report #1 - Soil								
Client Sample ID:	SB-11 (0'-2')			Lab Sample ID:	Z1235			
Matrix:	Soil			Date Sampled:	3/26/16			
Method:	SW846 8260B			Date Received:	3/27/16			
Project:	ALW #4567			Percent Solids:	92.5%			
	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch	Purge Volume
Run #1	Z123456-2	1	4/1/16	AW	3/27/16	XYZ	AL1569	5.0 mL
Run #2	Z123456-3	5	4/10/16	AW	3/27/16	XYZ	AL1570	5.0 mL
CAS No.	Compound	Result	RL	MDL	Units	Q		
71-43-2	Benzene	1320	5.0	1.0	ug/kg			
108-88-3	Toluene	1.9	2.1	0.54	ug/kg	J		
100-41-4	Ethylbenzene	13.5	2.1	0.43	ug/kg			
1330-20-7	Xylene (Total)	2.0	6.5	2.2	ug/kg	J		
CAS No.	Surrogate Recoveries	Run #1	Run #2	Limits				
1868-53-7	Dibromofluoromethane	92%	99%	87-116%				
17060-07-0	1,2-Dichloroethane-D4	98%	85%	76-127%				
2037-26-5	Toluene-D8	100%	96%	86-112%				
> = Not detected				J = Indicates an estimated value				
RL = Reporting Limit				B = Indicates analyte found in associated method blank				
E = Indicates value exceeds calibration range				N = Indicates presumptive evidence of a compound				
MDL = Method Detection Limit								

Soil Question #1

- Which result may not be dry-weight corrected?
 - Benzene is potentially not reported on a dry-weight basis
 - The reporting limits (RLs) and method detection limits (MDLs) for the other compounds appear to be adjusted for the percent solids of 92.5%
 - Benzene RL and MDL appear to not be corrected
 - Result may or may not be corrected
 - Need to verify reported result, RL, and MDL from the raw data (also confirm with laboratory)

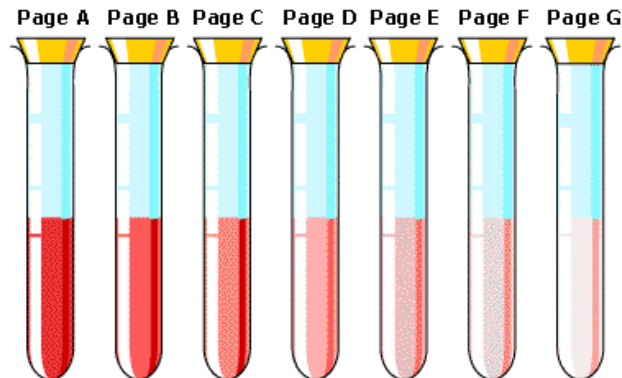
Soil Question #2

- Why were two analytical runs performed?

Laboratory Report #1 - Soil								
Client Sample ID:	SB-11 (0'-2')			Lab Sample ID:	Z1235			
Matrix:	Soil			Date Sampled:	3/26/16			
Method:	SW846 8260B			Date Received:	3/27/16			
Project:	ALW #4567			Percent Solids:	92.5%			
	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch	Purge Volume
Run #1	Z123456-2	1	4/1/16	AW	3/27/16	XYZ	AL1569	5.0 mL
Run #2	Z123456-3	5	4/10/16	AW	3/27/16	XYZ	AL1570	5.0 mL
CAS No.	Compound	Result	RL	MDL	Units	Q		
71-43-2	Benzene	1320	5.0	1.0	ug/kg			
108-88-3	Toluene	1.9	2.1	0.54	ug/kg	J		
100-41-4	Ethylbenzene	13.5	2.1	0.43	ug/kg			
1330-20-7	Xylene (Total)	2.0	6.5	2.2	ug/kg	J		
CAS No.	Surrogate Recoveries	Run #1	Run #2	Limits				
1868-53-7	Dibromofluoromethane	92%	99%	87-116%				
17060-07-0	1,2-Dichloroethane-D4	98%	85%	76-127%				
2037-26-5	Toluene-D8	100%	96%	86-112%				
> = Not detected				J = Indicates an estimated value				
RL = Reporting Limit				B = Indicates analyte found in associated method blank				
E = Indicates value exceeds calibration range				N = Indicates presumptive evidence of a compound				
MDL = Method Detection Limit								

Soil Question #2

- Why were two analytical runs performed?
 - The result for benzene required an additional dilution.
 - All other compounds were reported undiluted



Soil Question #3

- If benzene was reported from the 5-fold dilution analysis, what was the most likely lab qualifier for benzene in the initial analysis?

Laboratory Report #1 - Soil								
Client Sample ID:	SB-11 (0'-2')			Lab Sample ID:	Z1235			
Matrix:	Soil			Date Sampled:	3/26/16			
Method:	SW846 8260B			Date Received:	3/27/16			
Project:	ALW #4567			Percent Solids:	92.5%			
	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch	Purge Volume
Run #1	Z123456-2	1	4/1/16	AW	3/27/16	XYZ	AL1569	5.0 mL
Run #2	Z123456-3	5	4/10/16	AW	3/27/16	XYZ	AL1570	5.0 mL
CAS No.	Compound	Result	RL	MDL	Units	Q		
71-43-2	Benzene	1320	5.0	1.0	ug/kg			
108-88-3	Toluene	1.9	2.1	0.54	ug/kg	J		
100-41-4	Ethylbenzene	13.5	2.1	0.43	ug/kg			
1330-20-7	Xylene (Total)	2.0	6.5	2.2	ug/kg	J		
CAS No.	Surrogate Recoveries	Run #1	Run #2	Limits				
1868-53-7	Dibromofluoromethane	92%	99%	87-116%				
17060-07-0	1,2-Dichloroethane-D4	98%	85%	76-127%				
2037-26-5	Toluene-D8	100%	96%	86-112%				
> = Not detected				J = Indicates an estimated value				
RL = Reporting Limit				B = Indicates analyte found in associated method blank				
E = Indicates value exceeds calibration range				N = Indicates presumptive evidence of a compound				
MDL = Method Detection Limit								

Soil Question #3

- If benzene was reported from the 5-fold dilution analysis, what was the most likely laboratory qualifier for benzene in the initial analysis?
 - The initial analysis result for benzene was most likely over the calibration range of the instrument in the undiluted analysis which would have resulted in a laboratory qualifier of “E”.
 - Results outside the calibrated range of the instrument are inherently estimated and cannot be considered quantitative values.

Soil Question #4

- Which result was most likely not reported within the holding time?

Laboratory Report #1 - Soil								
Client Sample ID: SB-11 (0'-2')			Lab Sample ID: Z1235					
Matrix: Soil			Date Sampled: 3/26/16					
Method: SW846 8260B			Date Received: 3/27/16					
Project: ALW #4567			Percent Solids: 92.5%					
Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch	Purge Volume
Run #1	Z123456-2	1	4/1/16	AW	3/27/16	XYZ	AL1569	5.0 mL
Run #2	Z123456-3	5	4/10/16	AW	3/27/16	XYZ	AL1570	5.0 mL
CAS No.	Compound	Result	RL	MDL	Units	Q		
71-43-2	Benzene	1320	5.0	1.0	ug/kg			
108-88-3	Toluene	1.9	2.1	0.54	ug/kg	J		
100-41-4	Ethylbenzene	13.5	2.1	0.43	ug/kg			
1330-20-7	Xylene (Total)	2.0	6.5	2.2	ug/kg	J		
CAS No.	Surrogate Recoveries	Run #1	Run #2	Limits				
1868-53-7	Dibromofluoromethane	92%	99%	87-116%				
17060-07-0	1,2-Dichloroethane-D4	98%	85%	76-127%				
2037-26-5	Toluene-D8	100%	96%	86-112%				
> = Not detected				J = Indicates an estimated value				
RL = Reporting Limit				B = Indicates analyte found in associated method blank				
E = Indicates value exceeds calibration range				N = Indicates presumptive evidence of a compound				
MDL = Method Detection Limit								

Soil Question #4

- Which result was most likely not reported within the holding time?
 - Benzene was reported outside of the 14-day holding time in the diluted analysis.
 - The initial analysis was performed within holding time but was not acceptable due to needing an additional dilution.

Pop Quiz

Laboratory Report #2 - Aqueous

Client Sample ID:	MW-15	Lab Sample ID:	Z1234
Matrix:	AQ	Date Sampled:	3/25/16
Method:	SW846 8260B	Date Received:	3/26/16
Project:	ALW #4567	Percent Solids:	n/a

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch	Purge Volume
Run #1	A789456-4	1	4/1/16	AW	n/a	n/a	LW1287	5.0 mL
Run #2	A789456-7	1	4/5/16	AW	n/a	n/a	LW1288	5.0 mL

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	1.9	2.0	0.50	ug/L	J
108-88-3	Toluene	1.8	2.0	1	ug/L	B
100-41-4	Ethylbenzene	1.64	2.0	0.40	ug/L	J
1330-20-7	Xylene (Total)	<5	10	5	ug/L	

CAS No.	Surrogate Recoveries	Run #1	Run #2	Limits
1868-53-7	Dibromofluoromethane	92%	99%	87-116%
17060-07-0	1,2-Dichloroethane-D4	98%	85%	76-127%
2037-26-5	Toluene-D8	114%	96%	86-112%

Water Question #1

- Why were two analytical runs reported?

Laboratory Report #2 - Aqueous								
Client Sample ID: MW-15			Lab Sample ID: Z1234					
Matrix: AQ			Date Sampled: 3/25/16					
Method: SW846 8260B			Date Received: 3/26/16					
Project: ALW #4567			Percent Solids: n/a					
	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch	Purge Volume
Run #1	A789456-4	1	4/1/16	AW	n/a	n/a	LW1287	5.0 mL
Run #2	A789456-7	1	4/5/16	AW	n/a	n/a	LW1288	5.0 mL
CAS No.	Compound	Result	RL	MDL	Units	Q		
71-43-2	Benzene	1.9	2.0	0.50	ug/L	J		
108-88-3	Toluene	1.8	2.0	1	ug/L	B		
100-41-4	Ethylbenzene	1.64	2.0	0.40	ug/L	J		
1330-20-7	Xylene (Total)	<5	10	5	ug/L			
CAS No.	Surrogate Recoveries	Run #1	Run #2	Limits				
1868-53-7	Dibromofluoromethane	92%	99%	87-116%				
17060-07-0	1,2-Dichloroethane-D4	98%	85%	76-127%				
2037-26-5	Toluene-D8	114%	96%	86-112%				

Water Question #1

- Why were two analytical runs reported?
 - Surrogate Toluene-d8 recovered high (> 112%) in the initial analysis.
- Bonus Question – Which result would have been acceptable to report from the initial analysis?



NOT
ACCEPTABLE

Water Question #1

- Why were two analytical runs reported?
 - Surrogate Toluene-d8 recovered high (> 112%) in the initial analysis.
- Bonus Question – Which result would have been acceptable to report from the initial analysis?
 - **Total xylenes**
 - Why? - Total xylenes were reported as ND and high surrogates only impact positive results



NOT
ACCEPTABLE

Water Question #2

- Which result may not be native to the sample?

Laboratory Report #2 - Aqueous								
Client Sample ID:	MW-15				Lab Sample ID:	Z1234		
Matrix:	AQ				Date Sampled:	3/25/16		
Method:	SW846 8260B				Date Received:	3/26/16		
Project:	ALW #4567				Percent Solids:	n/a		
	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch	Purge Volume
Run #1	A789456-4	1	4/1/16	AW	n/a	n/a	LW1287	5.0 mL
Run #2	A789456-7	1	4/5/16	AW	n/a	n/a	LW1288	5.0 mL
CAS No.	Compound	Result	RL	MDL	Units	Q		
71-43-2	Benzene	1.9	2.0	0.50	ug/L	J		
108-88-3	Toluene	1.8	2.0	1	ug/L	B		
100-41-4	Ethylbenzene	1.64	2.0	0.40	ug/L	J		
1330-20-7	Xylene (Total)	<5	10	5	ug/L			
CAS No.	Surrogate Recoveries	Run #1	Run #2	Limits				
1868-53-7	Dibromofluoromethane	92%	99%	87-116%				
17060-07-0	1,2-Dichloroethane-D4	98%	85%	76-127%				
2037-26-5	Toluene-D8	114%	96%	86-112%				

Water Question #2

- Which result may not be native to the sample?
 - **Toluene**
 - The result for toluene includes a laboratory qualifier of “B” which often means the compound was detected in an associated blank sample.
 - First check the qualifier definition.
 - Then check the blanks for reported results for toluene.
 - If not native to the sample, what are your options for reporting?

Water Question #3

- If your regulatory limit for toluene is 2, what result should be reported to the regulator for toluene?

Laboratory Report #2 - Aqueous								
Client Sample ID:	MW-15	Lab Sample ID:	Z1234					
Matrix:	AQ	Date Sampled:	3/25/16					
Method:	SW846 8260B	Date Received:	3/26/16					
Project:	ALW #4567	Percent Solids:	n/a					
	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch	Purge Volume
Run #1	A789456-4	1	4/1/16	AW	n/a	n/a	LW1287	5.0 mL
Run #2	A789456-7	1	4/5/16	AW	n/a	n/a	LW1288	5.0 mL
CAS No.	Compound	Result	RL	MDL	Units	Q		
71-43-2	Benzene	1.9	2.0	0.50	ug/L	J		
108-88-3	Toluene	1.8	2.0	1	ug/L	B		
100-41-4	Ethylbenzene	1.64	2.0	0.40	ug/L	J		
1330-20-7	Xylene (Total)	<5	10	5	ug/L			
CAS No.	Surrogate Recoveries	Run #1	Run #2	Limits				
1868-53-7	Dibromofluoromethane	92%	99%	87-116%				
17060-07-0	1,2-Dichloroethane-D4	98%	85%	76-127%				
2037-26-5	Toluene-D8	114%	96%	86-112%				

Water Question #3

- If your regulatory limit for toluene is 2, what result should be reported to the regulator for toluene?
 - Toluene should be reported as < 2
 - The RL is 2 and the regulatory limit is 2.
 - There is also the possibility that this compound was detected in an associated blank at a similar level.

Conclusions

- There is more to laboratory reports than just results.
- A thorough understanding of the results, RLs/MDLs, parameters analyzed, and qualifications are necessary to understand how to use and report the data to end users and regulators.