

Appendix D

The Map Units for GLEES Soil Survey Area

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The soils map of GLEES watersheds is shown in chap. 5, fig. 5.1. The following map units are described in this Appendix:

1. Typic Cryoboralfs - Dystric Cryochrepts complex
2. Typic Cryoboralfs complex
3. Dystric Cryochrepts - Lithic Cryochrepts complex
4. Dystric Cryochrepts complex
5. Dystric Cryochrepts - Rubbleland, quartzite complex
- 5m. Dystric Cryochrepts - Rubbleland, mafic intrusives complex
6. Typic Cryumbrepts - Dystric Cryochrepts complex
7. Rock Outcrop, quartzite - Dystric Cryochrepts - Lithic Cryochrepts complex
- 7m. Rock Outcrop, mafic igneous intrusives - Dystric Cryochrepts - Lithic Cryochrepts complex
8. Histic Cryaquepts - Aeris Cryaquepts complex
9. Rubbleland
10. Rubbleland - Rock Outcrop complex
11. Permanent Snowfields and Icefields
12. Typic Cryorthents - Rubbleland complex
13. Dystric Cryochrepts - Lithic Cryumbrepts - Rock Outcrop complex
- W. Water

Detailed profile descriptions of the soil types identified in the map units are found in Appendix E.

1. Typic Cryoboralfs - Dystric Cryochrepts complex, 5–45% slopes

This complex consists of deep, well-drained soils on gently sloping to moderately steep slopes. The soils are developed in a relatively thin veneer of well-graded glacial till and nivation debris on summit, shoulder, backslope and footslope positions of moraine-like and kame terrace landforms of Neoglacial and Pinedale age. Resistant bedrock controls the location and form of structural benches that impart a stairstep backslope profile to these landforms. Outcrops of both quartzite and mafic igneous intrusives, high in actinolite and epidote, occur within delineations of this map unit. The map unit is primarily forested. Small areas of herbaceous vegetation occur throughout and are associated with late-melting snow accumulations.

Typic Cryoboralfs (loamy-skeletal, mixed) make up about 65% of the map unit. Dystric Cryochrepts (loamy-skeletal, mixed) make up about 25% of the unit. Included in the mapping are small areas of the named components on slopes that are less than 5% and greater than 45%, both quartzite and mafic igneous Rock Outcrop. In addition, Lithic Cryochrepts (loamy-skeletal, mixed) associated with the rock outcrops and Typic Cryumbrepts (loamy-skeletal, mixed) associated with small areas of late-melting snow accumulations may be found. These inclusions make up about 10% of the total extent of the map unit in the survey area.

The Typic Cryoboralfs are deep, are well-drained, and have moderate to moderately rapid permeability. They are formed in glacial till and are typically associated with gently sloping to moderately steep portions of benches on the backslopes and with shoulder and summit positions on the associated landform. Slopes are 5–30%, 10–20 m in length, and plane or slightly convex in shape. In most areas surface runoff is limited due to the forest litter layer at the surface. The erosion hazard is low. The majority of roots are located in the upper 60 cm of the profile with lesser amounts of very fine roots extending to 100 cm or more. Most areas of these soils support subalpine forest and/or krummholz vegetation.

In a representative profile of these Typic Cryoboralfs the surface layer is a black to very dark grayish-brown peat, composed of forest litter in various states of decomposition about 3 cm thick. The surface mineral horizon is a yellowish-brown or brown to very pale brown, very gravelly loam about 11 cm thick. The subsoil is a brown to light brown, extremely gravelly, silty clay loam about 20 cm thick over a yellowish-brown, dark-brown, and strong brown very cobbly sandy loam to 100 cm or more. Some areas of these soils are very or extremely cobbly, stony, or bouldery throughout the profile.

Detailed profile descriptions and associated selected physical and chemical laboratory data for representative soils are those provided for pedons WYGL001, WYGL002, WYGL005, and WYGL016.

The Dystric Cryochrepts are deep, well-drained, and have moderate to moderately rapid permeability. They are formed in glacial till and nivation debris and are typically associated with moderately steep slopes between benches on the backslopes of the associated landform. Slopes are 30–45%, 10–20 m in length, and plane or slightly convex in shape. Surface runoff is limited

due to the forest litter layer at the surface in most areas. The erosion hazard is low. The majority of roots are located in the upper 20 cm of the profile with lesser amounts of very fine roots extending to 100 cm or more. Most areas of these soils support subalpine forest and/or krummholz vegetation.

In a representative profile of these Dystric Cryochrepts, the surface layer is a very dark gray to very dark grayish-brown peat composed of forest litter in various states of decomposition about 4 cm thick. The surface mineral horizon is a brown to pale brown gravelly loam about 9 cm thick. The subsoil is a yellowish-brown and pink to very pale brown, very gravelly loam about 34 cm thick over a brown to pink, very cobbly to extremely gravelly loam to 105 cm or more. Some areas of these soils are very or extremely cobbly, stony, or bouldery throughout the profile.

Samples specific for this map unit were not collected. However, detailed profile descriptions and selected physical and chemical laboratory data are provided for WYGL006, WYGL007, and WYGL015, which are morphologically similar soils.

2. Typic Cryoboralfs complex, 5–20% slopes

This complex consists of deep, well-drained soils on gently sloping to moderately steep slopes. The soils are developed in a relatively thin veneer of well-graded glacial till and nivation debris on summit, shoulder, backslope, and footslope positions of glacial moraines and moraine-like landforms of Neoglacial and Pinedale age. The map unit is sparsely forested with large open areas of herbaceous vegetation.

The principal components of this map unit are both Typic Cryoboralfs (loamy-skeletal, mixed) that differ in the amount of cobblestones and stones on the surface. Very stony Typic Cryoboralfs (loamy-skeletal, mixed) make up about 75% of the map unit. Stony Typic Cryoboralfs (loamy-skeletal, mixed) make up about 20% of the map unit. Included in the mapping are small areas of Dystric Cryochrepts (loamy-skeletal, mixed) and Typic Cryumbrepts (loamy-skeletal, mixed) associated with small areas of late-melting snow accumulations. These inclusions make up about 5% of the total extent of the map unit in the survey area.

These Typic Cryoboralfs are deep, well-drained, and have moderate to moderately rapid permeability. They are formed in glacial till and are typically associated with gently sloping to sloping footslope, backslope, shoulder, and summit positions. Slopes are 5–20%, 10–20 m in length, and plane or slightly convex in shape.

Surface runoff is medium to rapid; however, erosion is slight to moderate due to the amount of rock fragments on the surface. The majority of roots are located in the upper 60 cm of the profile with lesser amounts of very fine roots extending to 100 cm or more. The species composition of the vegetation supported by the soils of this map unit is variable and complex. Most areas of the very stony phase of the Typic Cryoboralfs support open herbaceous vegetation. Most areas of the stony phase of

the Typic Cryoboralfs support subalpine forest and/or krummholz.

The Typic Cryoboralfs that compose the principal components of this map unit are morphologically similar but differ in the amount of cobblestones, stones, and boulders at the surface and by the presence or absence of a forest litter layer. A typical profile of the stony Typic Cryoboralfs is similar to the Cryoboralfs described for map unit 1, having a surface layer that is a black to very dark grayish-brown peat composed of forest litter in various states of decomposition about 3 cm thick. The surface mineral horizon is a yellowish-brown or brown to very pale brown, very gravelly loam about 11 cm thick. The subsoil is a brown to light brown, extremely gravelly, silty clay loam about 20 cm thick over a yellowish-brown, dark brown and strong brown, very cobbly sandy loam to 100 cm or more.

The very stony Typic Cryoboralfs exhibit morphological characteristics similar to those described above, but lack a surface forest litter layer. In these soils the surface layer is a dark gray to very dark grayish-brown, very stony loam.

Samples specific for this map unit were not collected. However, detailed profile descriptions and associated selected physical and chemical laboratory data are provided for similar soils—pedons WYGL001, WYGL002, WYGL005, and WYGL016.

3. Dystric Cryochrepts - Lithic Cryochrepts complex, 5–25% slopes

This complex consists of moderately deep and shallow, well-drained soils on gently sloping to moderately steep slopes. These soils are developed in nivation debris and residuum on summits and shoulders of subalpine and alpine ridges. The soils of this map unit primarily support herbaceous alpine vegetation. Small areas of krummholz vegetation occur throughout.

Dystric Cryochrepts (loamy-skeletal, mixed) make up about 55% of the map unit. Lithic Cryochrepts (loamy-skeletal, mixed) make up about 35% of the unit. Included in the mapping are small areas of both quartzite and mafic igneous Rock Outcrop and Rubbleland (talus), Typic Cryorthents (loamy-skeletal, mixed) at higher elevations, and Typic Cryoboralfs (loamy-skeletal, mixed) at lower elevations. The latter are developed in isolated pockets of well-graded glacial till. These inclusions make up about 10% of the total extent of the map unit in the survey area.

The Dystric Cryochrepts are moderately deep, well-drained, and have moderate to rapid permeability. They are formed in nivation debris and coarse residuum. Slopes are 5–25%, 10–35 m in length, and plane or slightly convex in shape. Surface runoff is medium to rapid. The erosion is slight to moderate due to the large amount of gravel and cobblestones on the surface. The majority of roots are located in the upper 30 cm of the profile with lesser amounts of very fine roots extending to the bedrock contact at less than 100 cm. Most areas of these soils support open alpine vegetation.

In a representative profile of these Dystric Cryochrepts, the surface layer is a very dark grayish-brown to yellowish-brown, extremely gravelly, sandy loam about 12 cm thick. The subsoil is a brown to reddish-yellow, extremely gravelly, coarse, sandy loam about 18 cm thick over a yellowish-brown to very pale brown, extremely stony, fine sandy loam about 17 cm thick. The substratum is a yellow to very pale brown, extremely stony, fine sandy loam about 12 cm thick, and is underlain by quartzite bedrock at about 59 cm.

The detailed profile description and associated selected physical and chemical laboratory data for WYGL003 are representative of this soil.

The Lithic Cryochrepts are shallow, well-drained and have moderate to rapid permeability. They are formed in nivation debris and coarse residuum. Slopes are 5–25%, 10–35 m in length, and plane or slightly convex in shape. Surface runoff is medium to rapid. The erosion is slight to moderate due to the large amount of gravel and cobblestones on the surface. The majority of roots are located in the upper 30 cm of the profile with lesser amounts of very fine roots extending to the bedrock contact at less than 50 cm. Most areas of these soils support open alpine vegetation.

The Lithic Cryochrepts typically exhibit morphological characteristics similar to those described above for the Dystric Cryochrepts, but the depth to hard bedrock is less than 50 cm. Specific samples of the soils in this map unit were not collected. However, the detailed profile description and selected physical and chemical laboratory data for WYGL003 would be pertinent.

4. Dystric Cryochrepts complex, 5–25% slopes

This complex consists of deep, well-drained soils developed in colluvium and nivation debris on gently sloping to moderately steep backslope and footslope positions of mountain sides and ridges. The map unit is primarily forested with open areas of herbaceous vegetation.

The principal components of this map unit are both Dystric Cryochrepts (loamy-skeletal, mixed) that differ in the amount of cobblestones and stones on the surface. Stony Dystric Cryochrepts (loamy-skeletal, mixed) make up about 60% of the map unit. Very stony Dystric Cryochrepts (loamy-skeletal, mixed) make up about 30% of the map unit. Included in the mapping are small areas of Lithic Cryochrepts (loamy-skeletal, mixed) and Rock Outcrop. These inclusions make up about 10% of the total extent of the map unit within the survey area.

The stony Dystric Cryochrepts are deep, are well-drained, and have moderate to moderately rapid permeability. Slopes are 5–25%, 10–20 m in length, and plane or slightly convex in shape. Surface runoff is limited due to the forest litter layer at the surface in most areas. The erosion hazard is low. The majority of roots are located in the upper 30 cm of the profile with lesser amounts of very fine roots extending to 105 cm or more. Most areas of these soils support forest vegetation.

In a representative profile of these Dystric Cryochrepts the surface layer is a very dark gray to very dark gray-

ish-brown peat composed of forest litter in various states of decomposition about 4 cm thick. The surface mineral horizon is a brown to pale brown, gravelly loam about 9 cm thick. The subsoil is a yellowish-brown and pink to very pale brown, very gravelly loam about 34 cm thick over a brown to pink, very cobbly to extremely gravelly loam to 105 cm or more. Some areas of these soils are very or extremely cobbly, stony, or bouldery throughout the profile.

Detailed profile descriptions and associated selected physical and chemical laboratory data of representative soils are those for WYGL006 and WYGL007. These soils are also morphologically similar to WYGL015 except that they lack the accumulation of clay (argillic horizon) in the solum.

The very stony Dystric Cryochrepts are deep, well-drained, and have moderate to moderately rapid permeability. Slopes are 5–25%, 10–30 m in length, and plane or slightly convex in shape. Surface runoff is medium to rapid. However, the erosion hazard is slight to moderate due to the high amounts of rock fragments at the soil surface. The majority of roots are located in the upper 30 cm with lesser amounts of very fine roots extending to about 90 cm. Most areas of these soils support open herbaceous vegetation. Scattered individual trees occur within these areas.

In a representative profile of the very stony Dystric Cryochrepts, the surface layer is a very dark gray and dark brown to very dark grayish-brown, extremely cobbly loam about 15 cm thick. The subsoil is a brown to very pale brown, extremely cobbly loam about 18 cm thick over a brown and yellowish-brown to very pale brown, extremely cobbly loam about 22 cm thick. The substratum is an olive brown and dark yellowish-brown to light yellowish-brown, extremely cobbly loam to 108 cm or more.

A detailed profile description and associated selected physical and chemical laboratory data of a representative soil are those for WYGL015.

5. Dystric Cryochrepts - Rubbleland, quartzite complex, 25–45% slopes

This complex consists of deep, well-drained soils and talus on moderately steep and steep portions of backslopes and shoulders of mountain sides and ridges. The map unit is sparsely forested, mostly krummholz, with open areas of herbaceous vegetation and talus.

Dystric Cryochrepts (loamy-skeletal, mixed), make up about 60% of the map unit. Rubbleland makes up about 30% of the unit. Included in the mapping are small areas of Lithic Cryochrepts (loamy-skeletal, mixed) Typic Cryumbrepts (loamy-skeletal, mixed), and quartzite Rock Outcrop. These inclusions make up about 10% of the total extent of the map unit within the survey area.

The Dystric Cryochrepts are deep, are well-drained, and have moderate to rapid permeability. They are formed in colluvium and nivation debris primarily from the local quartzite bedrock. Slopes are 25–45%, 10–30 m in length, and plane or slightly concave in shape.

Surface runoff is medium to rapid. However, the erosion hazard is low to moderate due to the high amount of rock fragments on the soil surface and to relatively thick vegetation. The majority of roots are located in the upper 30 cm of the profile with lesser amounts of very fine roots extending to about 90 cm. Most areas of these soils support open vegetation. Scattered individual trees occur within these areas.

In a representative profile of these Dystric Cryochrepts the surface layer is a very dark gray and dark brown to very dark grayish-brown, extremely cobbly loam about 15 cm thick. The subsoil is a brown to very pale brown, extremely cobbly loam about 18 cm thick over a brown and yellowish-brown to very pale brown, extremely cobbly loam about 22 cm thick. The substratum is an olive brown and dark yellowish-brown to light yellowish-brown, extremely cobbly loam to 108 cm or more.

Samples specific for this map unit were not collected. However, detailed profile descriptions and associated selected physical and chemical laboratory data for morphologically similar soils are provided by those for WYGL006, WYGL007, and WYGL015.

Rubbleland, quartzite consists of rock talus on moderately steep and steep slopes. Little or no fine earth material fills the interstices between the cobblestones, stones, and boulders composing the talus. These areas do not support vegetation. However, small, isolated areas having thin deposits of soil do support sparse herbaceous vegetation. Little or no surface runoff is experienced from these areas although snow meltwater passes freely downslope through this material.

5m. Dystric Cryochrepts - Rubbleland, mafic intrusives complex, 25–45% slopes

This map unit is similar to map unit 5, but differs in that it is associated with mafic igneous dikes. These mafic igneous rocks are high in actinolite and epidote (Rochette 1987).

Dystric Cryochrepts (loamy-skeletal, mixed), make up about 60% of the map unit. Rubbleland makes up about 30% of the unit. Included in the mapping are small areas of Lithic Cryochrepts (loamy-skeletal, mixed), Dystric Cryochrepts (fine-loamy, mixed), Typic Cryumbrepts (loamy-skeletal, mixed), Typic Cryorthents (loamy-skeletal, mixed), and mafic igneous Rock Outcrop. These inclusions make up about 10% of the total extent of this map unit within the survey area.

The Dystric Cryochrepts of this map unit are similar to those described as occurring in map unit 5 with respect to morphology, setting, surface runoff, erosion potential, and vegetation, but differ by being developed in colluvium and nivation debris from mafic igneous intrusives and by containing higher relative amounts of these rock types as fragments throughout the soil profile.

Samples specific for this map unit were not collected. However, detailed profile descriptions and associated selected physical and chemical laboratory data for morphologically similar soils are pedons WYGL006 and WYGL015. Moderately deep, well-drained Dystric Cryochrepts (fine-loamy, mixed) developed in weath-

ered residuum from the mafic intrusives are included in the map unit. A representative profile description together with selected physical and chemical laboratory data for this type of soil are provided by pedon WYGL012.

Rubbleland, mafic igneous intrusives, consists of rock talus on moderately steep and steep slopes. Little or no fine earth material fills the interstices between the cobblestones, stones, and boulders composing the talus. These areas do not support vegetation. However, small, isolated areas having thin deposits of soil do support sparse herbaceous vegetation. Little or no surface runoff is experienced from these areas although snow meltwater freely passes downslope through this material.

6. Typic Cryumbrepts - Dystric Cryochrepts complex, 0–20% slopes

This complex consists of deep, well-drained soils on nearly level to sloping footslopes and toeslopes of mountain sides and on structural benches in mid-backslope positions. The soils of this map unit primarily support open meadow vegetation. The margins of these areas may be sparsely forested. These areas are associated with significant pocket gopher activity and commonly have large accumulations of snow that persist well into the summer growing season.

Typic Cryumbrepts (loamy-skeletal, mixed) make up about 60% of the map unit. Dystric Cryochrepts (loamy-skeletal, mixed) make up about 30% of the map unit. Included in the mapping are small areas of Aquic Cryumbrepts (loamy-skeletal, mixed) and Cryaquepts. These inclusions make up about 10% of the total extent of the map unit in the survey area.

The Typic Cryumbrepts are deep, are well-drained, and have moderately slow to moderately rapid permeability. They are formed in water-worked colluvium and are typically associated with nearly level to gently sloping portions of footslope and toeslope positions. They tend to be more centrally located in a delineation. Slopes are 0–10%, 10–30 m in length, and plane or slightly convex in shape. Surface runoff is slow to medium and the erosion hazard is slight. The majority of roots are located in the upper 30 cm of the profile with lesser amounts of very fine roots extending to about 90 cm. Most of these soils support open alpine meadow and/or wet meadow vegetation.

In a representative profile of these Typic Cryumbrepts, the surface layer is a dark brown to brown silt loam about 9 cm thick. The subsoil is a dark brown to yellowish-brown silt loam about 21 cm thick over a brown to light yellowish-brown, very stony silt loam about 29 cm thick. The substratum is a yellowish-brown to very pale brown, extremely cobbly, sandy loam to 108 cm or more.

Detailed profile descriptions and associated selected physical and chemical laboratory data of representative soils are those provided for pedons WYGL009 and WYGL010.

The Dystric Cryochrepts are deep, well-drained, and have moderate to moderately rapid permeability. They are formed in colluvium and are typically associated

with nearly level to sloping portions of footslope and toeslope positions occurring throughout the unit. They tend to occur at significant slope breaks and near the margins of delineations, particularly along forest-meadow boundaries. Slopes are 5–20%, about 10 m in length, and plane in shape. Surface runoff is slow to medium and the erosion hazard is slight to moderate. The majority of roots are located in the upper 30 cm with lesser amounts of very fine roots extending to about 90 cm. Most areas of these soils support open herbaceous vegetation.

A typical profile of the Dystric Cryochrepts in this unit is similar to that described for the very stony phase in map unit 4, having a surface layer that is a very dark gray and dark brown to very dark grayish-brown, extremely cobbly loam about 15 cm thick. The subsoil is a brown to very pale brown, extremely cobbly loam about 18 cm thick over a brown and yellowish-brown to very pale brown, extremely cobbly loam about 22 cm thick. The substratum is an olive brown and dark yellowish-brown to light yellowish-brown, extremely cobbly loam to 108 cm or more.

Samples specific to this map unit were not collected. A detailed profile description and associated selected physical and chemical laboratory data of a morphologically similar soil are those provided for pedon WYGL015.

The included soils having high water tables are represented by pedon WYGL011.

7. Rock Outcrop, quartzite - Dystric Cryochrepts - Lithic Cryochrepts complex, 15–45% slopes

This complex consists of quartzite bedrock outcrops and deep and shallow, well-drained soils developed in colluvium and nivation debris on sloping to steep summits and shoulders of mountain sides and ridges. The soils of this map unit primarily support subalpine forest and krummholz vegetation. Small areas of open herbaceous vegetation occur throughout.

Rock Outcrop, quartzite makes up about 35% of the map unit. Dystric Cryochrepts (loamy-skeletal, mixed) make up about 30% of the map unit. Lithic Cryochrepts (loamy-skeletal, mixed) make up about 25% of the map unit. Included in the mapping are small areas of the named components on slopes that are less than 15% and greater than 45%, Typic Cryumbrepts (loamy-skeletal, mixed) and Rubbleland. These inclusions make up about 10% of the total extent of the map unit within the survey area.

Outcrops of quartzite bedrock are associated with sloping to steep structural benches. Slopes are typically 15–45%, but may be greater or lesser for short slope lengths. Slope shape is variable and complex. The vegetation of these areas is limited to lichens and mosses.

The Dystric Cryochrepts are deep, are well-drained soils associated with gently sloping to moderately steep slopes between bedrock-controlled benches. They have moderate to rapid permeability. Slopes are 15–45%, 10–25 m in length, and plane or slightly concave in shape.

Surface runoff is limited due to the forest litter layer at the surface in most areas. The erosion hazard is low. The majority of roots are located in the upper 30 cm of the profile with lesser amounts of very fine roots extending to 105 cm or more. Most areas of these soils support subalpine forest vegetation.

A typical profile of the Dystric Cryochrepts in this unit is similar to those described for map unit 4, having a surface layer that is a very dark gray to very dark grayish-brown peat composed of forest litter in various states of decomposition about 4 cm thick. The surface mineral horizon is a brown to pale brown, gravelly loam about 9 cm thick. The subsoil is a yellowish-brown and pink to very pale brown, very gravelly loam about 34 cm thick over a brown to pink, very cobbly to extremely gravelly loam to 105 cm or more. In some profiles a surface forest litter layer is absent. In these cases the surface layer is a very dark to dark grayish-brown, extremely gravelly silt loam.

Samples specific to this map unit were not collected. However, detailed profile descriptions and associated selected physical and chemical laboratory data of morphologically similar soils are those provided for pedons WYGL006 and WYGL007. These soils are also morphologically similar to pedon WYGL005 but lack the accumulation of clay (argillic horizon) in the subsoil.

The Lithic Cryochrepts are shallow, well-drained soils on sloping to moderately steep slopes. They have moderate to rapid permeability. Fracturing in the quartzite bedrock is extensive and deep in most areas within the survey area. Consequently, these Lithic Cryochrepts occur in close association with the bedrock outcrop and are not disseminated throughout the unit. Slopes are 15–45%, about 10 m in length, and plane or slightly convex in shape. Surface runoff is limited due to the forest litter layer at the surface in most areas and the erosion hazard is low. The majority of roots are located in the upper 20 cm of the profile with lesser amounts of very fine roots extending to the bedrock contact at less than 50 cm. Most areas of these soils support subalpine forest vegetation.

These soils are similar to the Dystric Cryochrepts described above but differ by being less than 50 cm to hard bedrock. Samples of these soils were not collected. Their morphology and their physical and chemical characteristics are similar to those described for the Dystric Cryochrepts in this unit except for depth.

7m. Rock Outcrop, mafic igneous intrusives - Dystric Cryochrepts - Lithic Cryochrepts complex, 15–45% slopes

This mapping unit is similar to map unit 7, but differs in that it is associated with mafic igneous dikes. These mafic rocks contain large amounts of actinolite and epidote (Rochette 1987).

Rock Outcrop, mafic igneous intrusives makes up about 35% of the map unit. Dystric Cryochrepts (loamy-skeletal, mixed) make up about 30% of the map unit. Lithic Cryochrepts (loamy-skeletal, mixed) make up

about 25% of the map unit. Included in the mapping are small areas of the named components on slopes that are less than 15% and greater than 45%, Dystric Cryochrepts (fine-loamy, mixed), Typic Cryumbrepts (loamy-skeletal, mixed), and Rubbleland. These inclusions make up about 10% of the total extent of the map unit within the survey area.

Outcrops of the mafic igneous dikes are associated with structural benches. Slopes are typically 15–45%, but may be greater or lesser for short slope lengths. Slope shape is variable and complex. The vegetation of these areas is limited to lichens and mosses.

The Dystric and Lithic Cryochrepts of this unit are similar to those described as occurring in map unit 7 with respect to morphology, setting, surface runoff, erosion potential, and vegetation; but they differ by being developed in colluvium and nivation debris from mafic igneous intrusives and by containing higher relative amounts of these rock types as fragments throughout the profile.

Samples specific for this map unit were not collected. However, detailed profile descriptions and associated selected physical and chemical laboratory data of morphologically similar soils are those provided for pedons WYGLOO6 and WYGL007. Moderately deep, well-drained Dystric Cryochrepts (fine-loamy, mixed) developed in weathered residuum from the mafic igneous intrusives are included in the map unit. They support vegetation communities similar to the Dystric Cryochrepts (loamy-skeletal, mixed). A representative profile description together with selected physical and chemical laboratory data for these included soils are those provided for pedon WYGL012.

8. Histic Cryaquepts - Aerice Cryaquepts complex, 0–10% slopes

This complex consists of deep, poorly and somewhat poorly drained soils on nearly level to gently sloping toeslopes and valley bottoms along streams. They are developed in alluvium and water-reworked colluvium and glacial drift. The Histic Cryaquepts occur in the lowest slope positions and in depressional areas. The Aerice Cryaquepts are typically associated with slightly higher slope positions, farther removed from the active stream course. For both named components, permeability is moderate to rapid, surface runoff is very slow to medium, and erosion hazard is low. The soils of this map unit primarily support thick stands of willow and herbaceous, wet meadow vegetation.

Histic Cryaquepts (loamy-skeletal, mixed) make up about 50% of the map unit. Aerice Cryaquepts (loamy-skeletal, mixed) make up about 40% of the map unit. Included in the mapping are small areas of Humic Cryaquepts (loamy-skeletal, mixed), Aquic Cryumbrepts (loamy-skeletal, mixed), Typic Cryofluvents (loamy-skeletal, mixed), and Typic Cryorthents (loamy-skeletal, mixed). These inclusions make up about 10% of the total extent of the map unit in the survey area.

These soils are limited within the survey area. They are located in the drainages downstream from the outlet of West Glacier Lake and Lost Lake. Samples for the major components were not collected. The named components and inclusions were observed during field work. Pedon WYGL011 may be considered representative of some of the soils included in this unit.

9. Rubbleland, nearly level to moderately steep

These areas consist of deep, complex combinations of alluvium, colluvium, and glacial debris. They are primarily associated with drainages, either as inlets or outlets to lakes, and are often located at the base of steep colluvial slopes. Slopes range from 0–35% and are variable and complex in shape. Internal drainage of these areas is extremely variable and site-specific, ranging from ponded to excessively drained. The permeability of these areas is extremely rapid. Little or no surface runoff is experienced, although subsurface flow through this material was observed. This, coupled with the extreme stoniness of these areas, maintains a low erosion hazard. The vegetation of these areas is limited to small isolated accumulations of fine soil material and is typically herbaceous.

Rubbleland comprises approximately 90% of these areas. Included in the mapping are small areas of Dystric Cryochrepts (loamy-skeletal, mixed) and Typic Cryorthents (loamy-skeletal over fragmental, mixed). These inclusions make up about 10% of the total extent of the map unit within the survey area.

10. Rubbleland - Rock Outcrop complex, steep to extremely steep

These areas consist of colluvium and bedrock on steep backslope and shoulder positions of mountain sides. Both quartzite and mafic igneous intrusive rock types occur. Slopes range from 35–90% and are plane in shape. Internal drainage of these areas is primarily excessive. The permeability of these areas is extremely rapid. Little or no surface runoff is experienced, although subsurface flow through this material from associated perennial snow and ice accumulations was observed. The lack of surface flow, coupled with the extreme stoniness of these areas, maintain a low erosion hazard. The vegetation of these areas is limited to small isolated accumulations of fine soil material and is typically herbaceous. The lack of significant lichen development on the rock of these areas indicates the probable instability of these slopes and/or the high seasonal avalanche activity.

Rubbleland comprises approximately 55% of these areas. Rock Outcrop makes up about 40% of the unit. Included in the mapping are small areas of the named components on slopes less than 35% and greater than 90%, Dystric Cryochrepts (loamy-skeletal, mixed), and Typic Cryorthents (loamy-skeletal over fragmental, mixed). These inclusions make up about 5% of the total extent of the map unit within the survey area.

11. Permanent Snowfields and Icefields

These areas consist of permanent snowfields and/or icefields. Most of these areas are on the upper third of backslopes and on shoulders of mountain sides. Slopes are extremely variable but are predominantly greater than 60%. Small areas of Rubbleland and Rock Outcrop comprise less than 5% of the total mapped extent of this unit, with the remainder being permanent snowfields and/or icefields.

12. Typic Cryorthents - Rubbleland complex, 25–45% slopes

This complex consists of deep, well-drained soils and talus on steep and extremely steep portions of backslopes of mountain sides. The mapping unit has sparse open areas of herbaceous vegetation and talus.

Typic Cryorthents (loamy-skeletal, mixed) make up about 55% of the map unit. Rubbleland makes up about 40% of the unit. Included in the mapping are small areas of the named components on slopes less than 45% and greater than 75%, and Rock Outcrop. These inclusions make up about 5% of the total extent of the map unit within the survey area.

The Typic Cryorthents are deep, are well-drained, and have moderate to very rapid permeability. They are formed in colluvium and are typically associated with moderately steep and steep slopes on the backslopes of mountain sides occurring throughout the unit. Slopes are 45–55%, 10–50 m in length, and plane or slightly concave in shape. Surface runoff is rapid to very rapid and the erosion hazard is moderate to very severe depending on the extent of permanently established vegetation. The majority of roots are located in the upper 50 cm of the profile with lesser amounts of very fine roots extending to more than 90 cm. Most areas of these soils support sparse herbaceous vegetation.

In a representative profile of these Typic Cryorthents the surface layer is a dark brown, extremely gravelly, silt loam about 21 cm thick. The underlying layer is a brown to pale brown, extremely gravelly, sandy loam about 22 cm thick. The next layer is a brown to pale brown, extremely stony, coarse sandy loam to more than 92 cm.

Detailed profile descriptions and associated selected physical and chemical laboratory data for representative soils are those provided for pedons WYGL004 and WYGL008.

Rubbleland consists of rock talus on steep to extremely steep slopes on backslopes of mountain sides. Little or no fine earth material fills the interstices between the cobblestones, stones, and boulders composing the talus. These areas do not support vegetation. However, small, isolated areas having thin deposits of soil do support sparse herbaceous vegetation. Little or no surface runoff is experienced from these areas although snow meltwater is known to pass freely downslope through this material.

13. Dystric Cryochrepts - Lithic Cryumbrepts - Rock Outcrop complex, 15–45% slopes

This complex consists of moderately deep and shallow, well-drained soils and outcrops of quartzite and mafic igneous intrusive rock on gently sloping to moderately steep backslopes and footslopes of mountain sides and ridges. These areas serve as unconfined drainages for snow meltwater and runoff from high intensity storms. Free water is commonly found in the profiles of these soils, although their internal drainage is typically good. The soils of this mapping unit primarily support dense stands of willow and krummholz vegetation. Small areas of herbaceous vegetation occur throughout.

Dystric Cryochrepts (loamy-skeletal, mixed) make up about 40% of the map unit. Lithic Cryumbrepts (loamy-skeletal, mixed) make up about 30% of the unit. Rock Outcrop makes up about 20% of the map unit. Included in the mapping are small areas of the named components on slopes less than 5% and greater than 40%, Typic Cryumbrepts (loam-skeletal, mixed), and Rubbleland. These inclusions make up about 10% of the total extent of the map unit in the survey area.

The Dystric Cryochrepts are moderately deep, moderately well- and well- drained, and have medium to rapid permeability. They are formed in water-reworked colluvium and coarse glacial debris, and are typically associated with unconfined drainages and overflow areas on gently sloping to moderately steep slopes. Slopes are 5–25%, 10–25 m in length, and plane and slightly concave in shape. Surface runoff is limited due to a litter layer at the surface in most areas, and the erosion hazard is low. However, seasonal high flows during runoff of snowmelt and high intensity rain storms can result in high-volume, rapid surface flow. While the internal drainage of these soils is generally good, free water may be found in them from downslope subsurface flow. This water is apparently well-oxygenated, since indicators of restricted drainage do not develop. The majority of roots are located in the upper 30 cm of the profile with lesser amounts of very fine roots extending to about 100 cm. Most areas of these soils support dense stands of willow.

In a representative profile of the Dystric Cryochrepts the surface layer is a very dark gray to very dark grayish-brown, extremely stony peat or mucky peat about 12 cm thick. The subsoil is a yellowish-red to very pale brown, extremely stony, sandy loam about 34 cm thick over a brown to pale brown, extremely stony, sandy loam to about 100 cm. A description and associated physical and chemical laboratory data for a similar soil are those provided for pedon WYGL014. It should be noted that this soil contains fewer rock fragments in the upper portions of the profile than is typical.

The Lithic Cryumbrepts are shallow, moderately well- and well-drained, and have moderate to rapid permeability. As is the case for the Dystric Cryochrepts in this unit, free water from subsurface flow may be found in the profile. They are formed in water-reworked colluvium and coarse glacial debris and are generally closely

associated with structural benches on moderately steep and steep slopes. Fracturing in the quartzite bedrock is extensive and deep in most areas within the survey area. Consequently, these Lithic Cryumbrepts occur in close association with outcropping of the bedrock and are not disseminated throughout the unit. Slopes are 20–45%, about 10 m in length, and plane or slightly concave in shape. Surface runoff is medium to rapid, but the erosion hazard is low due to thick surface vegetation. The majority of roots are located in the upper 30 cm of the profile with lesser amounts of very fine roots extending to the bedrock contact at 50 cm or less. Most areas of these soils support herbaceous vegetation.

These soils are similar to the Dystric Cryochrepts described above but differ by being less than 50 cm to a hard bedrock contact and by having a thicker surface layer that contains high amounts of humic material.

Samples of the soils were not collected but their presence and extent were observed during field work.

Outcrops of quartzite and mafic igneous intrusive bedrock are associated with gently sloping to moderately steep structural benches. Slopes are typically 5–40%, but may be greater or lesser for short slope lengths. Slope shape is variable and complex. The vegetation of these areas is limited to lichens and mosses.

W. Water

This unit consists of streams, lakes, and ponds that contain water throughout the year or for much of the year in most years. The minimum size of delineations is approximately 0.5 ha. The major delineations of this unit include East Glacier Lake, West Glacier Lake, and Lost Lake.