

SUMMARY DESCRIPTION OF MAP UNITS FOR BAINBRIDGE ISLAND GEOLOGIC CROSS SECTIONS, JUNE 2005

Age & Geologic Unit	Name	Summary Description	Thickness	Density/ Hardness	Permeability Factors
Holocene NONGLACIAL DEPOSITS					
Qmw	Mass-wastage deposits	Colluvium, soil, and landslide debris with indistinct morphology. Locally subdivided into:	Typically about 3 m, locally >10 m; along steep slopes	Loose to dense and soft to stiff	Intermixed fine and coarse-grained deposits
Qls	Landslide deposits	Diamict of broken to internally coherent surficial deposits transported down slope <i>en masse</i> by gravity. Blocks of native material are commonly fractured, have rotated or deformed bedding, and have abundant slickensided surfaces. Numerous areas of both landslide and related mass-wastage deposits occur along slopes and ravines draining into Puget Sound, particularly where coarse-grained deposits overlie fine-grained deposits. Vegetation, such as trees and roots, is commonly incorporated into the deposit	Variable, up to 20 m; along steep slopes	Very loose to very dense or soft to hard	Intermixed fine and coarse-grained deposits, voids common
Qw	Wetland deposits	Organic-rich sediment, peat, and fine-grained alluvium, poorly drained and intermittently wet. Areas identified from vegetation, maps, and topography; not all such deposits have been delineated	1 to 7 m; typically 2 to 3 m	Very soft to medium stiff or very loose to medium dense	Commonly saturated
Qb	Beach deposits	Loose sand and gravel deposited or reworked by modern wave action	<3 to 10 m; some as thick as 17 m	Loose to dense	Uniformly to well graded
Qbu	Uplifted beach deposits	Loose sand and gravel deposited by wave action and subsequently uplifted above modern tide level by tectonic movement	<3 to 10 m	Loose to dense	Uniformly to well graded
Qal	Alluvium	Sand, silt, gravel, and cobbles deposited by	A few m to	Loose to	Predominantly sandy and

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Pleistocene	YOUNGER GLACIAL DEPOSITS	streams and running water. May include landslide debris and colluvium at margins. Locally contains very soft peat lenses	10 m; in river and stream valleys	dense or soft to stiff	horizontally bedded, fine- and coarser-grained lenses
Qv	Deposits of Vashon stade of Fraser glaciation of Armstrong and others (1965) , not used as a map unit				
Qvr	Recessional outwash deposits	Stratified sand and gravel, moderately sorted to well sorted, and less common silty sand and silt. Deposited in outwash channels that carried south-draining glacial meltwater during ice retreat away from the ice margin. Also includes deposits that accumulated in or adjacent to recessional lakes. Discontinuous. May include thin lag on glacial till uplands although deposits less than about 1 m (3 ft) thick not shown. Locally divided into:	~1 to 6 m; typically in channels	Loose to dense	Horizontally bedded to cross bedded, uniformly to well graded, channelized, coarse lag deposits common
Qvr1	Recessional lacustrine deposits	Laminated silt and clay, low to high plasticity, with local sand layers, peat, and other organic sediments, deposited in slow-flowing water and ephemeral lakes. Locally includes high-plasticity clay with swell potential. Lenses and layers of ash and diatomite may be present	5 m typically on uplands; up to 16 m at the heads of recessional channels	Very soft to stiff	Horizontally bedded; sandy channels may breach the lacustrine deposits
Qvi	Ice-contact deposits	Intercalated till and outwash, irregularly shaped bodies of till and outwash. Outwash consists of sand and gravel, clean to silty, horizontally bedded to steeply dipping. The till consists of matrix supported gravely sandy silt that may or may not have been glacially overridden. Gradational with units Qvr and Qvt	3 to 15 m; in patches on the upland	Loose to very dense	Intermixed irregularly-shaped bodies of till and coarse-grained deposits
Qvt	Vashon till	Compact diamict of silt, sand and subrounded to well-rounded gravel, glacially transported and deposited under ice. Commonly fractured and has intercalated sand lenses. Generally forms	Typically 1 to 10 m	Very dense	Vertical fractures, sand lenses, and crude sub-horizontal bedding common

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Qva	Advance Outwash Deposits	undulating, elongated surfaces. Upper 1 meter of unit generally weathered and only medium dense to dense. Locally divided into:			
		Well-sorted sand and gravel deposited by streams issuing from advancing ice sheet. May grade upward into till. Silt lenses locally present in upper part and are common in lower part. Generally unoxidized to only slightly oxidized. Includes Esperance Sand Member of the Vashon Drift of Mullineaux and others (1965). Grades downward into unit Qv1c with increasing silt content	Locally over 60 m thick; wide-spread	Dense to very dense	Predominantly medium grained sand, horizontally to cross bedded, hard silt beds common throughout
Qv1c	Lawton Clay of Mullineaux and others (1965)	Laminated to massive silt, clayey silt, and silty clay with scattered dropstones deposited in lowland proglacial lakes. Marks transition from nonglacial to earliest glacial time, although unequivocal evidence for glacial or nonglacial origin may be absent. Deposits of correlative age and texture may be included in older fine-grained units where evidence of age and/or depositional environment is absent. Locally may include fine-grained sediment of unit Qob or distal deposits from the Cascade Mountains where indistinguishable from Qv1c. May be indistinguishable from unit Qpff without absolute age control	> 30 m; generally present in pre-Vashon valleys below 240 ft in elevation	Very stiff to hard	Vertical fractures, fine sand partings common near top and bottom of unit
<b>Pleistocene OLDER GLACIAL AND NONGLACIAL DEPOSITS</b>					
Qpf	Deposits of pre-Fraser glaciation age	Interbedded sand, gravel, silt, and diamicts of indeterminate age and origin. Locally divided into:		Very dense and hard	Localized iron-oxide cemented layers, interbedded and intermixed fine- and coarse-grained layers
Qpfc	Coarse-grained deposits	Sand and gravel, clean to silty, with some silt layers, lightly to moderately oxidized	Up to 15 m	Very dense	Localized iron-oxide cemented layers and channels
Qpff	Fine-grained deposits	Silt and clay, may have sandy interbeds, laminated to massive	Up to 30 m	Hard	Localized iron-oxide cemented layers and

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Qpn	Nonglacial deposits	Sand, gravel, silt, clay, and organic deposits of inferred nonglacial origin, based on the presence of peat, paleosols, and tephra layers; or a southern Cascade Range provenance for sedimentary clasts	3 to 10 m	Very dense and hard	Localized iron-oxide cemented layers, interbedded and intermixed fine- and coarse-grained layers
Qpnc	Coarse-grained nonglacial deposits	Sand and gravel, clean to silty, with some silt layers, with peat and tephra layers, lightly to moderately oxidized	3 to 10 m	Very dense	Localized iron-oxide cemented layers
Qpnt	Fine-grained nonglacial deposits	Silt and clay, with peat and tephra layers, with some sandy interbeds, laminated to massive	15 to 25 m	Hard	Localized iron-oxide cemented layers and sandy partings
Qob	Olympia beds	Sand, silt (locally organic-rich), gravel, and peat, discontinuously and thinly interbedded, may contain tephra and/or diatomaceous layers. Sand and gravel clast lithology varies depending on source area, from volcanic to reworked northern lithologies. Assigned to the Olympia interglaciation of Mullineux and others (1965) on the basis of stratigraphic position, correlation, and radiocarbon dates. Distinguished from Qv1c on the basis of coarser grain size and presence of organics. Locally identified previously as the 'sandy phase of the Lawton'	Absent to 25 m	Very dense and hard	Localized iron-oxide cemented layers, interbedded and intermixed fine- and coarse-grained layers
MIS 3 18-70 ka	of Minard and Booth (1988)				
Qpo	Deposits of pre-Olympia age	Interbedded sand, gravel, silt, and diamicts of indeterminate age and origin. Locally divided into:	3 to >50m	Very dense and hard	Localized iron-oxide cemented layers, interbedded and intermixed fine- and coarse-grained layers
Qpof	Fine-grained deposits	Silt and clay, may have sandy interbeds, laminated to massive	5 to 75 m	Hard	Localized iron-oxide cemented layers and sandy partings
Qpoc	Coarse-grained deposits	Sand and gravel, clean to silty, with some silt layers, lightly to moderately oxidized	3 to 30 m	Very dense	Localized iron-oxide cemented layers and channels

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Qpog	Glacial deposits	Silt sand, gravel and till of glacial origin Weakly to strongly oxidized. Underlies Vashon-age deposits and thus must also be of pre-Olympia age. Sediment is of inferred glacial (northern) origin, based on presence of clasts or mineral grains requiring southward ice-sheet transport	7 to >33 m	Very dense and hard	Localized iron-oxide cemented layers, interbedded and intrinixed fine- and coarse-grained layers
Qpogc	Coarse-grained glacial deposits	Sand and gravel, clean to silty, with some silt layers, moderately to heavily oxidized	1 to 15 m	Very dense	Localized iron-oxide cemented layers and channels
Qpogf	Fine-grained glacial deposits	Silt and clay, may have sandy interbeds, laminated to massive	2 to 30 m	Hard	Localized iron-oxide cemented layers and sandy partings
Qpogt	Till deposits	Compact diamict of silt, sand and subrounded to well-rounded gravel, glacially transported and deposited under ice	Discontinous, 1 to 10 m	Very dense and hard	Localized iron-oxide cemented layers, sandy partings, and lenses
Qpogm	Glaciomarine drift	Till-like material, but finer grained and with fewer gravel clasts than most Puget Lowland tills; shells and wood may be present, but rare	Discontinuous, 3 to 30 m	Very dense and hard	Localized iron-oxide cemented layers, sandy partings and lenses
Qpon	Nonglacial deposits	Sand, gravel, silt, clay, and organic deposits of inferred nonglacial origin, based on the presence of paleosols, and tephra layers; or a southern Cascade Range provenance for sedimentary clasts	3 to 23 m	Very dense and hard	Localized iron-oxide cemented layers, interbedded and intrinixed fine- and coarse-grained layers
Qponc	Coarse-grained nonglacial deposits	Sand and gravel, clean to silt, with silt layers, with peat and tephra layers, moderately to heavily oxidized	3 to 30 m	Very dense	Localized iron-oxide cemented layers, and channels
Qponf	Fine-grained nonglacial deposits	Silt and clay, may have sandy interbeds, with peat and tephra layers, laminated to massive	3 to 23 m	Hard	Localized iron-oxide cemented layers and sandy partings
Qpone	Estuarine deposits	Sand, silt (locally organic-rich), gravel, and peat, discontinuously and thinly interbedded. Identified on the basis of lithology and fossils	>10 m	Very dense and hard	Localized iron-oxide cemented layers
<b>Tertiary BEDROCK</b>					

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Tbh Miocene	Blakely Harbor Formation of Fulmer (1975) (in the subsurface)	Interbedded terrestrial sandstone, siltstone, and shale, recognized only in subsurface data and assigned to this unit on the basis of lithology and stratigraphic position	>1000m	Weakly lithified	Clayey when weathered, poorly cemented, jointed, folded, locally steeply dipping, shear zones
Tb Oligocene	Blakely Formation of Weaver (1916)	Medium-grained sandstone, coarse-grained sandstone, conglomerate, and minor siltstone, fresh to highly weathered, fossiliferous. Massive to well bedded. Deposited in a shallow marine near-shore sandy shelf environment. Distinguished from rocks of underlying Puget Group by presence of marine fossils and absence of volcanic flow rocks and breccias	>1000 m	Weakly to moderately lithified	Weathered zone is friable or soft and plastic, locally poorly cemented, jointed and folded, locally steeply dipping, shear zones