Washington State IFTNC Regions
Nutrition Guidelines By Rock Type

Nutrition guidelines for use in conjunction with 2005 digital geology for Washington state

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Introduction

This document was prepared as a guideline to help forest managers determine appropriate nutrient management strategies for stands on various rock types in the Intermountain Forest Tree Nutrition Cooperative (IFTNC) regions of Washington. State-wide digital geology compiled by the Washington Department of Natural Resources, Division of Geology and Earth Resources (DGER) personnel at the 1:100K scale was utilized in the development of these guidelines (Washington Division of Geology and Earth Resources 2005). Only those map units included in the three IFTNC regions in Washington were categorized for this report. These three regions include Northeast Washington, Central Washington and a portion of the Northeast Oregon region that occurs in southeastern Washington.

This report categorizes 1004 map units in the three IFTNC regions. The map units were classified into five major categories (major units), and further assigned to one of 25 subcategories (minor units). The minor units were then further subdivided into 53 lithology categories, which provided the basis for discussion of expected weathering behavior and recommended nutrient management guidelines and strategies. These guidelines are based on our current state of knowledge regarding rocks and forest growth in the inland northwest. **These recommendations are conservative and should not be viewed as absolute. We fully expect these guidelines to be further refined with additional research and experience.**

IMPORTANT: Geologic maps are a useful tool for forest management as long as we recognize that geologic maps were not developed for use at the forest stand scale. We have found the DGER maps to be very good for providing a general idea of the rocks likely to be found in a particular area, and often the maps are reasonably precise to the stand level. **Nonetheless, rock type should always be verified in the field as part of nutrient management planning. The information included in this report is intended only to provide general guidelines towards the formulation of silvicultural prescriptions. Managers will also need to take into account stand history and conditions, organizational objectives and other relevant information when formulating site-specific prescriptions.**

How To Use This Document

The Washington 1:100K digital state-wide geology may be obtained through the DGER website at ***http://www.dnr.wa.gov/geology/dig100k.htm***. A shapefile with the three IFTNC regions accompanies this report and may be used to clip the state-wide map, if desired. Paper maps for each 1:100K quadrangle are also available by contacting the DGER. During the compilation of this report, every geologic map unit occuring within the three IFTNC regions was assigned a major unit, minor unit and lithology grouping, with each lithology grouping receiving a weathering susceptibility estimate and a tree value (e.g. good rock/bad rock) rating. A summary of the weathering susceptibility, tree value and ash cap effects by major and minor unit is provided in **Appendix A**. Observations regarding ash effects on stand growth rate and fertilization response, as well as nutrient management and fertilizer recommendations, are discussed in the text of this report. Individual 1:100K quadrangles that were included in the compilation of this report are shown graphically in **Appendix B**.

This document may be used with digital geologic maps in a GIS by using the dBASE lookup table that accompanies this report (Wash_Lith_IFTNC_Apr2008_Lookup.dbf), which assigns the IFTNC nutrition guidelines categorization scheme to each individual map unit. A description of the information included in the dBASE table is provided in **Appendix C**, along with details on how to merge the table with the digital geologic map attribute table. The lookup table has also been partially reproduced in **Appendix D**. To use this document with paper maps, users should locate the geologic unit of interest on one of the geologic maps referenced in this report, and then look up the associated major unit, minor unit and lithology in Appendix D. The table in Appendix D has been alphabetized by quadrangle name and map unit code in order to facilitate use with paper maps. For both digital and paper maps, once the appropriate map unit code is located and categorizing according to the IFTNC heirarchy, refer to the text of this report for discussion of geology and silvicultural recommendations.

Rationale and Recommended Reading

The Intermountain Forest Tree Nutrition Cooperative (IFTNC) has been studying forest nutrition in the Inland Northwest since 1980. Initial studies focused on nitrogen (N) nutrition, and subsequent findings suggested that potassium (K) also plays an important role in forest health (Entry et al. 1991, Mika et al. 1993, Moore et al. 1994). Nitrogen tends to promote growth by increasing foliage biomass production, thereby providing for increased stem growth via increased photosynthetic capacity. In contrast, K appears to decrease mortality by promoting production of biochemical defense compounds. The source of K and most plant nutrients other than N is the underlying rock, which in some cases may be augmented or replaced by surficially deposited parent materials. To further determine the potential role of K in decreasing tree mortality, a region-wide N and K trial known as the Forest Health and Nutrition Study was implemented by the IFTNC in the mid-1990s. The study design incorporated bedrock geology and site moisture status (as indicated by potential climax vegetation) as the principal experimental effects. While rock and vegetation series had routinely been noted as factors affecting forest growth response to fertilization in earlier studies (Shen et al. 2000), the Forest Health and Nutrition Study was the first to require that stands meeting certain rock and vegetation series criteria be included in the study. The subsequent discovery that certain stand types (drier vegetation series) could not be found on certain rock types (metasedimentary) stimulated a more in-depth look at rocks and the effect of geology on soil conditions and stand growth and health (Moore and Mika 1997, Garrison-Johnston et al. 2003, Garrison-Johnston et al. 2003, Moore et al. 2004). While these findings led to the establishment of additional studies to observe the effects of rock type on the growth and health of seedlings and young stands, they also resulted in the incorporation of rock type as a major factor influencing forest management and fertilization recommendations (Garrison and Moore 1998, Garrison-Johnston and Moore 2001, Garrison-Johnston and Johnson 2004).

This report was developed to provide regional resource managers with the best information currently available based on the experiences and observations of IFTNC staff. Users will benefit from a *Dictionary of Geologic Terms* (American Geological Institute 1984), particularly when interpreting the terminology used on geologic maps. Two excellent books for learning about the geology of Washington and the northwest are *Roadside Geology of Washington* (Alt and Hyndman 1984) and *Northwest Exposures: A Geologic Study of the Northwest* (Alt and Hyndman 1995). Numerous textbooks on introductory geology are available through on-line book sellers. A recent review of currently available texts showed *The Practical Geologist: The Introductory Guide to the Basics of Geology and to Collecting and Identifying Rocks* (Dixon 1992) as being of potential interest to those interested in developing a deeper understanding of geology, and the *Smithsonian Handbooks: Rocks & Minerals* (Pellant 2002) as a nice field handbook, with numerous photographs and descriptive geology basics.

Geology Overview

This document assumes a certain level of familiarity with geological classification and terminology. The recommended readings should provide useful background information. A very brief review of geologic classification is also presented below, along with a description of how the IFTNC categorizes rock types. Volcanic ash is also briefly discussed.

Basic Classification: At the broadest scale, rocks are classified into three groups: Igneous, Sedimentary and Metamorphic:

1. **Igneous** rocks are those derived from magma that rises from the earth's interior, cooling as it rises to the surface. There are two broad categories of igneous rock based on where and how quickly the magma crystallizes. Magma that is extruded onto the earth's surface cools rapidly, forming fine-grained crystalline rocks called extrusive or volcanic. Basalt is a good example of a volcanic rock common to the Inland Northwest. Magma that is intruded or emplaced beneath the earth's surface cools slowly, forming large-grained crystalline rocks known as intrusive or plutonic rocks. Granite is a good example of a plutonic rock.
2. **Sedimentary** rocks are those formed from the transported fragments of other rocks that have broken down through either chemical or physical weathering, and been transported by mechanisms such as water (alluvial/fluvial/lacustrine), wind (eolian), gravity (colluvial), or snow and ice (glacial). Sedimentary deposits may become cemented together, or lithified, such as a sandstone or conglomerate rock. Other deposits may remain unconsolidated, such as alluvial, glacial or landslide deposits.
3. **Metamorphic** rocks are rocks that have been altered by heat and pressure, such as that which might occur following deep burial by sediments in a marine environment, or by tectonic or volcanic activity of a mountain-building event. These intense forces often result in deformation of the rock texture and changes in the rock's mineral composition. A weakly metamorphosed rock in which the parent rock is still recognizable is considered to have undergone low-grade metamorphism. Thus, the sedimentary rocks sandstone, siltstone and claystone that underwent a low-grade metamorphism became quartzite, siltite and argillite, respectively. Granitic rocks may undergo weak to moderate levels of metamorphism and still be recognizable, such as 'granite gneiss.' In other cases the rock is so strongly metamorphosed that the parent rock is not identifiable, and textural descriptors such as 'gneiss' or 'schist' are used, perhaps with mineral modifiers such as 'mica' (mica schist) or 'biotite' (biotite gneiss). This level of alteration is the result of high-grade metamorphism, and high-grade metamorphic rocks may be either sedimentary or igneous in origin. Metamorphic rocks are often classified as belonging to various formations that were named based on the locality in which they were first mapped.

Tree Nutrition Cooperative Classification: The IFTNC has traditionally categorized the geology underlying its research sites into four major groups (Granitic, Basaltic, Mixed and Metamorphic), based largely on the occurrence of rocks in its Inland Northwest research area. The Granitic and Basaltic units represent the intrusive and extrusive igneous rocks, respectively. The Mixed unit includes all sedimentary rocks, but relative to IFTNC research sites is dominated by glacial deposits. Similarly, the Metamorphic unit includes all metamorphic rocks, but tends to be dominated by the metasedimentary rocks, often Belt rocks, found at many research sites.

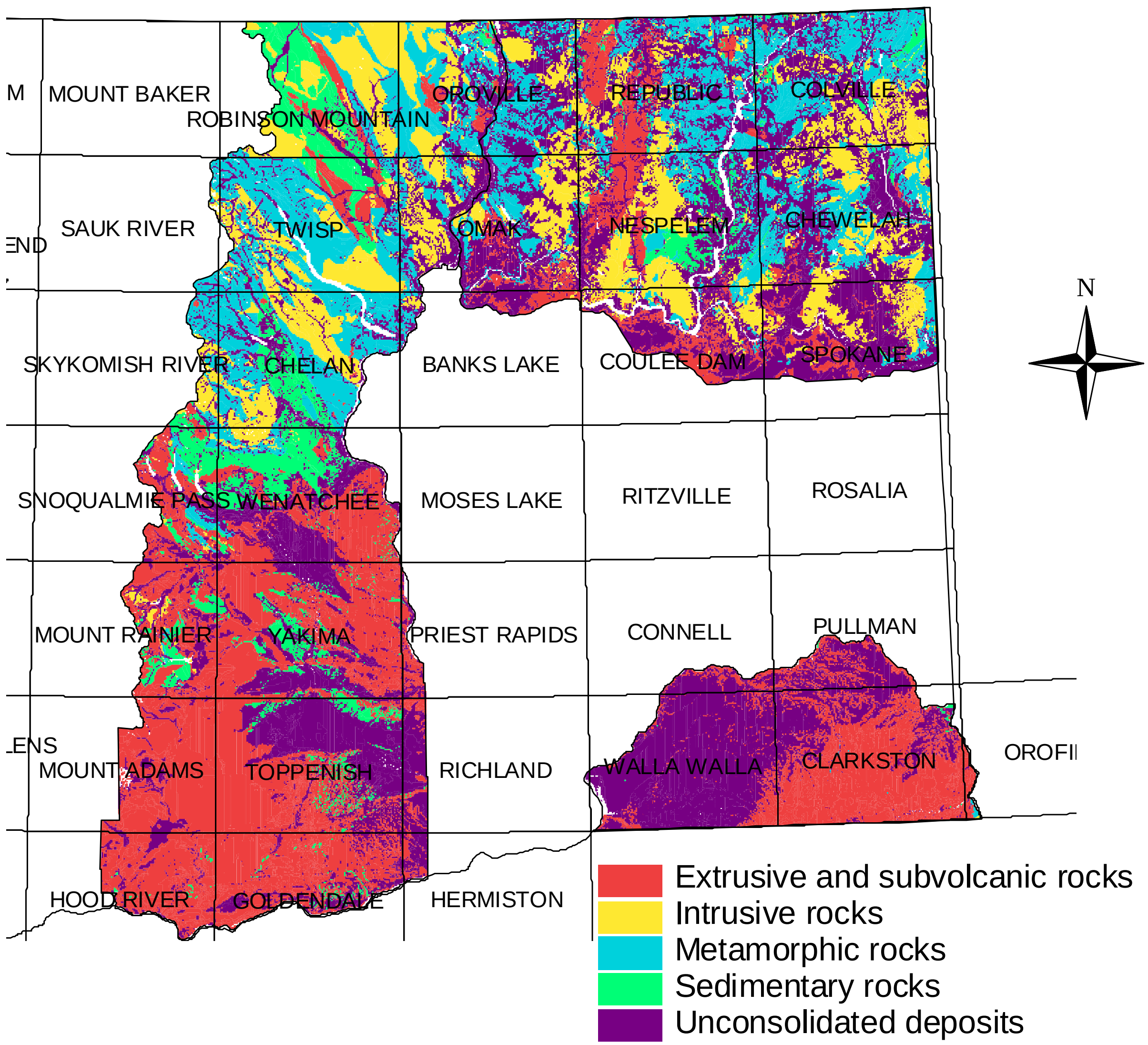
As information relative to the effects of rock type on forest productivity increased, there was a need to expand the classification categories used by IFTNC. For the purposes of this report, five major groups have been established (Figure 1). The original 'Granitic' and 'Basaltic' groups were renamed 'Intrusive Rocks' and 'Extrusive and Subvolcanic Rocks' to accommodate other igneous rocks besides granite and basalt. The Metamorphic Rocks unit was retained. The Mixed unit was divided into Sedimentary Rocks (for lithified or consolidated rocks like sandstone and conglomerate) and Unconsolidated Deposits (for loose materials such as alluvium, loess and sand). Several minor units were then created within each of the major units to allow additional detail within this classification system. In many instances the IFTNC does not have research sites on these rock types, and in some cases forest stands may not even occur on these rock types. Therefore, the nutrition management guidelines included in this report are based only on IFTNC experiences with forest growth and soil conditions on rocks with which we have familiarity. For the many rocks where we do not have research information, we state that the effects of that rock type on forest growth and fertilization response are 'unknown,' and offer a conservative nutrient management recommendation along with a recommendation for further research such as screening trials, if warranted. A rock type would warrant additional research if it is a common geologic parent material underlying the ownerships of our members.

Weathering Susceptibility: Field observation of soil development on various rocks suggests that deeper soils develop on some rocks than on others, even when other conditions (topographic, climatic, biotic, time) appear to be similar. This seems particularly evident amongst the Belt metasedimentary rocks, and appears related to the carbonate or calc-silicate component. In order to quantify these perceived differences in potential weathering susceptibility, an analysis of rock geochemical data from 446 samples collected throughout northern Idaho was performed by IFTNC, IGS and USGS personnel (Garrison-Johnston et al. 2003). A modification of Reiche's (1943) **weathering potential index (WPI)**[1] was selected to evaluate the potential variation in rock weathering rates due to rock geochemical composition. The WPI values were tabulated by lithology, and for most rocks ranged from a low of about 4 ('pure' quartzite, low weathering potential) to a high of about 22 (basalt, high weathering potential). It should also be noted that some rocks attained high WPI ratings based on geochemistry, but are not considered to have high weathering susceptibility because of other factors such as lack of permeability. Some examples of this would be dolomite (WPI: 72) and marble (WPI: 47). Weathering potential indices for the various lithologies are noted throughout this report, and additional commentary is included if the assigned weathering susceptibility rating varied from that suggested by the WPI analysis.

Volcanic Ash and Other Deposits: A variety of surficial deposits may overlay the mapped 'base' geology on any given site. Wind-blown loess deposits are likely to occur in much of central and south-eastern Washington, and occasionally in northeastern Oregon. Alluvial or older sedimentary deposits commonly occurred in conjunction with blocked drainage channels during the various flood basalt events that affected large portions of the state. Ash caps across much of the Inland Northwest resulted from past eruptions of Glacier Peak (WA), Mt. Mazama (Crater Lake, OR) and Mt. St. Helens (WA).

[1] Weathering Potential Index (WPI) is referred throughout this report as an index of weathering susceptibility.

Figure 1. Five major unit assignments for IFTNC nutrient management guidelines in Washington State.



We know a little more about volcanic ash compared to other surficial deposits, largely because of it's relatively easily identifiable, unique characteristics. Climatic conditions contribute to ash weathering. In cooler and drier areas, the ash cap is likely to have a grayish hue, but as moisture and temperature increase the ash may start to display a yellowish to reddish tint as chemical weathering commences. Ash cap soils are likely to show low bulk density, good porosity and high moisture-holding capacity. The nutritional value of ash is not particularly high, being composed primarily of silicon and aluminum. Potassium may comprise 2-3% of volcanic ash, and if plants are available on-site to take up that K then it may act as a K source. However, due to a relatively low cation exchange capacity, ash cap soil does not tend to have a strong nutrient-holding capacity, and its nutritional behavior is somewhat complicated by the development of variable-charge minerals as weathering progresses. The primary value of volcanic ash seems to be in its moisture-holding capacity, which often improves site productivity (Figure 2), and may affect fertilizer response (Figure 3). Volcanic ash will not be directly referenced as a parent material in this report, but is often referred to in the context of the improved site productivity and/or fertilization response associated with these deposits.

Site reconnaissance is usually necessary to establish the presence/influence of ash cap or other non-mapped surficial deposits, such as unmapped loess. If a shallow surficial deposit is present, that deposit may be expected to modify the effects of the underlying residual soils, but may also manifest itself in other site characteristics. For example, in northern Idaho, western red cedar or western hemlock vegetation series are often associated with deep ash deposits over various rock types. Nutrient management guidelines, in turn, rely in part on the moisture regime (as represented by vegetation series) in addition to underlying bedrock type.

Figure 2. Douglas-fir site index (ft at 50 years) by base parent material and ash cap presence. Parent materials include basalt, glacial deposit (glacial), granite, metasedimentary (metased), sedimentary (sed), modern sedimentary deposits (mod sed) and tertiary sedimentary deposits (tert sed).

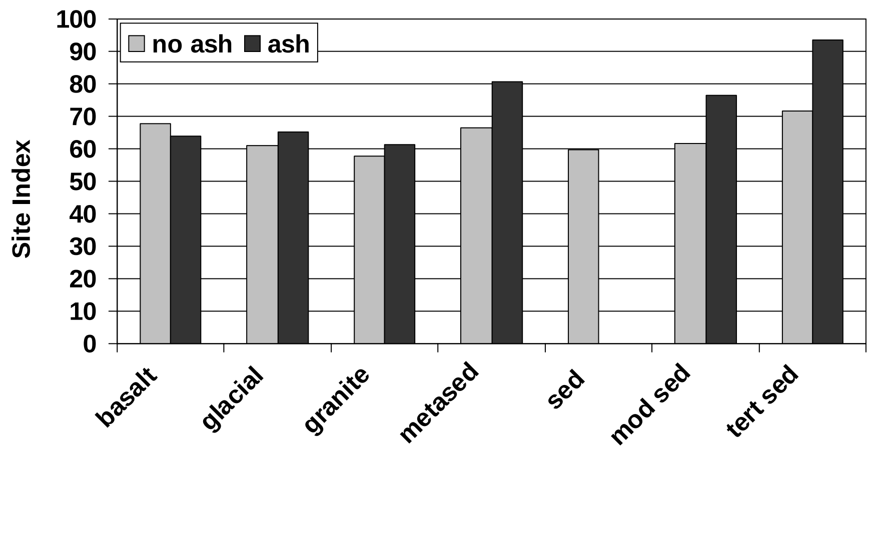
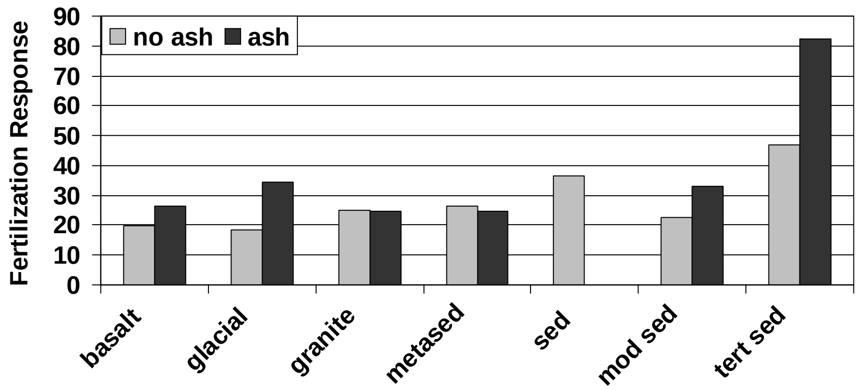


Figure 3. Six-year nitrogen fertilization response (ft^3 ac^{-1} yr^{-1}) by base parent material and ash cap presence. Parent materials include basalt, glacial deposit (glacial), granite, metasedimentary (metased), sedimentary (sed), modern sedimentary deposits (mod sed) and tertiary sedimentary deposits (tert sed).



Nutrition Overview

The term "nutrient" is used to denote any of seventeen naturally-occurring elements that are considered essential for plant growth. Three of these elements, carbon (C), hydrogen (H), and oxygen (O), are abundantly available in air, earth and water, and are not considered limiting factors to plant growth. Six elements, nitrogen (N), potassium (K), phosphorus (P), calcium (Ca), sulfur (S), and magnesium (Mg), occur in limited quantities, and because plants require these in relatively large quantities (500-14000 ppm) to grow and function adequately, they are referred to as "macronutrients." A number of other elements which occur in limited quantities are required by plants only in trace amounts (usually <100 ppm), and these are known as "micronutrients." Eight elements are currently considered micronutrients, and more will probably be added to this list over time as equipment detection levels and research techniques improve. Tables 1a and 1b respectively list the macro and micronutrients, their principal functions in higher plants, and their sources. Two non-nutritive elements that are occasionally referenced in this report are the common silicate mineral constituents, silicon (Si) and aluminum (Al).

Nutrient Diagnostics: Tests of foliage and soil chemistry may be performed as site-specific indicators of productivity and potential fertilization response. Most of our long-term results of fertilization research focus on N. Foliage N has been shown to be a better predictor of site productivity than soil N tests, while soil mineralizable N may be a better predictor of fertilizer response than foliage N tests (Garrison-Johnston et al. 2006). If satisfactory information on site productivity is available and the parent material/ash combination suggests that the site may be responsive to fertilization, managers should consider focusing on tests of soil mineralizable N. If mineralizable N is below 70 ppm, then the site should show a 6-year volume response of 10% or more to N-fertilization, with the potential response increasing as mineralizable N decreases.

Foliage N may be tested as an indicator of overall site productivity; however the time and expense of this test make it less desirable than performing simple site height/age measurements.

Nutrient Management: “Nutrient management" refers to silvicultural activities as they affect the nutrient capital of a forest stand. Nutrient management strategies may be cultural in nature, including stand improvement, harvesting and planting, or they may be more manipulative in nature, such as by adding nutrients in the form of fertilizer.

Harvesting: Most nutrients are held in limbs and foliage (Cole et al. 1967, Pang et al. 1987, Miller et al. 1993, Moller 2000); therefore, a conservative nutrient management strategy will leave the tops and limbs on-site during harvesting operations. Because the actual amount of material removed during a harvesting operation depends on the season of the year as well as the harvesting system, some consideration as to treatment timing can have an effect on management decisions. Whole-tree operations in late fall and winter, when breakage is more likely, should be more effective at leaving nutrients on the site than those which take place in spring and summer. Bole-only extraction includes tree-length operations where trees are limbed and topped in the woods, and is considered to be a conservative nutrient management strategy year-round. The level of nutrient removal during any harvest operation also depends on the merchantability standards in effect during the harvest, and whether the sub-merchantable trees are also harvested and removed. For purposes of this report, commercial thinning and regeneration harvest operations have been designated as ‘whole-tree’ or ‘bole-only’ extraction. We recognize that there is a gradient in the amount of material that may be left on-site, ranging from removal of most materials during ‘whole-tree’ operations, to leaving most materials during ‘bole-only’ operations. By specifying particular types of harvesting systems and timing of the operation, foresters should be able to target operations to fall somewhere within this range of variability. A recommendation of ‘bole-only removal’ in these guidelines would suggest that as much material be left on-site as possible. A recommendation of ‘whole-tree acceptable’ would suggest that the site may be resilient to the removal of a greater quantity of material.

- **Species Ecology**: Species differ in nutrient demand (Gordon 1983, Gower et al. 1993, Miller et al. 1993, Garrison and Moore 1995, Moore et al. 2004), therefore planting a nutritionally-challenged site with less-demanding species would be a good nutrient management strategy. In the experience of the IFTNC, species may be ranked from high to low demand as follows:

Species	Demand
Grand fir	very high
Douglas-fir	high
White pine	moderate to high
Ponderosa pine	moderate
Lodgepole pine	low
Western larch	low
Western hemlock	low? (based on our observations)

Tables 1(a): The macronutrients -- their function and source, and 1(b): The micronutrients -- their function and source. Most nutrient functions are from Marschner (1995). An asterisk indicates that a nutrient is available in fertilizer form.

Table 1(a): The macronutrients -- their function and source

Symbol	Element	Function	Source
N*	Nitrogen	Biomass production Photosynthesis (proteins)	Organic matter N-cycle
K*	Potassium	Disease resistance Osmotic potential, turgor Enzymatic transfer of glucose to starch Nitrate synthesis Photosynthesis and CO_2 fixation	Parent material
P*	Phosphorus	Structural constituent of DNA and RNA Basal metabolism (ATP and energy transfer) Photosynthesis (carbon partitioning)	Parent material
S*	Sulfur	Photosynthesis (proteins) Membrane structure Some defense substances	Atmosphere Parent material
Ca*	Calcium	Structural component (cell walls, membranes)	Parent material
Mg*	Magnesium	Chlorophyll Protein synthesis Enzymes and enzymatic reactions Carbohydrate partitioning	Parent material

Table 1(b): The micronutrients -- their function and source

Symbol	Element	Function	Source
Fe*	Iron	Chloroplast development, photorespiration Enzymatic reactions	Parent material
Mn*	Manganese	Enzymatic reactions Photosynthetic O_2 evolution	Parent material
Cu*	Copper	Nitrogen metabolism (NOTE: High N rates can induce Cu deficiency) Cell wall lignification Pollen formation and fertilization Carbohydrate and lipid content Enzymatic reactions	Parent material
Zn*	Zinc	Metabolic functions Complexes with N, O and S DNA replication Regulation of gene expression (NOTE: High P rates can induce Zn deficiency)	Parent material
Ni	Nickel	N metabolism	Parent material
Mo*	Molybdenum	N metabolism N_2-fixation May affect pollen formation/fruit formation Critical level increases with increasing N supply	Parent material
B*	Boron	Cell wall biosynthesis and structure Plasma membrane integrity Root elongation, apical dominance Deficient B associated with Eucosma sp. borer	Parent material
Cl*	Chlorine	Photosynthetic O_2 evolution Stomatal regulation	Parent material Atmosphere

- **Prescribed Fire**: Fire suppression has increased the presence of shade-tolerant, nutrient-demanding species and has also altered the cycle by which nutrients were naturally returned to the system through fire (Little and Klock 1985, Feller 1988). Furthermore, a cool fire can effectively return much of the on-site nutrient capital to the soil. Therefore, using cool burns for slash control, site preparation or intermediate treatments would be a good nutrient management strategy.

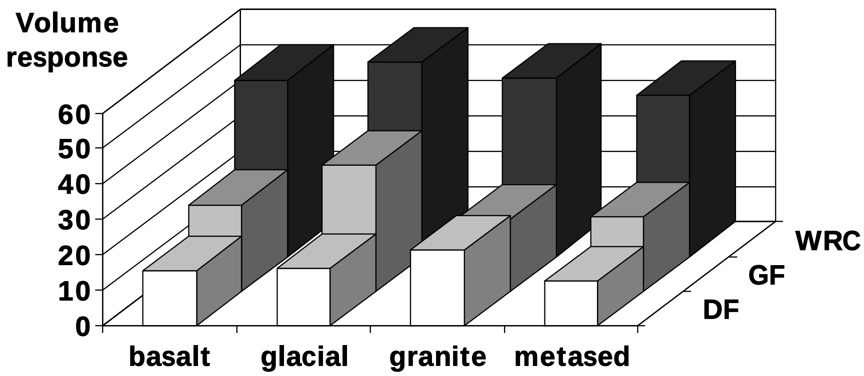
- **Fertilization**: Fertilization is an additional nutrient management strategy which may be used to improve the health or increase the productivity of a forest stand. Based on existing IFTNC research, a broad pattern of N fertilization response based on vegetation series and rock type has been detected (Figure 4), and has been incorporated into this report. The recommendations shown in this report will be based largely on our experiences in central and northeastern Washington, northeastern Oregon and northern and central Idaho. We do not yet have adequately replicated, long-term information on fertilization response for elements other than N; however, K, S and B often provide beneficial responses in terms of growth response and decreased mortality.

- **Fertilization Strategies:** *Things to consider when developing a fertilization regime:*
  → ***Moisture***: The first criteria to consider when contemplating fertilization is site moisture regime. In our experience, vegetation series is a good proxy for site moisture regime. Moist site types, characterized by western red cedar, western hemlock and western white pine, are the highest priority for fertilization, followed in descending order by sites on the grand fir vegetation series and those habitat types on the moist end of the Douglas-fir series. We have no fertilization response data for drier site types such as true ponderosa pine types, and at this time do not recommend fertilization of such sites. We strongly recommend further research in the form of short-term screening trials and long-term fertilization rate trials, particularly if drier site types comprise a significant portion of the organization's core ownership.

  → ***Parent Materials***: When selecting sites for potential fertilization or fertilization rate trials, if the vegetation series is appropriate for fertilization then rock type should next be considered along with surficial deposits. Use the guidelines in this report to determine whether a rock type is appropriate for fertilization, and what elements are recommended for application. It is assumed that the forest stand under consideration has been assessed and, based on moisture regime and organizational/financial objectives, has been deemed appropriate for fertilization. The decision of how much of each element to apply will be dictated by our current state of knowledge, as well as financial and other operational constraints. The IFTNC staff can provide guidance on application rates and expected responses.

  → ***Management History***: Recent experience suggests that young stands, particularly plantations established after high levels of biomass removal and mechanical site preparation, are often deficient in S and B. This seems to be true for all rock types, but the nutrient status is relatively worse on "bad" rock types. Thus, stand management history should also be considered when assigning fertilization priorities for any site.

Figure 4. Six-year nitrogen fertilization response (ft^3 ac^{-1} yr^{-1}) by base parent material and vegetation series. Parent materials include basalt, glacial deposit (glacial), granite and metasedimentary (metased). Vegetation series include Douglas-fir (DF), grand fir (GF) and western red cedar (WRC).

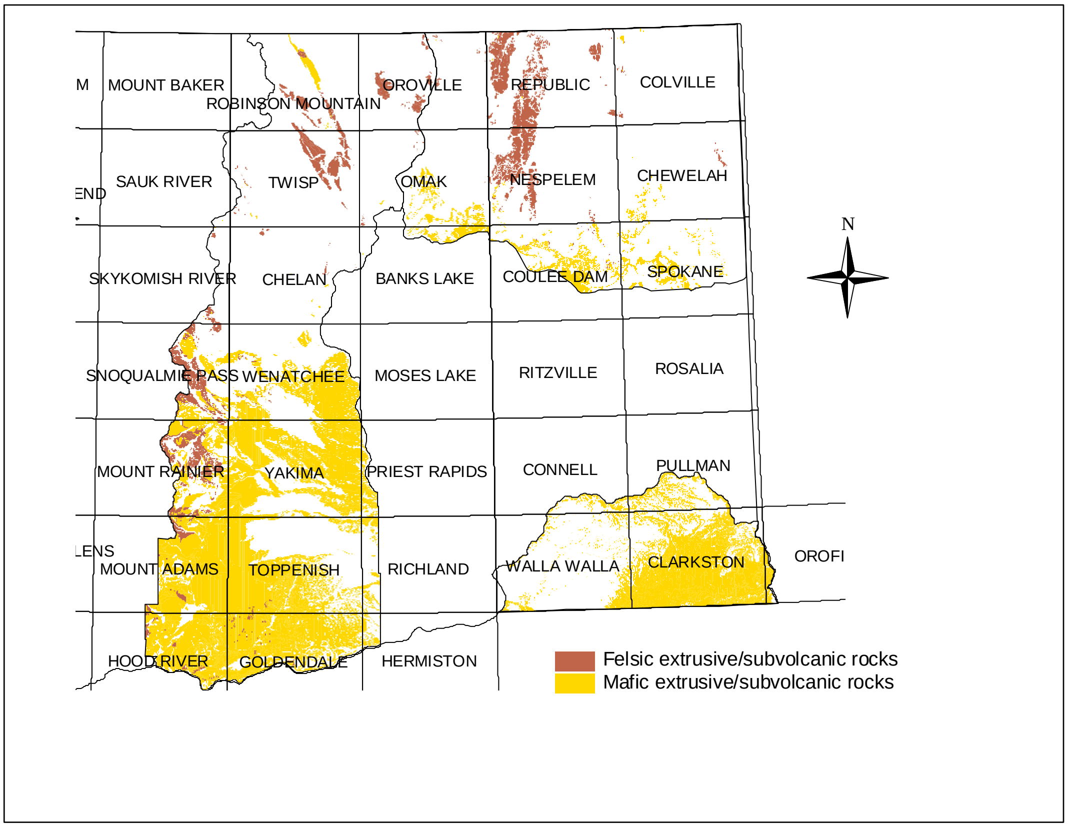


Acknowledgements

This report represents a significant revision of the previous nutrition guidelines for Washington rocks. We thank Ray Lasmanis of the Washington DGER for his review and valuable suggestions during the final phases of this report. We also appreciate the continued support and interest of all of our Cooperators in this effort. In the development of this report, we relied heavily on a similar geology guidelines report recently produced for northern Idaho and western Montana. The technical reviewers of the Idaho/Montana document included Reed Lewis of the Idaho Geological Survey, John Mandzak of Potlatch Forest Holdings, Jeff Lonn of the Montana Bureau of Mines and Geology, and Scott McLeod (now with Washington DNR) and Jeff Collins of the Montana DNRC. All of these reviewers provided significant improvements to the Idaho/Montana report, that are in turn reflected in this revised Washington report. We also thank the Washington DGER staff for compiling a great deal of geologic information very clear, accessible and user-friendly digital product that enhances our ability to incorporate geological information into these nutrition guideines and similar resource management applications.

Nutrient Management Guidelines

Major Unit: Extrusive and Subvolcanic Rocks



Minor Units

- **Felsic Extrusive and Subvolcanic Rocks**
- **Mafic Extrusive and Subvolcanic Rocks**

Overview: Extrusive and subvolcanic igneous rocks form when magma reaches the earth's surface either as a flow, explosive eruption or feeder dike or sill. Extrusive rocks cool rapidly, producing a fine grain size. Extrusive rocks may be broadly categorized based on the mineralogic composition as mafic (dark-colored) or felsic (light-colored). Basalts (a mafic extrusive) are the most common extrusive rock in Washington, occupying significant areas of southern portion of the state. In northeastern and north central Washington, small bodies of felsic extrusive rocks are found, principally dacite and felsic volcanic rocks.

Rock Descriptions

Felsic Extrusive and Subvolcanic Rocks

Dacite and rhyolite are light-colored extrusive rocks that are higher in silicon content than basalt. Weatherability of dacite and rhyolite is poor compared to mafic volcanic rocks (WPI: Rhyolite 8.9, Dacite 13.7). Rhyolite has a higher silicon content than dacite, and is likely to occur as ash flows/falls, but only rarely as a lava flow. Dacite is likely to occur as both lava flows and as ash flows/falls. A generalized technical explanation for this is that the higher silicon content, the more viscous the magma, and the more viscous the magma, the more explosive the eruption. The more explosive eruptions form ashes, tuffs, breccias and similar materials often referred to in geologic maps as *volcanics*. However, flow rocks are also considered volcanics, so particular attention should be paid to the map description when encountering this term. In the context of this report, volcanics generally consist of felsic airfall ash and debris, lava flows and reworked volcanic deposits such as breccia and tuffs. Landscapes underlain by felsic volcanic rocks often display a bouldery, rubbly topography with occasional outcrops of resistant materials. Volcanic rocks comprise over 50% of the felsic intrusive rocks occuring in the IFTNC mapping regions in Washington state.

Felsic dikes and sills are localized areas of rock at points where felsic volcanic magma intruded into small cracks and crevices in the earth's crust, or in some cases were vents for magma flows. Dikes and sills often occur as outcrops, indicating poor weatherability. In our experience, rocks comprising dikes and sills don't tend to support good tree growth, and forest stands on those rocks may be particularly susceptible to harboring forest insect populations during endemic years (Garrison-Johnston et al. 2003).

Mafic Extrusive and Subvolcanic Rocks

Typical basalts are composed mainly of plagioclase feldspar and clinopyroxene, and contain no quartz. Plagioclase feldspars contain Si and Al along with Ca and/or Na, but little or no K. A clinopyroxene is one of a group of minerals that contain Si, Ca, and some combination of Mg and/or Fe. Grain size and mineral composition affect the formation of clays in residual soils formed from these rocks. Basalts tend to form clay-rich soils with good moisture-holding capacity. Basaltic soils should also be fairly rich in several important nutrients, including Mg and Ca. While K content of basalt rocks is fairly low, the K-retention of basaltic soils should be quite good, again due to the clay content and resulting good cation exchange capacity (CEC). High CEC and base saturation are important qualities of basaltic soils. Expected weathering potential is high (WPI: 22.9). Basalt is by far the most common extrusive rock that occurs in Washington state, occupying over 90% of the land area classified as mafic extrusive/subvolcanic.

Andesites are very similar in composition and appearance to basalt, but contain more silicon and are likely to have a slightly lower weathering potential (WPI 20.9). Despite the similarity to basalt, andesitic soils do not seem to support high tree growth rates or strong fertilization response. In some cases this may be a topography issue, as discussed below. Mafic dikes and sills are similar in structure to the felsic dikes and sills described previously, but are composed of mafic magma.

Basalts and Topography

The 'good rock' reputation of basalts seems to have originated with the relatively flat topography of the Columbia River flood basalts in northeastern Oregon, southeastern Washington and portions of northern Idaho. The gentle slopes associated with those flood basalts appear to be accompanied by deeper in-place weathering than is associated with steeper topographies, as well as accumulation of overlying erosional materials resulting from blocked stream drainages during flow events, and in some cases accumulation of loess and ash caps. The soils are deep and generally have good water-holding capacity and high CEC, resulting in good tree growth and good fertilization response. However, as we approach the edges of the Columbia River flows along canyons, we find steeper topography. Associated with the steeper topography is a much lower degree of in-place weathering and less accumulation of deposited materials.

Some basalts are resistant to weathering to the extent that rounded cliffs may form, and tree growth is virtually non-existent. The same is often true for dikes, sills or otherwise resistant materials, regardless of lithology. Sites which are topographically unsuitable for supporting trees are not intended for consideration in this report.

Nutrient management recommendations

Good-to-medium: Basalt

Basalts associated with gentle topography are generally considered good rocks and good candidates for fertilization. Sites with slopes less than about 20% are likely to have some sort of accumulated deposit or deeply weathered-in-place soils. We recommend that conservative nutrient management strategies be followed. However, because of the high quality of these sites, they may be more resilient than other sites to nutrient-depleting management strategies such as intensive whole-tree removal. Research on IFTNC study sites in central Washington and northeast Oregon indicates that good response may be expected when N-only is applied, but that in some cases S may be necessary to elicit a growth response to N-fertilization.

Basalts associated with steeper topographies should be considered medium or even poor sites, and should be treated more conservatively. We would still expect moderate tree growth and moderate-to-good fertilization response.

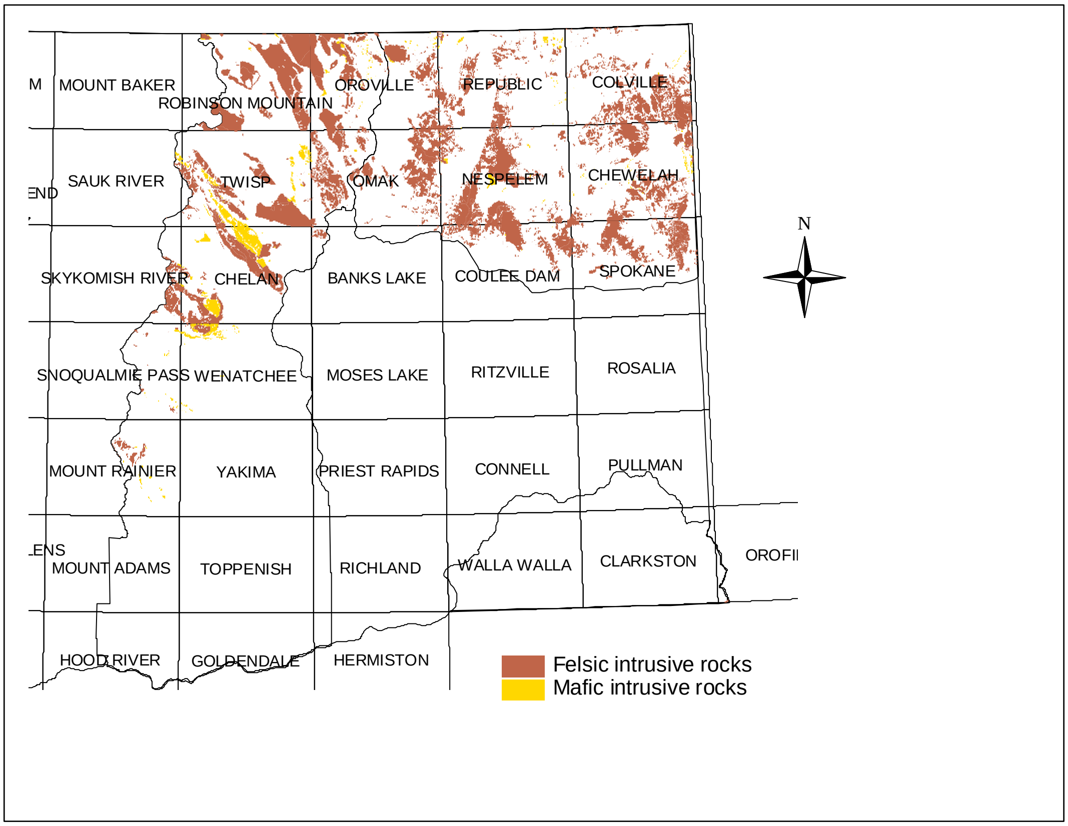
- Expected Soil Development: Moderate to deep, fine loamy soils
- Expected Nutrient Status: Good (gentle slopes) to Medium (moderate slopes)
- Ash Effect: Ash presence does not seem to affect productivity unless associated with moister climatic conditions, in which case productivity does improve. Improved response to N-fertilization is also associated with ash cap.
- Recommended Nutrient Management Strategies:
    - Thinning: bole-only preferred, but whole-tree removal probably OK on gentle slopes
    - Regeneration Harvest: bole-only preferred, but whole-tree removal probably OK on gentle slopes
    - Species Selection: most species will do well on this rock type
- Expected Fertilization Response: Moderate to good response to N
- Fertilizer Recommendation:
    - Recommended only for moist-end Douglas-fir habitat types and grand fir or moister vegetation series
    - Recommended formulation: Research suggests N or NK will probably produce a positive response; observation suggests NKSB will produce a better response.
    - Good multi-nutrient blend candidates; consider screening trials

Bad: All other (non-basalt) mafic and felsic extrusive rocks

These rock types are considered to have poor tree-growing value and to be poor candidates for fertilization. Conservative nutrient management practices should be followed.

- <u>Expected Soil Development</u>: Poor
- <u>Expected Nutrient Status</u>: Poor
- <u>Ash Effect</u>: None
- <u>Recommended Nutrient Management Strategies:</u>
    - Thinning: bole-only recommended, but whole-tree may be OK for thinning from below or other light thinning
    - Regeneration Harvest: bole-only
    - Species Selection: select for low nutrient-demanding species
- <u>Expected Fertilization Response</u>: Poor
- <u>Fertilizer Recommendation</u>:
    - If objectives are economic: Not recommended
    - If objectives are health- and productivity-related: Optional, grand fir or moister site types only
    - Rationale: We have not yet determined an appropriate fertilization regime to counter the “bad-rock” effect, though it will almost certainly involve various macro- and micro-nutrients besides N and K. The cost of these additional elements is not likely to justify their use, particularly if the cost must be carried over a number of years. The application of NK *may* reduce mortality in some cases; however, our understanding of when and why mortality may be affected is not yet clear. Consultation with IFTNC staff would be appropriate.

Major Unit: Intrusive Rocks



Minor Units

- **Felsic Intrusive Rocks**
- **Mafic Intrusive Rocks**

Overview: Intrusive rocks are igneous rocks formed when magma cools inside the earth's crust. Because of the associated slow cooling process, intrusive rocks form large grains which are usually visible in a hand sample. Granites are the most common example of intrusive rocks. Felsic intrusive rocks are dominated by silicate minerals and tend to occur in relatively large bodies. Mafic rocks tend to be dark, heavy, silicon-poor rocks that occur in dikes, sills and other smaller, localized bodies. Within the IFTNC regions of Washington state, intrusive rocks occur almost exclusively in northeastern and north central parts of the state.

Rock Descriptions

Felsic Intrusive Rocks

Granite, quartz monzonite, monzonite and monzogranite contain mostly quartz and potassium feldspar, with some plagioclase feldspar, and very few dark minerals. Those granites that are dominated by potassium feldspars may be pinkish in appearance. Weathering susceptibility of these rocks is rather low (WPI: ‘Pink’ granite 8.6). Granodiorite, monzodiorite, and tonalite contain primarily quartz and plagioclase (non-potassium) feldspar, with some potassium feldspar and an abundance of dark minerals. They will probably be grayish in color or have a salt-and-pepper appearance. Tonalite will have more plagioclase feldspar than granodiorite or monzodiorite, but otherwise will be difficult to distinguish from granodiorite and monzodiorite in the field. Weathering susceptibility of these rocks is somewhat higher than the potassium feldspar-dominated ‘pink’ granites (WPI: Granite 10.3, Granodiorite 11.4, Tonalite 14.6). Granite, granodiorite and tonalite together occupy over 60% of the felsic intrusive rocks mapped in the IFTNC regions of Washington state. In general, granitic rocks weather to coarse, well-drained soils with low water-holding and low nutrient-holding capacity. Soil particles will be largely composed of quartz, feldspars and mica. Clay content and cation exchange capacity (CEC) of granitic soils are expected to be low. One of the black minerals often contained in granites is biotite, a K-bearing mica. Biotite expands when it weathers, which contributes to a faster breakdown of the granite. Another dark mineral commonly found in granites is hornblende. Hornblende does not have the same weathering properties as biotite, and is not a major K source. In a hand sample, biotite appears very shiny and breaks easily into sheets. Hornblende is blocky, not as sparkly in the sun, and does not break into sheets.

Over one-fourth of the felsic intrusive rocks mapped in the IFTNC regions of Washington are classified as felsic intrusive bodies. This category includes any dikes or sills mapped as intrusive, as well as stocks, plutons and other similar intrusions. *Most of the felsic intrusive bodies in the IFTNC regions of Washington are identified as stocks or plutons.* While dikes and sills are usually narrow bodies occupying crevices in the earth’s crust, stocks tend to be somewhat more irregular in shape, and are likely to be larger than dikes or sills. The term pluton can be applied to a variety of intrusive bodies, including dikes, sills and stocks, and may also refer to groupings of intrusive bodies. We have conservatively classified felsic intrusive bodies as ‘bad’ rocks because of the slow weathering rates and potential health issues that are associated with dikes and sills. However, *site visits and individual stand assessment are highly recommended for stands on rocks in this category.* Many are noted as being of granitic, granodioritic, quartz monzonitic or other felsic intrusive composition. If the soils are well-formed and the forest stand is healthy and relatively productive, then the underlying rock should be upgraded to ‘medium’ and otherwise treated as for the noted lithology.

Pegmatite is a very coarsely-crystalline granitic rock, often dominated by feldspar, and often occurs in dikes. Other single-mineral-dominated rocks include syenite and anorthosite, both of which are relatively rare. Syenite is made up principally of orthoclase (potassium feldspar), which has a framework mineral structure that does not readily weather, despite a moderate WPI rating (WPI: Syenite 10.3). Syenites display the coarse-grained characteristic typical of granites, and therefore will likely form similarly coarse-grained soils, except that the soil particles will be predominantly potassium feldspar with little or no quartz. Clay content and CEC are expected to be low. Due to the mono-mineralic nature of syenite, its overall nutritive value is expected to be low.

Mafic Intrusive Rocks

Quartz diorite is the intrusive equivalent of andesite, while diorite and gabbro are the intrusive equivalents of basalt. Because of the similarity in chemical composition, weathering potential of these rocks is also similar to their extrusive equivalents (WPI: Quartz diorite 17.9, Diorite 22.4). Quartz diorite makes up over half of all mafic intrusive rocks in the IFTNC regions of Washington. However, mafic intrusives overall do not occupy significant areas in the IFTNC regions, and occur mostly in the Chelan and Twisp quadrangles.

Mafic intrusive bodies are equivalent to felsic intrusive bodies, except that they are composed of mafic magma. Mafic intrusive bodies tend to occur more often as dikes and sills, compared to the stocks and plutons more common to the felsic intrusive bodies. A few mafic intrusive bodies are noted as having basaltic composition, but others are noted as diabase, metagabbro or other compositions thought to be 'bad rocks.' As with the felsic intrusive bodies, a 'bad rock' rating has been assigned, but site visits are recommended and nutrient management guidelines should be modified as needed.

Nutrient management recommendations

Medium: All intrusive rocks except intrusive bodies, pegmatite, diorite, gabbro

Granitic rocks are generally considered 'medium' for tree growth, and conservative nutrient management strategies are recommended. Whole-tree removals on these rock types may run the risk of depleting some of the limited nutrients available on these sites. Generally, moderate to poor results have been obtained through fertilization with N-only on intrusive rock types. The addition of K to the blend is expected to give a better response than N alone, especially on the felsic intrusives. Multinutrient fertilization is an option; however, fertilization screening trials would be recommended to evaluate the potential response and cost-effectiveness of such an operation, in conjunction with growth response studies. Field evaluation of sites mapped as syenite is recommended before proceeding with nutrient management planning.

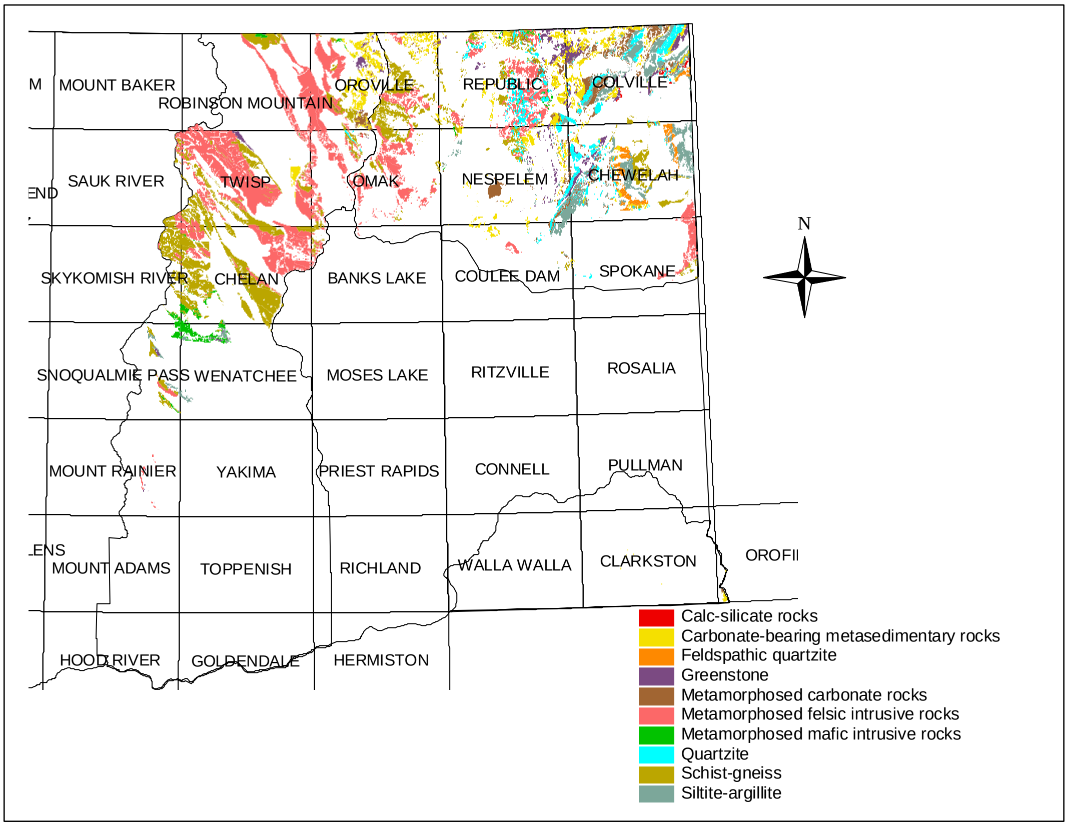
- Expected Soil Development: Moderate to deep coarse soils
- Expected Nutrient Status: Moderate (slightly better for mafic)
- Ash Effect: Slight improvement in productivity with ash presence, but no observed effect on fertilization response
- Recommended Nutrient Management Strategies:
    - Thinning: bole-only recommended, but whole-tree may be OK for thinning from below, especially on mafics
    - Regeneration Harvest: bole-only recommended
    - Species Selection: select for moderate to low nutrient-demanding species
- Expected Fertilization Response: Moderate (syenite and anorthosite unknown). Ash presence does not seem to affect response. On lower-productivity sites, even a low response may be of some value relative to the poor growth rates of unfertilized trees. Balance economic feasibility of return with management objectives.
- Fertilizer Recommendation:
    - All: Recommend grand fir or moister vegetation series.
    - Felsic intrusive rocks: Do not fertilize with N-only. A minimum formulation of NK is recommended. Observation suggests that NKSB may be preferred.
    - Mafic intrusive rocks: N-only or NSB might be acceptable if rock contains biotite. Otherwise NK or NKSB is recommended.
    - Syenite and anorthosite: Unknown response, no recommendation at this time
    - Possible multi-nutrient blend candidates -- recommend screening trials.

Bad: Intrusive bodies, pegmatite, diorite, gabbro

These rocks are considered to be poor candidates for fertilization. Conservative nutrient management practices should be followed.

- Expected Soil Development: Poor
- Expected Nutrient Status: Poor
- Ash Effect: None noted.
- Recommended Nutrient Management Strategies:
  - Thinning: bole-only
  - Regeneration Harvest: bole-only
  - Species Selection: select for low nutrient-demanding species
- Expected Fertilization Response: Unknown
- Fertilizer Recommendation:
  - If objectives are economic: Not recommended
  - If objectives are health- and productivity-related: Optional, grand fir or moister site types only.
  - Rationale: We have not yet determined an appropriate fertilization regime to counter the “bad-rock” effect, though it will almost certainly involve various macro- and micro-nutrients besides N and K. The cost of these additional elements is not likely to justify their use, particularly if the cost must be carried over a number of years. The application of NK *may* reduce mortality in some cases; however, our understanding of when and why mortality may be affected is not yet clear. Consultation with IFTNC staff would be appropriate.

Major Unit: Metamorphic Rocks



Minor Units

- **Calc-silicate Rocks**
- **Carbonate-bearing Metasedimentary Rocks**
- **Feldspathic quartzite**
- **Greenstone**
- **Metamorphosed Carbonate Rocks**
- **Metamorphosed Felsic Intrusive Rocks**
- **Metamorphosed Mafic Intrusive Rocks**
- **Quartzite**
- **Schist-Gneiss**
- **Siltite-Argillite**

Overview: Metamorphic rocks occupy fairly extensive portions of the IFTNC's northeastern region and northern half of the central region in Washington state. These rocks are challenging to classify from a geology-forest nutrition standpoint because they are so diverse in origin. Metamorphic map units 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 argillite and siltite. Strongly metamorphosed (high-grade metamorphic) rocks include schist and gneiss. Some rocks, such as quartzite, may be either high- or low-grade metamorphic rocks. If the original (or parent) rock is known, that may be referred to in the lithology description. 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. 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 many metamorphic rocks largely because we don't have a significant number of trials on these rock types. This is particularly true 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.

Rock Descriptions

Metamorphosed carbonate rocks, carbonate-bearing metasedimentary rocks and calc-silicate metasedimentary rocks

The carbonate rocks include limestone (calcium carbonate) and dolomite (calcium-magnesium carbonate), and in unaltered (non-metamorphosed) state are considered to be sedimentary rocks. For a carbonate rock to be included in the metamorphic category of this report, some heating and/or apparent alteration must have occurred. Limestones and dolomites mostly formed in marine environments. Because sands, silts and muds also occupied those marine environments, mixing between the carbonate and non-carbonate components often occurred. These rocks lithified (became cemented together), and some then underwent subsequent metamorphic processes. For this report, if the carbonate portion of a mixed-lithology rock dominated an otherwise clearly metamorphic rock, the ***metamorphosed carbonate rock*** designation was used. Marble (metamorphosed limestone or dolomite) was also included in this category. If the non-carbonate component dominated the resulting rock according to the map description, then it was labeled as a ***carbonate-bearing metasedimentary rock***. Based on our experience with fertilization research trials, metamorphosed carbonate rocks are considered poor candidates for tree growth and fertilization, likely because of the mono-mineralic nature of the rock (and therefore limited nutrient diversity), and low weathering rates, particularly in dry environments. In contrast, the more diverse mineral composition of the carbonate-bearing metasedimentary rocks leads us to categorize them as good rocks with high weathering potential (WPI: Carbonate-bearing quartzite 15.7, Carbonate-bearing siltite-argillite 18.1, Carbonate-bearing siltite 21.8). While ash cap presence may lead to improved productivity on carbonate-bearing metasedimentary rocks, ash cap does not seem to have a marked effect on N fertilization response.

Calc-silicate rocks include rocks formed by a relatively high degree of metamorphism of impure calcareous or dolomitic rocks. Metamorphism of the carbonate-bearing minerals in those rocks resulted in the formation of calcium-bearing silicate minerals such as diopside, wollastonite and actinolite. The rocks in this minor unit are predominantly calc-silicate gneiss. Calc-silicate rocks may or may not contain layers of dolomitic or calcitic marble, as the original carbonate minerals may or may not have transformed during metamorphosis. However, the calcareous or dolomitic influence should lend a soft, weatherable character to the rock (WPI: Calc-silicate quartzite 18.3, Calc-silicate schist 19.5, Calc-silicate gneiss 21.2). As a result, deeply weathered soils and productive stands may occur on rocks in this category. Ash cap may lead to improved productivity, but does not seem to affect fertilization response of stands on calc-silicate rocks.

Argillite, siltite, quartzite, feldspathic quartzite

Argillite and siltite were jointly assigned to a '***Siltite-argillite***' minor unit. These are low-grade metasedimentary rocks, meaning that the original 'parent' rock is usually still distinguishable. Argillites originated from claystones, are somewhat 'silky' in appearance and texture, have indistinguishable grains, and can be scratched sometimes with a fingernail and more easily with a knife. Argillites have a somewhat low weathering susceptibility (WPI: Argillite 8.0), and are likely to weather to flat, sharp-edged plates and form very shallow soils, particularly on steeper slopes. Siltites originated from siltstones, and are slightly coarser-grained than argillites, and can also be scratched with a knife, but with more difficulty than argillite (WPI: Siltite 9.0). In our experience, some argillites have a high K content, but little else in the way of nutrients. The IFTNC has one seedling establishment trial on a northeast Washington argillite that is part of the Deer Trail group. This is considered a bad rock site, with very thin soils and poor tree growth. Therefore, we have tentatively assigned 'medium' weathering and 'medium' tree value ratings to most siltites and argillites, except for the Deer trail argillites, which have been assigned a 'bad rock' rating. Site visits to validate soil depth and forest stand conditions are recommended.

Quartzites originate from sandstone and contain sand-sized grains mostly of quartz, and cannot be scratched with a knife. Quartzites in particular are very low in nutrients, containing mostly quartz sand (WPI: Quartzite 4.2). Although described here with low-grade metamorphic rocks, quartzites may have undergone either a high or low degree of metamorphism. These rocks are rated as very low weathering potential and very bad rocks for tree growth. ***Feldspathic quartzites*** are those that originated from feldspathic sandstones, and contain feldspars and mica in addition to quartz sand. Since feldspathic sandstones in central Washington have been found to show very good productivity and fertilization response, we carried the feldspathic designation through to these quartzites. However, we have also seen stands on quartzites show very poor productivity. Feldspathic quartzites received a low weathering/bad rock rating, except for Burke formation quartzites, which observations in north Idaho suggest show somewhat better response. Pending further research data, we recommend a field check to verify the productivity potential of stands on sites mapped as feldspathic quartzite.

Schist, gneiss, metamorphic felsic intrusive rocks, metamorphic mafic intrusive rocks, greenstone

High-grade metamorphic rocks underwent strong pressure and/or temperature changes during their formation. Because of the high degree of metamorphism, the parent rock is often very difficult to distinguish. For purposes of this report, if the precursor of a rock was not clearly identifiable in the description as intrusive, then a 'schist-gneiss' minor unit was assigned. If a mafic (dark-colored) or felsic (light-colored) intrusive rock was identified as the precursor of the mapped unit, then the rock was assigned to the 'metamorphosed mafic intrusive rock' or 'metamorphosed felsic intrusive rock' minor unit, respectively.

The ***schist-gneiss*** category includes those schists and gneisses that were not clearly identifiable as intrusive in origin. Schists usually contain aligned layers of mica, leading to a fine-layered appearance and platy breakage patterns, and are most often felsic in coloration. Gneisses are coarser and less friable rocks, with grain sizes of several millimeters, and usually contain alternating light and dark bands of felsic and mafic minerals. A few tectonic/breccia units occurred in the mapping area, and were grouped with gneisses and schists because a high degree of metamorphism was associated with these otherwise normally volcanic rocks. The 'schist-gneiss' minor unit occupies about 25% of the metamorphic rock area in the IFTNC mapping regions. Schists and gneisses usually contain quartz, potassium feldspar and plagioclase feldspar, along with mica and/or hornblende (WPI: Schist 8.3, Gneiss 9.1). Rocks in this minor unit received a 'medium' weathering rating and a 'medium' rock rating. However, we are uncertain of the behavior of the tectonic/breccia units, therefore sites on those rock types should be evaluated on an individual site basis.

The '***metamorphosed mafic intrusive rocks***' unit included amphibolite, mafic gneiss and ultrabasic rocks. Amphibolites are gneisses that are rich in plagioclase feldspar and hornblende, and low in quartz and potassium feldspar. They tend to be darker-colored in appearance than other gneisses due to the dominance of mafic minerals like hornblende. Similarly, ultrabasic rocks and mafic gneisses such as metamorphosed gabbro or diorite are characterized by dark-colored minerals, including those forming during metamorphosis. The '***metamorphosed felsic intrusive rocks***' unit includes metamorphosed granitic rocks and mylonite, both identified as felsic gneiss for the purposes of these guidelines. Mylonites are, broadly speaking, ground-up rocks containing mixtures of igneous (e.g. granitic and basaltic) and metamorphic minerals, depending on the rocks present at the interface of the metamorphic event. True mylonites are limited in distribution, and much of the mylonite that appears on geologic maps is really mylonitic gneiss, a type of quartz-feldspar gneiss. Metamorphosed felsic intrusive rocks occupy almost 40% of the metamorphic rocks in the IFTNC mapping area.

Highly metamorphosed rocks that contain green minerals such as chlorite and epidote were included in the ***greenstone*** category. Greenstones occur sporadically in small localized bodies in the northeastern and central regions of Washington, occupying only about 4% of the total metamorphic rock coverage in the IFTNC areas. While greenstones were conservatively treated as 'bad' rocks in this report, they are thought to be good nutrient sources in the moist, acidic climate of the northeastern United States. Generally speaking, greenstone is not a common rock type in the Inland Northwest.

Nutrient management recommendations

Good: Carbonate-bearing metasedimentary rocks and calc-silicate rocks

Field examination of stands on these rock types should be performed prior to determining silvicultural activities. If these sites show poor soil development, then refer to the nutrient management guidelines for 'medium' or 'bad' metamorphic rocks, depending on observed soil and stand conditions. If these sites show moderate to deep soil development, then they are considered medium to good for tree growth, especially if associated with ash cap. Conservative nutrient management strategies are recommended, however the higher quality sites in this category may be more resilient to higher levels of harvesting removals. Stands on these rock types are likely to be good fertilization candidates.

- Expected Soil Development: Moderate to deep, fine sandy to loamy soils, some cobbles
- Expected Nutrient Status: Moderate to good

- 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, but whole-tree may be OK
    - Regeneration Harvest: bole-only recommended, but whole tree probably OK
    - Species Selection: select for moderate to low nutrient-demanding species, but most species should do reasonably well on this rock
- Expected Fertilization Response: Moderate to good
- Fertilizer Recommendation:
    - Recommended only for moist-end Douglas-fir habitat types and grand fir or moister vegetation series
    - Recommended formulation: NKSB
    - Recommended for multinutrient (w/micronutrient) screening trials.

Medium: Siltite-argillite (except Deer Trail argillite), 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.

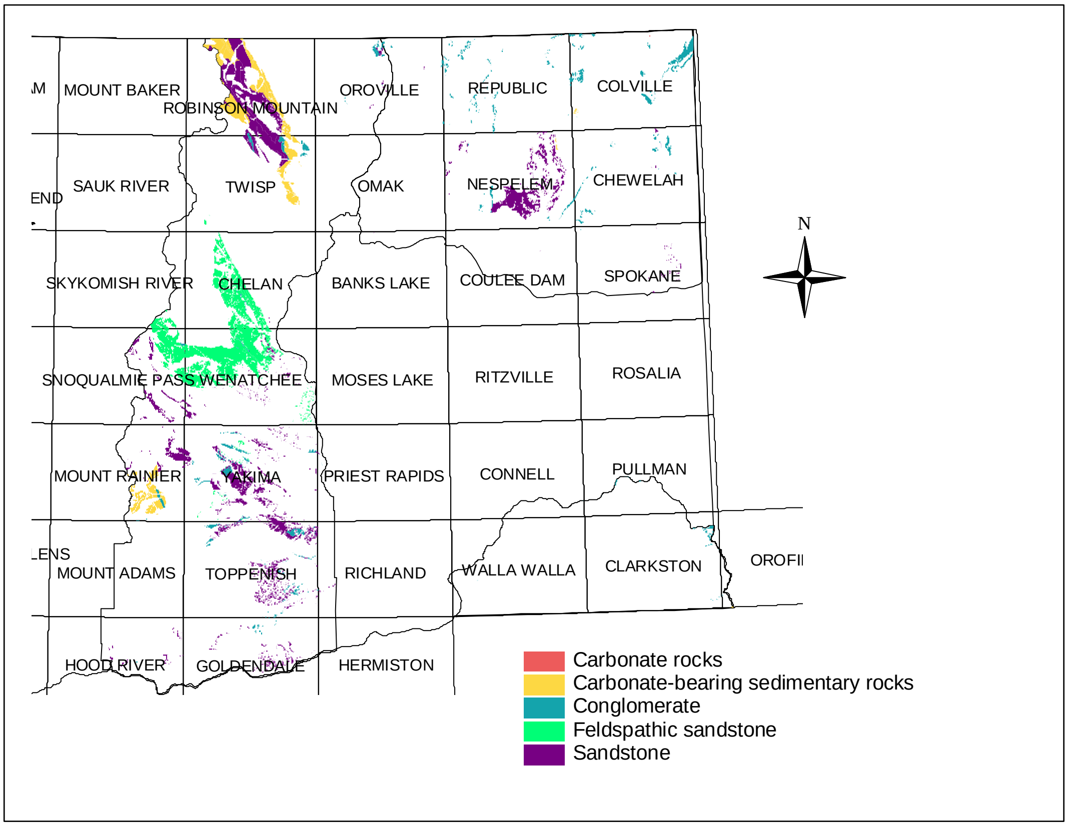
- Expected Soil Development: Moderate to deep sandy to loamy soils, cobbles may be present
- Expected Nutrient Status: Low to Moderate; better if ash present
- Ash Effect: Slight improvement in productivity with ash presence, but ash has no apparent effect on fertilization response.
- Recommended Nutrient 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.

Bad: Metamorphosed carbonate rocks, feldspathic quartzite, quartzite, Deer Trail argillite, amphibolite, ultrabasic rocks, greenstone

These rocks are not expected to support productive softwood stands. If a site shows deep soils and supports a healthy and productive forest stand, refer to prior recommendations for 'medium' metamorphic rocks. Otherwise, consider these as bad rocks, and follow conservative nutrient management strategies.

- Expected Soil Development: Poor
- Expected Nutrient Status: Poor
- Ash Effect: None noted. We have few research sites on these rock types, except for some feldspathic quartzites, which may behave similarly to siltite and argillite in terms of ash effect.
- Recommended Nutrient Management Strategies:
  - Thinning: bole-only recommended
  - Regeneration Harvest: bole-only recommended
  - Species Selection: select for low nutrient-demanding species
- Expected Fertilization Response: May be significant in comparison to the low, unfertilized growth rates on these rock types; may not be economically desirable
- Fertilizer Recommendation:
  - If objectives are economic: Not recommended
  - If objectives are health- and productivity-related: Optional, NKSB recommended on grand fir or moister vegetation series only.
  - Rationale: We have not yet determined an appropriate fertilization regime to counter the "bad-rock" effect, though it will almost certainly involve various macro- and micro-nutrients besides N and K. The cost of these additional elements is not likely to justify their use, particularly if the cost must be carried over a number of years. The application of NK *may* reduce mortality in some cases; however, our understanding of when and why mortality may be affected is not yet clear. Consultation with IFTNC staff would be appropriate.

Major Unit: Sedimentary Rocks



Minor Units

- **Carbonate Rocks**
- **Carbonate-bearing Sedimentary Rocks**
- **Conglomerate**
- **Feldspathic Sandstone**
- **Sandstone**

Overview: Sedimentary rocks generally consist of weathered and transported remnants of other rocks, or rocks such as limestone that formed in marine environments. To be included in this category, those transported materials must have been lithified or cemented together to form a consolidated rock. Sedimentary rocks overall do not comprise a large portion of the IFTNC regions in Washington (<5% overall), but do include an important unit of feldspathic sandstones know as the Chumstick formation.

Rock Descriptions

Conglomerate, feldspathic sandstone, sandstone

These rocks consist of mineral grains or rock fragments that originated from the weathering of igneous, metamorphic or other sedimentary rocks, and were transported to another location and cemented together (lithified). ***Conglomerates*** consist of rounded pebbles, cobbles and boulders of various rock types and sizes in a fine-grained and lithified matrix, while

sandstones consist of cemented sand-sized grains. These units are sometimes difficult to separate, as conglomerate rocks often occur as lenses (or inclusions) within sandstone rocks. Potassium is often a component of the cement which holds the mineral grains and rock fragments together in a sedimentary rock. The mineral grains most commonly found in sedimentary rocks are quartz, feldspar and mica, all of which are common rock-forming minerals resistant to weathering. Weathering susceptibility of these rocks is generally low. Sandstones and conglomerates together comprise about one-half of the sedimentary rocks in the IFTNC's Washington regions.

Some sandstones and conglomerate rocks in central Washington are noted as being ***feldspathic sandstones***, meaning that they are high in feldspar composition. Research experience on Chumstick formation feldspathic sandstone in this region suggests that forest stands on feldspathic sandstones may be high responders to N fertilization. Therefore, these rocks have been categorized separately from non-feldspathic sandstones and conglomerates in this report. Field examination and fertilization screening trials should be carried out to validate response of stands on this rock type to N and other elements. Feldspathic sandstones comprise about one-third of the sedimentary rocks in the IFTNC regions of Washington.

Carbonate rocks, carbonate-bearing sedimentary rocks

The carbonate rocks found in the IFTNC regions of Washington are comprised primarily of calcium- and magnesium-bearing carbonate minerals, and range in composition from calcium carbonate (limestone) to calcium-magnesium carbonate (dolomite). These rocks formed primarily in marine environments. Extensive mixing of the carbonate component with non-carbonate materials such as the silts, sands and clays found in these environments also occurred. The ***carbonate rocks*** minor unit includes the mostly pure <u>limestones</u> and dolomites. Though they have a high weathering potential index (WPI: Dolomite 72.1), limestones and dolomites have been observed to display low weatherability and form massive outcrops, particularly in dry environments. Their nutrient value to softwood forest stands is also considered fairly poor. In a dry forest environment, the carbonate rock units can be slow-weathering and form soils high in pH, which in turn can result in micronutrient deficiencies such as Fe and Mn. In southwestern Montana, carbonate rocks tend to support stands of poorly-performing Douglas-fir and ponderosa pine.

The ***carbonate-bearing sedimentary rocks*** unit includes the impure carbonate rocks that are dominated by the non-carbonate fraction. This unit also includes <u>calcareous sedimentary rocks</u>. The carbonate and calcareous minerals are likely to result in a soft, weatherable rock, particularly in moist conditions. The presence of non-carbonate minerals is thought to provide a somewhat richer nutrient environment than the pure carbonate rocks. Therefore, this minor unit was assigned a high weathering rate and good tree value on moister site types. Site visits are recommended to validate soil development and forest growth and health, as drier sites may exhibit conditions closer to the pure carbonate rocks. Together, the carbonate rocks and the carbonate-bearing sedimentary rocks comprise about 16% of the sedimentary rocks in the IFTNC's three Washington regions.

Coal and lignite: Occasional seams or deposits of coal or lignite occur in Washington state. These deposits were formed by the accumulation of organic matter, often in sedimentary basins and often comprised principally of trees. These deposits were buried by sand and mud resulting from periodic climatic or geologic disturbance. The associated increases in temperature and pressure under anerobic conditions led to decomposition of the organic materials, eventually converting the cellulose to elementary carbon, forming lignite and coal in the process. These deposits are not always mapped, but if present, should be noted during parent material assessments in the field.

Nutrient management recommendations

Good: Carbonate-bearing sedimentary rocks

Field examination of stands on these rock types should be performed prior to prescribing silvicultural activities. If these sites are dry or show poor soil development, then refer to the nutrient management guidelines for ‘bad’ or perhaps ‘medium’ sedimentary rocks, depending on the site assessment. If these sites are moist and show moderate to deep soil development, then they are considered medium to good for tree growth, with the better sites likely to be associated with ash cap. Conservative nutrient management strategies are recommended, though higher quality sites may be resilient to whole-tree removal.

- Expected Soil Development: Moderate to deep, sandy to loamy soils, some cobbles
- Expected Nutrient Status: Moderate; better if ash present
- Ash Effect: Ash presences improves both productivity and fertilization response.
- Recommended Nutrient Management Strategies:
  - Thinning: bole-only recommended, but whole-tree probably OK
  - Regeneration Harvest: bole-only recommended, but whole tree probably OK
  - Species Selection: select for moderate to low nutrient-demanding species, but most species should do reasonably well on this rock
- Expected Fertilization Response: Moderate to good
- Fertilizer Recommendation:
  - Recommended only for moist-end Douglas-fir habitat types and grand fir or moister vegetation series
  - Recommended formulation: NKSB
  - Recommended for multinutrient (w/micronutrient) screening trials.

Medium: Feldspathic sandstone

Rocks in this category are expected to form fine sandy or loamy soils. Moisture and nutrient-holding capacity are thought to be moderate to low. Site productivity is also likely to be moderate to low, though an overlying ash cap may boost productivity if present. Field examination should be performed to assess soil depth, ash presence and stand performance. For well-performing stands on productive soils, upgrade these recommendations accordingly (see ‘good’ nutrient status recommendations above). Whole-tree removals are discouraged, as they may run the risk of depleting some of the limited nutrient availability on these sites.

- Expected Soil Development: Moderate to deep sandy to loamy soils, cobbles may be present

- Expected Nutrient Status: Moderate to Poor
- Ash Effect: Expect some improvement in productivity and fertilization response with ash presence.
- 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 (mudstone) to good (feldspathic sandstone).
- Fertilizer Recommendation:
    - Recommended only for grand fir or moister site types
    - Recommended formulation: Research shows that N may be sufficient, particularly on deeper soils and in the presence of ash cap, however recent observations suggest that NSB may stimulate a better response.
    - Recommended for multinutrient (w/micronutrient) screening trials.

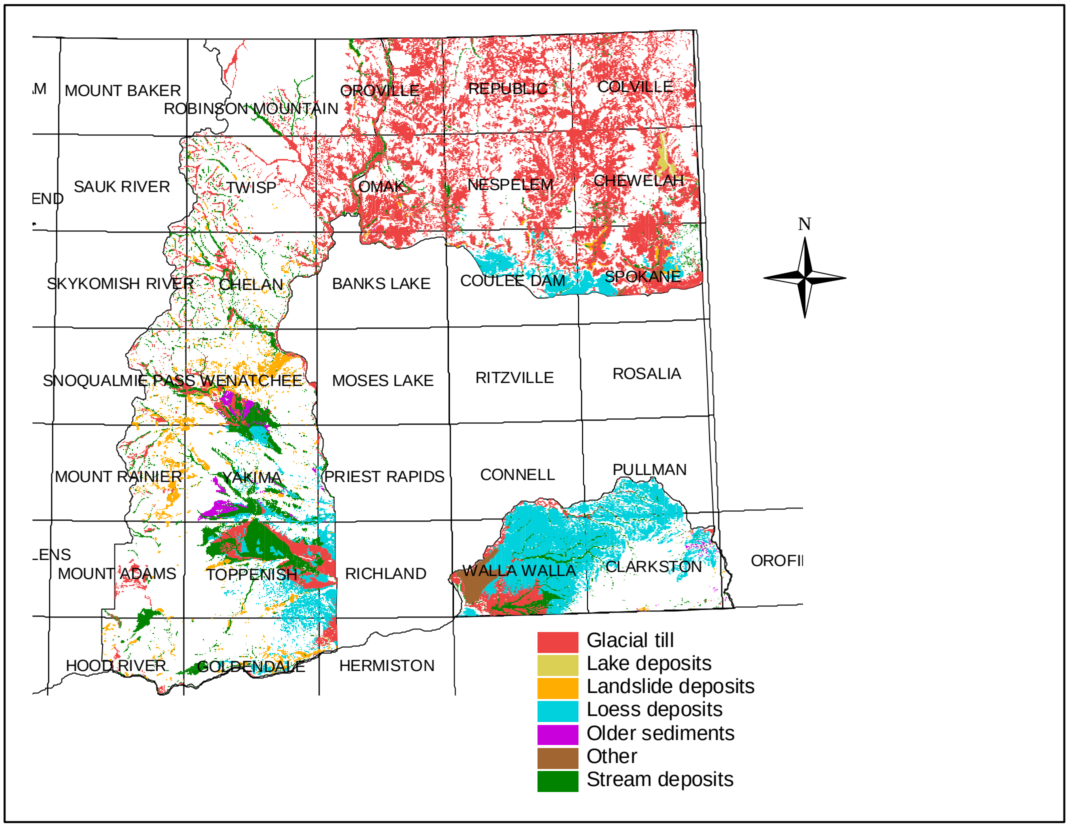
Bad: Sandstone, conglomerate, carbonate rocks

We do not have a great deal of experience with stands on carbonate rocks, sandstones or conglomerates. Limestones in southwestern Montana tend to support stands of poorly-performing Douglas-fir, and even worse-performing stands of ponderosa pine. We generally consider the carbonate rocks, conglomerates and sandstones as poor rocks, slow-weathering and forming high pH soils. We recommend conservative nutrient management strategies. We do not currently recommend fertilization on any of these rock types, especially if they have shallow soils. Further research is warranted, particularly on the conglomerate rocks.

- Expected Soil Development: Poor
- Expected Nutrient Status: Poor
- Ash Effect: None noted.
- Recommended Nutrient Management Strategies:
    - Thinning: bole-only recommended
    - Regeneration Harvest: bole-only recommended
    - Species Selection: select for low nutrient-demanding species
- Expected Fertilization Response: Unknown
- Fertilizer Recommendation:
    - If objectives are economic: Not recommended
    - If objectives are health- and productivity-related: Optional, NKSB recommended. Only fertilize grand fir or moister site types.
    - Rationale: We have not yet determined an appropriate fertilization regime to counter the “bad-rock” effect, though it will almost certainly involve various

macro- and micro-nutrients besides N and K. The cost of these additional elements is not likely to justify their use, particularly if the cost must be carried over a number of years. The application of NK *may* reduce mortality in some cases; however, our understanding of when and why mortality may be affected is not yet clear. Consultation with IFTNC staff would be appropriate.

Major Unit: Unconsolidated Deposits



Minor Units:

- **Glacial Till**
- **Lake Deposits**
- **Landslide Deposits**
- **Loess Deposits**
- **Older Sediments**
- **Stream Deposits**
- **Other Mapped Units**

Overview: Map units assigned to the 'Unconsolidated Deposits' major unit occupy more land in the IFTNC's Washington regions than any of the other four major units. This unit consists of deposits of weathered rock transported from another site to the present site, either by wind, water, gravity, glacial activity, tectonic activity, volcanic activity, other geomorphic processes, or some combination thereof. These deposits did not undergo subsequent lithification or cementation. Because of the variety in source material, site quality is likely to vary widely in this category. Recommendations for these sites are based on IFTNC research results, and research installations were highly likely to have been located on the better quality sites. Therefore, careful evaluation of sites in this category should be carried out prior to assigning a nutrient management strategy.

Rock Descriptions

Stream deposits were emplaced by running water, and include both poorly-sorted debris flow and better-sorted stream flow deposits. Many of the units in this subcategory are relatively young, Quaternary era occurrences. This category includes gravel and alluvial deposits. The gravel deposits are generally well-sorted and composed of resistant, transported materials. Gravel deposits are generally considered 'bad' rocks. Alluvial deposits may be comprised of pure to mixed rock types and sizes, depending on the source and distance of transport. Alluvial deposits are generally considered 'medium' rocks, but should be evaluated for site-specific conditions.

Lake deposits are associated with old or modern lakebeds. Likely components of lacustrine deposits are sand, silt and clay-sized particles of the stable minerals quartz, potassium feldspar and mica as well as clay minerals. Deposits associated with Glacial Lake Missoula are often dominated by silt-sized particles. Organic-rich rocks can also form in lacustrine environments. Research in the Missoula region of Montana suggests that moderate growth rates and fertilization response to N and NK can occur in forest stands on lake deposits, and strong responses have occurred following NKSB fertilization.

Older sediments may include gravel or other deposits that occurred in during the Tertiary (preglaciation) period. These deposits were erosional in origin and occurred when drainages were blocked by either mountain-building events (northeastern and north central Washington) or Columbia River Basalt flows (south central Washington to southeastern Washington/northeastern Oregon). This unit can encompass a variety of materials, ranging from water-deposited volcanic ash, to clay, to fluvial gravels to debris flow deposits. Older sediments are often indeterminate in origin and can vary widely in nutrient value, therefore site visits are recommended. The 'older sediments' minor unit occupies a relatively insignificant portion of the IFTNC's Washington regions. However, many small, unmapped areas of these deposits are likely to occur, particularly in and around the flood basalt areas of the state. Resource managers should always be on the lookout for these deposits, and evaluate them accordingly.

Glacial till often contains a wide array of rocks that vary in lithology, size and nutrient value. Over half of the unconsolidated deposits in the IFTNC regions of Washington consist of glacial till. Most of the glacial till is located in northeastern Washington, and was deposited by continental glaciers (continental glacial till) that carried rocks across a wide geographic region, and is characterized by hummocky topography. These deposits contain a variety of rocks of different mineralogies and at different stages of weathering, provide a fair to good nutrient environment for tree growth. Current stand condition and stand history should be assessed. For example, sites on the glacial flats in the Rathdrum Prairie area of northern Idaho were subjected to agricultural activities such as plowing and discing prior to forest stand establishment. These activities displaced and/or removed organic materials and topsoil to the extent that the nutrient environment was considerably altered. Forest plantations on these glacial flats often show signs of nutrient stress at or shortly after crown closure. Apine glaciers, in contrast to continental glaciers, occur in small localized areas in mountainous regions, and the associated alpine glacial tills may be characterized by somewhat homogenous rock composition. Stands on these sites may be more appropriately treated in a fashion similar to landslide deposits (below).

Landslide deposits consist of rock fragments that have been transported downslope as either a slow gravity-driven creep or as a more rapidly occurring landslide or avalanche deposit. This category includes talus as well. These deposits are likely to be somewhat homogenous in composition though not necessarily in size, and localized in distribution depending on the source rock. They may be modern or older in age. Whereas recent scree-type deposits will obviously not provide much in the way of soil development for tree growth, older deposits may have well-developed soils and support forest stands. The recommended approach is to treat the site based on the lithology of the deposited material, taking soil development and the presence of any surficial deposits into account as well. Landslide composition should be verified and assessed in the field, though localized information will often be available in the literature that accompanies the 1:100K geology maps.

Loess deposits are wind-deposited silts common to southeastern Washington. For a loess deposit to be assigned as a map unit on a bedrock geology map, the deposit was likely so deep as to obscure the underlying bedrock. Mapped loess deposits comprise almost 25% of the unconsolidated deposits in the IFTNC regions of Washington. From a forest standpoint, loess-dominated soils are thought to have low weathering potential and moderate-to-low productivity potential. Deeper loess deposits may be associated with poor forest growth and health conditions. Depending on the depth of the deposit, an underlying parent material may have an effect on forest growth and health, as may an overlying ash deposit.

Other mapped units

Several other geologic units that were mapped but are not specifically assigned nutrient recommendations in this report include "made ground", sand deposits (dunes), peat and mud deposits. These did not occur across significant areas, and were not assigned nutrient management recommendations.

Nutrient management recommendations

Medium: Glacial till, lake deposits, stream (alluvial) deposits, perhaps loess (verify stand condition prior to treatment)

Sites on these deposits should be checked for soil depth and development as well as productivity. Poor-performing sites or those with shallow soils should be treated as for sandstones, conglomerates, etc. (Sedimentary Rocks major unit). Good fertilization response has been obtained on some glacial tills and lake deposits. In the case of prior agricultural use or other management history involving extensive alteration, preliminary data indicate that P and B may also be necessary.

- Expected Soil Development: Moderately deep to deep, loamy and cobbly (glacial till) to sandy and cobbly (alluvial and lake deposits)
- Expected Nutrient Status: Moderate to Good
- Ash Effect: Expect better productivity and fertilization response with ash presence.
- Recommended Nutrient Management Strategies:
    - Thinning: bole-only recommended, but whole-tree may be OK for thinning from below or other light thinning
    - Regeneration Harvest: bole-only recommended

    - Species Selection: Select for moderate to low nutrient-demanding species. Areas that tend to be frost-influenced may be favorable for lodgepole pine.
- Expected Fertilization Response: Glacial till good, lake and stream deposits variable
- Fertilizer Recommendation:
    - Recommended only for grand fir or moister site types
    - Research suggests that N-only is probably OK, but NKSB and perhaps P would be preferable.
    - Multi-nutrient (including P and micronutrient) blend screening trials recommended.
    - Extensive agricultural use prior to forest stand establishment may dictate a need for P and B in the fertilization blend

Variable: Other unconsolidated deposits

Many unconsolidated deposits are not predictable from a forest nutrition standpoint. Weathering potential ranges from high (older deposits) to low (gravels). Nutritional value depends on the composition and size of the deposited materials. Sites with a greater variety of size classes and rock compositions will likely support more productive forest stands than those with a homogenous mix of materials. We have detected very good growth and fertilization response on some sites underlain by unconsolidated deposits, but have seen others that are unable to be successfully regenerated. Because of the large degree of variability encompassed by unconsolidated deposits, site visits are highly recommended to evaluate soil depth and productivity potential prior to selecting nutrient management strategies.

Recommended Nutrient Management Strategies:

- Poor quality site (poor soil development, poor tree growth): Treat as for sandstones, conglomerates etc. (Sedimentary Rocks major unit).
- Better quality site: Treat as for glacial till (above)

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Appendices

Appendix A: Quick Reference

Major Unit	***Minor Unit***	***Weathering susceptibility***	***Tree value***	***Ash effect on growth rate***	***Ash effect on fertilization response***
Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	medium	bad	no change	no difference
	Mafic extrusive/subvolcanic rocks	high	good (basalt, gentle slope) to bad (andesite, mafic dikes & sills)	better (moist) to no change (dry)	better
Intrusive rocks	Felsic intrusive rocks	medium	medium (most) to bad (pegmatite, felsic intrusive bodies, syenite)	slightly better	no change
	Mafic intrusive rocks	high	medium (quartz diorite) to bad (everything else)	slightly better (most) to no information (mafic int. bodies)	no change
Metamorphic rocks	Calc-silicate rocks	high	good	better	no change
	Carbonate-bearing metasedimentary rocks	high	good	better	no change
	Feldspathic quartzite	low (most) to medium	bad (most) to medium	better	no change
	Greenstone	medium	bad	no information	no information
	Metamorphosed carbonate rocks	medium	bad	no information	no information
	Metamorphosed felsic intrusive rocks	medium	medium	better	no change
	Metamorphosed mafic intrusive rocks	medium	bad	better	no change
	Quartzite	very low	very bad	better	no change

Appendix A Quick Reference Continued:

Major Unit	Minor Unit	Weathering susceptibility	Tree value	Ash effect on growth rate	Ash effect on fertilization response
Metamorphic rocks (continued)	Schist-gneiss	medium	medium	better	no change
	Siltite-argillite	medium	medium (most) to bad (Deer Trail argillites)	better	no change
Sedimentary rocks	Carbonate rocks	medium	bad	no information	no information
	Carbonate-bearing sedimentary rocks	high	good	better	better
	Conglomerate	low	bad	no information	no information
	Feldspathic sandstone/conglomerate	medium	medium	better	better
	Sandstone	low	bad	no information	no information
Unconsolidated deposits	Glacial till	medium (alpine) to low (continental)	variable (alpine) to medium (continental)	slightly better	better
	Lake deposits	medium	medium	slightly better	better
	Landslide deposits	medium	variable	slightly better	better
	Loess deposits	low	medium to bad	slightly better	better
	Older sediments	high	variable	better	better
	Other deposits	not evaluated (peat) to low (everything else)	not evaluated (made ground, peat) to bad (everything else)	no information	no information
	Stream deposits	low	medium (alluvial) to bad (gravels)	slightly better	better

Appendix B: Geologic Map Source

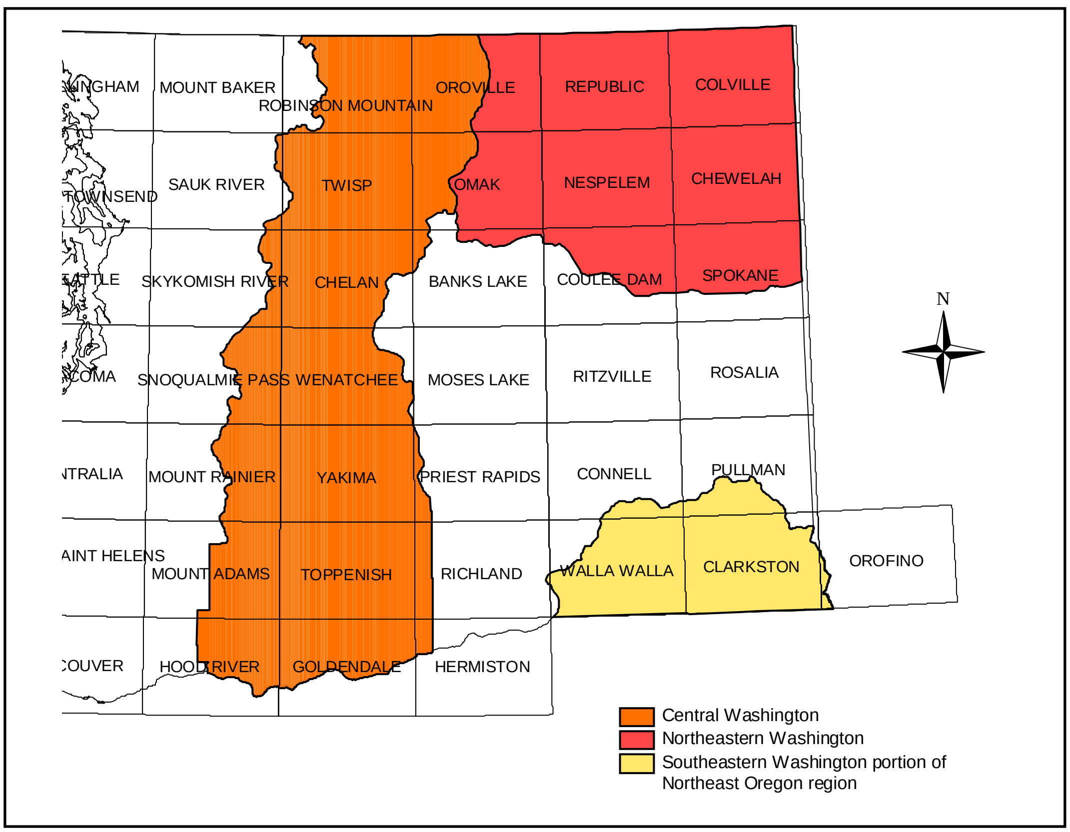
Digital and paper maps are available from the Washington State Department of Natural Resources, Division of Geology and Earth Resources (DGER). The following statewide compilation of 1:100K digital geology was used to develop the nutrient guidelines:

Washington Division of Geology and Earth Resources Staff, 2005. Digital 1:100,000-scale Geology of Washington State Version 1.0, Open File Report 2005-3, Olympia, Washington, December 2005.

The DGER (2005) report and associated files may be obtained through the DGER website at ***http://www.dnr.wa.gov/geology/dig100k.htm***. The geologic unit polygon shapefile entitled '***gunitp***' was utilized to derive the IFTNC nutrition guidelines.

A shapefile containing three polygons representing the three IFTNC regions in Washington is provided with these nutrition guidelines is entitled '***iftnc_waregions.'*** This shapefile may be used to clip the state-wide shapefile (***gunitp***), if desired. The ***iftnc_waregions*** shapefile uses them same geographic projection as the DGER digital geology (NAD83 HARN datum).

Paper maps for each 1:100K quadrangle are also available by contacting the DGER (visit their website for more information).



<u>Appendix C: Description of dBase Lookup Table</u>

Introduction: The dBASE file entitled ***Wash_Lith_IFTNC_Apr2008_Lookup.dbf*** was produced to supplement the report "<u>*Washington State IFTNC Nutrition Guidelines By Rock Type: Nutrition guidelines for use in conjunction with 2005 digital geology forWashington state*</u>" produced by the Intermountain Forest Tree Nutrition Cooperative at the University of Idaho in April of 2008.

Electronic Table Description: The dBASE file entitled ***Wash_Lith_IFTNC_Apr2008_Lookup.dbf*** was derived using the ***100k_units.xls*** spreadsheet that accompanied the digital geology obtained from the DGER (See Appendix B for source information). The dBASE file may be merged directly with the ***gunitp*** attribute table by joining on the 'GUNIT_TXT' column. The dBASE file consists of a lookup table that includes all the fields in the original DGER Excel spreadsheet ***100k_units.xls***, plus five new fields: '*Major_Unit,*' '*Minor_Unit*', '*IFTNC_Lithology,*' '*Weathering_Susceptibility*' and '*Tree_Value*'.

Hard-copy Lookup Table Description: An abbreviated hard-copy version of the lookup table (Appendix D) is arranged alphabetically by geologic quadrangle and map unit code. This table includes QUAD_NAME (1:100K quadrangle name), GUNIT_TXT (map units for the digital map) and OLD_SYM (map units for some of the older paper maps) from the original DGER Excel spreadsheet, followed by the IFTNC-assigned classifications of '*Major_Unit,*' '*Minor_Unit*', '*IFTNC_Lithology,*' '*Weathering_Susceptibility*' and '*Tree_Value*' ratings, respectively. For discussion of nutrient management recommendations, refer to the relevant section in the main text of this report.

Appendix D: Abbreviated Lookup Tables

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Banks Lake	EPAigd	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Banks Lake	Kbg(c)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Banks Lake	Kigb(c)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Banks Lake	KJmg(a)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Banks Lake	KJog(cj)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Banks Lake	Kmg(c)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Banks Lake	Kogm(c)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Banks Lake	pJhm(l)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Banks Lake	pKam(c)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad
Banks Lake	pKhm(c)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad
Banks Lake	pKhm(tm)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Banks Lake	TKit(a)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Bellingham	Jph(d)	---	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Cape Flattery	Qgl	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Centralia	Evc	Tvc(0)	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Centralia	Mir	Tir	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Centralia	MOian	Tia	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Centralia	MOid	Tidi	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Centralia	Mv(g)	Tgr	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Centralia	Ovc(oh)	Toh	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Chehalis River	Eib	Tib	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Chelan	Ecg(2ch)	Tcc	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Chelan	Ecg(2chf)	Tcmf	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Chelan	Eib(d)	Td	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Chelan	Eig(d)	Tdhb	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Chelan	Eir(d)	Tcrd	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Chelan	Evd(bp)	Tbp	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	dacite	medium	bad
Chelan	ice	---					
Chelan	Jam(i)	KJiam	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Chelan	Jhmc(i)	KJih	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Chelan	Jmv(i)	KJig	Metamorphic rocks	Greenstone	greenstone	medium	bad
Chelan	Jph(i)	KJip	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Chelan	JTRmb(c)	Kcm	Metamorphic rocks	Metamorphosed carbonate rocks	marble	medium	bad
Chelan	JTRsh(c)	Kcp	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Chelan	JTRsh(cm)	Kscm	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Chelan	JTRu	Ku	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Chelan	Kbg(w)	Kbgn	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Chelan	Kiaa(c)	Kcag	Intrusive rocks	Felsic intrusive rocks	pegmatite	medium	bad
Chelan	Kid(s)	Kmsd	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Chelan	Kigb(e)	Kceg	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Chelan	Kit(e)	Kcet	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Chelan	Kit(ecc)	Kcbg	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Chelan	Kit(sc)	Kmsc	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Chelan	Kmg(ch)	Kca	Metamorphic rocks	Metamorphosed mafic intrusive rocks	mafic gneiss	medium	bad
Chelan	Kmi(s)	Kmsx	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Chelan	Kog(a)	Kcga	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Chelan	Kog(cm)	Kcmt	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Chelan	Kog(df)	Kdf	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Chelan	Kog(t)	Ktpt	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Chelan	Kog(tim)	Ktpi	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Chelan	Kog(w)	Kbg	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Chelan	Kog(wr)	Kbw	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Chelan	Kog(wu)	Kbwu	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Chelan	Mva(bm)	Tbm	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Chelan	Mva(sp)	Tsp	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Chelan	Oc(w)	Tw	Sedimentary rocks	Sandstone	sandstone	low	bad
Chelan	Ovr(c)	Tcr	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	rhyolite	medium	bad
Chelan	Ovt(c)	Tcrt	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Chelan	pKigb(n)	Knmg	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Chelan	pTog(n)	Khlg	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Chelan	Qls(i)	Qlsi	Unconsolidated deposits	Landslide deposits	landslide deposits	medium	variable
Chelan	QMs	QTup	Unconsolidated deposits	Stream deposits	gravels	low	bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Chelan	TRhm(c)	Kta	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Chelan	TRhm(ch)	Kchg	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Chelan	TRPMam(n)	Knmb	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad
Chelan	TRPMhm(nq)	Khm	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Chelan	TRPMhmc(nh)	Kns	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Chelan	TRPMu(n)	Knsp	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Chewelah	bx	---	Metamorphic rocks	Schist-gneiss	tectonic/breccia	medium	medium
Chewelah	Ccb(l)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Chewelah	CZq(1a)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Chewelah	CZq(3a)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Chewelah	CZq(4a)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Chewelah	CZq(5a)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Chewelah	Dcb(v)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Chewelah	Ec(t)	---	Sedimentary rocks	Sandstone	sandstone	low	bad
Chewelah	Ecg(t)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Chewelah	Ei	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Chewelah	Eia(sp)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Chewelah	Eii(s)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Chewelah	Eiqm(l)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Chewelah	Eva(c)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Chewelah	Ji(l)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Chewelah	JTRii(f)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Chewelah	Kia(c)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Chewelah	Kia(fl)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Chewelah	Kia(gp)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Chewelah	Kia(s)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Chewelah	Kiaa	---	Intrusive rocks	Felsic intrusive rocks	pegmatite	medium	bad
Chewelah	Kiat(b)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Chewelah	Kiat(d)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Chewelah	Kiat(e)	---	Intrusive rocks	Felsic intrusive rocks	monzogranite	medium	medium
Chewelah	Kiat(g)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Chewelah	Kiat(p)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Chewelah	Kiat(s)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Chewelah	Kiat(sv)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Chewelah	Kig(lr)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Chewelah	Kog(n)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Chewelah	MDcb(1c)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Chewelah	MDcb(2c)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Chewelah	MDcb(3c)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Chewelah	OCcb(l)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Chewelah	Omm(l)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Chewelah	pCbg(h)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Chewelah	pChm	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Chewelah	PLMcg(c)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Chewelah	PZcb(gl)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Chewelah	PZcb(gu)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Chewelah	PZmm(g)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Chewelah	TKiaa(s)	---	Intrusive rocks	Felsic intrusive rocks	pegmatite	medium	bad
Chewelah	tz	---	Metamorphic rocks	Schist-gneiss	tectonic/breccia	medium	medium
Chewelah	Yar(b)	---	Metamorphic rocks	Siltite-argillite	argillite	medium	bad
Chewelah	Yar(dt)	---	Metamorphic rocks	Siltite-argillite	argillite	medium	bad
Chewelah	Ycb(e)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Chewelah	Ycb(s)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Chewelah	Yib	---	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Chewelah	Yms(bu)	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Chewelah	Yms(p)	---	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Chewelah	Yms(rr)	---	Metamorphic rocks	Feldspathic quartzite	feldspathic quartzite	low	bad
Chewelah	Yms(s)	---	Metamorphic rocks	Feldspathic quartzite	feldspathic quartzite	low	bad
Chewelah	Yms(w)	---	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Chewelah	Zcg(h)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Chewelah	Zmm(m)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Chewelah	Zmt(w)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Chewelah	Zmv(h)	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Clarkston-Orofino	Jm(ch)	---	Sedimentary rocks	Carbonate-bearing sedimentary rocks	calcareous sedimentary rocks	high	good
Clarkston-Orofino	KJi	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Clarkston-Orofino	Mv(i)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Clarkston-Orofino	Mv(sb)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Clarkston-Orofino	Mv(sl)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Clarkston-Orofino	Mv(swu)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Clarkston-Orofino	Mv(wem)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Clarkston-Orofino	Mv(wfs)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Clarkston-Orofino	Mv(wpr)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Clarkston-Orofino	pTmt	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Clarkston-Orofino	Qf(b)	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Clarkston-Orofino	Qf(m)	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Clarkston-Orofino	QMcg	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Clarkston-Orofino	QPLls	---	Unconsolidated deposits	Landslide deposits	landslide deposits	medium	variable
Clarkston-Orofino	TRcb(mb)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Clarkston-Orofino	TRmt(dc)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Clarkston-Orofino	TRmt(ws)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Colville	CDcb	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Colville	CDmm	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Colville	CDmt	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Colville	CDmv	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Colville	Comt	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Colville	Coq	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Colville	CZq(2g)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Colville	CZq(3g)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Colville	CZq(4g)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Colville	CZq(5g)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Colville	CZq(g)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Colville	Dcb(l)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Colville	Dcg	---	Sedimentary rocks	Carbonate rocks	limestone	medium	bad
Colville	Ecg(o)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Colville	Eia(s)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Colville	Eid	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Colville	Eigd(hr)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Eii	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Colville	Eik(w)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Colville	Eir	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Colville	Eis(c)	---	Intrusive rocks	Felsic intrusive rocks	syenite	medium	bad
Colville	Etz	---	Metamorphic rocks	Schist-gneiss	tectonic/breccia	medium	medium
Colville	Evd(s)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	dacite	medium	bad
Colville	Evdb(s)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Colville	Jcg(r)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Colville	Jmt(r)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Colville	Jmv(r)	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Colville	Ju	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Colville	Kcg(s)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Colville	Kia(l)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Colville	Kia(n)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Colville	Kia(sp)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Colville	Kia(spb)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Colville	Kiaa(m)	---	Intrusive rocks	Felsic intrusive rocks	pegmatite	medium	bad
Colville	Kiaa(sp)	---	Intrusive rocks	Felsic intrusive rocks	pegmatite	medium	bad
Colville	Kiat	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Colville	Kiat(gm)	---	Intrusive rocks	Felsic intrusive rocks	monzogranite	medium	medium
Colville	Kiat(gp)	---	Intrusive rocks	Felsic intrusive rocks	monzogranite	medium	medium
Colville	Kiat(h)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Kiat(hb)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Colville	Kiat(hh)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Kiat(hl)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Kiat(hm)	---	Intrusive rocks	Felsic intrusive rocks	monzogranite	medium	medium
Colville	Kiat(ho)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Kiat(hp)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Kiat(ht)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Kiat(m)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Kig(s)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Colville	Kigd(bg)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Kigd(mc)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Kigd(pl)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Kigd(sm)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	Kigd(y)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Colville	KYhm	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Colville	OCcb(b)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Colville	OCcb(d)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Colville	Omm(r)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Colville	PMcb(k)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Colville	PMmm(k)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Colville	PMmm(r)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Colville	PZq(g)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Colville	Scg(b)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Colville	Smm	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Colville	TRcb	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Colville	TRmm	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Colville	Yar(pl)	---	Metamorphic rocks	Siltite-argillite	argillite	medium	medium
Colville	Yar(pu)	---	Metamorphic rocks	Siltite-argillite	argillite	medium	medium
Colville	Ycb(p)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Colville	Ycs(p)	---	Metamorphic rocks	Calc-silicate rocks	calc-silicate gneiss	high	good

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Colville	Yib(p)	---	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Colville	Yms(rb)	---	Metamorphic rocks	Feldspathic quartzite	feldspathic quartzite	medium	medium
Colville	Yms(sr)	---	Metamorphic rocks	Feldspathic quartzite	feldspathic quartzite	low	bad
Colville	Yms(wl)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Colville	Yq(p)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Colville	Zcb(s)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Colville	Zcg(s)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Colville	Zib	---	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Colville	Zmv(l)	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Colville	Zph(s)	---	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Colville	Zq(s)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Colville	Zq(t)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Connell	Mv(slm)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Connell	Mv(swc)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Connell	Qf(bg)	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Connell	Qfs(t)	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Connell	Qla	---	Unconsolidated deposits	Lake deposits	lake deposits	medium	medium
Coulee Dam	CZq(a)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Coulee Dam	Eii(h)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Coulee Dam	Eimd(d)	---	Intrusive rocks	Felsic intrusive rocks	monzodiorite	medium	medium
Coulee Dam	Eimd(f)	---	Intrusive rocks	Felsic intrusive rocks	monzodiorite	medium	medium
Coulee Dam	EPAiat(s)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Coulee Dam	EPAig(g)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Coulee Dam	EPAmg(j)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Coulee Dam	Ev(s)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Coulee Dam	Eva(s)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Coulee Dam	Ki	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Coulee Dam	Kia(g)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Coulee Dam	Kia(m)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Coulee Dam	Kia(mr)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Coulee Dam	Kiat(pb)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Coulee Dam	Kig	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Coulee Dam	Kig(b)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Coulee Dam	Kig(l)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Coulee Dam	Kig(o)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Coulee Dam	Kigd(b)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Coulee Dam	Kigd(h)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Coulee Dam	Kir	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Coulee Dam	Mc(l)	---	Sedimentary rocks	Sandstone	sandstone	low	bad
Coulee Dam	OCcb(m)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Coulee Dam	Omm(c)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Coulee Dam	OYcb(c)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Coulee Dam	OYh(c)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Coulee Dam	OYmm(c)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Coulee Dam	OYph(c)	---	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Coulee Dam	OYq(c)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Coulee Dam	pTbg(e)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Coulee Dam	Qd	---	Unconsolidated deposits	Other	sand deposits	low	bad
Coulee Dam	Qgpo	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Coulee Dam	Qgpt	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Coulee Dam	Tbx(s)	---	Metamorphic rocks	Schist-gneiss	tectonic/breccia	medium	medium
Coulee Dam	TKid(j)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Coulee Dam	TKig(c)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Coulee Dam	Yar(m)	---	Metamorphic rocks	Siltite-argillite	argillite	medium	bad
Coulee Dam	Yar(t)	---	Metamorphic rocks	Siltite-argillite	argillite	medium	bad
Forks	Qa	---	Unconsolidated deposits	Stream deposits	alluvial deposits	low	medium
Goldendale	Mcg(es)	Mcg	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Goldendale	PLc(d)	Tdl	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Goldendale	QMc	QTg	Unconsolidated deposits	Stream deposits	gravels	low	bad
Goldendale	QPLiad(s)	QTsd	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Goldendale	QPLv(s)	QTsv	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Goldendale	QPLvr(s)	QTsr	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	rhyolite	medium	bad
Hermiston	Qfg	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Hood River	Mc(d)	Tdl	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Hood River	MOvt	Tvt	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Hood River	Mvba(3)	Tvba(3)	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Hood River	QPLc(s)	QTg	Unconsolidated deposits	Stream deposits	gravels	low	bad
Hood River	QPLida(g)	QTid	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Hood River	QPLvb(bl)	QTvbl	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Hood River	QPLvd(sn)	QTvsd	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	dacite	medium	bad
Hood River	Qv	Qvu	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Hood River	Qva(l)	Qvla	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Hood River	Qva(mf)	Qvmf	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Hood River	Qva(rs)	Qvrs	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Hood River	Qvb(cp)	Qvcp	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Hood River	Qvb(fm)	Qvfm	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Hood River	Qvb(gc)	Qvgc	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Hood River	Qvb(gm)	Qvgm	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Hood River	Qvb(su)	Qvsu	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Hood River	Qvb(uw)	Qvuw	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Hood River	Qvb(wn)	Qvwn	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Hood River	Qvb(ws)	Qvws	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Hood River	Qvba(qb)	Qvqb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Moses Lake	Mv(wr)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	MOv	Tv	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Adams	Ovc(2)	Tvc(2)	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Adams	PLv(d)	Pdv	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Adams	PLvc	Pvs	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Adams	PLvt	Pvt	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Adams	Qad	Qdu	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Mount Adams	Qad(md)	Qdmr	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Mount Adams	Qap(ws)	Qdw	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Mount Adams	Qat(e)	Qdet	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Mount Adams	QPLian	Qia	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Mount Adams	QPLvb	QTvb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	QPLvb(l)	QTvl	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Mount Adams	QPLvb(s)	QTsb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qva	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Adams	Qva(a)	Qaax	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Adams	Qva(ah)	Qaah	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Adams	Qva(hb)	Qaao	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Adams	Qva(os)	Qvos	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Adams	Qva(sb)	Qvsb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Adams	Qva(sg)	Qvsg	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Adams	Qvb(bn)	Qvbn	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(co)	Qvco	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(ga)	Qvga	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(go)	Qvgo	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(gr)	Qvgr	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(gt)	Qvgt	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(ic)	Qvic	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(lc)	Qvlc	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(lk)	Qvlk	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(rb)	Qvrb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(sc)	Qvsc	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(sm)	Qvsm	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(to)	Qvto	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvb(w)	Qvwl	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Adams	Qvba(lm)	Qvlm	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Adams	Qvba(ph)	Qvph	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Adams	Qvba(sn)	Qvsn	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Adams	Qvc(a)	Qaav	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Adams	Qvd(a)	Qaad	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	dacite	medium	bad
Mount Adams	Qvl(t)	Qmt	Unconsolidated deposits	Other	mud deposits	low	bad
Mount Adams	Qvr(a)	Qaar	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	rhyolite	medium	bad
Mount Baker	Ec	Tos	Sedimentary rocks	Sandstone	sandstone	low	bad
Mount Baker	Kigb	Kg	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Mount Baker	Kog(ef)	TKef	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Mount Baker	Qta	Qt	Unconsolidated deposits	Stream deposits	gravels	low	bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Mount Baker	TKmi(s)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Mount Baker	TKog(s)	TKso	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Mount Baker	TRhm(cc)	Kcs	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Mount Olympus	Qap	---	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Mount Rainier	Ec(2lo)	Tlo	Sedimentary rocks	Sandstone	sandstone	low	bad
Mount Rainier	Ec(2na)	Tna	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Rainier	Ec(2pg)	Tpg	Sedimentary rocks	Sandstone	sandstone	low	bad
Mount Rainier	Eva	Tva	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Rainier	Evb(dc)	Tdc	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Rainier	Evb(s)	Tsb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Rainier	Evb(tp)	Ttp	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Rainier	Evt(sc)	Tsnt	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Rainier	Jiq(i)	Jid	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Mount Rainier	Jog(i)	Jif	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Mount Rainier	KJm(r)	KJr	Sedimentary rocks	Carbonate-bearing sedimentary rocks	calcareous sedimentary rocks	high	good
Mount Rainier	KJmct(r)	KJrc	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Mount Rainier	KJmv(r)	KJrg	Metamorphic rocks	Greenstone	greenstone	medium	bad
Mount Rainier	KJvb(r)	pTgr	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Rainier	Mia(bl)	Tibl	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Mount Rainier	Mia(tr)	Tit	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Mount Rainier	Migd	Tigd	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Mount Rainier	Migd(bl)	Tiblgd	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Mount Rainier	MOiv(mx)	Timx	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Mount Rainier	MOva	Tva(2)?	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Rainier	MOvc	Tvc(2)?	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Rainier	MOvt(bm)	Tbm	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Rainier	MOvt(br)	Tbr	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Rainier	MOvt(rt)	Trt	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Rainier	Mvba(1)	Tvba(3)	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Rainier	Mvt	Tvt(3)	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Rainier	Ova	Tva(2)	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Rainier	Ovb(mc)	Twcb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Mount Rainier	Ovc(1)	Tvc(1)	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Rainier	Ovc(sc)	Tsns	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Rainier	Ovc(scc)	Tsnc	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Rainier	Ovc(wc)	Twc	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Mount Rainier	Ovr(1)	Tvr(1)	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	rhyolite	medium	bad
Mount Rainier	PLc	Tvs(6)	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Mount Rainier	PLMiad	Tid	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Mount Rainier	PLOian	Tia	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Mount Rainier	PLvb(b)	Tbt	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Rainier	PLvb(dw)	Tdw	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Rainier	PLvd	Tvd(6)	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	dacite	medium	bad
Mount Rainier	PLvr(d)	Tdv	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	rhyolite	medium	bad
Mount Rainier	pTvr(r)	pTvr	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	rhyolite	medium	bad
Mount Rainier	Qad(e)	Qde	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Mount Rainier	QPLva	QTva	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Rainier	QPLva(g)	QTvg	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Rainier	QPLvb(hm)	QThm	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Rainier	QPLvd	QTvd	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	dacite	medium	bad
Mount Rainier	Qva(dl)	Qvdl	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Rainier	Qva(dp)	Qvdp	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Rainier	Qva(pl)	Qvpe	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Rainier	Qva(rm)	Qvro	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Rainier	Qva(ru)	Qvru	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Mount Rainier	Qvb(hm)	Qvhm	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Rainier	Qvb(rr)	Qvrr	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Rainier	Qvb(tm)	Qvtm	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Mount Rainier	Qvd(sp)	Qvsp	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	dacite	medium	bad
Mount Saint Helens	Evd	Tvd	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	dacite	medium	bad
Mount Saint Helens	Qapt(h)	Qoht	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Mount Saint Helens	Qvb	Qvb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Nespelem	COar	---	Metamorphic rocks	Siltite-argillite	argillite	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Nespelem	COcb	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Nespelem	Cocg	---	Sedimentary rocks	Carbonate-bearing sedimentary rocks	carbonate-bearing sedimentary rocks	high	good
Nespelem	Comm	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Nespelem	Comv	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Nespelem	Cow	---	Sedimentary rocks	Sandstone	sandstone	low	bad
Nespelem	Cph(m)	---	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Nespelem	Dcb	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Nespelem	Eid(l)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Nespelem	Eig(dh)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Nespelem	Eig(gm)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Nespelem	Eigd(j)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Nespelem	Eimd(k)	---	Intrusive rocks	Felsic intrusive rocks	monzodiorite	medium	medium
Nespelem	Eiqm(f)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Nespelem	Eir(w)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Nespelem	EPAia(j)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Nespelem	EPAia(mc)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Nespelem	EPAia(s)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Nespelem	EPAiaa(mg)	---	Intrusive rocks	Felsic intrusive rocks	pegmatite	medium	bad
Nespelem	EPAiaa(mm)	---	Intrusive rocks	Felsic intrusive rocks	pegmatite	medium	bad
Nespelem	EPAig(cc)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Nespelem	EPAig(d)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Nespelem	EPAig(kb)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Nespelem	EPAig(mc)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Nespelem	EPAig(mm)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Nespelem	EPAig(mmf)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Nespelem	EPAig(mt)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Nespelem	Ev(sc)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Nespelem	Evc(s)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Nespelem	Evs(s)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Nespelem	Evt(s)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Nespelem	Kia(o)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Nespelem	Kig(g)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Nespelem	Kigd(f)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Nespelem	KJia(bc)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Nespelem	KJia(g)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Nespelem	KJia(m)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Nespelem	KJid(s)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Nespelem	KJigd(r)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Nespelem	MZPZu(p)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Nespelem	Oigb	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Nespelem	Ow(c)	---	Sedimentary rocks	Sandstone	sandstone	low	bad
Nespelem	pKid(n)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Nespelem	pKigb(b)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Nespelem	pKigb(s)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Nespelem	pTam	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad
Nespelem	pTgn(h)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Nespelem	pThm(h)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Nespelem	pTog(d)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Nespelem	pTog(h)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Nespelem	pTqz(h)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Nespelem	pTsc(h)	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Nespelem	PZar	---	Metamorphic rocks	Siltite-argillite	argillite	medium	medium
Nespelem	PZcb	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Nespelem	PZhm	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Nespelem	PZmm	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Nespelem	PZw	---	Sedimentary rocks	Sandstone	sandstone	low	bad
Nespelem	Qgd	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Nespelem	Qgl(n)	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Nespelem	Qglf(n)	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Nespelem	TKia(h)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Nespelem	Yq(b)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Nespelem	Yq(t)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Omak	Eida(c)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Omak	Eida(g)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Omak	Eig(s)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Omak	Eii(g)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Omak	Eimd(s)	---	Intrusive rocks	Felsic intrusive rocks	monzodiorite	medium	medium
Omak	EPAia(cc)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Omak	EPAia(mw)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Omak	EPAig(a)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Omak	EPAig(cs)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Omak	EPAig(m)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Omak	EPAig(mcc)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Omak	EPAigd(mc)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Omak	EPAigd(o)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Omak	Kia(cl)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Omak	Kia(e)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Omak	Kia(v)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Omak	Kig(f)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Omak	Kig(v)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Omak	Kigd(cm)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Omak	Kigd(cr)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Omak	Kigd(g)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Omak	Kigd(sl)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Omak	Kiqm(l)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Omak	Kiqm(p)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Omak	KJid(i)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Omak	KJigd(br)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Omak	KJigd(m)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Omak	KJit(s)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Omak	KJmg(sf)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	KJmi(b)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	KJmi(bm)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	KJmi(lc)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	KJmi(s)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	KJmi(w)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Omak	KJog(g)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	KJog(gm)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	KJog(m)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	mafic gneiss	medium	bad
Omak	KJog(s)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	Mv(gN2)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Omak	MZigb(d)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Omak	MZog(l)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	MZog(r)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	mafic gneiss	medium	bad
Omak	MZog(w)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	mafic gneiss	medium	bad
Omak	MZPZu	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Omak	pJhm(b)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Omak	pJhm(s)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Omak	pJhm(t)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Omak	pJmb(s)	---	Metamorphic rocks	Metamorphosed carbonate rocks	marble	medium	bad
Omak	pJqz(s)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Omak	pJtz	---	Metamorphic rocks	Schist-gneiss	tectonic/breccia	medium	medium
Omak	pKam(f)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad
Omak	pKcs(b)	---	Metamorphic rocks	Calc-silicate rocks	calc-silicate gneiss	high	good
Omak	pKhm(a)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Omak	pKog(m)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	pTam(t)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad
Omak	pTog(f)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	pTog(m)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Omak	PZhm(c)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Omak	PZhm(p)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Omak	TKigd(v)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Omak	TRcb(c)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Omak	TRmm(c)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Oroville	Ecg	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Oroville	Eian	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Oroville	Eian(o)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Oroville	Eida	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Oroville	EPAia(b)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	EPAiaa(b)	---	Intrusive rocks	Felsic intrusive rocks	pegmatite	medium	bad
Oroville	EPAid(b)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Oroville	Ev	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Oroville	Evc(a)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Oroville	Evc(o)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Oroville	Jcg(e)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Oroville	Jia(s)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	Jik(s)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	Jik(sb)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	Jiqm(s)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Oroville	Jmi(n)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Oroville	Jmv(e)	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Oroville	JTRigd(b)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Oroville	JTRigd(l)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Oroville	JTRog(t)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Oroville	Kia(a)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	Kia(b)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	Kia(cb)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	Kid(a)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Oroville	Kigd(c)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Oroville	Kiq(l)	---	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Oroville	Kiqm(h)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Oroville	KJia(w)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	KJid(b)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Oroville	KJigb(g)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Oroville	KJigd(a)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Oroville	KJigd(d)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Oroville	KJii(s)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	KJii(w)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	KJiq(b)	---	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Oroville	KJmi(tx)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Oroville	KJog(l)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Oroville	KJog(w)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Oroville	MZi	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	MZia	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	MZog(ll)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	mafic gneiss	medium	bad
Oroville	MZog(s)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Oroville	pJhm(c)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Oroville	pJhm(tc)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Oroville	pJmb(c)	---	Metamorphic rocks	Metamorphosed carbonate rocks	marble	medium	bad
Oroville	PMcb(s)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Oroville	PMmm(a)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Oroville	PMmm(b)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Oroville	PMmm(s)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Oroville	PMmv(s)	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Oroville	pTbg(t)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Oroville	pTbg(tm)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Oroville	pTgn	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Oroville	pTmb	---	Metamorphic rocks	Metamorphosed carbonate rocks	marble	medium	bad
Oroville	pTog(a)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Oroville	pTog(c)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Oroville	pTsc	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Oroville	Qoa	---	Unconsolidated deposits	Stream deposits	alluvial deposits	low	medium
Oroville	TKik	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Oroville	TRib(m)	---	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Oroville	TRmm(cx)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Oroville	TRmv(c)	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Oroville	TRog(o)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Oroville	TRPMib	---	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Oroville	TRPMib(c)	---	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Oroville	TRPMmt(k)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Oroville	TRPMmv(p)	---	Metamorphic rocks	Greenstone	greenstone	medium	bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Oroville	TRPMu(c)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Port Angeles	Qgo	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Priest Rapids	Mc	---	Unconsolidated deposits	Older sediments	older sediments	high	variable
Priest Rapids	Mcg	---	Unconsolidated deposits	Older sediments	older sediments	high	variable
Priest Rapids	Mv(gN2u)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Priest Rapids	Mv(sem)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Priest Rapids	Mv(sp)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Priest Rapids	Mv(w)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Priest Rapids	PLMcg(r)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Priest Rapids	Qafo	---	Unconsolidated deposits	Stream deposits	alluvial deposits	low	medium
Priest Rapids	Qfg(4)	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Priest Rapids	Qfs(3)	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Pullman	Mv(gR1)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Pullman	Mv(gR2)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Pullman	Mv(sa)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Pullman	Mv(su)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Pullman	Mv(swr)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Republic	Ccb(m)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Republic	CDmm(k)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Republic	CDmm(m)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Republic	CDmv(m)	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Republic	Ebx(k)	---	Metamorphic rocks	Schist-gneiss	tectonic/breccia	medium	medium
Republic	Ec(k)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Republic	Ec(o)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Republic	Eia(f)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Republic	Eian(r)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Republic	Eib(k)	---	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Republic	Eib(t)	---	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Republic	Eidaa	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Republic	Eig(h)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Republic	Eig(o)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Republic	Eig(u)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Republic	Eigd(b)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Republic	Eigd(h)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Republic	Eik	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Republic	Eim(h)	---	Intrusive rocks	Felsic intrusive rocks	monzonite	medium	medium
Republic	Eim(ho)	---	Intrusive rocks	Felsic intrusive rocks	monzonite	medium	medium
Republic	Eimd(h)	---	Intrusive rocks	Felsic intrusive rocks	monzodiorite	medium	medium
Republic	Eiqm(d)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Republic	Eiqm(h)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Republic	Eiqm(k)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Republic	Eitr	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Republic	EPAia(m)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Republic	Evc(k)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Republic	Evd(k)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	dacite	medium	bad
Republic	Evdv(k)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Republic	Evr(k)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	rhyolite	medium	bad
Republic	Evt(k)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Republic	Jib	---	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Republic	Jiq	---	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Republic	Jmm(r)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Republic	Kiat(mm)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Republic	Kiqm(k)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Republic	KJigd(b)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Republic	KJigd(w)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Republic	KJik(s)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Republic	MZid(s)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Republic	MZu	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Republic	Ocb(c)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Republic	Omv(c)	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Republic	PMcb	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Republic	PMmm	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Republic	pTmb(1)	---	Metamorphic rocks	Metamorphosed carbonate rocks	marble	medium	bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Republic	pTmb(2)	---	Metamorphic rocks	Metamorphosed carbonate rocks	marble	medium	bad
Republic	pTmg	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Republic	pTog	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Republic	pTog(e)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Republic	pTogp	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Republic	pTpg(2)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Republic	pTqz(2)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Republic	pTqz(4)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Republic	pTsc(1)	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Republic	pTsc(3)	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Republic	PZcb(s)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Republic	PZmm(h)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Republic	PZmm(s)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Republic	TRPMid(b)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Republic	TRPMmm	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Republic	TRPMmt	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Republic	TRPMmv	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Republic	Zcb(m)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad
Republic	Zmt(m)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Richland	Mv(s)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Richland	Mv(se)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Richland	PLMc(r)	---	Sedimentary rocks	Sandstone	sandstone	low	bad
Richland	QPLcg	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Robinson Mountain	Ec(i)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Robinson Mountain	Eib(m)	---	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Robinson Mountain	Eig(g)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Robinson Mountain	Eig(m)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Robinson Mountain	Eigd(c)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Robinson Mountain	Eigd(l)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Robinson Mountain	Eiq(c)	---	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Robinson Mountain	Ev(i)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Robinson Mountain	Eva(i)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Robinson Mountain	Jit(b)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Robinson Mountain	Jm(l)	---	Sedimentary rocks	Carbonate-bearing sedimentary rocks	calcareous sedimentary rocks	high	good
Robinson Mountain	Jm(t)	---	Sedimentary rocks	Carbonate-bearing sedimentary rocks	calcareous sedimentary rocks	high	good
Robinson Mountain	Kc(m)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Robinson Mountain	Kian	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Robinson Mountain	Kig(p)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Robinson Mountain	Kigb(a)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Robinson Mountain	Kigd(cb)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Robinson Mountain	Kigd(p)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Robinson Mountain	Kigd(r)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Robinson Mountain	Kii(f)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Robinson Mountain	Kiqm(cb)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Robinson Mountain	Kiqm(e)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Robinson Mountain	Kit(b)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Robinson Mountain	KJit(b)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Robinson Mountain	KJit(d)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Robinson Mountain	KJmg(s)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Robinson Mountain	KJog(e)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Robinson Mountain	KJog(lb)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Robinson Mountain	KJog(p)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Robinson Mountain	KJogm(r)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	mafic gneiss	medium	bad
Robinson Mountain	KJvs(n)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Robinson Mountain	Km(g)	---	Sedimentary rocks	Carbonate-bearing sedimentary rocks	calcareous sedimentary rocks	high	good
Robinson Mountain	Km(h)	---	Sedimentary rocks	Carbonate-bearing sedimentary rocks	calcareous sedimentary rocks	high	good
Robinson Mountain	Km(p)	---	Sedimentary rocks	Carbonate-bearing sedimentary rocks	calcareous sedimentary rocks	high	good
Robinson Mountain	Km(v)	---	Sedimentary rocks	Sandstone	sandstone	low	bad
Robinson Mountain	Ks(wv)	---	Sedimentary rocks	Sandstone	sandstone	low	bad
Robinson Mountain	Kva(i)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Robinson Mountain	Kvc(m)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Robinson Mountain	Kvs(b)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Robinson Mountain	PAKog(g)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Robinson Mountain	pJam(s)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad
Robinson Mountain	pJbg(q)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Robinson Mountain	Qs	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Robinson Mountain	TKi	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Robinson Mountain	TKi(h)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Rosalia	Yms(wu)	---	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Sauk River	Jsc(c)	Kcgg	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Sauk River	Jsh(s)	Kes	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Sauk River	Kbg(bl)	Kblg	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Sauk River	Kbg(n)	Kng	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Sauk River	Kigd(fc)	Kfc	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Sauk River	Kog(bl)	Kbl	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Sauk River	Kog(e)	TKeb	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Sauk River	Kog(td)	Ktd	Metamorphic rocks	Metamorphosed mafic intrusive rocks	mafic gneiss	medium	bad
Sauk River	Kog(ti)	Kti	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Sauk River	Kog(tl)	Ktl	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Sauk River	Mig(c)	Tcpl	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Sauk River	Migd(c)	Tcpu	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Sauk River	Qls(m)	Qmw	Unconsolidated deposits	Landslide deposits	landslide deposits	medium	variable
Sauk River	Qva(lc)	Qaf	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Sauk River	Qvb(wc)	Qcc	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Sauk River	TRiq(m)	TKmd	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Sauk River	TRms(cc)	Kcc	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Sauk River	TRog(mm)	TKmm	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Sauk River	TRPMhmc(n)	Kns	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Seattle	Evr	Tsv	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	rhyolite	medium	bad
Seattle	Evt	Tav	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Skykomish River	Ec(1f)	Tss	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Skykomish River	Ec(1g)	Tssc	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Skykomish River	Ev(na)	Tnv	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Skykomish River	JTRhm(c)	Kca	Metamorphic rocks	Schist-gneiss	schist	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Skykomish River	JTRsc(c)	Kcb	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Skykomish River	JTRu(c)	Ku	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Skykomish River	Ju(i)	KJim	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Skykomish River	Kigb(s)	Ksm	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Skykomish River	Kit(se)	Kse	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Skykomish River	Kit(sh)	Kswh	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Skykomish River	Kit(sw)	Ksw	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Skykomish River	Kog(b)	Kbgg	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Skykomish River	Kog(p)	Kbgp	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Skykomish River	MOig(sh)	Tsh	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Skykomish River	MOigd(s)	Tst	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Skykomish River	Oian(d)	Tdia	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Skykomish River	Ols(d)	Tdb	Unconsolidated deposits	Landslide deposits	landslide deposits	medium	variable
Skykomish River	Ovd(d)	Tdd	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	dacite	medium	bad
Skykomish River	PLMida(1)	Tcd	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Skykomish River	PLMida(2)	Tcp	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Skykomish River	Qad(p)	Qgp	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Skykomish River	Qp	Qb	Unconsolidated deposits	Other	peat	NA	NA
Snoqualmie Pass	Ec(1m)	Tm	Sedimentary rocks	Sandstone	sandstone	low	bad
Snoqualmie Pass	Ec(1sc)	Tsc	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Snoqualmie Pass	Ec(2nag)	Tng	Sedimentary rocks	Sandstone	sandstone	low	bad
Snoqualmie Pass	Ec(2nas)	Tns	Sedimentary rocks	Sandstone	sandstone	low	bad
Snoqualmie Pass	Ec(2ru)	Tru	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Snoqualmie Pass	Eva(ss)	Tssp	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Snoqualmie Pass	Eva(t)	Tta	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Snoqualmie Pass	Evb(fm)	Tbf	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Snoqualmie Pass	Evb(na)	Tnb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Snoqualmie Pass	Evb(nap)	Tnbg	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Snoqualmie Pass	Evr(na)	Tnr	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	rhyolite	medium	bad
Snoqualmie Pass	Evt(na)	Tnmc	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Snoqualmie Pass	Evx(fm)	Tbfb	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Snoqualmie Pass	Jam(lm)	pTla	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad
Snoqualmie Pass	Jbg	Kbg	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Snoqualmie Pass	Jigb(i)	KJid	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Snoqualmie Pass	Jigb(lm)	pTlg	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Snoqualmie Pass	Jit(qm)	pTqm	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Snoqualmie Pass	Jog(hb)	Khb	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Snoqualmie Pass	Jsc(lm)	pTlm	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Snoqualmie Pass	Jsh(tz)	Ktz	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Snoqualmie Pass	Ju(is)	KJis	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Snoqualmie Pass	KJhm(tz)	TKt	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Snoqualmie Pass	KJu(tz)	TKtu	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Snoqualmie Pass	Mian	Tip	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Snoqualmie Pass	Mida	Tidp	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Snoqualmie Pass	Mit	Tit	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Snoqualmie Pass	Mva(fp)	Tf	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Snoqualmie Pass	Mva(fpb)	Tfeb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Snoqualmie Pass	Mva(h)	Th	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Snoqualmie Pass	Mvc(cp)	Tcp	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Snoqualmie Pass	Mvc(fp)	Tfv	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Snoqualmie Pass	Oir(d)	Tdgr	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Snoqualmie Pass	Ov(d)	Tdv	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Snoqualmie Pass	Ovc	Tv	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Snoqualmie Pass	Ovr(d)	Tdr	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	rhyolite	medium	bad
Snoqualmie Pass	Ovt(d)	Tdrd	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Snoqualmie Pass	Ovt(oh)	Tolk	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Snoqualmie Pass	PDmv(np)	Knp	Metamorphic rocks	Greenstone	greenstone	medium	bad
Spokane	CYmm	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Spokane	Eiat(r)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Spokane	Eigd(t)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Spokane	Eiqm(s)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Spokane	Kiat(ls)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Spokane	Kiat(o)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Spokane	Kigd(fl)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Spokane	Kigd(w)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Spokane	Kog(ms)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Spokane	Kog(s)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Spokane	pCam(p)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad
Spokane	pChm(p)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Spokane	PLMcg	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Spokane	Qglf	---	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Spokane	TKia	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Spokane	TKia(c)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Spokane	TKia(f)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Spokane	TKia(mc)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Spokane	TKiaa	---	Intrusive rocks	Felsic intrusive rocks	pegmatite	medium	bad
Spokane	Yq(dt)	---	Metamorphic rocks	Quartzite	quartzite	very low	very bad
Tacoma	Qf	ml	Unconsolidated deposits	Other	made ground	low	NA
Tacoma	Qgp	Qdp	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Tacoma	Qgt	Qvt	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Tacoma	Qls	Qls	Unconsolidated deposits	Landslide deposits	landslide deposits	medium	variable
Toppenish	Mcg(e)	Mcg	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Toppenish	Ql	Qlo	Unconsolidated deposits	Loess deposits	loess deposits	low	medium to low
Toppenish	QPLvd(s)	QTsd	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Twisp	Ec(2)	---	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Twisp	Ei(s)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Twisp	Ei(sr)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Twisp	Eia(fp)	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Twisp	Eian(gm)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Twisp	Eida(gm)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Twisp	Eig(c)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Twisp	Eig(r)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Twisp	Eigd(bb)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Twisp	Eigd(cm)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Twisp	Eigd(ho)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Twisp	Eigd(ll)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Twisp	Eigd(n)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Twisp	Eigd(rc)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Twisp	Eim(r)	---	Intrusive rocks	Felsic intrusive rocks	monzonite	medium	medium
Twisp	Eiq(d)	---	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Twisp	Eiq(dc)	---	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Twisp	Eiq(h)	---	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Twisp	Eiqm(c)	---	Intrusive rocks	Felsic intrusive rocks	quartz monzonite	medium	medium
Twisp	Eit(ch)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	Eit(chc)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	Eit(h)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	Eog(c)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	Kc(mv)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Twisp	Kc(w)	---	Sedimentary rocks	Sandstone	sandstone	low	bad
Twisp	Kcg(2)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Twisp	Kcg(p)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Twisp	Kcg(v)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Twisp	Kid(e)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Twisp	Kid(mc)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Twisp	Kid(t)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Twisp	Kigd(bp)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Twisp	Kigd(hp)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Twisp	Kigd(t)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Twisp	Kiq(c)	---	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Twisp	Kiq(cp)	---	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Twisp	Kit	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	Kit(cm)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	Kit(cp)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	Kit(cpc)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	Kit(ec)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	Kit(ep)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	Kit(s)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	KJam(o)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad
Twisp	KJcb(n)	---	Metamorphic rocks	Metamorphosed carbonate rocks	metamorphosed carbonate rocks	medium	bad

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Twisp	KJigb(f)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Twisp	KJigb(r)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Twisp	KJiq(a)	---	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Twisp	KJiq(f)	---	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Twisp	KJit(f)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	KJm(n)	---	Sedimentary rocks	Carbonate-bearing sedimentary rocks	calcareous sedimentary rocks	high	good
Twisp	KJmi(t)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	KJmv(n)	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Twisp	KJog(c)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	mafic gneiss	medium	bad
Twisp	KJog(o)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	KJvd(n)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	dacite	medium	bad
Twisp	KJvt(n)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Twisp	Km(2)	---	Sedimentary rocks	Sandstone	sandstone	low	bad
Twisp	Kog(bm)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	Kog(br)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	Kog(brp)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	Kog(c)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	Kog(l)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	Kog(tc)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	Kog(tf)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	Kv(m)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Twisp	Kvs(w)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Twisp	Mian(c)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Twisp	Mida(c)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Twisp	Mida(ca)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	felsic dikes and sills	medium	bad
Twisp	Mix	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Twisp	PAc(p)	---	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Twisp	PAit(o)	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	PAKog(b)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	PAog(b)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	PAog(j)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	PAog(o)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Twisp	PAog(t)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	PAog(w)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	pCam(s)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	amphibolite	medium	bad
Twisp	pCgn(s)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Twisp	pKbg(l)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Twisp	pKhm(l)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Twisp	pKhm(s)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Twisp	pKhm(tv)	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Twisp	pKmv(n)	---	Metamorphic rocks	Greenstone	greenstone	medium	bad
Twisp	pKog(a)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Twisp	pKog(l)	---	Metamorphic rocks	Metamorphosed mafic intrusive rocks	mafic gneiss	medium	bad
Twisp	pTgn(e)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Twisp	pTigb(r)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Twisp	pTigb(rl)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Twisp	pTmt(m)	---	Metamorphic rocks	Carbonate-bearing metasedimentary rocks	carbonate-bearing metasedimentary rocks	high	good
Twisp	Qaf	---	Unconsolidated deposits	Stream deposits	alluvial deposits	low	medium
Twisp	Qls(a)	---	Unconsolidated deposits	Landslide deposits	landslide deposits	medium	variable
Twisp	Qvp(gp)	---	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Twisp	Tia	---	Intrusive rocks	Felsic intrusive rocks	felsic intrusive bodies	medium	bad
Twisp	Tib(c)	---	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Twisp	TKid(y)	---	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Twisp	TKig(sc)	---	Intrusive rocks	Felsic intrusive rocks	granite	medium	medium
Twisp	TKigd(e)	---	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Twisp	TKit	---	Intrusive rocks	Felsic intrusive rocks	tonalite	medium	medium
Twisp	TKog(b)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	TKog(m)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	TKog(p)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	TKog(r)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	TKog(ss)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	TRhm(cb)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Twisp	TRhm(cg)	---	Metamorphic rocks	Schist-gneiss	gneiss	medium	medium
Twisp	TRhm(cs)	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Twisp	TRog(d)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	TRog(da)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	TRog(dd)	---	Metamorphic rocks	Metamorphosed felsic intrusive rocks	felsic gneiss	medium	medium
Twisp	TRPMhmc(nb)	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Twisp	TRPMhmc(nq)	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Twisp	TRPMhmc(nr)	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Twisp	TRPMhmc(nt)	---	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Walla Walla	Mv(sih)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Walla Walla	Mv(wfe)	---	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Wenatchee	Ec(1s)	Tssh	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Wenatchee	Ec(1sa)	Tsa	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Wenatchee	Ec(2ch)	Tc	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Wenatchee	Ec(2chn)	Tcn	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Wenatchee	Ec(2rl)	Trl	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Wenatchee	Ec(2rm)	Trm	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Wenatchee	Ecg(1sf)	Tsf	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Wenatchee	Ecg(2chr)	Tcr	Sedimentary rocks	Conglomerate	conglomerate	low	bad
Wenatchee	Eib(c)	Tcl	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Wenatchee	Eigb	Thg	Intrusive rocks	Mafic intrusive rocks	diorite and gabbro	high	bad
Wenatchee	Eva(p)	Tap	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad
Wenatchee	Evb(ch)	Tcb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Wenatchee	Evb(t)	Ttb	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Wenatchee	Jar(ip)	Kjiar	Metamorphic rocks	Siltite-argillite	argillite	medium	medium
Wenatchee	Jib(i)	Kjid	Intrusive rocks	Mafic intrusive rocks	mafic intrusive bodies	high	bad
Wenatchee	Jmv(ih)	Kjim	Metamorphic rocks	Greenstone	greenstone	medium	bad
Wenatchee	Jsc(ih)	Kjihs	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Wenatchee	Ju(isc)	Kjisc	Metamorphic rocks	Metamorphosed mafic intrusive rocks	ultrabasic	medium	bad
Wenatchee	Kigd(s)	Kmsm	Intrusive rocks	Felsic intrusive rocks	granodiorite	medium	medium
Wenatchee	Kiq(s)	Kmsq	Intrusive rocks	Mafic intrusive rocks	quartz diorite	high	medium
Wenatchee	Mc(ev)	Tesv	Sedimentary rocks	Feldspathic sandstone	feldspathic sandstone	medium	medium
Wenatchee	Mvc(e)	Tev	Extrusive and subvolcanic rocks	Felsic extrusive/subvolcanic rocks	volcanic	medium	bad
Wenatchee	Mvi(gR2h)	Tgh	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Wenatchee	Mvi(gR2o)	Tghc	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good

QUAD__NAME	GUNIT_TXT	OLD_SYM	IFTNC_Major_Unit	IFTNC_Minor_Unit	IFTNC_Lithology	Weathering Susceptibility	Tree Value
Wenatchee	OEian	Tmd	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Wenatchee	Oian(h)	Thp	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	mafic dikes and sills	high	bad
Wenatchee	pJph	pJmp	Metamorphic rocks	Siltite-argillite	siltite-argillite	medium	medium
Wenatchee	pJsh	pJmg	Metamorphic rocks	Schist-gneiss	schist	medium	medium
Wenatchee	PLcg(t)	Tts	Unconsolidated deposits	Older sediments	older sediments	high	variable
Wenatchee	PLMa	Twh	Unconsolidated deposits	Stream deposits	alluvial deposits	low	medium
Wenatchee	PLMls	---	Unconsolidated deposits	Landslide deposits	landslide deposits	medium	variable
Wenatchee	Qao(lb)	Qlbs	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qao(ld)	Qldm	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qao(lr)	Qlrm	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qap(l)	Qlm	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qapo(k)	Qks	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qapo(ki)	Qkim	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qapo(ks)	Qkss	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qapt(k)	Qkt	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qapt(ki)	Qkit	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qapt(ks)	Qkst	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qat(lb)	Qlbt	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qat(lh)	Qlht	Unconsolidated deposits	Glacial till	alpine glacial till	medium	variable
Wenatchee	Qla(ki)	Qkil	Unconsolidated deposits	Lake deposits	lake deposits	medium	medium
Wenatchee	Qla(kso)	Qkslo	Unconsolidated deposits	Lake deposits	lake deposits	medium	medium
Wenatchee	Qla(ksy)	Qksly	Unconsolidated deposits	Lake deposits	lake deposits	medium	medium
Wenatchee	Qt	Qta	Unconsolidated deposits	Stream deposits	gravels	low	bad
Wenatchee	Qta(r)	Qrg	Unconsolidated deposits	Stream deposits	gravels	low	bad
Yakima	Mc(e)	Tel	Sedimentary rocks	Sandstone	sandstone	low	bad
Yakima	Mv(gN1)	Tgn1	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	basalt	high	good
Yakima	Qfs	Qf	Unconsolidated deposits	Glacial till	continental glacial till	low	medium
Yakima	Qva(ti)	Qvti	Extrusive and subvolcanic rocks	Mafic extrusive/subvolcanic rocks	andesite	high	bad