

Formation Properties Table

Age		Unit Name (Symbol)	Features and Description	Erosion Resistance	Suitability for Development	Hazards	Potential Paleontologic Resources	Potential Cultural Resources	Mineral Specimens	Karst Issues	Mineral Resources	Habitat	Recreation Potential	Global Significance	Limits on restoration
West	East														
QUATERNARY		Glacial and Alluvial Sediments (Qal, Qc, Qls, Qg, Qtr, Qor, Qac, Qrg, Qta, Qso, Qtr, Qtz, Qtg, Qes, Qt3, Qat, Qtdi)	Unconsolidated surface deposits 0 - 50 m (0- 164 ft) thick; includes alluvium, alluvial fill, colluvium, landslide deposits, terrace gravel, glacial till and outwash deposits; till is jumbled assortment of subangular bouldery rubble combined with sand, silt and clay; landslides are large slumps, block slides and earth flows; colluvium is comprised of unsorted, angular gravel- size clasts in a sand- silt- clay rich matrix with small pockets of till, talus, rock-avalanche and debris flow deposits; alluvium consists of sand and gravel deposits as well as channel and overbank deposits of silt and sand	Very low	Unconsolidated material underlies most valleys of the park where buildings already exist and may heave with frost or extreme moisture	Slump and slide potential high	None	Possible camp sites preserved and other Native American artifacts	None	None	Sand, gravel, clay	Valley fill	Good for trails and campgrounds	None documented	None
TERTIARY		Kishenehn Formation (Tku, Tkp, Tkcc)	Unit is more than 610 m (2000 ft) thick; contains layered gravel, sand, mud, volcanic ash, limestone, and coal; appears pale gray and tan in outcrop, with poor cementation; interlayered sandstone, mudstone and conglomerate; most pebbles are from Belt Supergroup rocks, some up to 2.5 m (8.2 ft) in diameter; oil shale, coal, marlstone, litharenite, lignite and tuff beds are locally present	Low	Altered volcanic clays and poorly cemented rock layers render this unit rather unstable for development, especially for roads and structure foundations	Slump, slide and rockfall potential high if slope is present	Abundant petrified wood (Dawn redwood), fossil gastropods, mammals and palynomorphs, fish, insects and mollusks; leaves of <i>Macginitia augustiloba</i>	Possible camp sites preserved	Zircon in tuff beds	None	Several hundred feet of oil shale and some seeps; coal; sand and gravel	None documented	Good for trails and campgrounds	Thick, Tertiary- aged deposits; type section in North Fork of the Flathead River Valley	None
MP		McNamara Formation (Ym)	Exposed locally at GLAC, unit is 61 m (200 ft) thick near Mt. Shields; contains grayish- green siltstone and argillite with fining upward sequences common; some local beds of calcareous siltstone and arenite	Moderate	Locally exposed in park; suitable for all development unless highly fractured	Rockfall potential in steeper terrain	None	None	Mud breccias	None	None documented	None documented	Good for all uses	Precambrian sedimentary rock	Only locally exposed
MP		Bonner Quartzite (Ybo)	Exposed locally at GLAC, unit is 244 m (800 ft) thick near Mt. Shields; consists of pinkish- gray to pale red, very fine- to medium- grained feldspathic arenite, some channel deposit sand some siltstone and argillite in fining upward sequences; ripple marks are common	High	Locally exposed in park; suitable for all development unless highly fractured	Rockfall potential in steeper terrain	None	Possible tool material	None	None	Attractive flagstone potential	None documented	Good for rock climbing and other uses	Extensive Precambrian sedimentary rock	None
MP		Mt. Shields Formation (Yms)	Unit 777 m (2550 ft) thick in GLAC; maroon to pale purple argillite, siltstone and some greenish- gray siltstone and arenite, some unique cream colored limestone beds present locally (contain stromatolites), and black argillite at the top of the unit; fining upward sequences are common, as well as wavy and parallel bedding and salt casts.	Moderate	Good for most uses unless thin bedding is present, providing planes of weakness in the rock column. Mostly exposed at higher elevations	Rockfall potential in steeper terrain	Stromatolites in unique limestone layers	None	Salt casts	If severe dissolution is present, karst may be an issue	None documented	Vugs on cliffs may provide bird nest habitat	Good for all uses	Type section at Mt. Shields; Precambrian sedimentary rock with stromatolites in conspicuous limestone layer	None
MP		Shepard Formation (Ysh)	Ranges from 472- 168 m (1550- 550 ft) thick in GLAC; yellowish, greenish- gray dolomite and pyritic siltstone and argillite, with beds of coarse- grained calcarenite, sandstone, limestone and dolomite locally as well as stromatolites and "molar tooth" calcite	Moderate	Good for most uses unless pervasive dissolution is present	Usually exposed on cliffs; rockfall potential high	Stromatolites are common in this unit	None	"Molar tooth" calcite crystals, and pyrite	If severe dissolution is present, karst may be an issue	Pyrite present locally	Vugs on cliffs may provide bird nest habitat	Good for all uses	Type section near Shepard Glacier; Precambrian sedimentary rock with stromatolites	Usually exposed at high elevation
MP		Purcell Lava (Ypb)	Sequence of mafic lava flows forms a marker bed 77- 15 m (253- 50 ft) thick; fine- grained, vesicular bluish- gray to greenish- gray altered basalt; subaqueous pillow structures and vent facies alternate with surface (pahoehoe) flows	Moderate	Exposure limited; if altered volcanic clay is present, may be unstable for construction	Rough surface; locally could pose walking hazard	None	None	Chlorite vesicular filling	None	None documented	None documented	Rough surface for trails; good for all uses	Precambrian lava flows and sedimentary rock; type section locality at Mt. Snowslip	Only locally exposed
MP		Snowslip Formation (Ysn)	Ranges from 357.2 m to 489.5 m (1171- 1606 ft) thick; contains terrigenous green and red argillite, dolomitic argillite and muddy sandstone; some calcareous siltstone and arenite locally; mud breccia occurs in some lower beds; some beds contain calcite and dolomite cements; stromatolite beds common; beds are thin to thick, with prevalent fining upward sequences; contains the Purcell Lava	Moderate	Only in layers where calcite or dolomite cement is present; if dissolved out, rock is friable and weak	Potential rockfall hazards in cirques and cliffs	Stromatolites common in some beds	None	None	Not enough carbonate present					

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MP	MP	Helena Formation (Yh, Ycs)	750- 1030 m (2460- 3380 ft) thick dolomite, limestone and minor quartz arenite in conspicuous gray cliffs; stromatolites make up entire beds, some ripples, mostly parallel bedding; diorite sill 39.6 m (130 ft) thick forms obvious band on many outcrops; many "molar tooth" calcite beds, oolitic limestone and stromatolite beds present; <i>Baicalia-Conophyton</i> cyclic stromatolite marker beds stand in relief; contains the most fossil algae of all Belt rocks in park; marker bed ranges from 24 to 32 m (79- 105 ft) thick	Moderate to high	Good for most uses unless pervasive dissolution is present	Some rockfall potential where unit is present as cliff face	Unique <i>Conophyton-Bacalia</i> stromatolite cycles documented	Occasional chert may have provided tool material	"Molar tooth" calcite crystals	Caves are present in the Helena Formation in GLAC; others likely undiscovered	Limestone and dolomite for building	Vugs on cliffs may provide bird nest habitat	Good for all uses, considerable; caving interest	Unique stromatolites including important marker bed, Precambrian sedimentary rock	Only if karst is present
MP	MP	Empire Formation (Ye)	In GLAC, the unit is 122- 158 m (400- 518 ft) thick; green argillite, subordinate maroon argillite, buff and green siltstone and quartz sandstone; locally dolomitic with "molar tooth calcite" present; unit contains carbonate cement in upper beds and quartz sandstone in lower beds. Iron sulfide ooids in lowermost beds; thin to thick bedded.	Moderate	Good foundation, except in upper layers where carbonate cement may weather easily making the rock friable	Where rock is friable in upper layers, rockfalls on slopes	None	None	"Molar tooth" calcite crystals	Not enough carbonate present	None documented	None documented	Good for all uses	Precambrian sedimentary rock, "molar tooth" calcite specimens	None
MP	MP	Grinnell Formation (Ygl)	530- 790 m (1740- 2590 ft) thick; brilliant, conspicuous beds of maroon argillite and sandstone with beds of green, white, purple, and brown colored crossbedded layers locally present; generally coarse- grained and prominent in outcrop; unit is terrigenous with argillite, sandy argillite, muddy sandstone, sandstone, and quartz arenite; mud cracks, mud breccias and oolites common; east to west unit gets finer grained, less intensely colored, quartz sand; iron oxide rich beds locally present	Moderate to high	Good foundation for all uses	Rockfall potential where highly fractured and along cliffs	Some mound shaped dolomitic stromatolites	None	Mud breccias are attractive to collectors	Not enough carbonate present	None documented	None documented	Good for all uses	Precambrian sedimentary rock, some stromatolites; fine red- bed sequence, type section at Mt. Grinnell	None
MP	MP	Appekunny Formation (Yap, Yapa, Yapp)	671 m (2200 ft) thick; green, fine- grained argillite; interbeds of pale- maroon siltstone and arenite are commonly parallel to nonparallel with some cross stratification and ripple marks; shrinkage cracks present along with associated mud breccias, load structures, and calcite clots; some beds have iron sulfide; upper beds mud- rich	Low to moderate	Strong bedding with contrasting rock types in sharp contact may present structural weakness; competent enough for most uses	Rock fall and slide potential where upper part exposed	None	None	None	None	None documented	None documented	Fine for trails	Precambrian sedimentary rock; type section locality near Many Glacier	None
MP		Prichard Formation (Yapp)	About 1219 m (4000 ft) thick, thin, parallel laminae of rusty- weathered, blackish gray argillite and light- gray siltstone; carbonate, limestone, breccia, and quartz arenite occur locally; some small scale crossbedding; iron sulfide bearing beds sparsely present; some lenticular beds and limestone breccia deposits as well as occasional stromatolites dot the unit	Low to moderate	Probably okay as a foundation layer, but not if slope is present	Rock slides and slumps parallel to bedding on exposed slopes	None	None	None	Not enough carbonate present	Some pyrite and pyrrhotite locally	Exposed in lower valleys	OK for trail base	Precambrian sedimentary rock	None
	MP	Altyn and Waterton Formations (Ya, Yapa, Ywt, Yae)	238 to 256 m (780- 840 ft) thick; thin to thick beds of buff weathered dolomite, limestone, and arenite; fine- to coarse- grained; stromatolites common in cyclic units as well as desiccation cracks and herringbone lamination	Moderate	Where highly fractured & exposed (east edge of park) new construction should be avoided	Rockfall potential where exposed on slopes	Stromatolites common in lower beds	None	None	None documented; carbonate content suggests possibility	Attractive flagstone potential	Vugs on cliffs may provide bird nest habitat	OK for trails	Precambrian sedimentary rock, and stromatolites	None
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CRETACEOUS (K)	UPPER K	Willow Creek Formation (Ku)	Composed of 244 m (800 ft) of variegated clayey rocks, mudstone, and sandstone with occasional limestone nodules; outcrop is reddish in color	Low to moderate	Clay rich layers might prove unstable for construction	Slump and slide potential	Fresh water mollusks and an occasional dinosaur bones	None	None	None	None documented	None documented	OK trail base	Contains the top of the Cretaceous stratigraphic column	Only locally exposed
	UPPER K	St. Mary River Formation (Ku)	Unit is 305 m (1000 ft) thick and is composed of greenish- gray mudstone interlayered with lenticular beds of fine- to medium- grained crossbedded sandstone, some red mudstone locally and thin coal beds	Low to moderate	Shaly layers may prove incompetent as foundation material for construction	Slump and slide potential	Fossils of nonmarine bivalves, such as <i>Fusconaia? stantoni</i> , and locally, fossil leaves; incomplete skeleton of <i>Montanaceratops</i>	None	None	None	Coal beds	None documented	OK trail base	Fossil rich	None
	UPPER K	Horsethief Sandstone (Ku)	About 27 m (90 ft) thick; composed of a massive, light- gray, fine- to coarse- grained sandstone which is commonly crossbedded and contains calcareous concretions	High	None documented	Rock fall potential where highly fractured	Brackish water bivalves <i>Crassostrea wyomingensis</i> and <i>Veloritina occidentalis</i> , the gastropod <i>Melania wyomingensis</i> , and a shallow- water marine bivalve, <i>Tancredia?</i>	Concretions may have been used for tools	None	None	Titanium bearing magnetite	None documented	Good for all uses, esp. rock climbing	None documented	None

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	UPPER K	Bearpaw Shale (Ku)	Unit is 72- 122 m (235- 400 ft) thick, dark- gray marine shale interbedded with sandstone, siltstone and bentonite; sandstones are very fine- to fine- grained and thin bedded; fossil rich	Low	Swelling clays make unit poor for most development; friable shale layers are also unstable	Slump and slide potential high	Fossils of <i>Baculites compressus</i> , <i>B. coneatus</i> , and <i>B. reesidei</i> ; ammonites <i>Hoploscaphites</i> and <i>Placenticas</i> , and bivalves <i>Nucula</i> , <i>Nuculana</i> , <i>Inoceramus</i> , <i>Oxytoma</i> , <i>Cymella</i> and <i>Nymphalucina</i>	None	None	None	None documented	None documented	Unstable for most uses	Fossil rich	None
	UPPER K	Two Medicine Formation (Ku)	About 610 m (2000 ft) thick in GLAC area; silty, calcareous mudstone; weathers to pale greenish- gray; some calcareous concretions present locally as well as interbeds of sandstone, conglomerate and coal; conglomerate contains clasts of limestone, dolomite, quartzite, hornfels, welded volcanic tuffs and other igneous rocks	Moderate to high	Where calcareous shaly layers have weathered, slopes can be unstable for construction, if altered volcanic clays are present, unit is unstable	Slump and slide potential	Fauna include the dinosaur <i>Barchyoceratops montanensis</i> , scales of ganoid fishes, ostracodes and fresh- water mollusks	Concretions may have been used for tools	None	Not enough carbonate present	Some coal beds present	Vugs on cliffs may provide bird nest habitat	OK for trails	Igneous pebbles are useful for tectonic correlation	None
	UPPER K	Virgelle Sandstone (Ku)	The unit is 49 m (160 ft) thick and consists of light- gray to white, fine- to medium- grained, partly calcareous arkosic sandstone; some cross- beds and sandstone concretions present locally	High	None documented	Rock fall potential where highly fractured	Fossils of ammonites <i>Desmoscaphites bassleri</i> and <i>Inoceramus lundbreckensis</i>	None	Some concretions	None	Titanium bearing magnetite	None documented	Good for all uses, rock climbing	Magnetite deposits useful for tectonic correlation	None
	UPPER K	Telegraph Creek Formation (Ku)	Unit is 36- 52 m (120- 170 ft) thick consisting of interbedded shale and sandstone of gray to buff color; most of the unit is very fine- grained with abundant ripple marks and some burrows	Moderate	None documented, though shale layers may be less stable	Rock fall potential where exposed	Scant mollusk fossils; Inoceramids and oysters; some wood	None	None	None	Some carbonized wood suggests coal present	None documented	Okay trail base	Some fossils present	Only exposed locally
	UPPER K	Marias River Shale (Km)	Unit is 366- 396 m (1200- 1300 ft) thick and contains dark- gray shale, with sandy, silty, pebbly, and calcareous beds and some calcareous and ferruginous concretions; marlstone, bentonite and limestone locally present	Low to moderate	Some bentonite layers present make development risky; other layers contain shale partings which are somewhat unstable	Slump and slide potential	Fossils include: <i>Inoceramus (Mytiloides) labiatus</i> , <i>Ostrea</i> , <i>Watinoceras reesidei</i> , <i>Scaphites nigricollensis</i> , <i>Inoceramus deofmis</i> , <i>Baculites mariasensis</i> , and <i>Scaphites preventricosus</i>	Chert and concretions are tool material	Large calcite crystals in some concretions	Not enough carbonate present	Some coal beds present	None documented	Rather unstable unit, unsuitable for most uses	Fossils and concretions	Only locally exposed
	LOWER K	Blackleaf Formation (Kb, Kbk)	Unit is 229- 244m (750- 800 ft) thick, composed of dark- gray fissile shale and sandstone with alternating beds of light colored clastics and conglomerates; some mudstone beds are locally bentonitic and carbonaceous	Low	Swelling clays make unit poor for most development; friable shale layers are also unstable	Slump and slide potential high	Arenicolites present, some fossil plants, large logs locally	None	None	None	Coal beds and other fossil rich layers	None documented	Unstable unit, not suitable for most uses	Fossils present	Only locally exposed
	LOWER K	Kootenai Formation (Kk, Kbk)	Unit thickness is around 305 m (1000 ft); composed of variegated mudstone, siltstone and sandstone; unit is typically grayish- green in color, some pebble conglomerate locally, as well as fossiliferous limestone beds	Low to moderate	Rather friable for foundation purposes, scanty exposed	Slumping possible in clay rich beds	Bivalves <i>Protelliptio douglassi</i> , <i>P. reesidei</i> , <i>Lampsilis farr</i> ; gastropods <i>Stantonogyra silberlingi</i> and questionably <i>Reesidella montanaensis</i>	Chert cobbles and pebbles are tool material	None	None	Not enough carbonate present	Potential reservoir rock for hydrocarbons	Vugs on cliffs may provide bird nest habitat	Good for all uses unless highly fractured	Nonmarine fossil rich coquina beds