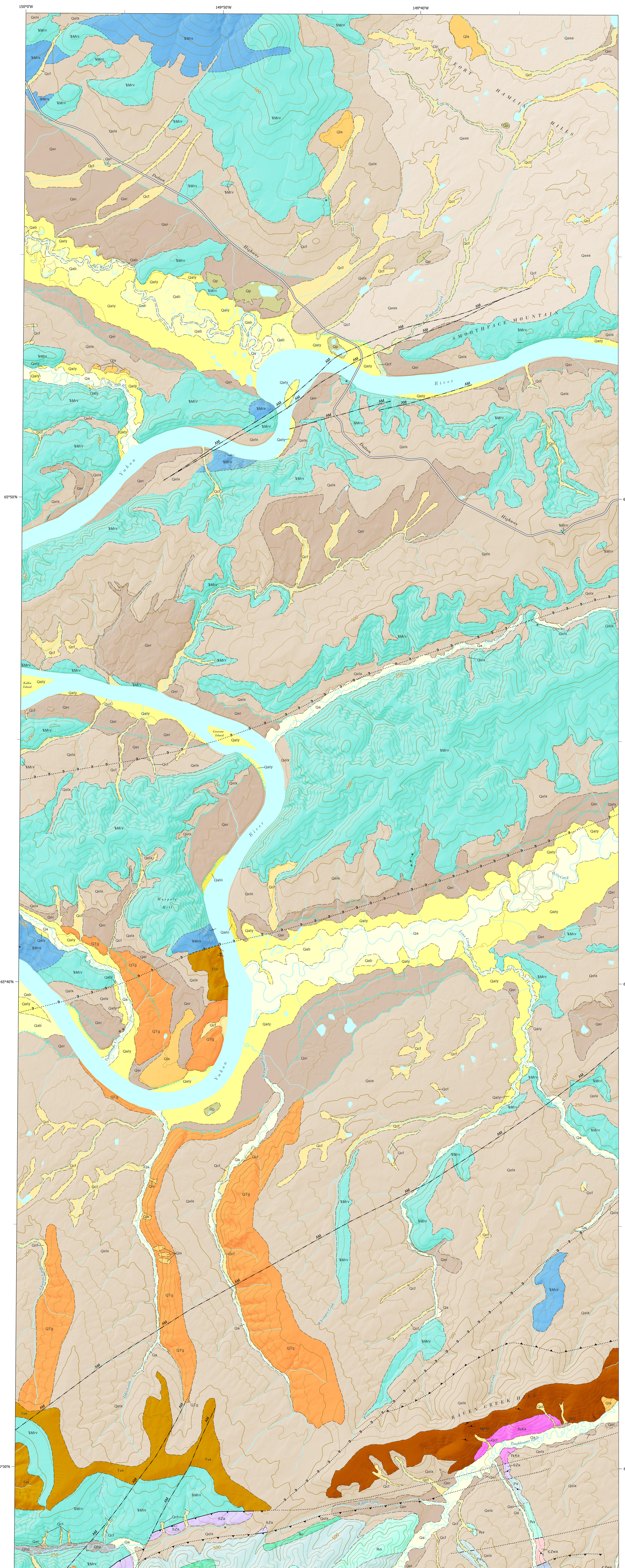
Preliminary Interpretive Report 2026-4
Hubbard and others, 2026
SHEET 1 OF 1



INTRODUCTION

Geologists from the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted fieldwork during June and July 2016 in Livengood D-6, C-6, and the northern portion of B-6 quadrangles, as part of the Yukon River Crossing Capital Improvement Project. The study area spans approximately 567 mi² (1,458 km²) and focuses on a geologically complex and vulnerable segment of the Trans Alaska Pipeline and the Dalton Highway. The project seeks to improve understanding of the local geology near the Yukon River highway bridge crossing, where a 2012 landslide occurred west of the bridge's south abutment. Field data were collected during a helicopter-supported program from June 23– July 4, 2016. Surficial geology is interpreted through a desktop study of remotely sensed imagery and relevant literature, with verification by field observations. The bedrock geology of this map is adapted from Weber and others (1992; 1997) and Chapman and others (1971; orientation points only) with limited modifications based on geophysical surveys (Emond and others, 2018; Emond and MPX Geophysics, Ltd., 2022) and field observations. Together, these datasets form the basis for updated geologic unit definitions, geomorphic interpretations, and structural observations presented in this map. This mapping offers stakeholders information about geologic hazards, including those associated with seismic activity and slope stability, near the economically significant Yukon River Dalton Highway crossing. These data are provided as a Preliminary Interpretive Report under an open end-user license and are available on the DGGS website (http://doi.org/10.14509/32121).

DESCRIPTION OF MAP UNITS

SURFICIAL UNITS

ALLUVIAL DEPOSITS

Qa UNDIFFERENTIATED ALLUVIUM (Holocene)
Chiefly silt, sand, and moderately to well-sorted stratified polymictic gravel, comprising channel and overbank deposits of generally small streams. May include active, inactive, and abandoned floodplain and terrace deposits that are too small to distinguish at the map scale. Deposits often include a silt cover that partially or completely obscures alluvial features such as oxbows and abandoned channels, especially on older surfaces. The deposits may include retransported silt and small alluvial fans, especially at the base of steep slopes where valleys are narrow. Deposits may be locally frozen in narrow or abandoned channels (Weber and others, 1992).

Qab ABANDONED FLOODPLAIN ALLUVIUM (Holocene)
0.5 to 1.5 m of silty overbank deposits overlying stratified polymictic bedload sand and gravel. Deposits are characterized by distinct abandoned channels often with standing water or partially filled with organic silt and discontinuous surface peat as well as crevasse splays, and natural levees. Locally, surface features are obscured by retransported silt. May include multiple surface levels, generally not exceeding 4.5 m in elevation above active stream channels (Weber and others, 1992).

Qaty YOUNGER TERRACE DEPOSITS (Quaternary)
Deposits of overbank silt and sand overlying polymictic bedload sand and gravel on surfaces above modern streams and no longer subject to inundation by streams that deposited the alluvium. Unit is mapped along the Yukon River where deposits are sufficiently large to be distinguished at map scale, but may also be present along smaller streams. May include multiple terrace surface levels. Surfaces are typically covered by several meters of retransported silt and lowland loess (Twelker and others, 2016; Reger and Burns, 2013).

Qato OLDER TERRACE DEPOSITS (Quaternary)
Silty sand overlying polymictic, bedload sand and gravel 10 to 25 m above modern streams and no longer subject to inundation by streams that deposited the alluvium. Surfaces are typically mantled with a 0.3 to 3 m cover of retransported silt and lowland loess that obscures oxbow lakes, crevasse splays, and former channels (Chapman and others, 1982; Twelker and others, 2016). Deposits are mapped along larger streams where they are sufficiently large to be distinguished at map scale but may also be present along smaller streams.

QTg HIGH-LEVEL GRAVEL (Quaternary to Pliocene)
Poorly to semi-consolidated polymictic alluvial gravels with some sand and silt. Tightly packed gravel clasts are subrounded to well-rounded, with a distinctive bright-orange silt and clay matrix (Reifenstuhl and others, 1997). Clasts typically do not exceed 5 cm in diameter, with rare boulders up to 2 m in diameter (Kachadoorian, 1971; Reifenstuhl and others, 1997). Perennially frozen. Locally may be as thick as 30 m, capping Idaho Bar and nearby hills in the Hunter Creek area (Weber and others, 1992). Also exposed as north-south trending ridges along Alder and McDermott Creeks. Locally auriferous. Widely mantled with thick (up to 10 m), frozen primary loess and retransported silt (Reifenstuhl and others, 1997). Numerous landslides occur within the units where capped with loess along Alder Creek.

EOLIAN DEPOSITS

Qelx FROZEN LOESS WITH CONSIDERABLE GROUND ICE (Quaternary)
On north-, east-, and west-facing upper and middle slopes, a blanket 1.5 to 14 m thick of massive to laminated, very well-sorted eolian silt may contain soil horizons and organic layers (Kreig and Reger, 1982, plate 12). Transitional on middle slopes with retransported silt and lowland loess covering lower slopes. Thickness increases northward toward the main source of eolian sediments in the Yukon River lowland (Williams, 1962; Brown and Kreig, 1983; Muhs and Budhan, 2006). Perennially frozen to within ≤1 m of ground surface and locally contains massive ground ice (Kreig and Reger, 1982, plate 12, table 18). Dissected by dendritic, pinnate gullies with convex walls and narrow floors (Kreig and Reger, 1982, plate 12, fig. 8). Tree cover is dominantly black spruce forest mixed with scattered paper birch; large black spruce trees and willow shrubs follow drainages, where the active layer is thicker.

Qess SAND AND SILT (Quaternary)
Well-sorted silt to fine sand. Differentiated from the frozen loess (Qelx) unit because of its subdued dune morphology. Found in the northeastern part of the map area.

COLLUVIAL DEPOSITS

Qls LANDSLIDE DEPOSITS (Holocene)
Lunate to triangular or fan-shaped, heterogeneous mixtures of materials moved downslope by creep, flowing, and sliding of failed bedrock and unconsolidated materials. Deposit lithology is influenced by the source material, typically comprising primary or retransported loess with variable concentrations of colluvial pebbles, cobbles, and boulders or bedrock blocks. Koehler and others (2013) describe a landslide west of the south side of the Yukon River bridge on the Dalton Highway that initiated in frozen and retransported loess, underlain by highly weathered bedrock, typical of several landslides observed in the map area.

COMPLEX DEPOSITS

Qcf MIXED COLLUVIUM AND ALLUVIUM (Quaternary)
Elongate deposits of heterogeneous, poorly stratified silt, sand, and gravel generally deposited in steep valleys with small or seasonal streams. Colluvial processes are dominant over fluvial. Grades into retransported silt and alluvial terraces at the margins of lowlands (Twelker and others, 2016).

Qer RETRANSPORTED SILT (Quaternary) (Reger and Burns, 2013)
Chiefly massive to laminated organic silt and silt with trace to some fine sand, lenses and tongues of locally derived gravel, and scattered to numerous angular rock fragments (particularly in upper valleys of small, ephemeral streams). Deposited primarily by hyperconcentrated flows (Tuck, 1940; Taber, 1953, 1958; Costa, 1998; Fraser and Burn, 1997), draining weathered bedrock slopes thinly covered by silt (loess) and generated by thawing ice-rich permafrost or during brief, intense summer rainstorms. Complexly mixed with gelifluction and debris-flow deposits in upper stream drainages and primary airfall loess in lowland sites (Kreig and Reger,1982). Transitional on middle slopes with frozen loess containing considerable ground ice. Fluvial processes >> colluvial processes. Lowland surfaces are fairly smooth with scattered open-system pingos and local thermokarst pits, ponds, and lakes. Erosion on slopes by ephemeral drainages produces subparallel gullies separated by linear ridges and ellipsoidal and triangular remnants that are generally shallowly frozen, except beneath well-developed aspen and birch on upper south-facing aspects (Kreig and Reger, 1982, plate 11). Maybe subject to seasonal stream and slope icings. May contain fossil remains of late Pleistocene mammals. Continuously to discontinuously frozen with moderate to high ice content; locally contains considerable massive ground ice (Kreig and Reger, 1982, plate 12) (yedoma of Kanevskiy and others, 2011). Includes unit cf of Waythomas and others (1984) and units Qcfl, Qcfu, and Qe–c of Athey and Craw (2004).

PALUDAL DEPOSITS

Qp SWAMP DEPOSITS (Holocene)
Primarily silt and organic material deposited in poorly drained low-lying areas (Kreig and Reger, 1982).

MANDMADE DEPOSITS

Qhp PLACER-MINE TAILINGS (Holocene)
Reworked stream gravels from placer-mining activity. Areas too minor for delineation at the map scale are included in Qa.

OTHER

WATER BODIES

BEDROCK UNITS

SEDIMENTARY ROCKS

Tvs SEDIMENTARY ROCKS, UNDIVIDED (Eocene)
Conglomerate, graywacke, siltstone, shale, coal, greenstone, basalt, and tuff. Poorly to well consolidated, friable, calcareous, some nodules, lenses, and thin layers of non-marine ironstone. Conglomerate has locally derived well-rounded pebble- to boulder-sized clasts of greenstone, black chert, rare white quartz and colored chert; siltstone and shale less common (Weber and others, 1992).

INTRUSIVE IGNEOUS ROCKS

PɛKa ALASKITE (Paleogene to Early Cretaceous)
Exposed at Raven Creek Hill. Alaskitic rocks that grade to pegmatite and granite; commonly contain as much as 10 percent muscovite and a trace to 1-2 percent biotite; typically contain scattered tiny pink garnets. Schistose in places south of Troublesome Creek. Tourmaline in both igneous and contact rocks (Weber and others, 1992). Age of crystallization determined by U-Pb monazite at 111.3 ± 0.3 Ma (sample 02ADw518; TIMS multigrain, Till and others, 2007), while U-Pb zircon dating of a pegmatitic variant yielded an age of 60.1 ± 0.8 Ma (sample 02ATi28f; Till and others, 2007).

ALLOCHTHONOUS RAMPART GROUP

TɾMrv RAMPART GROUP IGNEOUS ROCKS (Triassic to Mississippian)
Intrusive and associated extrusive mafic igneous rocks, a few interlayered sedimentary rocks. Igneous rocks range from aphanitic greenstone to coarse-grained diorite and gabbro, to very rare occurrences of ultramafic rock, but are mostly fine- and medium-grained originally holocrystalline rocks. (Weber and others, 1992). Rampart gabbro and basalt are tholeiitic and have a slightly enriched light rare-earth-element profile (Twelker and others, 2025), which distinguishes this unit from the mafic rocks of the Amy Creek Unit. Age of crystallization supported by a U-Pb zircon age of 229.5 ± 0.2 Ma located 11 km west of the map area (sample 03ATi22a; TIMS; Wilson and others, 2015).

TɾMrs RAMPART GROUP SEDIMENTARY ROCKS (Triassic to Mississippian)
Argillite, chert, graywacke, shale, limestone, and minor amounts of mafic igneous rocks. Interlayered fine-grained clastic rocks and medium dark green mafic welded crystal tuff and pillow basalt (Weber and others, 1992).

SEDIMENTARY AND METASEDIMENTARY ROCKS

Kwcs WILBUR CREEK FLYSCH (Early Cretaceous)
Shale, siltstone, and graywacke. Shale, locally contains pebbles and laminae of siltstone. Rhythmically and thinly interbedded graywacke to quartz-wacke, moderately sorted, very fine- to medium-grained, subangular to subrounded, some very well-rounded quartz grains, and rare load casts. Graywacke may occur as discontinuous ripple-laminated or flaser-bedded lenses of small-scale channels that locally grade upward into siltstone and shale (Weber and others, 1992).

KJw WOLVERINE QUARTZITE (Early Cretaceous to Late Jurassic)
Quartzite, very fine- to medium-grained, well sorted, siliceous, locally feldspathic and has shale rip-ups, thinly to thickly bedded, internally massive, bioturbated, rarely conglomeratic. Interbedded shale, graphitic, siliceous and siltstone. Rare coquinoidal beds, poorly sorted, gritty, locally calcareous (Weber and others, 1992).

Tɾc SHALE OR SLATE, CHERT, AND TUFF (Triassic)
Interlayered black shale or slate, light olive-greenish-gray, thinly-bedded to massive and thickly bedded chert and light greenish-gray tuff (Weber and others, 1992).

Ps SEDIMENTARY ROCKS, ARGILLITE, SILTSTONE, SANDSTONE, AND MINOR CONGLOMERATE (Permian)
Argillite, siltstone, sandstone, and minor conglomerate. Thinly and rhythmically interbedded argillite, and siltstone. Sandstone very fine- to fine-grained, well-sorted, sheared, platy. Quartz and chert granule- to pebble-conglomerate, locally calcareous, fossiliferous, poorly-sorted. Estimated 87 percent interbedded argillite and siltstone, 10 percent sandstone, 1 to 2 percent coarse grit, and less than 1 percent conglomerate (Weber and others, 1992).

Pzs SEDIMENTARY ROCKS (Late Paleozoic)
A tectonically disrupted section of slate; chert and cherty argillite, brecciated, laminated, iron stained, banded; and greenstone. Lime wackestone, recrystallized, occurs as two prominent tors on west side of Troublesome Creek. Trace of conglomerate (Weber and others, 1992).

Dq QUAIL UNIT PHYLLITE, SILTSTONE, QUARTZOSE SANDSTONE, GRAYWACKE, AND CONGLOMERATE (Devonian)
Phyllite, siltstone, quartzose sandstone, graywacke, and conglomerate. Phyllite has laminae of locally calcareous gray siltstone to very fine-grained gray quartzose sandstone; graywacke has quartz, chert, and argillite grains in a phyllitic or siliceous matrix (Weber and others, 1992).

Dt TROUBLESOME UNIT (Devonian?)
Rhythmically interbedded dark gray to black cherty argillite to chert, and thin beds of black to gray, siliceous slate. Extensive mafic intrusive and extrusive rocks are associated with this unit, but they do not penetrate the overlying units (Weber and others, 1992). Gabbro sampled for this study is alkaline and light rare-earth-element enriched, similar to Amy Creek Unit mafic rocks (Twelker and others, 2025).

SZa AMY CREEK UNIT (Silurian to Neoproterozoic (?))
Dolomite, light- to medium-gray, medium-grained; mud-, wacke-, and packstone. Interbedded chert, black carbonaceous argillite, and dolomite. Interbedded and interlayered minor lime mudstone, chert, basaltic greenstone, lenses of tuff, tuffaceous siltstone, shale, and minor volcaniclastic graywacke. Basaltic flows and flow breccia at least 100 m thick occur locally in shaly rocks on Amy Creek and elsewhere (Weber and others, 1992). Amy basalt is distinguished from Rampart Group mafic rocks by alkaline bulk compositions and pronounced light rare-earth-element enrichment (Twelker and others, 2025).

ЄZwa MAROON AND GREEN ARGILLITE, GRIT, AND METASEDIMENTARY ROCKS (early Cambrian to Neoproterozoic)
Argillite is characteristically maroon, light- to medium-green, or grayish-green, fissile to blocky fracturing, and locally phyllitic or slaty. Bimodal grit, quartzite, wacke, and quartz wacke grit are light to medium olive-gray, commonly conglomeratic or unsorted, with locally abundant feldspars. Graded bedding locally observed. Age control is based on the trace fossil *Oldhamia* observed in the northeastern Livengood Quadrangle (Weber and others, 1992).

METAMORPHIC ROCKS

MzPzr RAVEN CREEK HILL UNIT (Mesozoic to Paleozoic)
Medium- to medium-dark gray, garnetiferous quartz biotite-muscovite-chlorite schist, epidote, some carbonate, some mostly quartzitic layers, tourmaline present. Locally gneissic containing incipient albite porphyroblasts near adjoining pluton; as distance from pluton increases, metamorphic grade decreases to phyllite, dark gray slate and shale (Weber and others, 1992).

EXPLANATION OF MAP SYMBOLS

Linework is solid where location is accurate, long-dashed where location is approximate, short-dashed where location is inferred, and dotted where features are concealed. Question marks indicate the existence or identity of the feature is questionable.

CONTACTS AND FAULTS

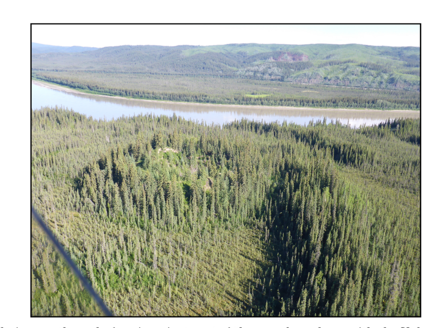
- CONTACT
- FAULT - sense of movement indeterminate
- STRIKE-SLIP FAULT, RIGHT-LATERAL OFFSET
- THRUST FAULT - sawteeth on upper plate
- LIKELY FAULT - based on aeromagnetic linear (Emond and others, 2018; Emond and MPX Geophysics LTD, 2022)

MISCELLANEOUS FEATURES

- FLUVIAL TERRACE SCARP - Identity or existence questionable, location approximate. Hachures point down scarp.
- PINGO
- LANDSLIDE - too small for map scale

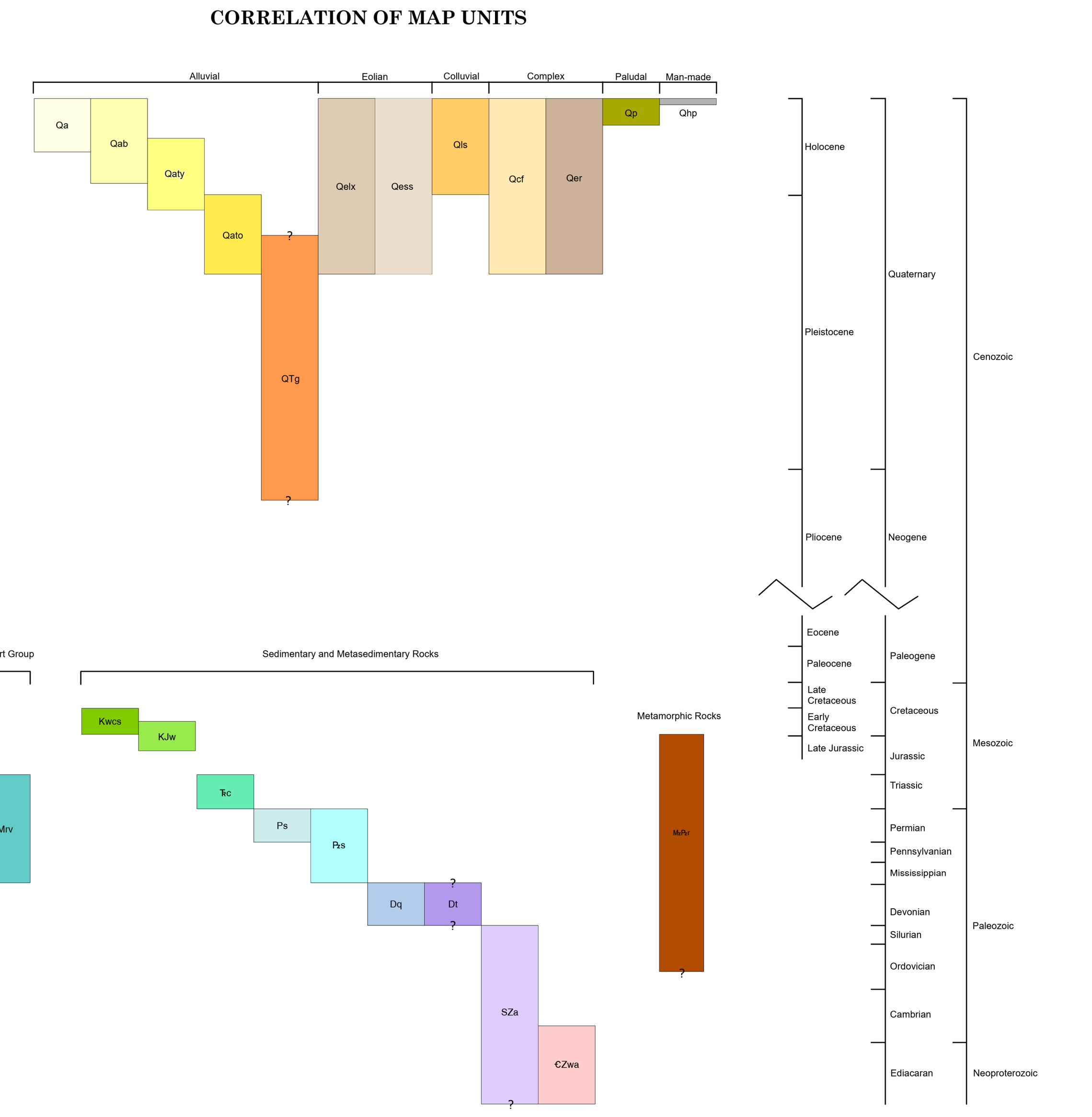
PLANAR FEATURES

- INCLINED BEDDING - showing strike and dip
- VERTICAL BEDDING - showing strike
- OVERTURNED BEDDING - showing strike and dip
- INCLINED CLEAVAGE - showing strike and dip
- INCLINED METAMORPHIC or TECTONIC FOLIATION - showing strike and dip
- VERTICAL METAMORPHIC or TECTONIC FOLIATION - showing strike



Aerial view northward of a pingo just east of the map boundary, with the Yukon River and Kalka Island visible in the background (photograph taken 06/25/2016 by R.D. Koehler).

CORRELATION OF MAP UNITS



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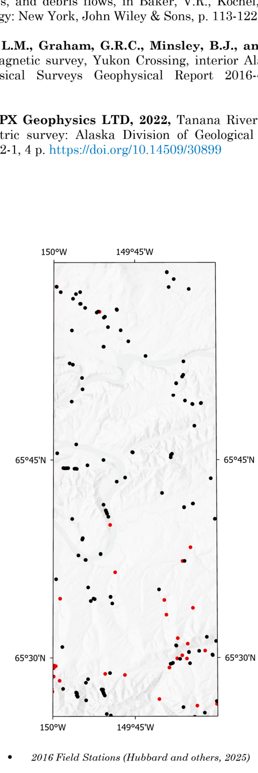
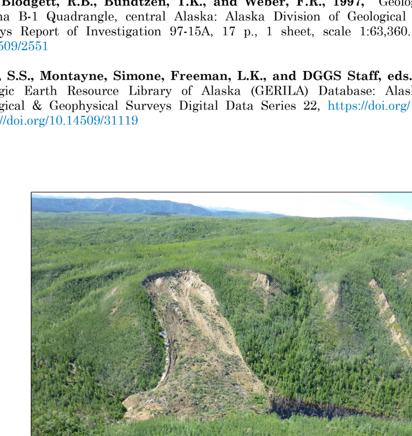


• *2016 Field Stations (Hubbard and others, 2025)*
• *Legacy Field Stations (Seitz and others, 2024)*



Landslide approximately 1.5 miles north of the Lynx Creek and Hess Creek confluence (photograph taken 06/23/2016 by R.D. Koehler).

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Hydrology adapted from:
U.S. Geological Survey National Hydrologic Dataset (2022)
Projection:
Universal Transverse Mercator Zone 6N
Datum:
North American Datum of 1983
Geologic field investigations by:
T.D. Hubbard, R.D. Koehler, E. Twelker, and J.D. Barefoot (2016)
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Geologic Map of the Yukon River Crossing Area, Livengood Quadrangle, Alaska

by

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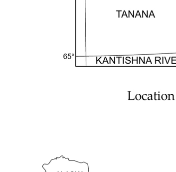
2026

Location of Map Area

SCALE 1:50 000
1 1/2 0 1 2 3 4 MILES
3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
1 .5 0 1 2 3 4 5 KILOMETERS
CONTOUR INTERVAL 50 METERS



MAP LOCATION

17½° TRUE NORTH MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2016

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