Appendix C

RLWD Laboratory Information for STORET Data Entry

Here are the analytical methods for RMB Laboratories they are MDH certified and have performed laboratory analysis for the RLWD since 1998.

Table 4.0
Analytical Methods

Parameter	Method	References			SOP #	Detection Limit
		Std Methods	EPA	Other		
Water & Wastewater - Microbiology						
Coliform, Total	Membrane Filtration	9222 B			01-001	< 1 TC/100 mL
Coliform, Total	Presence / Absence	9221 D			01-002	< 1 TC/100 mL
E. coli	Presence / Absence	9221 D			01-003	Pres/Abs
Coliform, Fecal	Membrane Filtration	9222 D			01-004	< 1 FC/100 mL
Fecal Streptococci	Membrane Filtration	9230 C			01-005	< 1
Fecal Streptococci	Most Probable Number	9230 B			01-006	< 1
Iron Bacteria	Microscope	9240 B			01-007	Neg./Pos.
Water & Wastewater - Inorganic & Nutrients						
Acidity	Titrimetric	2310	305.1		Sub (1)	1 mg/L
Alkalinity, Total	Titrimetric	2320	310.1		001-121	10 mg/L
BOD	Dissolved Oxygen Probe	5210			01-100	1 mg/L
BOD, Carbonaceous	Dissolved Oxygen Probe	5210			01-101	1 mg/L
Chloride		4500-Cl C	325.1	SW846-9251A	01-122	0.5 mg/L
Chlorine, Residual	Colormetric	4500-Cl G	330.5		Sub (1)	0.05 mg/L
Chlorophyll-a	Colormetric/Spectrophotometric	1020 OH		(1)	01-102	1 ug/l
COD	Manual Spectrophotometric	5220 D			01-103	5 mg/L
Color	Visual	2120 B	110.2		Sub (1)	5 units
Conductance, Specific	Wheatstone Bridge	2150			01-104	0.1 umhos/cm
Fluoride	Electrode	4500-F C			01-105	0.05 mg/l
Hardness, Total	Calculation	2340 B	200.7		Sub (1)	2.0 mg/L
Nitrogen, Total				(2)	01-106	1 ug/L
Nitrogen, Kjeldahl Total	Automated		351.2	ASTM-D3590	Sub (1)	0.01 mg/L
Nitrogen, Nitrate + Nitrite	Cadmium Reduction	4500-NO3 E			01-107	0.02 mg/L
Nitrogen, Nitrate	Electrode	4500-NO3 D			01-108	0.5 mg/l
	Cadmium Reduction	4500-NO3 E			01-109	0.02 mg/L
Nitrogen, Nitrite	Cadmium Reduction	4500-NO2 B			01-110	0.02 mg/L
Nitrogen, Ammonia	Electrode	4500-NH3 F			01-111	0.01 mg/L
Oil & Grease	Extraction, Gravimetric		413.1		Sub (2)	2 mg/L
Oxygen, Dissolved	Winkler Probe	4500-O C			01-112	1 mg/L
pH	Electrometric	4500 HB			01-113	1 unit
Phaeophytin	Spectrophotometric	1020 OH			01-114	1 ug/L
Phosphorus, Total	Digestion, Colormetric	4500-P E			01-115	0.005 mg/L
Phosphorus, Ortho	Colormetric	4500-P E			01-116	0.005 mg/L
Solids, Total	Gravimetric, 105 C	2540 B			01-117	1 mg/L
Solids, Total Volatile	Gravimetric, 550 C	2540 E	160.4		Sub (1)	1 mg/L
Solids, Total Suspended	Gravimetric, 105 C	2540 D			01-118	1 mg/L
Solids, Total Settleable	Gravimetric	2540 F	160.5		Sub (1)	0.5 mg/L
Solids, Total Dissolved	Gravimetric, 180 C	2540 C			01-119	1 mg/L
Solids, Suspended Volatile	Volumetric, Imhoff Cone	2540 E	160.4		Sub (1)	4 mg/L

Table 4.0
Analytical Methods

Parameter	Method	References			SOP #	Detection Limit
		Std Methods	EPA	Other		
Water & Wastewater - Inorganics and Nutrients						
Sulfate	Turbidimeter	4500-SO4 E	375.4	SW846-9038	Sub (1)	10 mg/L
	Automated		375.2		Sub (1)	10 mg/L
Surfactants	Spectrophotmetric	5540 C			Sub (1)	0.01 mg/L
Temperature	Thermometer	2550			01-120	NA
Turbidity	Nephelometric, Turbidimeter	2130	180.1		Sub (1)	0.1 NTU
Water & Wastewater - Metals						
Aluminum (Al)	ICP		200.7	6010A	Sub (1)	0.05 mg/L
	AA Furnace		202.2		Sub (1)	8 ug/L
Antimony (Sb)	ICP		200.7	6010A	Sub (1)	0.05 mg/L
	AA Furnace		204.2	7041	Sub (1)	6 ug/L
Arsenic (As)	ICP		200.7	6010A	Sub (1)	0.05 mg/L
	AA Furnace		206.2	7060A	Sub (1)	2 ug/L
Barium (Ba)	ICP		200.7	6010A	Sub (1)	0.01 mg/L
	AA Furnace		208.2		Sub (1)	11 ug/L
Beryllium (Be)	ICP		200.7	6010A	Sub (1)	0.005 mg/L
	AA Furnace		210.2	7091	Sub (1)	0.2 ug/L
Boron (B)	ICP	3120	200.7		Sub (1)	0.07 mg/L
Bromide	Ion Specific Electrode		320.1		Sub (2)	0.2 mg/L
Cadmium (Cd)	ICP		200.7	6010A	Sub (1)	0.01 mg/L
	AA Furnace		213.2	7131A	Sub (1)	0.2 ug/L
Calcium (Ca)	ICP		200.7	6010A	Sub (1)	0.2 mg/L
Chromium, Hexavalent (Cr+6)	Colormetric	3120, 3500-Cr D		7196A	Sub (1)	0.05 mg/L
Chromium, Total (Cr)	ICP		200.7	6010A	Sub (1)	0.01 mg/L
	AA Furnace		218.2	7191	Sub (1)	0.5 ug/L
Cobalt (Co)	ICP		200.7	6010A	Sub (1)	0.02 mg/L
	AA Furnace		219.2	7201	Sub (1)	2 ug/L
Copper (Cu)	ICP		200.7	6010A	Sub (1)	0.01 mg/L
	AA Furnace		220.2	7211	Sub (1)	1 ug/L
Hardness, Total	Calculation	2340 B	200.7		Sub (1)	2.0 mg/L
Iron (Fe)	ICP		200.7	6010A	Sub (1)	0.02 mg/L
	AA Furnace		236.2	7381	Sub (1)	6 ug/L
Lead (Pb)	ICP		200.7	6010A	Sub (1)	0.03 mg/l
	AA Furnace		239.2	7421	Sub (1)	2 ug/L
Magnesium (Mg)	ICP		200.7	6010A	Sub (1)	0.05 mg/L
Manganese (Mn)	ICP		200.7	6010A	Sub (1)	0.01 mg/L
	AA Furnace		243.3	7461	Sub (1)	3 ug/L
Mercury (Hg)	Cold Vapor Flame AA		245.2/245.5	7470A/7471A	Sub (1)	0.2 ug/L
Molybdenum (Mo)	ICP		200.7	6010A	Sub (1)	0.01 mg/L

Table 4.0
Analytical Methods

Parameter	Method	References			SOP #	Detection Limit
		Std Methods	EPA	SW 846		
Water & Wastewater - Metals						
Nickel (Ni)	ICP		200.7	6010A	Sub (1)	0.02 mg/L
	AA Furnace		249.2		Sub (1)	6 ug/L
Potassium (K)	ICP		200.7	6010A	Sub (1)	0.2 mg/L
Selenium (Se)	ICP		200.7	6010A	Sub (1)	0.05 mg/L
Silver (Ag)	ICP		200.7	6010A	Sub (1)	0.02 mg/L
	AA Furnace		272.2	7761	Sub (1)	1 ug/L
Sodium (Na)	ICP		200.7	6010A	Sub (1)	0.3 mg/L
Strontium (Sr)	ICP		200.7	6010A	Sub (1)	0.01 mg/L
	AA Furnace		200.9		Sub (1)	2 ug/L
Thallium (Tl)	ICP		200.7	6010A	Sub (1)	0.2 mg/L
	AA Furnace		279.2	7841	Sub (1)	2 ug/L
Tin (Sn)	ICP	-	200.7	-	Sub (1)	0.10 mg/L
	AA Furnace	-	-	-	Sub (1)	2 ug/L
Titanium (Ti)	ICP	-	200.7	-	Sub (1)	0.03 mg/L
Vanadium (V)	ICP	-	200.7	6010A	Sub (1)	0.1 mg/L
	AA Furnace	-	286.2	7911	Sub (1)	2 ug/L
Zinc (Zn)	ICP	-	200.7	6010A	Sub (1)	0.02 mg/L

Parameter		References			Wisc.	Detection Limit
		EPA	MDH	SW 846		
Water & Wastewater - Organic Compounds						
BTEX, MTBE	Gas Chromatography			8310, 8270		1.0 ug/L
GRO	Subcontracted				GRO	100 ug/L
DRO	"				DRO	100 ug/L
TPH as Fuel Oil	"			5030, 8015		500 ug/L
TPH as Gasoline	"			5030, 8015		100 ug/L
Volatile Organics	"	502.2	465D, 466A	5030, 8021	PVOC	

Std Methods : Standard Methods for the Examination of Water and Wastewater, 18th Edition

EPA: US EPA Methods of Chemical Analysis of Water and Waste, EPA 600/4-79-020, Revised March 1983

SW 846: US EPA Test Methods for Evaluating Solids Waste Physical/Chemical Methods, 3rd Edition, 1986

(1) "Measuring Chlorophyll and Phaeophytin: Whom should you believe?"
Richard P. Axler and Christopher J. Owen, NRRI.

(2) "A comparability study of a New Method for Measuring Total Nitrogen in Florida Waters."
Roger W. Bachmann and Daniel E. Canfield Jr. R.

Sub (1) Analyses completed by subcontract laboratory: Braun Intertec Corporation

Sub (2) Analyses completed by subcontract laboratory: Minnesota Valley Testing Laboratories

Here is the information for data prior to 1998. The analysis for this data was performed by RLWD staff at the laboratory at the University of Minnesota Crookston. The lab was certified by the Minnesota Department of Health in April of 1992.

Table 3-3. University of Minnesota Crookston Laboratory Precision, Accuracy and Data Completeness for Period of Study (April 1992-March 1993)

Parameter	Precision (%)[1]	Accuracy (%)[2]	Range (µg/l)	Units	Data Completeness[3]
Alkalinity (as $CaCO_3$)	0.3 - 4.1	88 - 110	10 - 500	µg/L	100
Ammonia	0 - .17	80 - 116.3	.02 - 2	µg/L	100
Chemical Oxygen Demand	0 - 15.9	N/A	0 - 150	µg/L	100
Color	0 - 17.1	N/A	0 - 500	Pt/Co	100
Conductivity[4]	0 - .75	N/A	0 - 20,000	µmho/cm	100
Fecal Coliforms	0 - 33.6	N/A	0 - TNC	colonies/100 ml	100
Nitrate (as N)	0 - 5.3	87 - 108	1 - 100	µg/L	100
Orthophosphate (as P)	0 - 12.5	67.7 - 128.2	2 - 100	µg/L	100
pH	0 - .59	N/A	40 - 10.0	pH units	100
Total Dissolved Oxygen	0 - .74	N/A	0 - 10,000	µg/L	100
Total Kjeldahl Nitrogen (as N)	0 - 26.5	80.8 - 123.2	.1 - 5.0	µg/L	100
Total Phosphorus (as P)	0 - 24.2	85.4 - 125.2	2 - 100	µg/L	100
Total Suspended Solids	0 - 25.9	N/A	0 - 500	µg/L	100
Turbidity	0 - 8.7	N/A	0 - 200	NTU	100
Total Volatile Solids	0 - 182	N/A	0 - 500	µg/L	100
MCPA-Soil	0 - 10	65 - 120	.05[5]	mg/l	100
MCPA-Water	0 - 10	65 - 120	3.0[5]	µg/l	100
2,4-D-Soil	0 - 10	70 - 120	0.01[5]	mg/l	100
2,4-D-Water	0 - 10	70 - 120	0.5[5]	µg/l	100

[1] Based on duplicate analysis of laboratory split samples. Equals absolute difference of splits samples divided by mean of splits.
[2] Based on spike sample recovery. Percentage of spike recovered.
[3] Percentage of sample analyzed, which were delivered to the laboratory.
[4] Conductivity used to calculate dissolved solids.
[5] Detection limits (mg/l).

Table 3-1 IntraLaboratory Assurance Goals for Range of Concentration Anticipated in Surface Waters

Parameter	Method	Precision (Coef. Var.)	Accuracy as Percent Recovery	Data Completeness	Minimum Detection Limit (mg/L)	APHA Standard Reference
Total Phosphorus & Soluble Reactive Phosphorus	Automated Ascorbic Reduction	<10%	98%	95%	0.01	424G
Total Kjeldahl Nitorgen	Digestion followed by Automated Phenate Method	<10%	95%	95%	0.02	420A & 417G
Nitrate + Nitrate Nitrogen	Automated Cadmium Reduction	<10%	96%	95%	.001	418F
Ammonia Nitrogen	Automated Phenate	<10%	97%	95%	0.02	417G
Total Supspended Solids	Drying and Gravimetric			95%		209F
Total Suspended Volatile Solids	Drying and Gravimetric			95%		209F
Dissolved Oxygen	Azide Modification of Winkler Titration	<5%		95%		421B
Chemical Oxygen Demand	Closed Reflux followed by Colorimetric			95%		508C
Specific Conductance	Meter	<3%	<3%	95%		205
Turbidity	Nephlometric Method	<5%	<5%	95%		214A
pH	Specific Ion Electrode	2.50%	<1%	95%		423
Total Alkalinity	Automated Titration	<6%	<10%	95%	10.0	403
Chlorophyll-a	Filtration followed by acetone extraction			95%		1002G
Chloride	Automated Ferricyanide Method	2.27%	97%	95%	1.0	4500 cl-E
Fecal Coliform	Membrane Filter Technique			95%		9222A
Color	Platinum Cobalt Method			95%	1.0	2120