Map Unit Properties Table

Age	Unit Name (Symbol)	Features and Description	Erosion Resistance	Suitability for Development	Hazards	Paleontological Resources	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance
QUATERNARY (Holocene)	Alluvial and eolian deposits (Qae) Level-2 alluvial and eolian deposits (Qae2)	Qae: Well- to very well sorted, well-rounded sand and silt deposited by wind; locally mixed with sand, silt, and fine gravel deposited by alluvial processes; forms poorly developed dunes, mounds, and sheet-like deposits in depressions and areas protected from erosion for long periods of time; similar in setting and composition to *Qe* deposits except evidence of alluvial activity is more common and dune forms are less developed; mostly derived from, and present on, upper surface of Navajo Sandstone; common residual lag of underlying rock; 0–15 m (0–50 ft) thick. Qae2: Similar in composition and setting to some *Qae* deposits; differentiated where levels are large enough to be mappable at 1:24,000 scale; incised by active washes forming inactive terraces and benches 6–12 m (20–40 ft) above adjacent wash; generally has eolian mantle since upper surface is isolated from most alluvial erosion; 0–6 m (0–20 ft) thick.	Low	High porosity and permeability renders unit unsuitable for waste facilities; buildings constructed within the canyon could prove susceptible to flash floods	Minor slumping possible	None documented	Possible American Indian sites	Sand and gravel	Arid to semi-arid vegetation; sagebrush; few grasses	Short walk to bridge viewing area from Lake Powell	Form most recent river and wind deposits
QUATERNARY (Pleistocene–Holocene)	Talus deposits (Qmt) Talus deposits and eolian sand (Qmte) Eolian sand (Qe) Eolian and alluvial sand and silt (Qea)	<u>Holocene to Upper Pleistocene</u> Qmt: Very poorly sorted, angular blocks mixed with minor fine-grained materials deposited on steep slopes; composed primarily of accumulated rockfall debris; commonly includes minor to moderate amounts of eolian sand; 0–9 m (0–30 ft) thick. Qmte: Similar to *Qmt* deposits except commonly-blanketed by moderate to large amounts of eolian sand that locally completely covers the rockfall debris. <u>Holocene to Middle(?) Pleistocene</u> Qe: Well- to very well sorted, well-rounded sand with minor silt deposited by wind; forms poorly to well developed dunes, mounds, and sheet-like deposits in depressions and areas protected from erosion for long periods of time; locally slightly reworked by alluvial processes and burrowing animals; mostly derived from and present on upper surface of Navajo; residual lag of underlying rock is common; 0–15 m (0–50 ft) thick. Qea: Similar in setting and composition to *Qe* deposits except evidence of alluvial activity is more common and dune forms are less developed.	Variable; rockfall debris more resistant than eolian sand	Infrastructure should avoid talus slopes	Slumps, rock slides, and mass wasting possible	None documented	Possible American Indian sites	Sand	Talus slopes have limited vegetation. Eolian sand may be stabilized by roots	Talus slopes may be unstable; difficult hiking; potentially unsafe to walk next to cliff face	Talus slopes record canyon widening by rockfall
QUATERNARY (Upper to Middle Pleistocene)	Intermediate alluvial gravel deposits (Qagm)	Poorly to moderately sorted boulder to cobble gravel with varying amounts of sand, silt, and clay; clasts are mostly angular to subrounded, well-silicified sandstone and conglomerate boulders up to 2 m (6 ft) in diameter; many clasts were derived from the Jm, and most have a dark-brown weathering patina that gives deposits a dark-brown to brownish-black color; probably mostly reworked from *Qago* deposits; generally on benches and slopes 6–30 m (20–100 ft) above the floor of small streams and washes, but still within the canyons; 0–9 m (0–30 ft) thick.	Variable; finer material is less resistant than boulders and cobbles	Infrastructure within the canyon could prove susceptible to flash floods.	Minor slumping or boulders rolling off benches	None documented	Possible American Indian sites	Sand and gravel	Arid to semi-arid vegetation; sagebrush; few grasses	Suitable for hiking	Terrace-like remnants of alluvium and debris flow deposits in channels draining Navajo Mountain
QUATERNARY (Middle to Lower Pleistocene)	Older alluvial gravel deposits (Qago)	Qago: Similar to *Qagm*, but covers an erosion surface over sloping benches, and commonly has thick carbonate-rich soil accumulation in upper part; cap high, gently-sloping benches and knolls up to about 430 m (1,400 ft) above the floor of adjacent small streams and washes; 0–18 m (0–60 ft) thick.	Variable; finer material is less resistant than boulders and cobbles	Infrastructure should avoid areas with slopes.	Slumps, slides, and mass wasting possible	None documented	Possible American Indian sites	Sand and gravel	Arid to semi-arid vegetation; sagebrush; few grasses	Unstable slopes unsafe for recreational use	May be remnants of an alluvial-fan formed on flanks of Navajo Mountain
	Level 8 mixed alluvial river terrace and gravel deposits (Qatg8)	Alluvial river terrace deposits; moderately- to well-sorted cobble to pebble gravel and sand; minor silt and clay; major component of large boulders (as described in *Qago*) incorporated into terrace deposits along the Colorado River; includes minor talus and colluvial debris from adjacent bedrock units; includes reworked terrace deposits that drape downslope from the original terrace deposits where the terraces are being eroded; up to 280 m (930 ft) above the modern river channels; mapped levels include *Qat2* to *Qat12*; numbers denote relative heights above the modern channel; 0–9 m (0–30 ft) thick; not all levels are preserved in this area.	Variable; finer material is less resistant than boulders and cobbles	Terrace deposits have relatively limited extent and are relatively unstable; large boulders present problems.	Slumping possible	None documented	Possible American Indian sites	Sand and gravel	Arid to semi-arid vegetation; sagebrush; few grasses	Unstable slopes unsafe for recreational use	Form terrace remnants on benches and slopes near the San Juan and Colorado rivers
QUATERNARY (L. Pleistocene)	Level 9 mixed alluvial river terrace and gravel deposits (Qatg9) Level 12 mixed alluvial river terrace and gravel deposits (Qatg12)	Alluvial river terrace deposits; moderately- to well-sorted cobble to pebble gravel and sand; minor silt and clay; major component of large boulders (as described in *Qago*) incorporated into terrace deposits along the Colorado River; includes minor talus and colluvial debris from adjacent bedrock units; includes reworked terrace deposits that drape downslope from the original terrace deposits where the terraces are being eroded; up to 280 m (930 ft) above the modern river channels; mapped levels include *Qat2* to *Qat12*; numbers denote relative heights above the modern channel; 0–9 m (0–30 ft) thick; not all levels are preserved in this area.	Variable; finer material is less resistant than boulders and cobbles	Terrace deposits have relatively limited extent and are relatively unstable; large boulders present problems.	Slumping possible	None documented	Possible American Indian sites	Sand and gravel	Arid to semi-arid vegetation; sagebrush; few grasses	Unstable slopes unsafe for recreational use	Form terrace remnants on benches and slopes near the San Juan and Colorado rivers

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	REGIONAL UNCONFORMTIY in GLEN CANYON NATIONAL RECREATION AREA											
JURASSIC (Upper)	Morrison Formation (Jm)	Salt Wash Member (Jms)	Pale- to medium yellowish-gray, reddish-gray, and greenish-gray, weathering to dark brown, very fine to medium-grained, cross-bedded sandstone, pebble conglomerate, and conglomeratic sandstone, interbedded with minor pale-grayish-green to medium-reddish-brown mudstone and siltstone; forms ledgy cliffs; resistant basal ledge commonly protrudes as an overhanging lip above the ledgy Entrada Formation beds below; only present in one small exposure southwest of Rainbow Bridge where it caps a ridge; regionally, member is about 94 m (310 ft) thick, but only the lower about 60 m (200 ft) is preserved within the Rainbow Bridge area. Not exposed in Rainbow Bridge National Monument.	Ledges of sandstone and conglomerate more resistant than interbedded mudstone and siltstone	Ledges not suitable for development. Not exposed within Rainbow Bridge National Monument	Minor rockfall potential	Dinosaur fossils in other parts of Utah and Colorado. Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Relatively free of vegetation. Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Renowned for its dinosaur fossils and uranium deposits in other western North American localities
	REGIONAL UNCONFORMITY in GLEN CANYON NATIONAL RECREATION AREA											
JURASSIC (Middle)	Entrada Formation (Je)	Middle Member (Jem)	Moderate-reddish-orange to moderate-reddish-brown, medium- to thick-bedded, cross-bedded, calcareous, very fine grained sandstone, interbedded with thin partings of moderate- to dark-reddish-brown siltstone and mudstone, and with scarce, very thin beds of grayish-purple bentonitic clay; forms red and white banded ledgy cliffs; generally less contorted than the Lower Member; upper contact is unconformable; about 110 m (360 ft) thick. Not exposed in Rainbow Bridge National Monument.	Ledges of sandstone and conglomerate are more resistant than mudstone and siltstone	Ledges not suitable for development. Not exposed in Rainbow Bridge National Monument	Minor rockfall potential	Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Vegetation scarce. Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Forms the arches in Arches National Park
		Lower Member (Jel)	Pale-reddish-yellow to moderate-reddish-orange, thick-bedded to massive, calcareous, fine-grained sandstone, interbedded with thin partings of moderate reddish-brown siltstone and mudstone; contorted bedding, small internal faults and complex small-scale folds from extensive and complex soft-sediment deformation; fingers and tongues of the Lower Member commonly sag or protrude as pedestals and bulges into the underlying Carmel Formation; forms massive smooth cliffs, rounded bare domes, and broad, rolling slickrock swells with common large weathering pits; abundant secondary alteration and bleaching impart mottled, streaked, and banded appearance to outcrops; about 140 m (460 ft) thick. Not exposed in Rainbow Bridge National Monument.	Sandstone more resistant than interbedded mudstone and siltstone	Cliffs and rounded domes not suitable for development. Not exposed in Rainbow Bridge National Monument	Minor rockfall potential	Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Vegetation scarce. Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Most widespread of the preserved late Paleozoic and Mesozoic eolianites (wind derived rocks) on the Colorado Plateau
	Carmel Formation (Jc)		Medium-grayish-red to pale-reddish-gray, interbedded, fine- to very fine-grained sandstone, silty sandstone, siltstone, and mudstone; generally gypsiferous and calcareous; commonly has highly contorted bedding showing a variety of soft-sediment structures produced by loading of the Entrada Formation before Carmel Formation strata were lithified; forms prominent red ledgy slope between the cliff-forming Entrada and Navajo/Page sandstones; 30–42 m (100–140 ft) thick. Not exposed in Rainbow Bridge National Monument.	Less resistant than Entrada Formation and Page Sandstone	Not exposed in Rainbow Bridge National Monument	Minor rockfall potential from ledgy slope	Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Gypsum; Not exposed in Rainbow Bridge National Monument	Gypsum limits vegetation	Not exposed in Rainbow Bridge National Monument	Deposited in tidal flats and near-shore environments
	Page Sandstone (Jp)		Moderate-reddish-orange to moderate reddish-brown, fine-grained, very thickly cross-bedded sandstone; locally has very sparse, small angular chert fragments at base; 0–30 m (0–100 ft) thick. Contact with Navajo Sandstone may or may not be an unconformity; if no unconformity, may actually be part of the Navajo Sandstone. Not exposed in Rainbow Bridge National Monument.	Moderate	Not exposed in Rainbow Bridge National Monument	Minor rockfall potential	Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Not exposed in Rainbow Bridge National Monument	Sandstone does not retain water; slopes limit vegetation	Not exposed in Rainbow Bridge National Monument	Restricted marine, marginal marine, and eolian (wind) deposits
	REGIONAL UNCONFORMITY in GLEN CANYON NATIONAL RECREATION AREA											
JURASSIC (Lower)	Navajo Sandstone (Jn) limestone beds (Jnl)		Moderate- to pale-reddish-brown to reddish-orange, medium- to thick-bedded, cross-bedded, fine- to medium-grained, poorly sorted sandstone, interbedded with very thin to thin-bedded, moderate- to dark-reddish-brown siltstone and muddy sandstone; grains are subangular to subrounded; calcareous cement; locally contains beds of conglomerate with pebbles of sandstone, siltstone and claystone; forms thick ledges to ledgy cliffs; locally contains thin beds of pinkish-gray limestone; contacts gradational and interlayered with overlying and underlying strata; 60–73 m (200–240 ft) thick.	High except in fractured areas where frost-wedging occurs	Forms cliffs that are not conducive to development	Rockfall potential	None documented in Rainbow Bridge National Monument	Possible American Indian sites in alcoves	Groundwater reservoir in other parts of Colorado Plateau	Cliff-forming units. Some vegetation along groundwater seeps	Rock-climbing potential on cliffs	Forms Rainbow Bridge. Renowned for eolian cross-bedding; extensive ancient erg deposit
	Kayenta Formation (Jk)		Moderate- to pale-reddish-brown to reddish-orange, medium to thick bedded, cross-bedded, fine- to medium-grained, poorly sorted sandstone, interbedded with very thin to thin-bedded, moderate- to dark-reddish-brown siltstone and muddy sandstone; grains are subangular to subrounded; calcareous cement; locally contains beds of conglomerate with pebbles of sandstone, siltstone and claystone; forms thick ledges to ledgy cliffs; locally contains thin beds of pinkish-gray limestone; contacts gradational and interlayered with overlying and underlying strata; 60–73 m (200–240 ft) thick.	Variable. Sandstone more resistant than siltstone and muddy sandstone	Not suitable. Exposed beneath Rainbow Bridge	Minor rockfall associated with ledgy cliffs	Tridactyl (three-toed) theropod dinosaur track at bridge viewing area; locally contains sparse fossil wood	American Indian sacred sites at base of Rainbow Bridge	None documented in Rainbow Bridge National Monument	Forms vertical banks along Bridge Creek and Lake Powell so not conducive to vegetation	Bridge viewing area is located on Kayenta	Deposited in a hot, river floodplain environment

Map source: Willis, G. C. 2004. Interim geologic map of the lower San Juan River area, eastern Glen Canyon National Recreation Area and vicinity, San Juan County, Utah. Scale 1:24,000. Utah Geological Survey, Open-File Report 443 DM.