Geology: Nutrition Guidelines Update for the Inland Northwest

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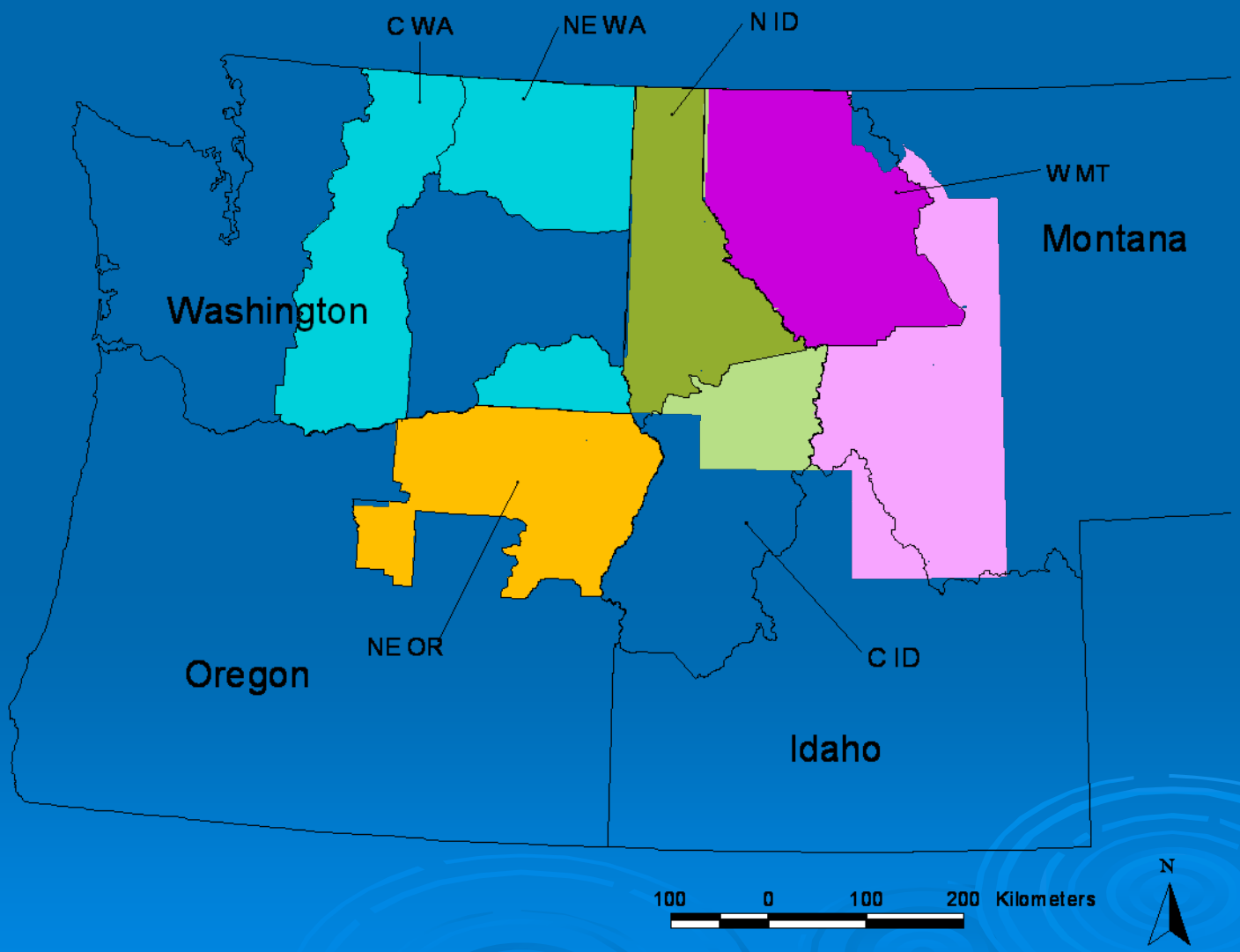
Good Rocks-Bad Rocks

- Geology: A contributor to forest nutrition and health (mid-1990's)
- Regional digital geologic mapping
- Chemistry? Weathering?
- Nutritional assessment: "Relative" nutritional value of various rock types
- Geology/nutrition guidelines for various regions

Regional Geology Guidelines

- 2001: North Idaho (first version)
- 2004: Washington (first version)
- 2006: Western Montana (preliminary)
- 2007: Combined North Idaho and Western Montana (both revised)
- 2007: Washington (revised)
- 2008: Northeast Oregon (pending)

Geology by Region

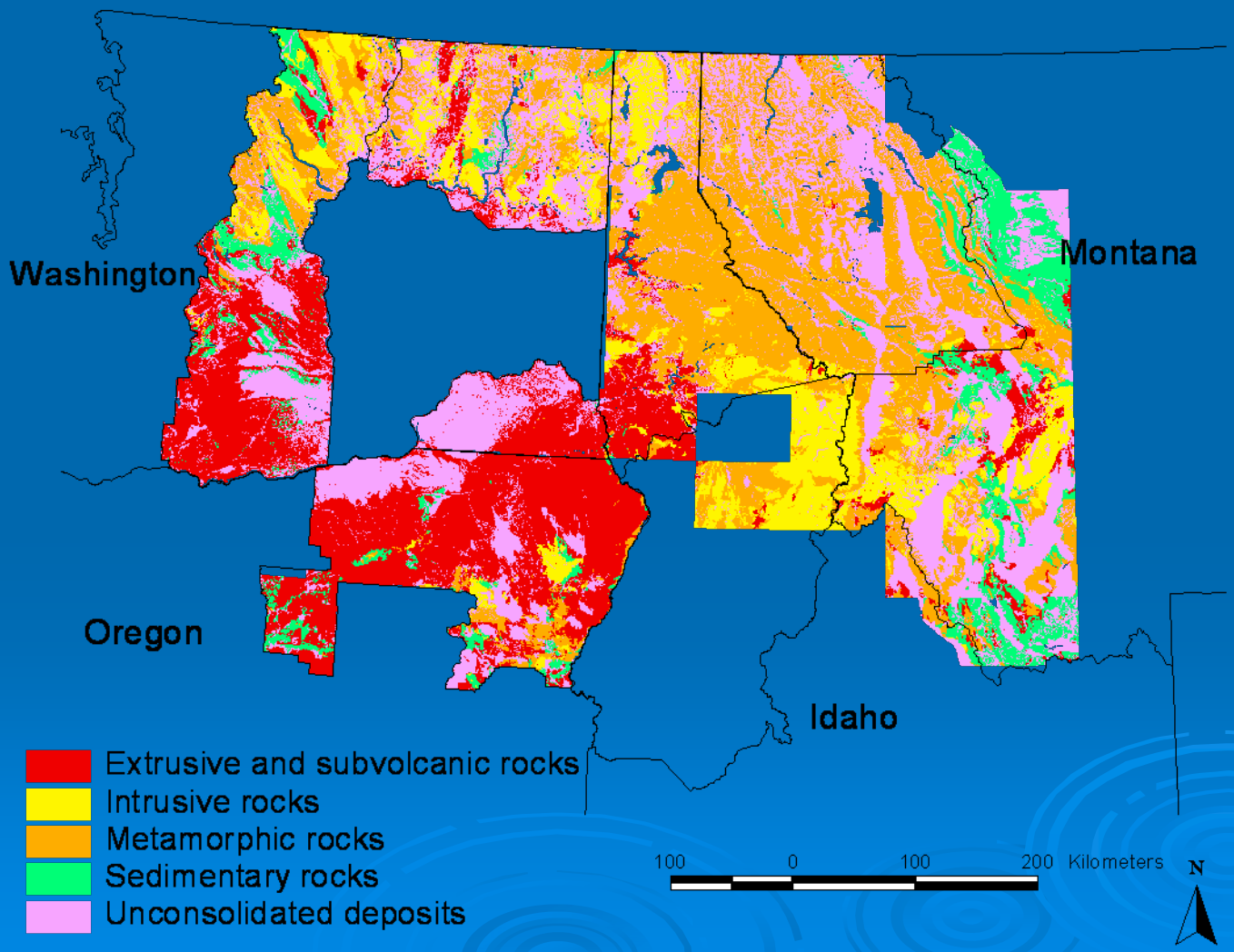


Nutrition/Geology Guidelines

Major Units:

1. Extrusive & sub-volcanic rocks
2. Intrusive rocks
3. Metamorphic rocks
4. Sedimentary rocks
5. Unconsolidated deposits

Major Units


Washington
Montana
Oregon
Idaho
Extrusive and subvolcanic rocks
Intrusive rocks
Metamorphic rocks
Sedimentary rocks
Unconsolidated deposits
100 0 100 200 Kilometers
N

Other attributes

- Minor Unit
- Lithology
  - Weathering susceptibility *(high/medium/low/other)*
  - Tree value *(good/medium/bad/other)*

Geology/Nutrition Guidelines

1. Introductory/Review Section

- Introduction
- Geology overview
  - *Geologic terms & classification*
  - *IFTNC categorization*
  - *Weathering potential (susceptibility)*
  - *Surficial deposits*
- Nutrition overview
  - *Nutrients*
  - *Diagnostics*
  - *Management strategies*
  - *Fertilization*

Geology/Nutrition Guidelines

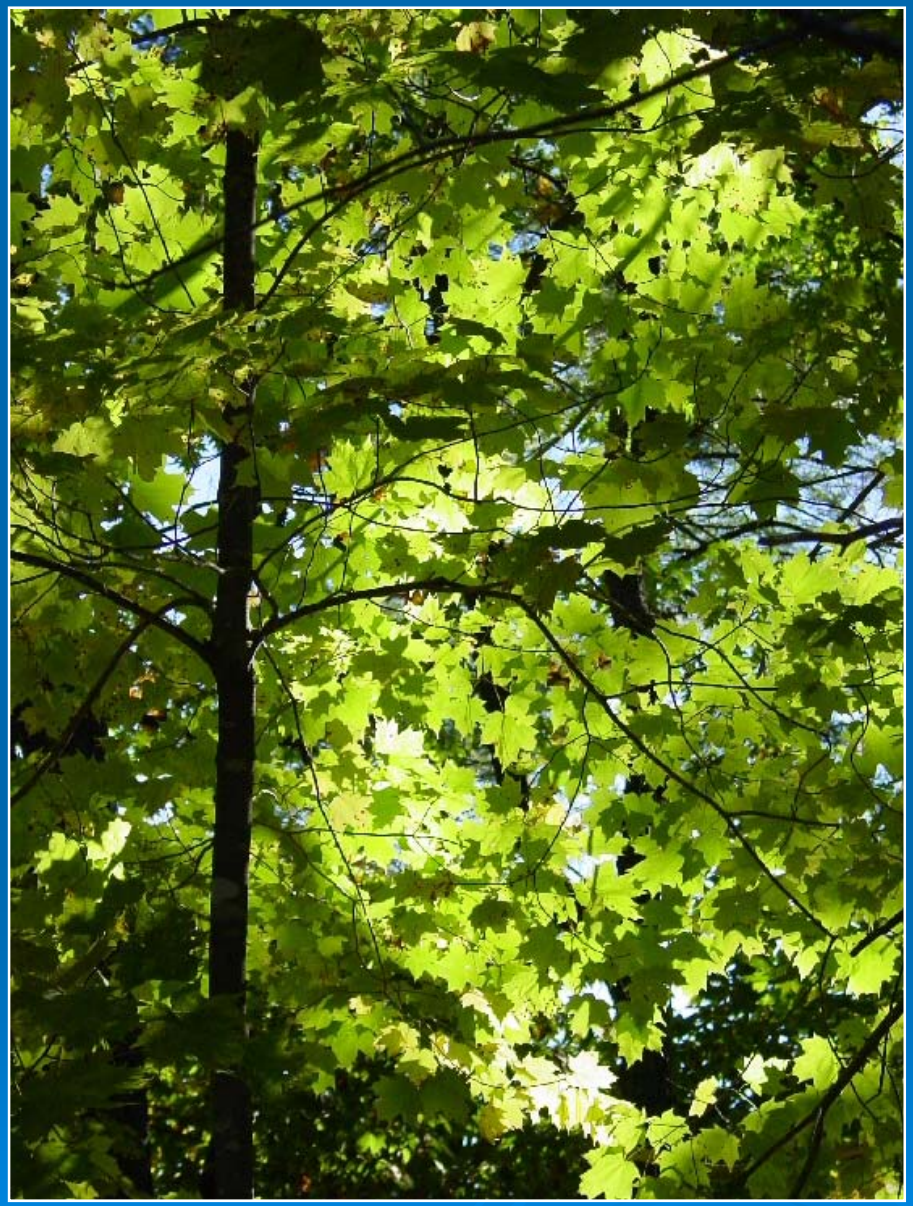
2. Rock descriptions/recommendations

- Organized by Major Unit (5)
  - *Overview*
  - *Description (minor unit → lithology)*
  - *Nutrient management recommendations*
    - *Based on Tree_Value attribute*

Geology/Nutrition Guidelines

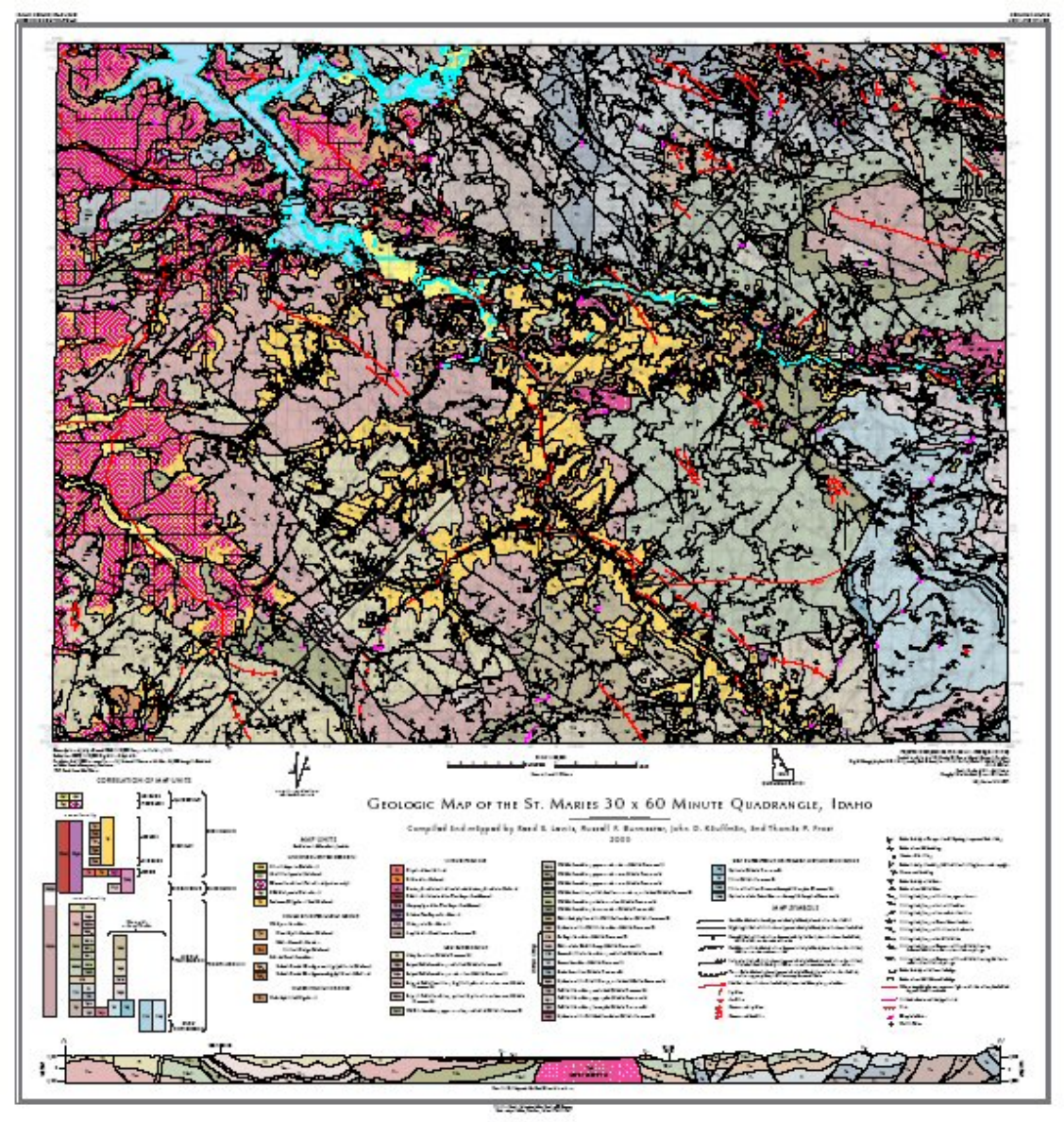
3. Appendices

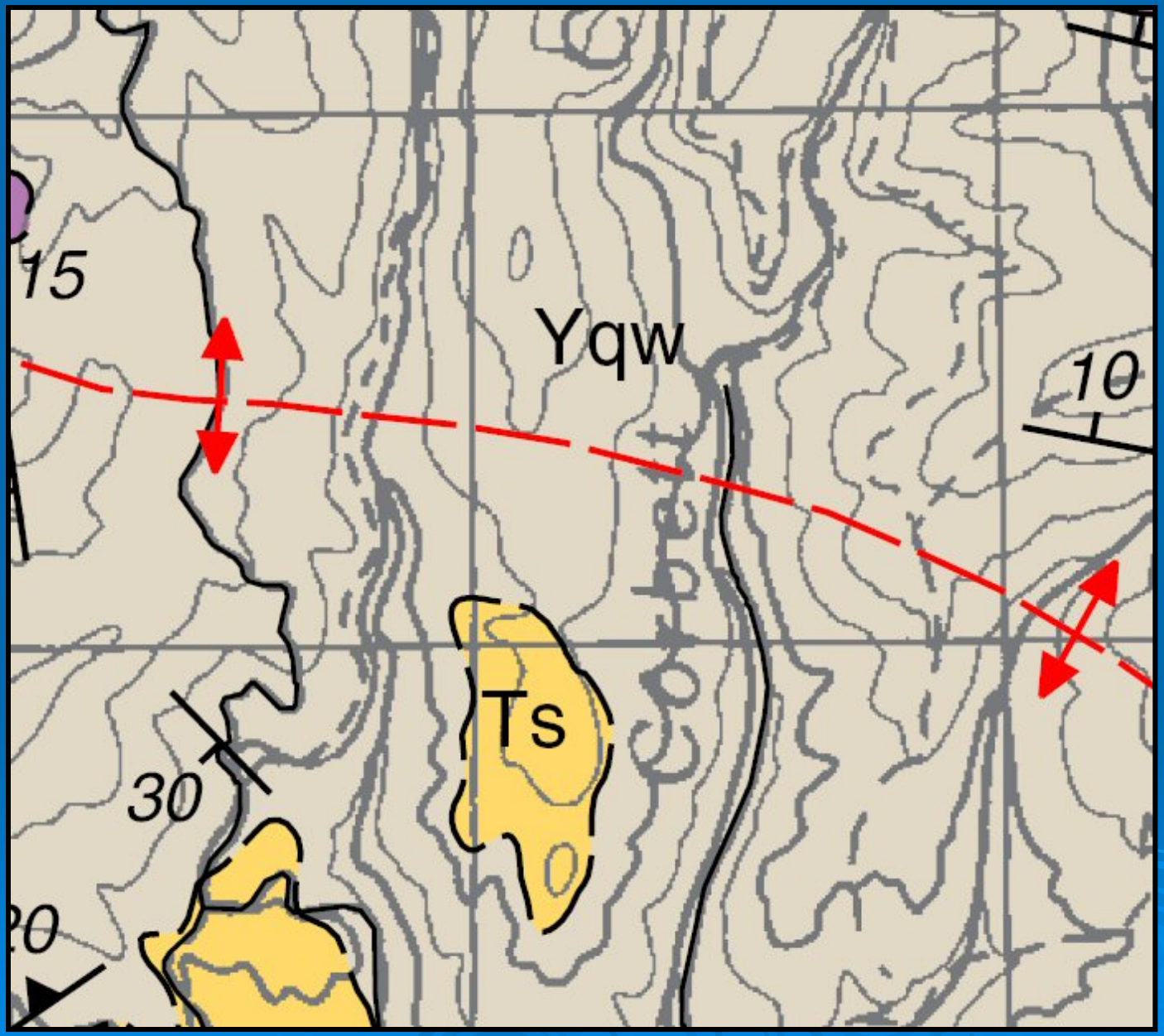
- Quick Reference Table
- Where to get digital geology
- How to assign the IFTNC categories to geologic map units using digital and/or paper map
- Abbreviated version of lookup tables

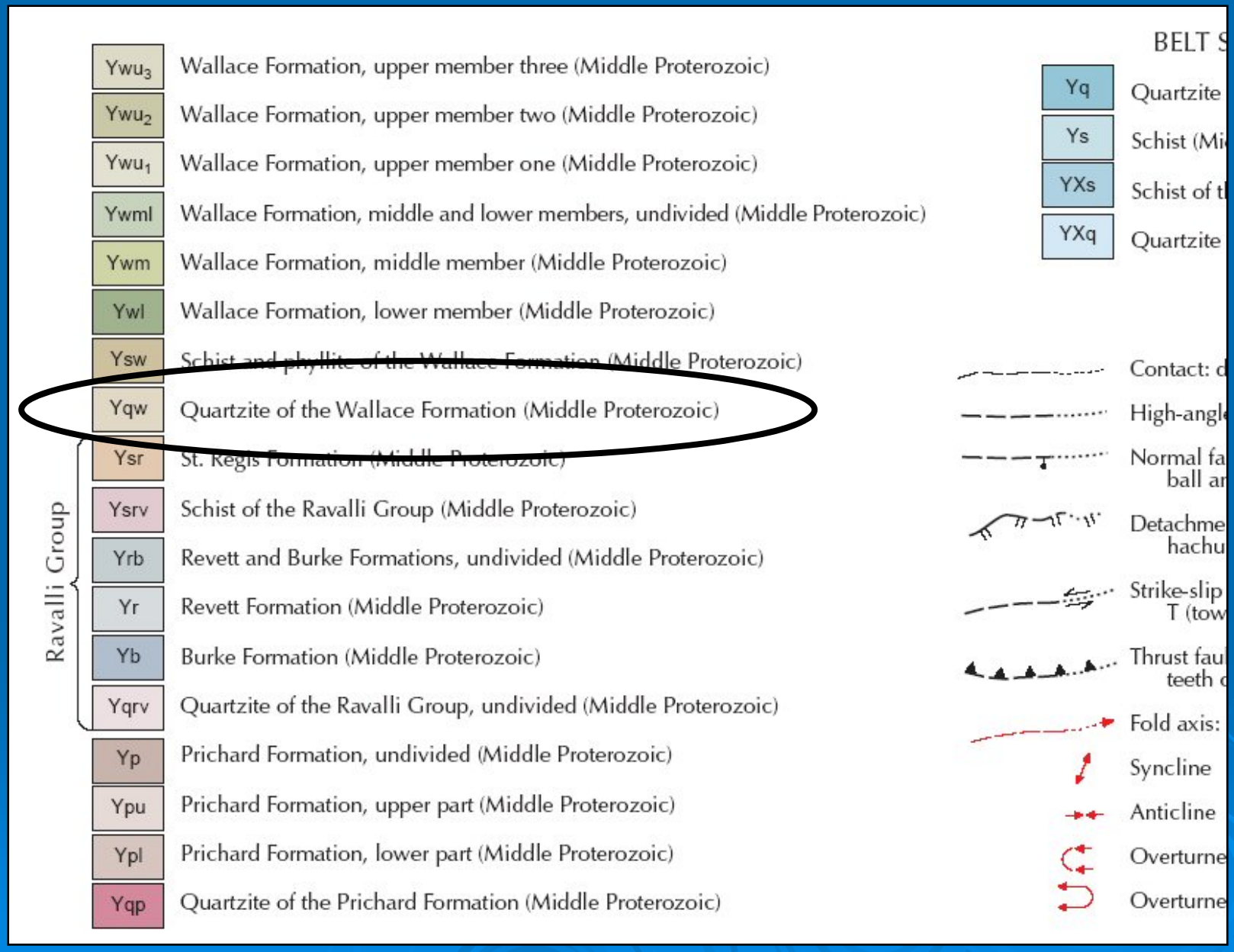


- An Example . . .

St. Maries 30 x 60 Minute Quadrangle




15
Yqw
10
Ts
30
20


Ywu3 Wallace Formation, upper member three (Middle Proterozoic)
Ywu2 Wallace Formation, upper member two (Middle Proterozoic)
Ywu1 Wallace Formation, upper member one (Middle Proterozoic)
Ywml Wallace Formation, middle and lower members, undivided (Middle Proterozoic)
Ywm Wallace Formation, middle member (Middle Proterozoic)
Ywl Wallace Formation, lower member (Middle Proterozoic)
Ysw Schist and phyllite of the Wallace Formation (Middle Proterozoic)
Yqw Quartzite of the Wallace Formation (Middle Proterozoic)
Ysr St. Regis Formation (Middle Proterozoic)
Ravalli Group
Ysrv Schist of the Ravalli Group (Middle Proterozoic)
Yrb Revett and Burke Formations, undivided (Middle Proterozoic)
Yr Revett Formation (Middle Proterozoic)
Yb Burke Formation (Middle Proterozoic)
Yqrv Quartzite of the Ravalli Group, undivided (Middle Proterozoic)
Yp Prichard Formation, undivided (Middle Proterozoic)
Ypu Prichard Formation, upper part (Middle Proterozoic)
Ypl Prichard Formation, lower part (Middle Proterozoic)
Yqp Quartzite of the Prichard Formation (Middle Proterozoic)
BELT S
Yq Quartzite
Ys Schist (Mi
YXs Schist of t
YXq Quartzite
Contact: d
High-angl
Normal fa
ball ar
Detachme
hachu
Strike-slip
T (tow
Thrust fau
teeth
Fold axis:
Syncline
Anticline
Overturne
Overturne

St. Maries 1:100K Quadrangle (IGS) *continued*:

Value	New IGS ID	Major Unit	Minor Unit	Lithology	Weathering Susceptibility	Tree Value
Yqw	Yqw	Metamorphic rocks	Feldspathic quartzite	feldspathic quartzite	medium	medium
Yr	Yr	Metamorphic rocks	Feldspathic quartzite	feldspathic quartzite	low	bad
Yrb	Yrb	Metamorphic rocks	Feldspathic quartzite	feldspathic quartzite	medium	medium
Ys	Ysgp	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Ysp	Ysp	Metamorphic rocks	Feldspathic quartzite	feldspathic quartzite	low	bad
Ysp1a	Ysp1a	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Ysp1q	Ysp1q	Metamorphic rocks	Feldspathic quartzite	feldspathic quartzite	medium	medium
Ysp4	Ysp4	Metamorphic rocks	Feldspathic quartzite	feldspathic quartzite	low	bad
Ysr	Ysr	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Ysrv	Ysrv	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Ysw	Ysw	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Ywl	Ywl	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Ywm	Ywm	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Ywml	Ywml	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Ywu	Ywu	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Ywu1	Ywu1	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Ywu2	Ywu2	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Ywu3	Ywu3	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
YXq	YXq	Metamorphic rocks	Quartzite	quartzite	very low	very bad

Major Unit: Metamorphic Rocks **18**
Rock Descriptions **19**
Carbonate-bearing and calc-silicate metasedimentary rocks 19
Low-grade metasedimentary rocks (Non-carbonate/non-calc-silicate) 19
High-grade metasedimentary or meta-igneous rocks (Non-carbonate/non-calc-silicate) 20
Greenstone and ultramafics 21
Nutrient management recommendations **21**
Good: Carbonate-bearing metamorphic rocks and calc-silicate rocks 21
Medium: Siltite-argillite, some feldspathic quartzites, quartz diorite gneiss, felsic gneiss, schist and gneiss 22
Bad: Metamorphosed carbonate rocks, most feldspathic quartzites, quartzite, amphibolite, ultramafic rocks, greenstone 23

Major Unit: Sedimentary Rocks **24**
Rock Descriptions **24**
Non-carbonate sedimentary rocks 24
Carbonate and carbonate-bearing sedimentary rocks 24
Nutrient management recommendations **25**
Good: Carbonate-bearing sedimentary rocks 25
Medium: Feldspathic sandstone, mudstone 25
Bad: Sandstone, conglomerate, carbonate rocks 26

Major Unit: Unconsolidated Deposits **28**
Rock Descriptions **28**
Glacial till 28

Major Unit: Metamorphic Rocks

Minor Units

- *Carbonate-bearing and calc-silicate metasedimentary rocks*
  - **Calc-silicate Rocks**
  - **Metamorphosed Carbonate Rocks**
  - **Carbonate-bearing Metasedimentary Rocks**
- *Low-grade metasedimentary rocks (Non-carbonate/non-calc-silicate)*
  - **Feldspathic quartzite**
  - **Quartzite** *(may also be high-grade metasedimentary)*
  - **Siltite-Argillite**
- *High-grade metasedimentary or meta-igneous rocks (Non-carbonate/non-calc-silicate)*
  - **Metamorphosed Felsic Intrusive Rocks**
  - **Metamorphosed Mafic Intrusive Rocks**
  - **Schist-Gneiss**
- *Greenstone and ultramafics*
  - **Greenstone**
  - **Ultramafic Rocks**

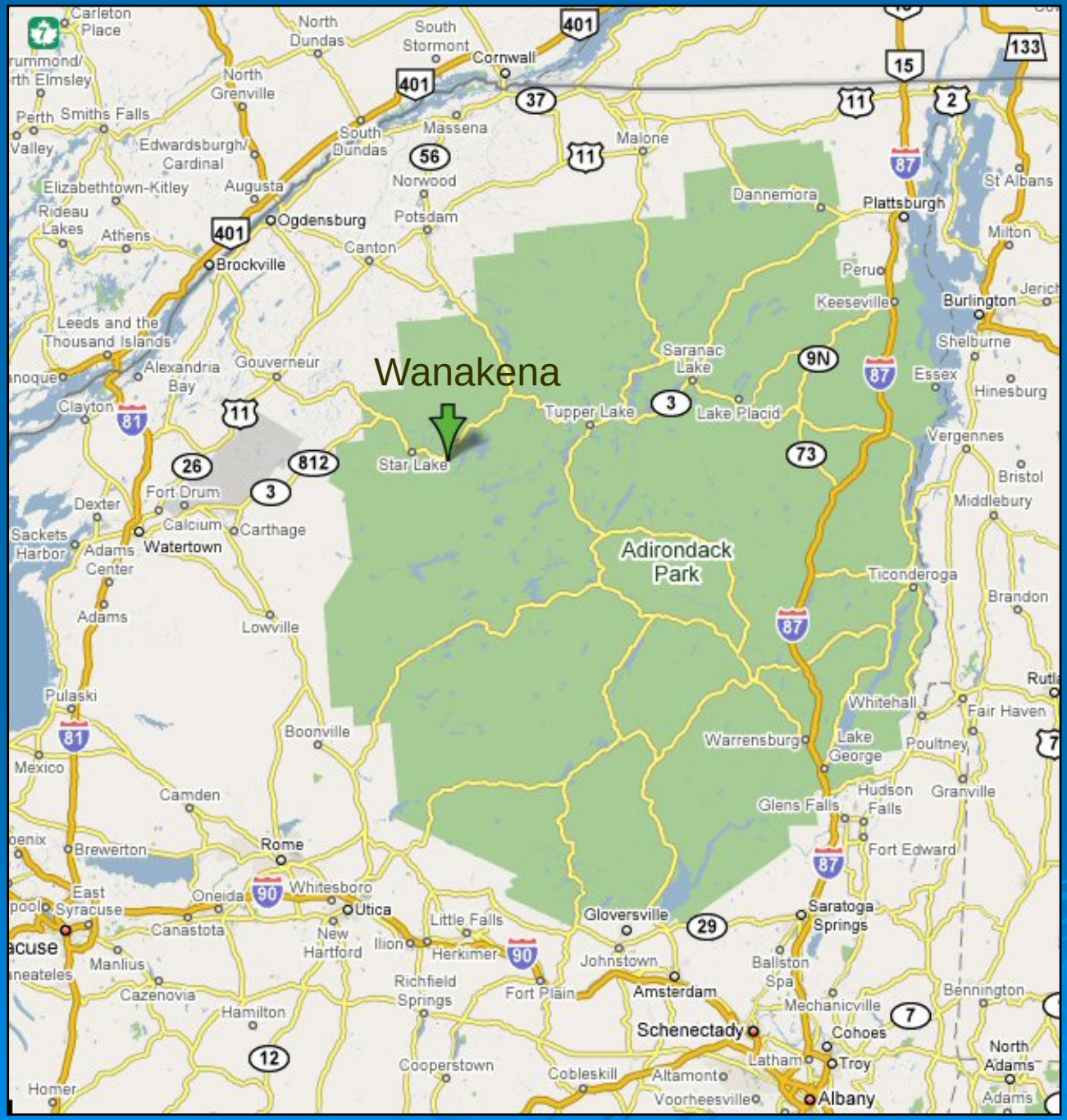
Overview: Large areas of northern Idaho and western Montana are dominated by metamorphic rocks. These rocks are challenging to classify from a geology-forest nutrition standpoint because they are so diverse in origin. The metamorphic map units in these regions often contain mixed lithologies resulting from variation in original composition, reflecting sedimentary and/or igneous origins. Metamorphic rocks are classified either by their texture, which in turn is related to the degree of pressure and temperature changes (e.g. metamorphism) that they have undergone, or by composition. Some are weakly metamorphosed (low-grade metamorphic) rocks such as Belt argillite, siltite and quartzite. Strongly metamorphosed (high-grade metamorphic) rocks include schist and gneiss. Some rocks, such as quartzite, may be either high- or low-grade metamorphic rocks. Metamorphic rocks are sometimes further described by color, with 'felsic' referring to light-colored and 'mafic' referring to dark-colored rocks. Further description is provided by mineral-content modifiers placed in order of increasing abundance, such as muscovite schist or quartz-feldspar gneiss. Many of the metamorphic map units in northern Idaho and western Montana are of mixed lithology. For this report, the major and minor units were assigned based on the dominant lithology. At the moment, we do not have strong fertilization recommendations for metamorphic rocks largely because we don't have a significant number of trials on these rock types, especially in western Montana. This is particularly tre for the suspected 'bad' rocks, as we were unlikely to establish research plots in the associated poor-quality stands. We do, however, have some theories based on observation of weathering characteristics of these rocks that helped guide our selection of nutrient management guidelines.

Medium: Siltite-argillite, some feldspathic quartzites, quartz diorite gneiss, felsic gneiss, schist and gneiss

Rocks in this category are expected to form fine sandy or loamy soils, and often contain colluvial and residual cobbles. Soil particles will be largely composed of quartz, muscovite and feldspars. Moisture and nutrient-holding capacity are thought to be low. Site productivity is likely to be low to moderate, though an overlying ash cap may boost productivity if present. Field examination should be performed to assess soil depth, ash presence and stand performance. Extensive whole-tree removals are discouraged, as they may run the risk of depleting some of the limited nutrients available on these sites.

- Expected Soil Development: Moderate to deep sandy to loamy soils, cobbles may be present
- Expected Nutrient Status: Low to Moderate; better if ash present
- Ash Effect: Slight improvement in productivity with ash presence, but ash has no apparent effect on fertilization response.
- Recommended Nutrient Management Strategies:
  - Thinning: bole-only recommended
  - Regeneration Harvest: bole-only recommended
  - Species Selection: select for moderate to low nutrient-demanding species
- Expected Fertilization Response: Moderate. On poor sites, response may be relatively good when compared to the poor growth rates of unfertilized trees. Consider economic feasibility of return if objectives are financially-based.
- Fertilizer Recommendation:
  - Recommended only for grand fir or moister vegetation series
  - Recommended minimum formulation is NK, but consider S and B as well
  - Recommended for multinutrient (w/micronutrient) screening trials.

Consult with IFTNC for latest recommendations and guidelines!


Wanakena
Adirondack Park
Carleton Place
North Dundas
South Stormont
Cornwall
North Grenville
Perth
Smiths Falls
Valley
Edwardsburgh/ Cardinal
South Dundas
Massena
Malone
Elizabethtown-Kitley
Augusta
Norwood
Rideau Lakes
Athens
Ogdensburg
Potsdam
Canton
Brockville
Dannemora
Plattsburgh
St Albans
Milton
Peru
Keeseville
Burlington
Leeds and the Thousand Islands
Alexandria Bay
Gouverneur
Saranac Lake
Shelburne
Essex
Hinesburg
Clayton
Tupper Lake
Lake Placid
Vergennes
Star Lake
Bristol
Middlebury
Dexter
Fort Drum
Sackets Harbor
Calcium
Carthage
Watertown
Adams Center
Adams
Lowville
Ticonderoga
Brandon
Pulaski
Whitehall
Fair Haven
Boonville
Warrensburg
Lake George
Poultney
Mexico
Camden
Glens Falls
Hudson Falls
Granville
Brewerton
Rome
Fort Edward
East Syracuse
Oneida
Whitesboro
Utica
Little Falls
Gloversville
Saratoga Springs
Canastota
New Hartford
Ilion
Herkimer
Johnstown
Ballston Spa
Manlius
Richfield Springs
Fort Plain
Amsterdam
Bennington
Cazenovia
Hamilton
Mechanicville
Schenectady
Cohoes
Cooperstown
Cobleskill
Altamont
Latham
Troy
North Adams
Homer
Voorheesville
Albany
Adams