

## SOILS

### List of Acronyms

<i>ABDTPA</i>	<i>Ammonium Bicarbonate Diethylenetriaminepentaacetic Acid</i>	<i>Mg</i>	<i>Magnesium</i>
<i>ABP</i>	<i>Acid Base Potential</i>	<i>N</i>	<i>Nitrogen</i>
<i>AGP</i>	<i>Acid Generating Potential</i>	<i>Na</i>	<i>Sodium</i>
<i>ASA</i>	<i>American Society of Agronomy</i>	<i>NaHCO<sub>3</sub></i>	<i>Sodium Bicarbonate</i>
<i>ASTM</i>	<i>American Society for Testing and Materials</i>	<i>NH<sub>4</sub></i>	<i>Ammonia</i>
<i>Ca</i>	<i>Calcium</i>	<i>NH<sub>4</sub>OAC</i>	<i>Ammonium Acetate</i>
<i>COD</i>	<i>Chemical Oxygen Demand</i>	<i>NO<sub>3</sub></i>	<i>Nitrate</i>
<i>DEQ</i>	<i>Department of Environmental Quality</i>	<i>PSA</i>	<i>Particle Size Analysis</i>
<i>DTPA</i>	<i>Diethylenetriaminepentaacetic Acid</i>	<i>SAR</i>	<i>Sodium Adsorption Ratio</i>
<i>EC</i>	<i>Electrical Conductivity</i>	<i>SSSA</i>	<i>Soil Science Society of America</i>
<i>E</i>	<i>U.S. Environmental Protection Agency Agency</i>	<i>TKN</i>	<i>Total Kjeldahl Nitrogen</i>
<i>HCl</i>	<i>Hydrochloric Acid</i>	<i>USDA</i>	<i>U.S. Department of Agriculture</i>
<i>HNO<sub>3</sub></i>	<i>Nitric Acid</i>	<i>WAD</i>	<i>Weak Acid Dissociable</i>
<i>ICP</i>	<i>Inductively Coupled Plasma</i>		
<i>KCl</i>	<i>Potassium Chloride</i>		

TM

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## 1. AGRICULTURAL SOILS

ANALYSIS PACKAGE	
<b>COMPLETE ANALYSIS (2 depths)</b>	
Upper Depth (0-6")	pH, nitrate, sodium, sulfate, salt hazard (conductivity), texture, lime, potassium, organic matter, available phosphorus
Lower Depth (6-24")	Nitrate, sulfate, and texture
<b>COMPLETE ANALYSIS - Lawns and Gardens (1 depth)</b>	
Upper Depth only (0-6")	pH, nitrate, sodium, sulfate, salt hazard (conductivity), texture, lime, potassium, organic matter, available phosphorus, calcium
<b>PARTIAL ANALYSIS (2 depths)</b>	
Upper Depth (0-6")	Nitrate, phosphorus, potassium, zinc(irrigated soils), sulfate (non-irrigated soils)
Lower Depth (6-24")	Nitrate
<b>GYPSUM APPLICATION PACKAGE (2 depths)</b>	pH, sodium, conductivity
<b>INDIVIDUAL SOIL PARAMETERS - - see page Soil – 4-5</b>	

## 2. SOIL AND OVERBURDEN - ACID-BASE ACCOUNTING

ACID-BASE ACCOUNTING	DETECTION LIMIT	UNIT
<b>MODIFIED SOBEK METHOD, includes the following</b>	-	-
Neutralization Potential	1	T CaCO <sub>3</sub> /1000 T
Acid Potential (hot water wash)	1	T CaCO <sub>3</sub> /1000 T
Acid-Base Potential	1	T CaCO <sub>3</sub> /1000 T
Total Sulfur	0.01	%
Hot Water Soluble Sulfur	0.01	%
Cold HCl Soluble Sulfur	0.01	%
Hot HNO <sub>3</sub> Soluble Sulfur	0.01	%
Residual Sulfur	0.01	%
<b>SCHAFFER METHOD, includes the following:</b>	-	-
Neutralization Potential	1	T CaCO <sub>3</sub> /1000 T
Acid Potential (hot HCl wash)	1	T CaCO <sub>3</sub> /1000 T
Acid-Base Potential	1	T CaCO <sub>3</sub> /1000 T
Total Sulfur	0.01	%
Hot HCl Soluble Sulfur	0.01	%
Hot HNO <sub>3</sub> Soluble Sulfur	0.01	%
Residual Sulfur	0.01	%

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## 3. SOIL AND OVERBURDEN - NON-METALS

PARAMETER	DETECTION LIMIT	UNIT
Sample Preparation	-	-
Sample Crushing	-	-
Other extractions (Acetic Acid, HCl, DTPA, Water, etc.)	-	-
Acid-Base Potential	-	T CaCO <sub>3</sub> /1000 T
Acid Potential	0.01	T CaCO <sub>3</sub> /1000 T
Ammonia as N	1	mg/Kg
Available Lime Index	0.1	weight %
Base Saturation	0.1	%
Bicarbonate, Saturated Paste	0.01	meq/L
Bromide	0.5	mg/Kg
Bulk Density	0.01	g/cc
Calcium, Saturated Paste	0.1	meq/L
Calcium Oxide by Rapid Sugar Method	0.1	weight %
Carbon, Total	0.05	%
Cation Exchange Capacity	0.1	meq/100 g
Chloride	1	mg/Kg
Coarse Fragments + 10 mesh, 2 mm	2	%
Conductivity, paste extract	0.1	mmhos/cm
Exchange Sodium Percentage – includes CEC, soluble sodium, available sodium, saturation %	0.1	%
Exchangeable Acidity	1	meq/100 g
Fertilizer Recommendation	NA	NA
Lime	0.1	%
Lime Requirement, SMP Buffer Method	1	T CaCO <sub>3</sub> /1000 T
Loss on Ignition	0.1	%
Magnesium, Saturated Paste	0.1	meq/L
Moisture	0.1	%
Neutralization Potential	-	T CaCO <sub>3</sub> /1000 T
Net Acid Generating Potential with Peroxide (includes pH and EC after reaction)	1	T CaCO <sub>3</sub> /1000 T
Nitrate as N (NO <sub>3</sub> )	1	mg/Kg
Nitrogen, Total Kjeldahl (TKN)	1	mg/Kg
Nitrogen, Total (TKN+ NO <sub>3</sub> )	1	mg/Kg
Nitrogen, Organic (TKN – NH <sub>4</sub> )	1	mg/Kg
Organic Carbon	0.1	%
Organic Matter	0.1	%
pH, saturated paste	0.1	Std. units
Phosphorus Absorption Capacity	1	mg/Kg
Phosphorus, NaHCO <sub>3</sub> (Olsen)	1	mg/Kg
Phosphorus (Bray)	1	mg/Kg
Potassium	1	mg/Kg
Potassium, Saturated Paste	0.1	meq/L

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## 3. SOIL AND OVERBURDEN - NON-METALS, continued

PARAMETER	DETECTION LIMIT	UNIT
SAR (includes Ca, Mg, Na)	0.01	unitless
Saturation Percentage	0.1	%
Sieve Analysis	0.1	%
Sodium, extractable	0.1	meq/100 g
Sodium, available	0.1	meq/100 g
Sodium, sat. paste	0.1	meq/L
Sulfate	1	mg/Kg
Sulfur Forms	0.01	%
Sulfur, Total	0.01	%
Texture (PSA) sand, silt, clay	1	%
Very Fine Sand	0.01	%
Water Holding Capacity	0.1	NA

## 4. SOIL AND OVERBURDEN - METALS

PARAMETER	DETECTION LIMIT, TOTALS	DETECTION LIMIT, EXTRACTABLES	UNITS
Total Metals Digestion (Method SW 3050)	-	-	NA
Total Metals Digestion, Mercury (Method SW 7471)	-	-	NA
Aluminum	5	0.1	mg/Kg
Arsenic	1	0.02	mg/Kg
Barium	1	0.1	mg/Kg
Beryllium	1	0.1	mg/Kg
Boron	1	0.1	mg/Kg
Cadmium	1	0.1	mg/Kg
Calcium	5	1	mg/Kg
Chromium	1	0.1	mg/Kg
Copper	1	0.1	mg/Kg
Iron	5	1	mg/Kg
Lead	1	0.1	mg/Kg
Magnesium	5	1	mg/Kg

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## 4. SOIL AND OVERBURDEN – METALS, continued

PARAMETER	DETECTION LIMIT, TOTALS	DETECTION LIMIT, EXTRACTABLES	UNITS
Manganese	1	0.1	mg/Kg
Mercury	1	0.1	mg/Kg
Molybdenum	1	0.1	mg/Kg
Nickel	1	0.1	mg/Kg
Selenium	1	0.01	mg/Kg
Silver	1	0.5	mg/Kg
Zinc	1	0.1	mg/Kg

## 5. SOIL AND OVERBURDEN – CYANIDES

PARAMETER	DETECTION LIMIT	UNIT
Cyanide, Total	0.5	mg/Kg
Cyanide, Weak Acid Dissociable	0.5	mg/Kg
Cyanide, Free	2.0	mg/Kg

## 6. SOIL AND OVERBURDEN – GEOTECHNICAL SOILS ANALYSES

PARAMETER	DETECTION LIMIT	UNIT
pH	0.1	s.u.
Marble pH	0.1	s.u.
Sulfate	0.01	%
Conductivity, Saturated Paste Extract	0.01	mmhos/cm
Resistivity, Calculated	1	ohm-cm
Minimum Resistivity	100	Ohm X cm

## 7. SOIL AND OVERBURDEN – ICP SCAN

Aluminum	Calcium	Lead	Phosphorus	Strontium
Barium	Chromium	Magnesium	Potassium	Thallium
Beryllium	Cobalt	Manganese	Silicon	Titanium
Boron	Copper	Molybdenum	Silver	Vanadium
Cadmium	Iron	Nickel	Sodium	Zinc
<b>NOTES:</b> These elements analyzed in solids by ICP to 50 mg/Kg reporting limit. (Other elements are available on request)				

**ORGANIC CONTAMINANTS** - see *Organic Chemistry* section

**PETROLEUM CONTAMINATED SOILS** – see *Organic Chemistry* section

**RADIOCHEMISTRY** – see *Radiochemistry* section

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## RECOMMENDATIONS FOR SAMPLING AND METHODS LISTINGS

MEASUREMENT	Extraction Method	Analysis Method	Minimum As Received Sample Required for Analysis
Acid Base Potential (ABP)	Calculated from Acid & Neutralization Potential	Calculation	100 g (soil jar)
Acid Potential	Calculated from Non-Sulfate Sulfur	Calculation	100 g (soil jar)
Alkalinity, saturated paste	ASA Mono. #9, Part 2, Method 10-3.2	A 2320B	1500 g (half of gallon resealable bag)
Ammonia as N, KCl Extract	ASA Mono. #9, Part 2, Method 37-7	E350.1	100 g (soil jar)
Base Saturation	Calculation from NH <sub>4</sub> Oac Ca, Mg, Na, K, and CEC	Calculation	1500 g (half of gallon resealable bag)
Carbon, Total	NA	LECO SC-444 (203-601-222)	100 g (soil jar)
Cation Exchange Capacity (CEC)	USDA Handbook 60, Method 19	E6010/E6020	100 g (soil jar)
Chloride (H <sub>2</sub> O Extract)	ASA Mono. #9, Part 2, Method 10-2.3.2	E300.0 (Ion Chromatography)	100 g (soil jar)
Coarse Fragments	ASA Mono. #9, Part 1, Method 15-5	2 mm sieve	1500 g (half of gallon resealable bag)
Conductivity (EC), saturated paste	ASA Mono. #9, Part 2, Method 10-3.3	Conductivity Meter	1500 g (half of gallon resealable bag)
Cyanide, Total	E335.2 (Sed.) Mod.	E335.4 (midi)	100 g (soil jar)
Cyanide, Weak Acid Dissociable	ASTM D2036 Mod.	NA	100 g (soil jar)
Cyanide, Free	ASA Mono. #9, Part 2, Method 10-2.3.1	Electrode Manufacturer's Instructions	100 g (soil jar)
Exchangeable Acidity	ASA Mono. #9, Part 2, Method 9-4.1	Titration	1500 g (half of gallon resealable bag)
Exchangeable Sodium Percentage (ESP)	Calculated from CEC, soluble sodium, & extractable sodium	E6010/E6020	1500 g (half of gallon resealable bag)
Lime as CaCO <sub>3</sub>	USDA Handbook 60, Method 23C	Titration	100 g (soil jar)
Lime Requirement, SMP Single Buffer	ASA Mono. #9, Part 2, Method 12-3.4.4	pH meter	100 g (soil jar)
Moisture (dry basis)	USDA Handbook 60, Method 26	NA	1500 g (half of gallon resealable bag)
Net Acid Generating Potential (NAG)	Field & Lab. Methods Applicable to Overburdens & Mine Spoil, Sobek, 1978 pp69-72	Titration	100 g (soil jar)
Neutralization Potential	USDA Handbook 60, Method 23C	NA	100 g (soil jar)
Nitrate as N (NO <sub>3</sub> + NO <sub>2</sub> )	ASA Mono. #9, Part 2, Method 33-8.1	E353.2	100 g (soil jar)
Minimum Resistivity	-	California 643	1500 g (half of gallon resealable bag)

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## RECOMMENDATIONS FOR SAMPLING AND METHODS LISTINGS, continued

MEASUREMENT	Extraction Method	Analysis Method	Minimum As Received Sample Required for Analysis
Organic Carbon & Organic Matter (Walkley-Black)	ASA Mono. #9, Part 2, Method 29-3.5.2	Spectrophotometer	100 g (soil jar)
Organic Nitrogen	Calculation from TKN-NH <sub>3</sub>	Calculation	100 g (soil jar)
pH, Saturated Paste	ASA Mono. #9, Part 2, Method 10-3.2	pH Meter	1500 g (half of gallon resealable bag)
Particle Size Analysis (PSA) includes % sand, silt, clay	ASA Mono. #9, Part 1, Method 15-5	Hydrometer	1500 g (half of gallon resealable bag)
Phosphorus, NaHCO <sub>3</sub> (Olsen)	ASA Mono. #9, Part 2, Method 24-5.4	E365.1	100 g (soil jar)
Phosphorus, (Bray)	ASA Mono. #9, Part 2, Method 24-5.1	E365.1	100 g (soil jar)
Potassium (NH <sub>4</sub> Oac)	ASA Mono. #9, Part 2, Method 13-3.5	E6010/E6020	100 g (soil jar)
Saturated Paste Extracts	ASA Mono. #9, Part 2, Method 10-2.3.1	E6010/E6020	1500 g (half of gallon resealable bag)
Saturation Percentage	USDA Handbook 60, Method 27A	N/A	1500 g (half of gallon resealable bag)
Sieve Analysis	ASA Mono. #9, Part 1, Method 15-2.2	Specified Sieve Sizes	1500 g (half of gallon resealable bag)
Sodium Adsorption Ratio (SAR-Ca, Mg, Na)	ASA Mono. #9, Part 2, Method 10-3.4	E6010/E6020	1500 g (half of gallon resealable bag)
Sodium, extractable (NH <sub>4</sub> OAc)	ASA Mono. #9, Part 2, Method 13-4.3	E6010/E6020	100 g (soil jar)
Sodium, available	ASA Mono. #9, Part 2, Method 13-4.5	E6010/E6020	100 g (soil jar)
Sodium, soluble (saturated paste)	ASA Mono. #9, Part 2, Method 10-3.4	E6010/E6020	100 g (soil jar)
Sulfate, water soluble	ASA Mono. #9, Part 2, Method 28-5.1	E300.0	100 g (soil jar)
Sulfate, HCl soluble (geochemical)	Montana State Department of Highways	Gravimetric	100 g (soil jar)
Sulfur Forms (Modified Sobek)	Field & Lab. Methods Applicable to Overburdens & Mine Spoil, Sobek, 1978 pp60-62	LECO SC-444 (203-601-222)	100 g (soil jar)
Total Nitrogen	Calculation from TKN & NO <sub>3</sub>	Calculation	100 g (soil jar)
Total Kjeldahl Nitrogen (TKN)	ASA Mono. #9, Part 2, Method 31-3.1	A 4500 N org	100 g (soil jar)
Total Sulfur	N/A	LECO SC-444 (203-601-222)	100 g (soil jar)
Very Fine Sands (VFS)	ASA Mono. #9, Part 1, Method 15-5	140 mesh sieve	1500 g (half of gallon resealable bag)
ABDTPA Extracts	ASA Mono. #9, Part 2, Method 3-5.2	E6010/E6020	100 g (soil jar)
DTPA Extracts	ASA Mono. #9, Part 2, Method 19-3.3	E6010/E6020	100 g (soil jar)
Saturated Paste Extracts (H <sub>2</sub> O)	ASA Mono. #9, Part 2, Method 10-2.3.1	E6010/E6020	1500 g (half of gallon resealable bag)
HCl Extracts	ASA Mono. #9, Part 2, Method 19-3.4	E6010/E6020	100 g (soil jar)