

*Block 23. Avoidance, Minimization, and
Compensation*

Donlin Gold Project
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Block 23. Avoidance, Minimization, and Compensation

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Avoidance and Minimization

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Avoidance and Minimization

Donlin Gold, LLC (Donlin Gold) has planned the proposed project to avoid and minimize impacts to Waters of the United States (WOUS) to the extent practicable during the construction, operation, reclamation, and closure phases of the project. The following is a description of avoidance and minimization efforts for the proposed project. For ease of explanation the narrative has been grouped by the three distinct project areas: Mine Area (MA), Transportation Area (TA), and Pipeline Area (PA). A description of compensatory mitigation follows the avoidance and minimization discussions.

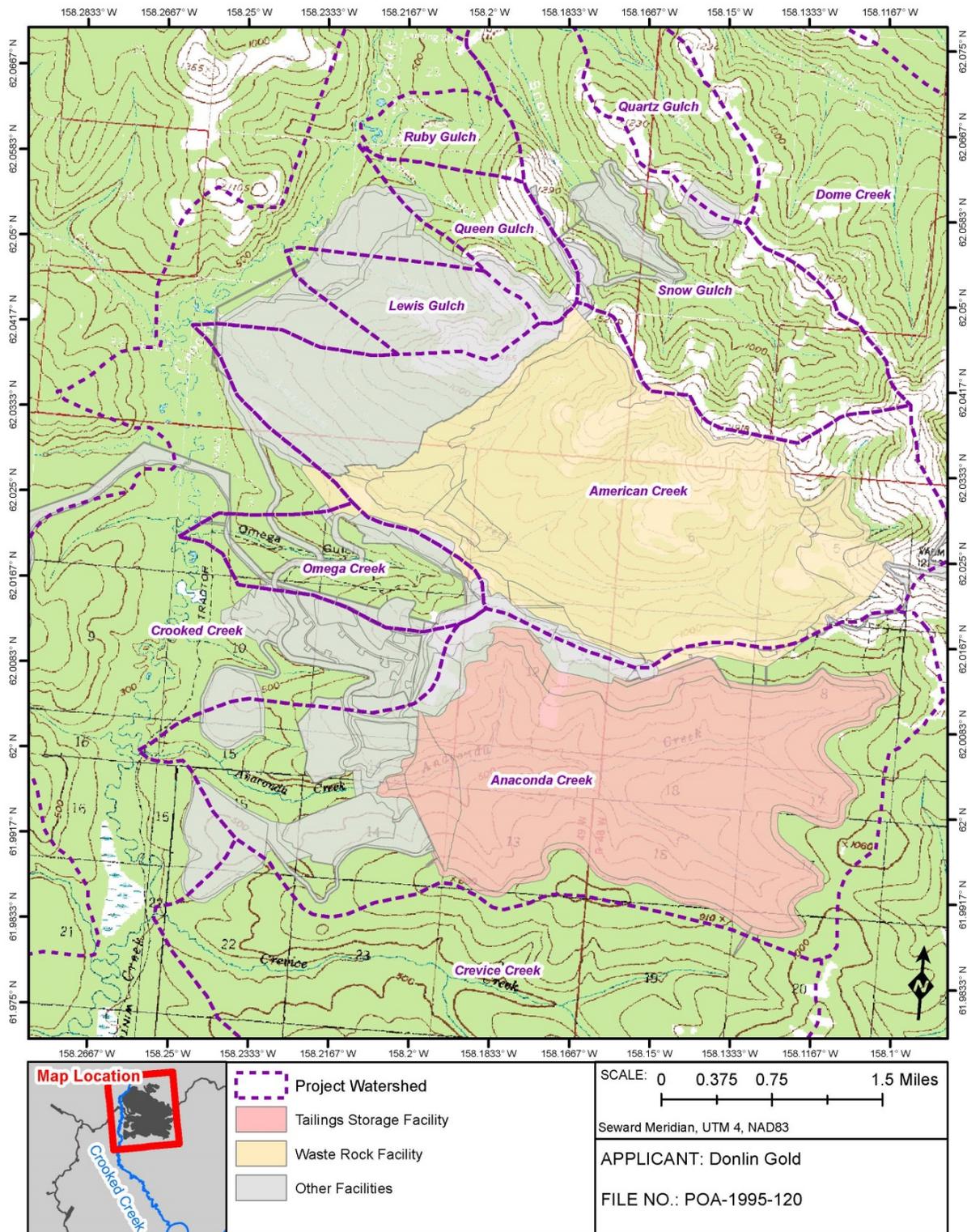
Mine Area (MA)

The proposed facilities in the MA include the open pit, waste rock facility (WRF), tailings storage facility (TSF), mill facilities, shop, power plant, stockpiles, fuel storage, water management facilities, laydown areas, material sites, connecting roads, and other associated facilities. Figure 1 depicts the watersheds in the proposed MA. The proposed mine footprint encompasses approximately 9,000 acres. There are approximately 6,430 acres of uplands within the proposed mine footprint, and 2,570 acres of wetlands. The following measures to avoid and minimize impacts to WOUS were included in the project design and construction plans.

Avoidance and Minimization during Design

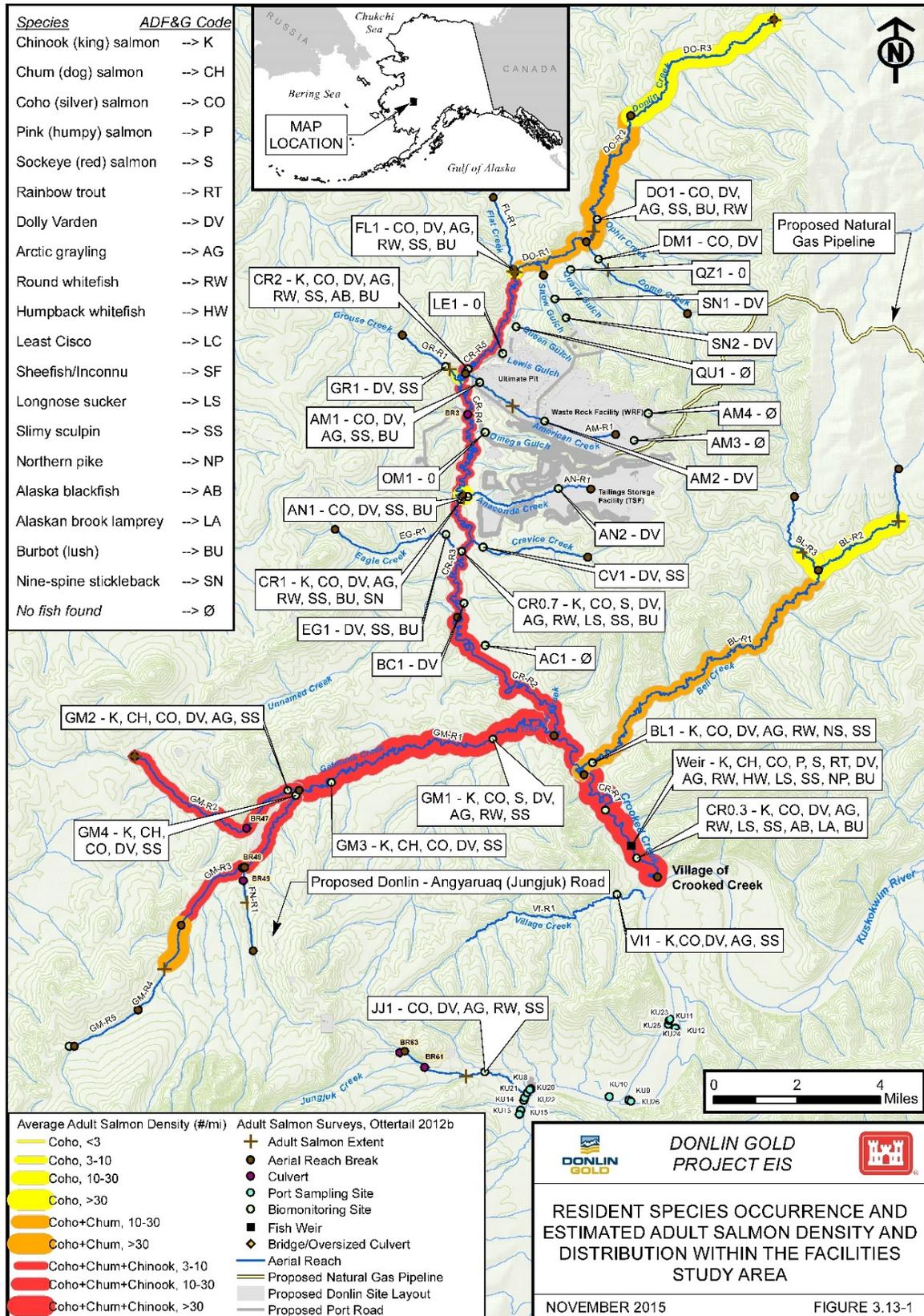
- Placement of Facilities to Avoid and Minimize WOUS Impacts – Due to the abundance of wetlands within the project area, avoiding all fill discharges into WOUS is not practicable. The 2007 Preliminary Jurisdictional Determination (PJD) (Michael Baker International 2017a, 2017b) delineation for the project shows that ridgetops and hillsides at higher elevations in watersheds are upland, while WOUS are more prevalent in valley bottoms and hillsides at lower elevations in watersheds. The proposed project infrastructure layout maximizes the use of uplands, while minimizing WOUS encroachment to the extent practicable. Potential mine impacts were reduced by placing facilities in fewer watersheds and WOUS. Facility placement and design are typically more efficient on flatter ground. However, to avoid WOUS, the facilities were placed on upland ridges as feasible; where additional site preparation work will be needed to provide level and stable pads.
- Anadromous and Resident Fish Habitat – The proposed locations of the WRF, TSF, mine facilities, Snow Gulch freshwater reservoir and material sites, and north and south overburden and material sites avoid anadromous fish habitat. Resident Dolly Varden are the only species of fish observed at higher creek elevations in the American and Anaconda Creek watersheds. See Figure 2 for the extent of Anadromous and Resident Fish within the proposed MA.
- Open Pit – The open pit is immovable and irreplaceable in nature. Design criteria included: access to the mineral resources; minimizing waste rock volumes; maintaining pit wall stability; and minimizing disturbance footprint. Studies were completed to determine the steepest practicable wall slopes to maintain stability, and consequently minimize the surface disturbance of the pit. The impacts to WOUS by the open pit are unavoidable, and have been minimized to the extent practicable.

Figure 1 Watersheds within the Proposed Mine Area



DG: MATA_Watersheds_AM.mxd, 09/14/2017, R01

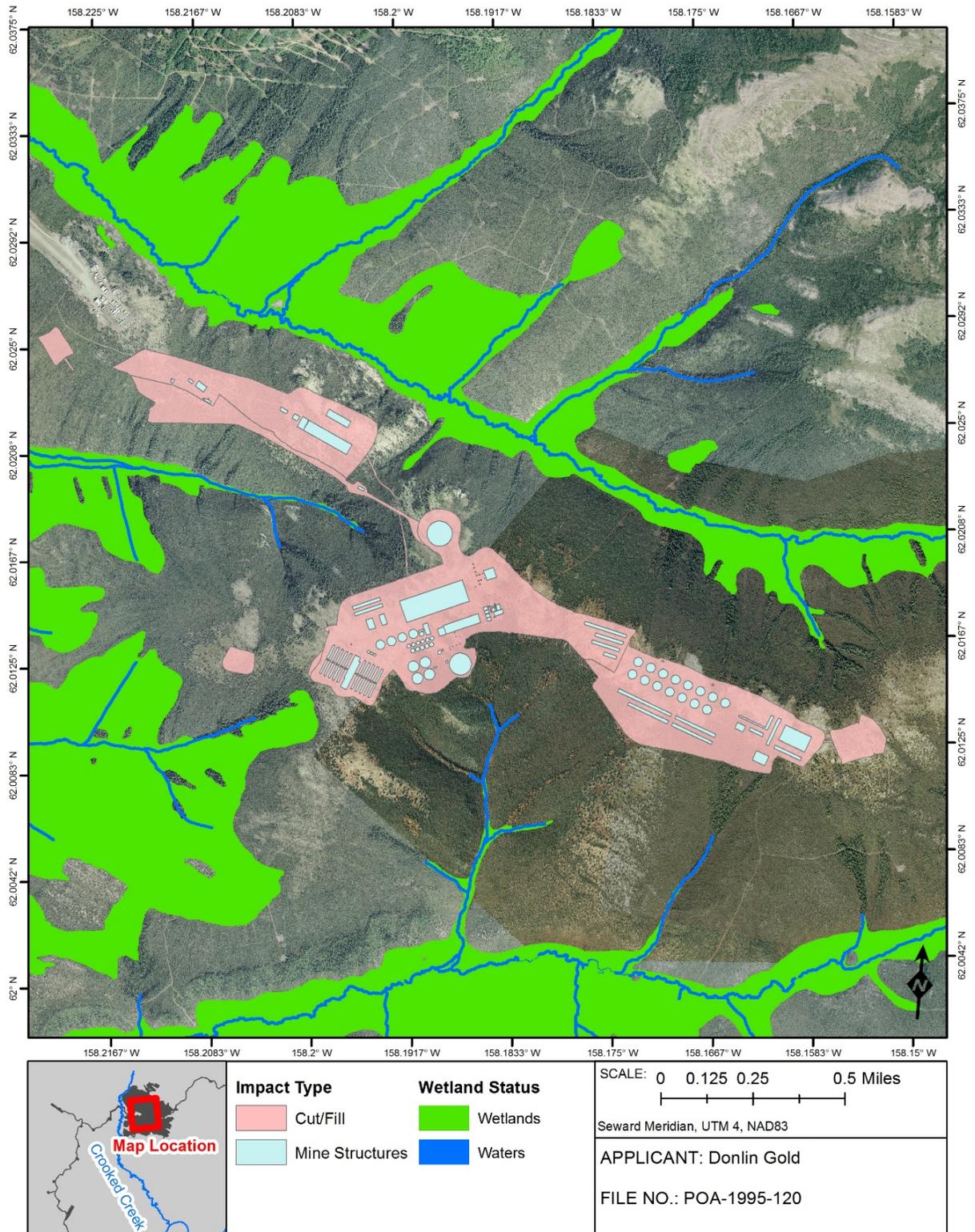
Figure 2 Anadromous and Resident Fish Habitat Extent



- Waste Rock Facility – General design criteria for the WRF location included: capacity to store approximately 2,449 million short tons (Mst) of waste rock and 46 Mst of overburden fill; ability to manage runoff water; proximity to the open pit to minimize transportation costs; wetlands avoidance and minimization; and geotechnical factors such as hydrology, slope stability, and seismic stability. Potential locations for storage of waste rock considered placement of all waste rock in the American Creek valley, or splitting the waste rock storage between American Creek and Anaconda Creek or Snow Gulch. Siting the WRF within American Creek watershed provided the most practical option because of the proximity to the open pit to minimize transportation cost, and the ability to use the open pit to control runoff post mine closure. The WRF minimizes WOUS impacts with a compact footprint located in the upper watershed of American Creek. The WRF was designed to an overall slope of 3(H):1(V). This design allowed for placement of all waste rock within the American Creek valley, to an elevation of 1,705 feet above sea level, avoiding potential impacts from waste rock management in Snow Gulch or Anaconda Creek valley.
- Tailings Storage Facility – General design criteria for the TSF location included: capacity to store 334,298 acre-feet of tailings; proximity to the MA facilities to minimize tailings transportation costs; wetlands avoidance and minimization; and geotechnical factors such as hydrology, slope stability, and seismic stability. Potential locations for storage of tailings considered placement of all tailings in the Anaconda Creek, Crevice Creek, and Snow Gulch valleys, or dividing the tailings between the Anaconda Creek and American Creek valleys. Siting the TSF within the Anaconda Creek valley provided the most practical option because of the proximity to the MA facilities, availability of construction material sources, and capacity to manage tailings within a single area. The TSF minimizes WOUS impacts with a compact footprint. The TSF dam was designed with a maximum height of approximately 462 feet to maximize the storage capacity within the east half, or upper reaches of the Anaconda Creek valley, thus limiting the TSF footprint and avoiding additional wetland impacts in the lower valley, closer to Crooked Creek; avoiding potential impacts from TSF management in Snow Gulch or American Creek valley. It is not feasible to collocate the WRF and TSF in one valley.
- Mine Area Facilities – General design criteria for the MA facilities included: sufficient space to accommodate mine facilities (e.g., crusher, processing facility, power plant, fuel storage, and laydown pads); proximity to the open pit, ore stockpile, and TSF to minimize ore and tailings transportation costs; geometrically designing pads with the lowest volumes of cut and fill; wetlands avoidance through strategic location of facilities; and factors such as hydrology, and soil stability. Potential locations for the MA facilities considered included the lower (near Crooked Creek) or middle portion of the American Creek ridge because of proximity to the open pit and TSF. The lower American Creek ridge location would have resulted in longer roads to the ore stockpile and TSF and greater impacts to WOUS. Locating the facilities in the middle portion of the American ridge avoided all impacts to WOUS. See Figure 3.
- Material Sites – Material sites are necessary for the construction of mine facilities and roads. River floodplains are typically valuable sources of aggregate material. Donlin Gold recognized early in the MA development that using material near Crooked Creek would likely have impacts

to anadromous fish reaches. All material sites chosen were sited outside the floodplain of Crooked Creek. The material sites identified are immovable and irreplaceable in nature. The sites identified provide high volume, high-quality material, while minimizing access road distances. The amount of aggregate estimated to be required was minimized by designing facilities and roads that would need the least material to construct and maintain. The material site required for the Snow Gulch freshwater dam has been sited on a ridgetop where suitable material is present to avoid WOUS. In summary, although some material sites are in WOUS, they were sited outside of the Crooked Creek floodplain and away from headwater streams.

Figure 3 Mine Facilities Footprint



DG: MATA_Facilities_AM_v02.mxd, 06/13/2017, R02

- Mine Roads – Mine roads are used to transport personnel, goods, and materials between mine facilities. These roads have been designed to meet traffic and safety requirements for the mine truck fleet. General design criteria for locating mine roads included: development of a two-lane transportation route that is suitable for mine trucks, safe transport of mine supplies with a grade of less than eight percent; minimizing construction and maintenance costs; geometrically designing roads with the lowest volumes of fill; minimizing drainage crossings and locating necessary crossings at hydrologically prudent locations; locating suitable material sites within proximity of the proposed project to minimize road construction cost and associated impacts of material site access roads; and avoidance and minimization of impacts to WOUS. The length of road access required was minimized by the compact design of the mine facilities, which shortened the distance between areas and minimized impacts to WOUS. Where practicable, mine roads were designed to reach multiple locations via the same access, and avoid the need for secondary roads and additional WOUS impacts.
- Laydown Pads – Laydown pads are areas to store equipment and mine supplies. General design criteria for locating laydown pads included: proximity to mine facilities; geometrically designing pads with the lowest volumes of cut and fill; wetlands avoidance and minimization; and factors such as hydrology and soil stability. Where practicable, laydown areas were located in uplands and adjacent to other pads to minimize mine road construction needs and additional impacts to WOUS, including stream crossings. Development of laydown areas at the MA adjacent to long-term disturbance areas reduces the need for additional equipment and material storage at the proposed Jungjuk (Angyaruaq) Port.
- Facilities Co-located with Other Facilities – Where practicable, facilities were designed to share space and accommodate multiple uses to minimize the project ground disturbance footprint. Two proposed material sites within the Omega and Anaconda drainages will be used as overburden storage areas after the required material volume has been extracted. The ore stockpile and contact water dams have been located within the footprint of the WRF.
- Road Stream and Drainage Crossings – The mine roads were designed to minimize the number of stream and drainage crossings. Where these were unavoidable, the road was designed to approach each WOUS perpendicular to the flow to minimize WOUS impacts. Bridge structures or culverts will be installed at each stream and drainage crossing to facilitate vehicle passage and minimize impacts. Bridge structures will be installed at major crossings. Minor stream crossings and drainages will have culverts installed to ensure cross-flow and hydrologic connectivity. Crooked Creek is only crossed once at the MA. A full-span bridge, with no in-channel supports, will be used to avoid impacts to Crooked Creek. Retaining walls would be installed as needed to contain road embankment fill. See Engineering Drawings TA-310D1a through TA-310D1b of the Crooked Creek Bridge.
- Mine Area Restoration – The TSF Material Site-06/ TSF Stockpile 2 and TSF Material Site-07/TSF Stockpile 3 within the Anaconda drainage will be used as growth media storage areas after the material has been extracted. Post mine, the growth media fills will be removed and used for reclamation purposes, and the sites will be returned to WOUS. See Block 23 CMP Attachment C for a detailed description of proposed MA restoration plan related to these facilities.

- Condemnation Drilling – Condemnation drilling tests were conducted under the mine facilities to verify that no recoverable minerals occur, so that facilities could be sited without the risk of future relocation impacting additional WOUS.
- Reclamation and Closure – A reclamation and closure plan has been prepared for the mine. To summarize: stockpiled overburden and organic materials will be used to reclaim the WRF, TSF, pads, material sites, and the majority of mine roads. While some of the reclaimed areas will no longer meet WOUS criteria, these areas will provide habitat for wildlife species and native plants.

Minimization During Construction

- Vegetation Clearing Activities – Vegetation clearing for the proposed MA facilities will be scheduled to occur outside the migratory bird nesting season as best possible consistent with the United States Fish and Wildlife Service (USFWS) guidance. If avoiding the suggested window is not possible, the area will be surveyed for the presence of nests immediately prior to clearing activities during the restricted clearing periods, and identified nests can be provided appropriate protection; or if otherwise authorized by permit from the USFWS. The Migratory Bird Treaty Act (MBTA) prohibits the killing or harassment of migratory birds, and migratory bird nests, eggs, or nestlings if work were to be conducted in nesting habitat during the spring and summer breeding season. Clearing will not be conducted outside established vegetation clearing boundary limits. Cut vegetation will be piled within the project disturbance limits, so as not to block surface water flows or adversely affect nearby WOUS except when used to provide Best Management Practices (BMPs) for stormwater management under the Multi-Sector General Permit (MSGP).
- Erosion Control Measures – Erosion control and construction methods will be described in the Donlin Gold Stormwater Pollution Prevention Plan (SWPPP) required by the State of Alaska 2015 MSGP for Stormwater Discharges Associated with Industrial Activity. BMPs for embankment stabilization, including contouring and seeding will be employed project-wide to reduce embankment erosion and potential sediment runoff into WOUS. The State of Alaska will provide a Certification under Section 401 of the Clean Water Act. The Donlin Gold Project will comply with the State's Water Quality Standards.
- Construction in Drainages – To minimize potential sediment suspension and transport, stream crossing structures will be constructed during periods of low flow or normal flow regimes. Water diversion structures will be implemented where required.
- Temporary Construction Work Areas – Temporary construction work areas (buffers) are located adjacent to all proposed MA facilities to provide a transition between proposed cut and fill locations and adjacent land use. Buffer widths vary, but are typically 25 feet. Trees and tall shrubs will be cut, but organic soil and root mass will be left intact as practicable. Stumps will only be removed if it is determined that intact stumps would pose a risk to the installation of structures, the movement of equipment, or the safety of personnel. Stockpiled materials will not be placed in WOUS. Existing disturbed areas for temporary construction activities will be used to the maximum extent possible to avoid new disturbance.

- Development of Material Sites – Material sites within Omega Gulch and Anaconda Creek watersheds would have unavoidable impacts to WOUS. The following construction guidelines are provided to limit the disturbance footprint, prevent impacts to nearby WOUS, and minimize the overall footprint to WOUS. Construction considerations for material sites include:
 - Source material testing for metal leaching and acid rock drainage potential will be completed on hard rock material sites prior to mining. Material that does not meet environmental standards will not be used as fill. By not using acid generating and metal leaching material, water quality standards will be met.
 - Material site and work area boundaries will be surveyed and monumented with a Global Positioning System (GPS) device as well as physically marked, using rebar stakes and flagging prior to breaking ground to avoid impacting WOUS outside of the permitted area.
 - Vegetation and organic soils will be stockpiled separately from overburden in uplands as practicable for future use in reclamation.
 - Appropriate offsets will be provided between overburden berms and the active pit areas.
 - Material work pads will be used in summer construction over thaw-unstable permafrost and any overlaying wetlands and soft soils; the organic layer will be left intact to slow thermal degradation and to aid in final reclamation.
 - Mining will proceed in a benched manner. Individual benches will be no more than 40 feet apart vertically, and will be no narrower than 20 feet wide. Multiple benches can be in production at one time, with slope angles of approximately 2 Horizontal (H):1 Vertical (V).
- Material Sites Reclamation – Material sites will be reclaimed following these guidelines:
 - Grade overburden or unusable material piles after use to slopes of 3(H):1(V), or flatter.
 - Except where the steepness of the wall makes it impractical or impossible, pits and quarry walls will be reclaimed as follows:
 - The pit and quarry walls will be reclaimed when future development is not required.
 - Pit and quarry walls will be graded to 2(H):1(V) or flatter. Stockpiled overburden or unusable material can be used for grading.
 - Available organic soils will be spread over re-graded slopes. Spread available vegetative material over the organic soils to aid re-establishment of native species, and seed as necessary.
 - At the end of use, un-reclaimed faces will be scaled of loose and dangerous rock so that the faces are left in a condition such that they will not collapse or allow loose rock to present a safety hazard.
 - The pit floor or pad will be graded to a flat or gently sloping shape, and all equipment and non-native debris and waste will be removed.

- The active work area will be reclaimed with access roads and culverts removed and reclaimed when access is no longer needed.
- Invasive Plant Species – Construction activities requiring re-seeding of vegetation cover will utilize certified seed materials meeting requirements of the State of Alaska Seed Regulations (11 Alaska Administrative Code [AAC] 34 Articles 1 & 4) regarding purity, germination, and weed restrictions. Construction BMPs will be employed to keep equipment clean and prevent the spread of invasive species. BMPs can include establishing an equipment cleaning practice, invasive species education for staff and contractors, scheduling work at times when plants do not have viable seeds, using certified weed-free erosion control products, controlling invasive species at material sites, disposing of spoil and vegetation contaminated with invasive species appropriately, re-vegetating with local native plant species, and developing a monitoring and treatment plan. Stream corridors are pathways for the spread of invasive species. Crooked Creek has only one bridged crossing, and the project includes only one facility (treated water discharge facility) near the floodplain, thus minimizing the potential for invasive species to spread through the downstream Crooked Creek floodplain.
- Spill Prevention – Procedures to avoid or minimize the potential for spills into WOUS will be implemented. Refueling activities and fuel storage will take place in uplands and 100 feet from WOUS, except under the following circumstances: equipment that is not mobile or must remain on site for prolonged periods to safely complete a construction task (e.g., drill rigs, cranes for structure installation, water pumps) may be refueled in wetlands, providing that proper temporary spill prevention, control, and containment procedures are employed. In addition, there is only one crossing of Crooked Creek and one facility in the floodplain, minimizing the risk of spills reaching Crooked Creek.
- Fugitive Dust Control – The Donlin Gold Project (Project) incorporates design features that minimize dust emissions that have the potential to adversely affect local air quality from ore processing activities (e.g., ore crushing, ore conveying, and stockpiling of crushed ore) through a combination of emissions capture and control, and enclosures. A Fugitive Dust Control Plan (FDCCP) has been developed, which includes BMPs to minimize fugitive dust emissions.

Transportation Area (TA)

The proposed facilities in the TA include the Jungjuk (Angyaruaq) Port, a 30-mile mine access road, a 5,000-foot airstrip and connecting road, a camp with associated utility corridors, and material sites with associated access roads. The following measures were included in the Project to avoid and minimize impacts to WOUS.

Avoidance and Minimization During Design

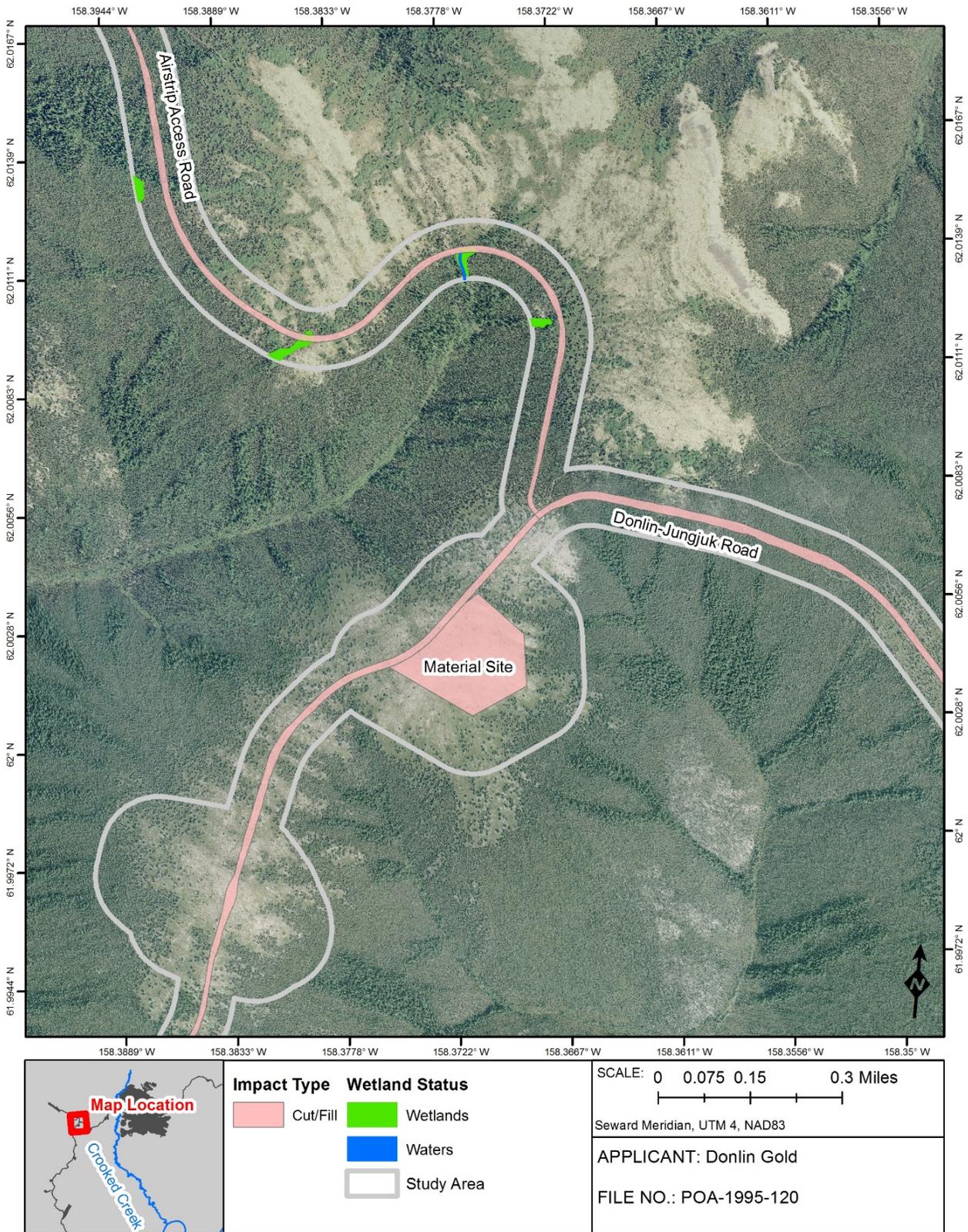
- Transportation Area Alternatives – Project development considered two practical port location alternatives: Birch Tree Crossing (BTC) and Jungjuk (Angyaruaq) Port, each with a road connecting the port to the proposed MA. In evaluating each port/road alternative, the following engineering design criteria were utilized: development of a two-lane transportation road that is safe for transporting mine supplies with a grade of less than eight percent; minimizing construction and maintenance costs; geometrically designing a facility with the lowest volumes of fill; minimizing drainage crossings and placing crossings perpendicular to flow, locating

suitable material sites close to the proposed road to reduce impacts of material site access roads. The BTC route is 76 miles long and would require 32 material sites (1,012 acres total), with potential to impact 285 acres of WOUS. The Jungjuk (Angyaruaq) Port is 30 miles long, and requires 13 material sites (431 acres total), impacting 36 acres of WOUS. The BTC road itself would impact approximately 260 acres; while the Jungjuk (Angyaruaq) Port road would impact 55 acres of WOUS. The selection of the Jungjuk (Angyaruaq) Port site over the BTC port site and associated roads and material sites, results in reduced wetland impacts.

- Placement of Facilities to Avoid and Minimize Impacts to WOUS – TA facilities were located on upland ridgetops instead of wetter hillsides and valleys, as practicable, or sited away from WOUS. Examples of this are: the Donlin-Jungjuk Road (Figure 4), camp (Figure 5), and airstrip (Figure 6). The TA project facilities require the development of 13 material sites, five of which would impact WOUS. Material site boundaries were adjusted to avoid and minimize impacts to WOUS, as practicable. The transportation facilities are designed to limit the number of watersheds disturbed. The road leaving the port first climbs up out of the Jungjuk Creek watershed, then enters the Crooked Creek watershed, where it remains for the remainder of the route. After crossing the Getmuna tributary to Crooked Creek, the road straddles the ridge line/drainage divide between Crooked Creek and the Iditarod River watershed to the west, but does not impact wetlands in that watershed. The airstrip is the only other facility located outside the Crooked Creek watershed, but is located on a ridge line, avoiding wetlands (see Figure 6). The airstrip was placed on a ridgetop to minimize the amount of cut and fill in WOUS.
- Jungjuk (Angyaruaq) Port Design – The port location selection criteria included: distance to the mine to minimize road footprint and transportation costs; avoidance of private land; adequate depth to dock and maneuver barges throughout the summer season without the need to dredge; avoidance of cultural resources; avoidance of WOUS; minimization of the amount of onshore grading; minimization of the probability of water or ice jams overtopping the wharf during the freshet; and sizing to fit 1,000 Twenty-foot Equivalent Units (TEU); stackable containers. The proposed Jungjuk (Angyaruaq) Port is 30.5 acres and includes 16.2 acres of unavoidable impacts to WOUS. The Jungjuk (Angyaruaq) Port footprint was reduced by: planning to store cargo temporarily rather than permanently for transport to and from the mine; transporting cargo in stackable TEU containers; and stacking loaded containers up to three TEUs high, and empty containers up to six TEUs high. Following mine closure, the port will be reclaimed by removing the wharf fills, including sheet pile, and the area will be re-contoured leaving the access road and a “beach-type” landing in place.
- Co-located Facilities – Where practicable, facilities will share space or accommodate multiple uses to minimize the Project ground disturbance footprint: the proposed camp facilities will be constructed within the disturbance footprint of Material Site-01; non-wetland material sites will be used for the temporary storage of construction equipment, refueling, and overburden storage during construction; the airport will be placed in the closest practicable location to the Donlin-Jungjuk Road. The Donlin-Jungjuk Road will be used to gain access to the airport with a short spur road. Transmission lines were designed parallel to roads to reduce access route footprints and the number of drainages disturbed.

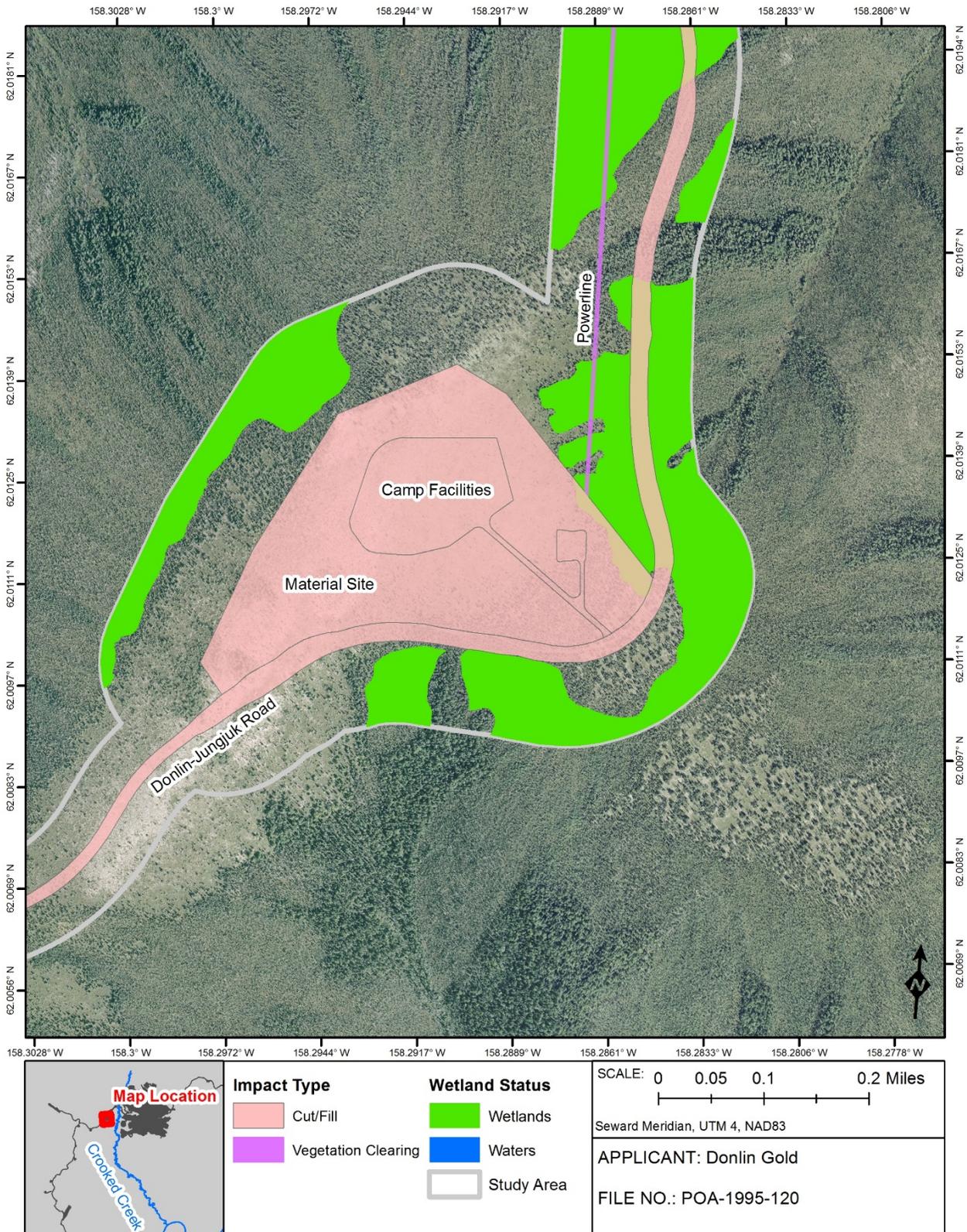
- Road Stream and Drainage Crossings – The Donlin-Jungjuk Road was designed to minimize the number of stream and drainage crossings by following upland ridgelines to the extent practicable (Figure 4). Where stream crossings were unavoidable, the road approaches are designed to be perpendicular to the flow to minimize WOUS impacts. Bridge structures and/or culverts will be installed at each stream and drainage crossing to facilitate vehicle passage and minimize impacts. Bridge structures will be installed at six major stream crossings where fish presence has been identified. Each bridge was designed to span the width of the creek, either as a steel span or steel span arch, and designed to account for high-water flow conditions. Riprap will be placed along the length of the arch or wall bases on both the upstream and downstream ends of the structure to protect the arch bases from erosion. Minor stream crossings and drainages will have appropriately sized culverts installed to ensure cross flow and maintain hydrologic connectivity. The State of Alaska will provide a Certification under Section 401 of the Clean Water Act. The Project will comply with the State’s Water Quality Standards.
- Material Site Restoration – Material sites that impact WOUS were evaluated to determine viable opportunities to offset impacts through restoration. Material Sites-01, 05, 10, 12, and 16 have unavoidable impacts to WOUS. Material Sites-10, 12, and 16 were identified as most likely to provide wetland restoration and creation opportunities based on proximity to groundwater hydrology and final grading elevations. Block 23 CMP Attachment F describes Donlin Gold’s plans to restore wetlands in these areas.

Figure 4 Transportation Corridor – Avoidance Measures



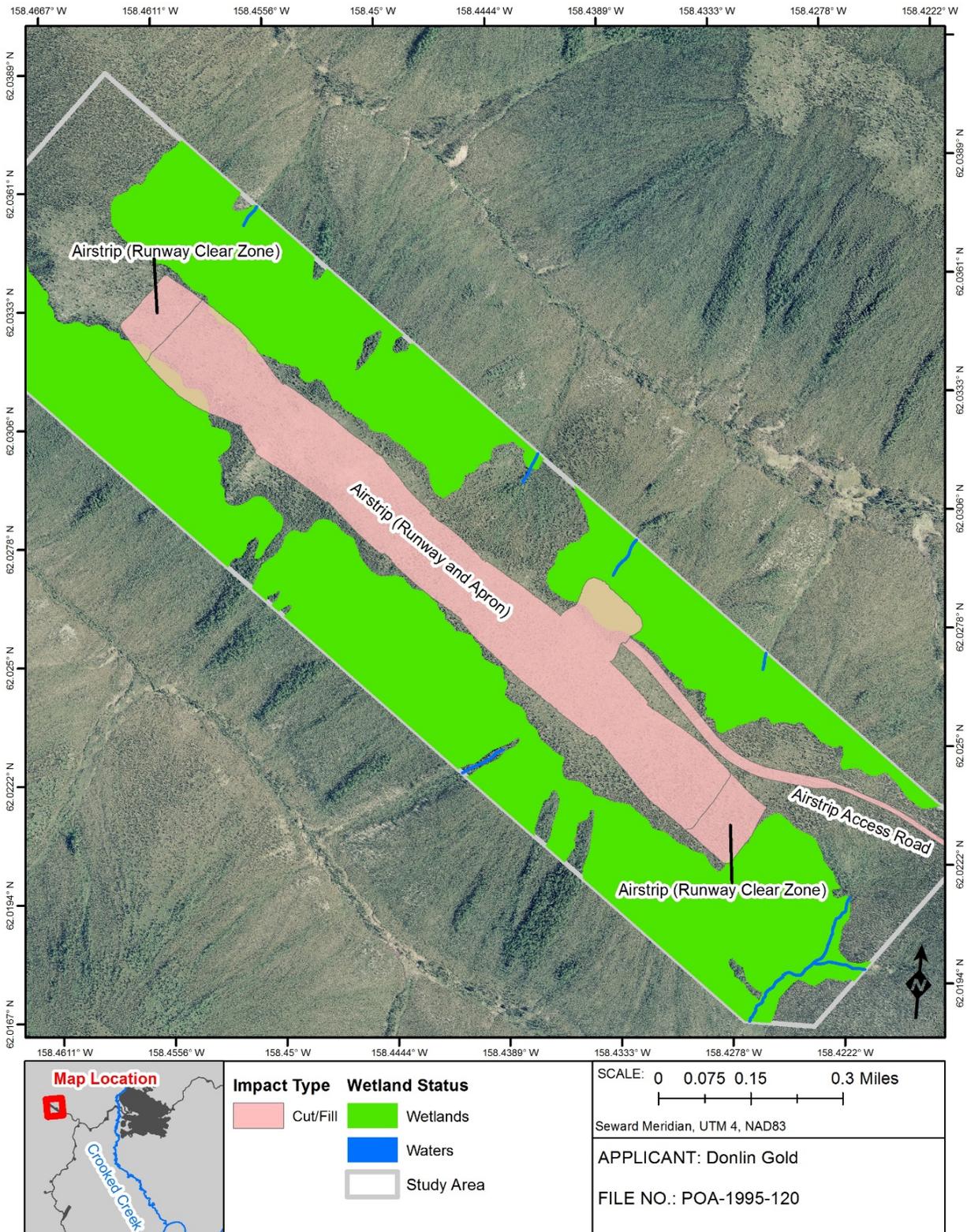
DG: MATA_Road_AM_v02.mxd, 06/16/2017, R03

Figure 5 Camp Facilities Location



DG: MATA_Camp_AM_v02.mxd, 06/16/2017, R03

Figure 6 Airstrip Location



DG: MATA_Airstrip_AM_v02.mxd, 06/13/2017, R02

Minimization During Construction

- Vegetation Clearing Activities – Vegetation clearing for the proposed TA facilities will be scheduled to occur outside the migratory bird nesting season as best possible, consistent with USFWS guidance. If avoiding the suggested window is not possible, the area will be surveyed for the presence of nests immediately prior to clearing activities during the restricted clearing periods, and identified nest can be provided appropriate protection; or if otherwise authorized by permit from the USFWS. The MBTA prohibits the killing or harassment of migratory birds, and migratory bird nests, eggs, or nestlings if work were to be conducted in nesting habitat during the spring and summer breeding season. Clearing will not be conducted outside established vegetation clearing boundary limits. Cut vegetation will be piled within the Project disturbance limits, so as not to block surface water flows or adversely affect nearby WOUS except when used to provide BMPs for stormwater management under the MSGP.
- Erosion Control Measures – Erosion control and construction methods will be described in the SWPPP required by the State of Alaska 2016 Construction General Permit for Stormwater Discharges for Large and Small Construction Activities. BMPs for embankment stabilization, including contouring and seeding, will be required Project-wide to reduce embankment erosion and potential sediment runoff into WOUS. Stockpiling of material, equipment staging, and mobilization will avoid WOUS, as practicable. When filling in wetlands, temporary straw waddles, silt fencing, or other BMPs will be employed to reduce sediment runoff into temporary short-term fill areas. Embankments will be tracked and stabilized in accordance with BMPs to prevent embankment erosion and sediment runoff. The State of Alaska will provide a Certification under Section 401 of the Clean Water Act. The Project will comply with the State's Water Quality Standards.
- Construction in Drainages – To minimize potential sediment suspension and transport, culverts and bridges will be constructed during periods of low flow or normal flow.
- Temporary Construction Work Areas – Temporary construction work areas (buffers) are provided adjacent to all proposed TA facilities. Buffers vary in width, but are typically 25 feet. Trees and tall shrubs will be cut, but organic soil and vegetative mat will be left intact and stockpiled materials will not be placed in WOUS, as practicable. Stumps will only be removed if it is determined intact stumps pose a risk to the installation of structures, the movement of equipment, or the safety of personnel.
- Development of Material Sites – Material Sites-01, 05, 10, 12, and 16 have unavoidable impacts to WOUS. The following construction guidelines limit the disturbance footprint, prevent impacts to nearby WOUS, and minimize the overall impacts to WOUS. Construction considerations for material sites included:
 - Source material testing for metal leaching and acid rock drainage potential will be completed on hard rock material sites prior to mining. Material that does not meet environmental standards will not be used as fill. By not using acid generating and metal leaching material, water quality standards will be met.

- Material site and work area boundaries will be surveyed and marked with high visibility stakes and flagging prior to breaking ground to avoid impacting WOUS outside of the permitted area.
- Vegetation and organic soils will be stockpiled separately from overburden in uplands as practicable for future use in reclamation.
- Appropriate offsets (10 feet typical) will be provided between overburden berms and the active pits.
- Mining will proceed in a benched manner. Individual benches will be no more than 40 feet apart vertically, and will be no narrower than 20 feet wide. Multiple benches can be in production at one time, with slope angles of approximately 2(H):1(V).
- Material Sites Reclamation – When no longer needed, material sites will be reclaimed following these guidelines:
 - Overburden or unusable material piles will be graded after use to slopes of 3(H):1(V), or flatter.
 - Except where the steepness of the wall makes it impractical or impossible, pits and quarry walls will be reclaimed as follows:
 - Pit or quarry walls will be reclaimed when future development is not required.
 - Pit or quarry walls will be graded to 2(H):1(V) or flatter. Stockpiled overburden or unusable material can be used for grading.
 - Available organic soils will be spread over re-graded slopes. Available vegetative material will be spread over the organic soils to aid re-establishment of native species, and seeded as necessary.
 - At the end of use, un-reclaimed faces will be scaled of loose and dangerous rock so that the faces are left in a condition such that they will not collapse or allow loose rock to present a safety hazard.
 - The pit floor or pad will be graded to a flat or gently sloping shape, and all equipment and non-native debris and waste will be removed.
 - The active work area will be reclaimed and access roads will be removed or reclaimed.
- Invasive Plant Species – Construction activities requiring re-seeding of vegetation cover will utilize certified seed materials meeting requirements of the State of Alaska Seed Regulations (11 AAC 34 Articles 1 & 4) regarding purity, germination, and weed restrictions. Construction BMPs will be employed to keep equipment clean and prevent the spread of invasive species. BMPs can include establishing an equipment cleaning practice, invasive species education for staff and contractors, scheduling work at times when plants do not have viable seeds, using certified weed-free erosion control products, controlling invasive species at material sites, disposing of

spoil and vegetation contaminated with invasive species appropriately, re-vegetating with local native plant species, and developing a monitoring and treatment plan.

- Spill Prevention – Procedures to avoid or minimize the potential for spills into WOUS will be implemented. Refueling activities and fuel storage will take place in uplands and 100 feet from WOUS, except under the following circumstances: equipment that is not mobile or must remain on-site for prolonged periods to safely complete a construction task (e.g., drill rigs, cranes for structure installation, water pumps) may be refueled in wetlands, providing that proper temporary spill prevention, control, and containment procedures are employed.
- Fugitive Dust Control – The Project incorporates design features that minimize dust emissions that have the potential to adversely affect local air quality, from ore processing activities (e.g., ore crushing, ore conveying, and stockpiling of crushed ore) through a combination of emissions capture and control, and enclosures. A FDCP has been developed, which includes BMPs to minimize fugitive dust emissions.

Pipeline Area (PA)

The proposed PA facilities include a natural gas pipeline and fiber optic cable, compressor station, metering station, pig launcher/receiver site, check valves, and associated construction related facilities such as: camps and temporary airstrips, construction access roads, material sites, Pipe Storage Yard, shoofly and site access roads, HDD workspaces, water extraction site and access roads, work pads and the pipeline construction Right-of-Way (ROW). The following measures are included in the Project to avoid and minimize impacts to WOUS:

Avoidance and Minimization During Design

- Pipeline Area ROW Alternatives – Design considerations for the proposed pipeline route included selection of the shortest pipeline length possible to minimize Project footprint, while avoiding the following to the extent practicable: geotechnical hazards; hydrological hazards; known environmental and cultural sites, the Iditarod National Historic Trail (INHT); and potential land use conflict areas. The pipeline route and ROW design also considered seasonal construction schedules; constructability; and avoidance and minimization of impacts to WOUS. Several route alternatives were evaluated to traverse the Alaska Range, which is the largest geographical obstacle between the origin and terminus of the pipeline. The Jones River and Rainy Pass (Dalzell Gorge) routes were deemed practical, but the Jones River route was determined to be the preferred alternative to avoid geohazards in the Dalzell Gorge and potential land use conflicts with the INHT. The North Route avoids crossing the Happy and Skwentna Rivers, contains less WOUS impact acres and linear feet, and moves the PA ROW away from the INHT. Routing alternatives developed leading up to and through the Alaska Range are shown in Table 1 and Figure 7. Other re-routes avoided geohazards at the Castle Mountain and Denali Fault locations and the Susitna Flats State Game Refuge near the mouth of the Susitna River. Routes were moved higher on mountain sides and along ridgetops to avoid wetlands and streams along valley bottoms, as practicable.

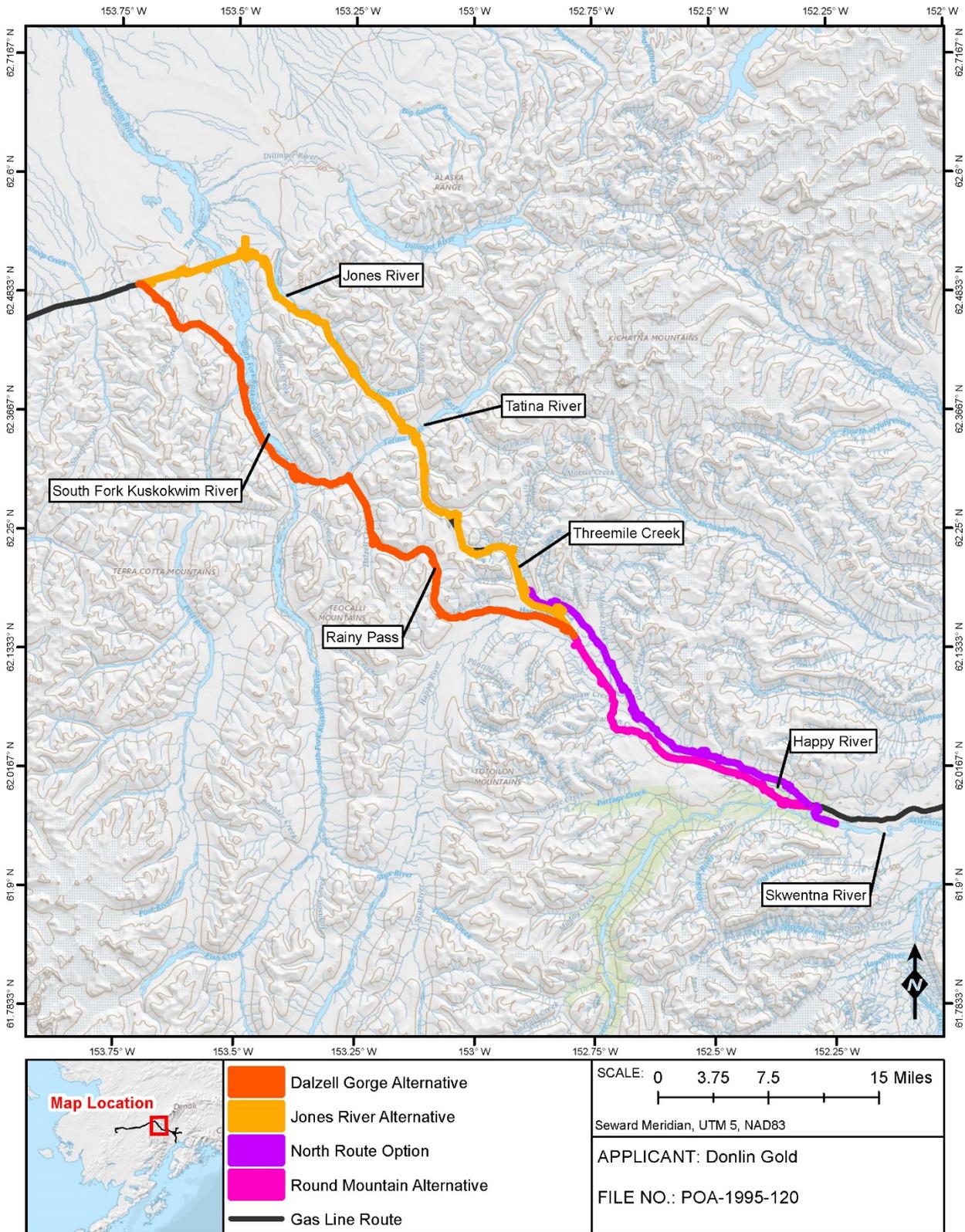
Table 1 Alaska Range Alternative Locations

Pipeline Route Alternative	General Description	Estimated WOUS Acres Impacted
Dalzell Gorge	Route alternative from MP 106.1 to 153.1. Traverses Rainy Pass and parallels the South Fork Kuskokwim River.	257
Jones Route	Route alternative from MP 106.1 to 153.1. Diverges at Threemile Creek, crosses the Tatina River, and parallels the Jones River.	89
North Route (Proposed)	Route alternative from MP 85 to 112. Parallels the Happy River on the north side from its confluence with the Skwentna River to Threemile Creek.	44
Round Mountain Route	Route alternative from MP 85 to 112. Crosses the Happy River near its confluence with the Skwentna River and parallels the Happy River on the south side.	65

- Compressor Station – During design, the compressor station was converted from electric power to natural gas power. This eliminated the need for a transmission line. The transmission lines would have needed adjacent corridors with cleared vegetation. Transmission lines can lead to increased all-terrain vehicle use in accessible areas. One compressor station is adequate to meet the pipeline design capacity.
- Pipeline Diameter – The pipeline diameter was increased during design from 12-inch to 14-inch to ensure adequate capacity of natural gas for mine operations. This reduced the need for future upgrades to the pipeline.
- Roadless Design – The pipeline has been designed to be installed primarily underground, eliminating the need for road access which would have created permanent roads and long-term impacts along the pipeline route.
- Horizontal Directional Drilling (HDD) – All pipeline stream crossings were analyzed for flow, width, and characterization to determine crossing modes to avoid major diversions in rivers and major re-routes. HDD methods will be used to install the pipeline underneath the Skwentna, Happy, Kuskokwim, George, East Fork George, and the North Fork George Rivers. Excavated cuttings from HDD sites will not be placed in waterbodies or in drainages. Without HDD crossings, there would be a larger disturbance footprint for gravel pads necessary for crossing and work areas, and likely aerial crossings of these rivers. Criteria for HDD stream crossing locations included 100-year flood recurrence interval, depth of cover, setbacks for pipe exposure, bank mitigation/restoration to prevent erosion, bank protection, fish habitat and recreation value, and adverse impacts to WOUS. The State of Alaska will provide a Certification

under Section 401 of the Clean Water Act. The Project will comply with the State's Water Quality Standards.

Figure 7 Alaska Range Alternative Locations



DG: PL_Route_Alternatives_AM.mxd, 12/20/2017, R02

- Use of Existing Facilities and Infrastructure – The barge landing in Cook Inlet would utilize an existing landing area and access road. Existing winter roads would be used to access the eastern portions of the pipeline. The Farewell airstrip will be used to access portions of the pipeline and transport equipment and personnel.
- Use of Barge, and Winter Access Routes – Barge traffic and winter access routes included in the design reduce the need for additional permanent roads. Construction of barge landings on the Kuskokwim River will not require placement of fill below ordinary high water. The barge landing on Cook Inlet is an existing developed facility. The Cook Inlet barges will use their attached loading ramps to help offload pipe and supplies. No dredging will be conducted and no fill will be placed below mean high tide.
- Reduced Footprint Design of Ancillary Facilities – Where practicable, material sites, airstrips, and camps are within the pipeline ROW or adjacent to each other to enhance collocation, decrease the need for ancillary roads, and thus reduce footprint size.
- Placement of Material Sites to Avoid and Minimize WOUS – The PA includes 69 material sites totaling 1,008 acres. Six of the PA material sites impact wetlands and waters, totaling 10.4 acres of impact. Of the six material sites, three (Material Sites-01, 38, and 41), were identified as most likely to provide wetland restoration and creation opportunities based on proximity to groundwater hydrology and final grading elevations.
- Placement of Other Facilities to Avoid and Minimize WOUS – Work pads will be the minimum size necessary for equipment and construction activities and were sited in uplands along the pipeline ROW. Temporary construction camps and airstrips were sited in uplands. Existing winter trails will be integrated into the winter ice routes for transportation of pipeline construction infrastructure. The timing of the construction and use of ice roads eliminates the need for permanent gravel access roads and construction pads. The pig launcher/receiver site (Figure 8) was sited in uplands.
- Co-located Facilities – Several facilities along the pipeline will be multi-purpose. These include: material sites, laydown areas, equipment storage, staging areas, fueling areas, material and pipeline stockpiling, camp units, and airstrips.
 - The compressor station (Figure 9) is sited at an existing previously disturbed area. The Kuskokwim River HDD crossing includes a pipe laydown area collocated with a material site (Figure 10). Figure 9 and Figure 10 illustrate the siting of these facilities in uplands to avoid wetlands and WOUS.
 - The Skwentna River HDD Exit will be located on a material site pad.
 - The currently operating Cook Inlet Barge Landing will be used for supplies transport in addition to stockpiling pipe and materials.

Figure 8 Pig Launcher/Receiver Site

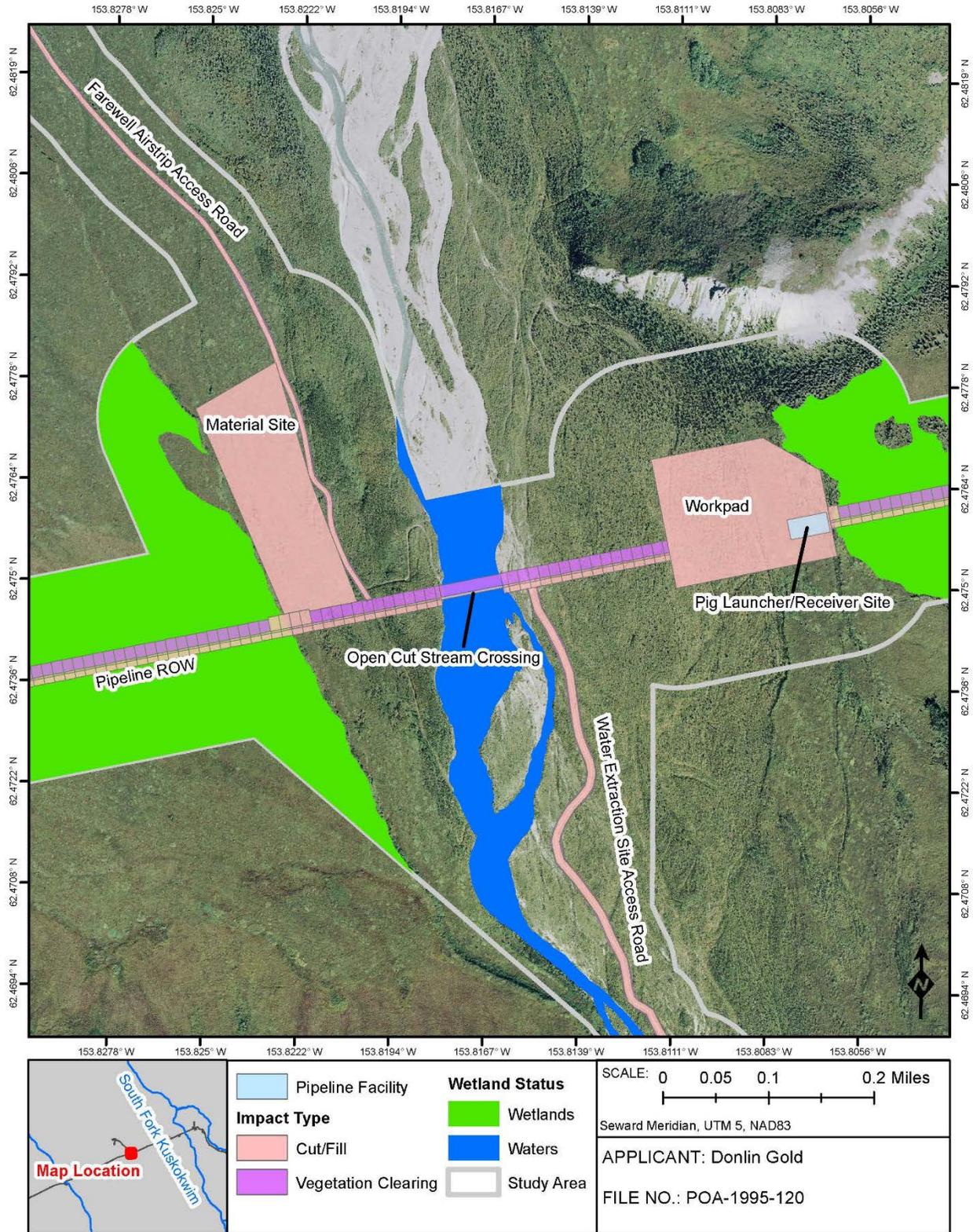
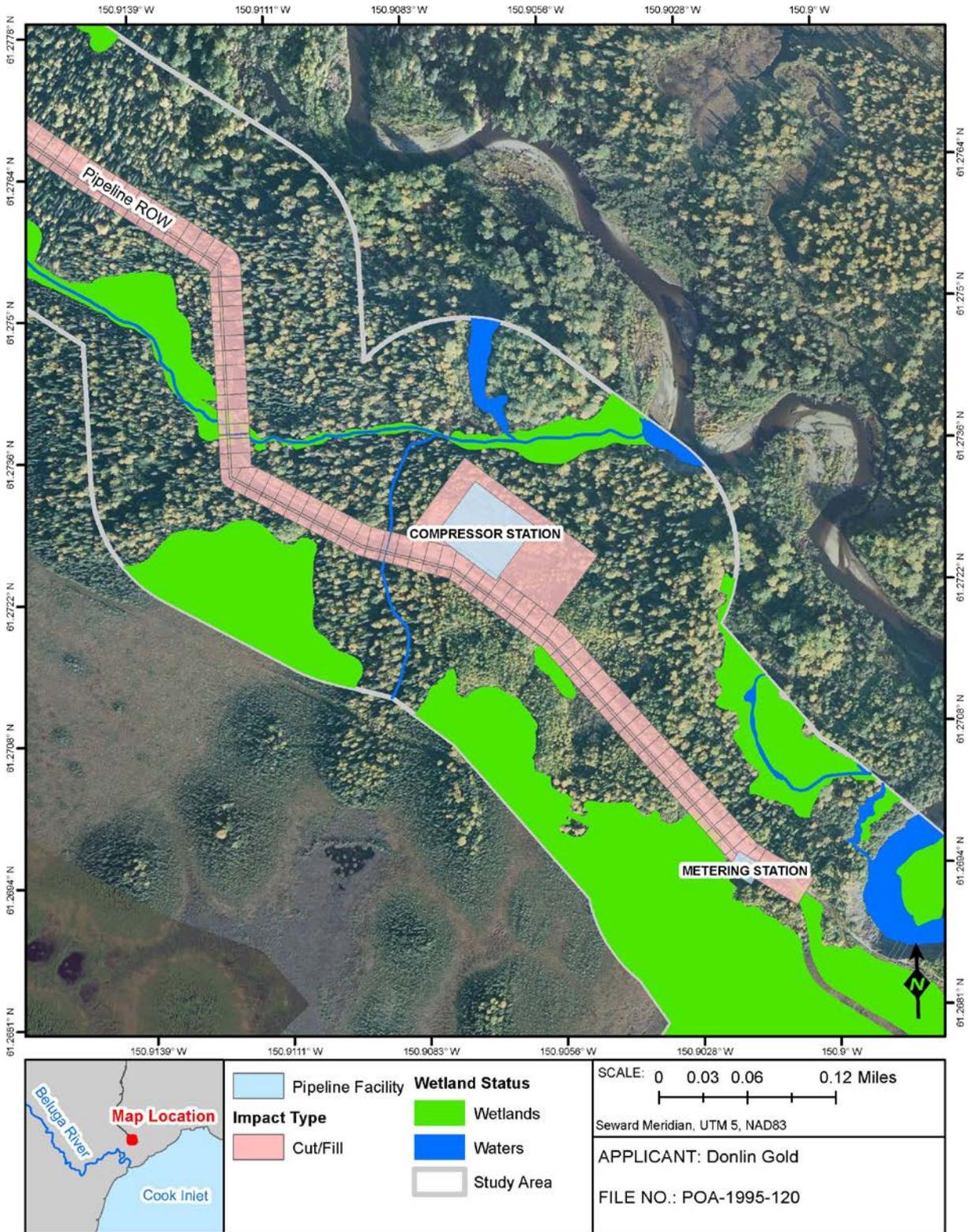
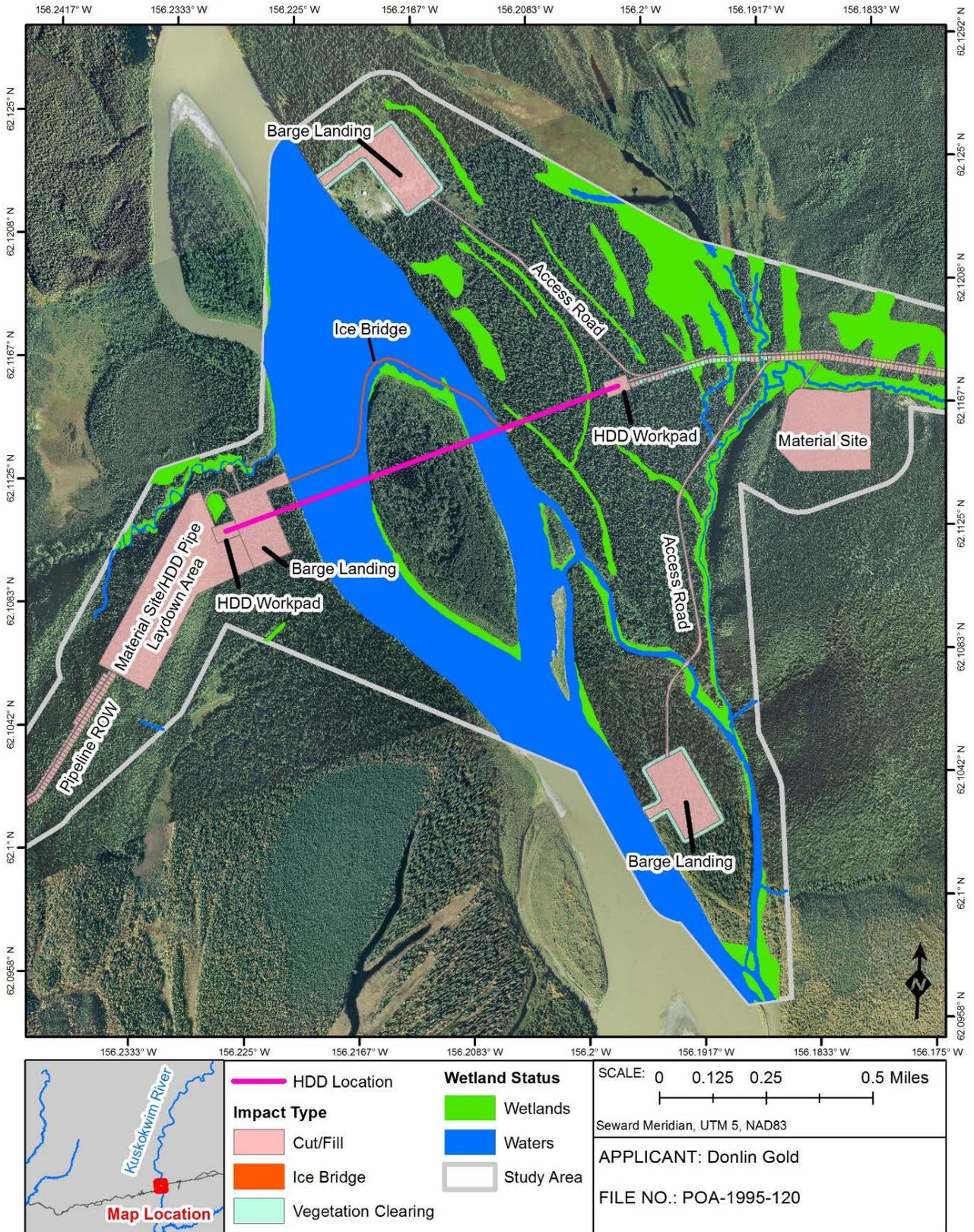


Figure 9 Compressor Station Location



DG: Pt_Compressor_AM_v02.mxd, 12/14/2017, R04

Figure 10 Kuskokwim River HDD Crossing Location



DG: PL_Kuskokwim_AM.mxd, 06/16/2017, R06

- Stream and Drainage Crossings – The pipeline was designed to minimize the number of stream and drainage crossings, and the total pipeline length and ROW width. The pipeline ROW was designed to the minimum width necessary to complete construction activities: approximately 100 to 150 feet for construction in wetlands depending on site-specific conditions.

Minimization During Construction

- Vegetation Clearing Activities – Vegetation clearing for the proposed PA facilities will be scheduled to occur outside the migratory bird nesting season as best possible, consistent with USFWS guidance. If avoiding the suggested window is not possible, the area will be surveyed for the presence of nests immediately prior to clearing activities during the restricted clearing periods, and identified nest can be provided appropriate protection; or if otherwise authorized by permit from the USFWS. The MBTA prohibits the killing or harassment of migratory birds, and migratory bird nests, eggs, or nestlings if work were to be conducted in nesting habitat during the spring and summer breeding season. Clearing will not be conducted outside established vegetation clearing boundary limits. Cut vegetation will be piled within the Project disturbance limits, so as not to block surface water flows or adversely affect nearby WOUS except when used to provide BMPs for stormwater management under the MSGP.
- Erosion Control Measures – Erosion control and construction methods will be described in the SWPPP, and will comply with the State of Alaska 2016 Construction General Permit for Stormwater Discharges for Large and Small Construction Activities. BMPs for embankment stabilization, including contouring and seeding will be required Project-wide to reduce embankment erosion and potential sediment runoff into WOUS. Construction methods in wetlands will minimize construction-related effects on wetlands, including marking wetland boundaries and clearing limits, using winter construction to the maximum extent practicable, confining activities to the construction zone to prevent disturbance of surrounding vegetation, maintaining slope stability, controlling erosion, using mats or other ground protection during non-winter months, maintaining existing wetland hydrology, minimizing disturbance in wetlands, and constraining permanent facilities to uplands. Mats will be utilized in a leap frog construction technique. All mats will be removed from wetlands. The State of Alaska will provide a Certification under Section 401 of the Clean Water Act. The Project will comply with the State's Water Quality Standards.
 - While working in wetlands, crews will use mats, where practical to protect vegetation and soils from equipment; low ground-pressure tires will be used on equipment operating on or near wetlands. Ditch plugs will be installed in the pipe trench at stream crossings and at wetland-upland interfaces as needed.
- Stream and River Crossings – Open-cut stream crossings will be used during normal to low flow and low-habitat sensitivity periods. Disturbed areas will be stabilized using geotextile matting, gravel blankets, riprap, gabions, or other geosynthetics. All stream banks will be stabilized and re-vegetated as soon as practicable following the methods described in the Project restoration plan. Where practicable, mobile modular bridges will be used. The East Fork of the George River will be crossed with a temporary floating bridge during construction. For descriptions of reclamation at stream crossings, see Engineering Drawings PA-142T through PA-147T.

- Temporary Construction Activities – Grading will only occur where necessary for equipment to access construction locations. The organic layer will remain intact except at the trench cut or where side hill cuts occur along the alignment. On steep side slopes, double benching will be employed to reduce the cut and fill volume and associated impacts. If sufficient organic soils are present, these materials will be segregated and stockpiled for use during reclamation. Where necessary, material work pads will be used over thaw-unstable permafrost. Unless specifically required, the organic layer will be left intact to slow thermal degradation and to aid in final reclamation.
- Construction Seasons – Most areas underlain by permafrost will be crossed during winter to minimize disturbance from trenching. A seasonal construction timeline minimizes impacts to WOUS, by timing construction activities in lowlands in the winter and in uplands during the summer. Approximately 60 percent of the total pipeline length would be constructed during frozen winter conditions to minimize wetland and soil disturbances from equipment (Pipeline Construction Execution Plan December 2016). Snow and ice roads with frost packing will provide a stable surface for equipment to operate.
- Development of Material Sites – The following construction guidelines limit the disturbance footprint, prevent impacts to nearby WOUS, and minimize the overall impacts to WOUS:
 - Source material testing for metal leaching and acid rock drainage potential will be completed on hard rock material sites prior to mining. Material that does not meet environmental standards will not be used as fill. By not using acid generating and metal leaching material, water quality standards are met.
 - Material site and work area boundaries will be surveyed and monumented with a GPS device as well as physically, using rebar stakes and flagging to avoid impacting WOUS outside of the permitted area.
 - Vegetation and organic soils will be stockpiled separately from overburden in uplands as practicable for future use in reclamation.
 - Appropriate offsets will be provided between overburden berms and the active pits.
 - Material work pads will be used in summer construction over thaw-unstable permafrost and any overlying wetlands and soft soils; the organic layer will be left intact to slow thermal degradation and to aid in final reclamation.
 - Mining will proceed in a benched manner. Individual benches will be no more than 40 feet apart vertically, and will be no narrower than 20 feet wide. Multiple benches can be in production at one time, with slope angles of approximately 2.0(H):1(V).
- Material Site Reclamation – When no longer needed, material sites will be reclaimed following these guidelines:
 - Overburden or unusable material piles will be graded after use to slopes of 3(H):1(V), or flatter.

- Except where the steepness of the wall makes it impractical or impossible, pits and quarry walls will be reclaimed as follows:
 - Pit or quarry walls will be reclaimed when future development is not required.
 - Pit or quarry walls will be graded to 2(H):1(V) or flatter. Stockpiled overburden or unusable material can be used for grading.
 - Available organic soils will be spread over re-graded slopes. Available vegetative material will be spread over the organic soils to aid in re-establishment of native species, and seeded as necessary.
 - At the end of use, un-reclaimed faces will be scaled of loose and dangerous rock so that the faces are left in a condition such that they will not collapse or allow loose rock that presents a safety hazard.
 - The pit floor or pad will be graded to a flat or gently sloping shape, and all equipment and non-native debris and waste will be removed.
 - The active work area will be reclaimed and access roads will be removed or reclaimed.
- Invasive Plant Species – Construction activities requiring re-seeding of vegetation cover will utilize certified seed materials meeting requirements of the State of Alaska Seed Regulations (11 AAC 34 Articles 1 & 4) regarding purity, germination, and weed restrictions. Construction BMPs will be employed to keep equipment clean and prevent the spread of invasive species. BMPs can include establishing an equipment cleaning practice, invasive species education for staff and contractors, scheduling work at times when plants do not have viable seeds, using certified weed-free erosion control products, controlling invasive species at material sites, disposing of spoil and vegetation contaminated with invasive species appropriately, re-vegetating with local native plant species, and developing a monitoring and treatment plan.
- Spill Prevention – Procedures to avoid or minimize the potential for spills into WOUS will be implemented. Refueling activities and fuel storage will take place in uplands and 100 feet from WOUS, except under the following circumstances: equipment that is not mobile or must remain on-site for prolonged periods to safely complete a construction task (e.g., drill rigs, cranes for structure installation, water pumps) may be refueled in wetlands, providing that proper temporary spill prevention, control, and containment procedures are employed.

References

Michael Baker International. 2017a. Preliminary Jurisdictional Determination - Donlin Gold Project-Southwest Alaska. December 2016.

Michael Baker International. 2017b. North Route Addendum to the Preliminary Jurisdictional Determination – Donlin Gold Project – Southwest Alaska. August 2017.

Compensatory Mitigation Plan

Executive Summary

Donlin Gold, LLC (Donlin Gold) is proposing the development of an open pit, hard rock gold mine in Alaska. The mine is located 277 miles west of Anchorage, 145 miles northeast of Bethel, and 10 miles north of the village of Crooked Creek on the Kuskokwim River. Bethel, the largest community in western Alaska, is the administrative and transportation center of the Yukon-Kuskokwim (Y-K) Delta. The proposed Jungjuk (Angyaruq) Port site is approximately 178 river miles upstream of Bethel, and about 57 river miles upstream of Aniak, the regional transportation center for the middle Kuskokwim Valley.

The minerals at the Project are owned and were selected by Calista Corporation (Calista), an Alaska Native regional corporation, under the authority of the Alaska Native Claims Settlement Act (ANCSA) in partial compensation for the extinguishment of Alaska Native title claims. Most of the surface lands at the site are owned by The Kuskokwim Corporation (TKC), an Alaska Native village corporation comprising the ten Alaska Native villages closest to the site. Donlin Gold operates the Project pursuant to a Mining Lease with Calista and a Surface Use Agreement (SUA) with TKC.

Donlin Gold submitted a Preliminary Application for the Department of the Army Permit (DA Permit) to the United States Army Corps of Engineer (USACE) in July 2012, pursuant to Clean Water Act (CWA) Section 404 and Rivers and Harbors Act of 1899 (RHA) Section 10. In December 2012, USACE published a Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Donlin Gold Project (Project). Donlin Gold updated its DA Permit application in December 2014 and August 2015. The Draft EIS and the DA Permit application were released for public comment in November 2015. Donlin made a final update to its DA application in December 2017. Donlin Gold's Conceptual Compensatory Mitigation Plan (CMP) was submitted in November 2015 and a CMP was included with the December 2017 DA application. The Final EIS was released in April 2018 along with a Special Public Notice (SPN) soliciting public comments on the 2017 CMP. This Final CMP responds to agency and public comments on the SPN.

In 2008, the USACE and the United States Environmental Protection Agency (EPA) published regulations (33 Code of Federal Regulations [CFR] 332; 40 CFR 230) entitled, "Compensatory Mitigation for Losses of Aquatic Resources" (Mitigation Rule, or Rule). The Rule emphasized the selection of compensatory mitigation sites on a watershed basis and established operating standards for mitigation providers and mechanisms: mitigation banks, in-lieu fee (ILF) programs, and permittee responsible mitigation (PRM) Plans. Where the Project's permanent impacts primarily occur in the Crooked Creek watershed (Hydrologic Unit Code [HUC]-10 definition), no approved mitigation banks can provide credits currently, or in the timeframe of the Project permitting process. There are also no statewide ILF providers. Hence, the Project is proposing all compensatory mitigation for permanent fill impacts in the Crooked Creek watershed through PRM Plans.

Donlin Gold has evaluated all available and practicable options to assure compliance with the provisions of the Rule and the 1994 Alaska Wetland Initiative (EPA et al. 1994) through PRM alternatives, focusing first on the immediate (HUC-10) watershed and then systematically assessing larger hydrologic units (e.g., HUC-08, HUC-06, HUC-04) for compensatory mitigation opportunities. This assessment specifically included a detailed examination of the current land conditions in the Crooked Creek drainage to determine restoration opportunities.

The Project design avoids and minimizes fill impacts to wetlands and streams to the maximum extent practicable. Some Project activities in wetland areas include vegetation clearing, winter roads, and work areas where no fill placement will occur. For these activities, no compensatory mitigation credit is being proposed.

Permanent fill impacts from the proposed Project total 2,876 acres of wetlands and 173,953 linear feet (32.9 miles) of streams. The Mine Area (MA) and Transportation Area (TA) will permanently fill 2,676 wetland acres and 173,953 (32.9 miles) linear feet of streams, and the Pipeline Area (PA) includes 200 acres of permanent wetland fill with no permanent fill impacts to streams.

Donlin Gold proposes two PRM Plans, and a limited purchase of mitigation bank credits to offset the Project permanent fill impacts. They are:

- The Upper Crooked Creek PRM Plan (Attachment D) will yield substantive, near-term benefits to aquatic resources. The Upper Crooked Creek PRM Plan includes the enhancement, reestablishment, restoration, rehabilitation and preservation of wetlands, riparian areas, stream channels, and uplands within 221.5 acres. The PRM Plan will restore degraded acreage in Quartz, Snow, Ruby and Queen gulches, and at the Wash Plant Tailings Area. The PRM Plan will restore 95.7 acres of degraded floodplains into 93.0 acres of wetlands and 2.75 acres of riverine channel. A total of 8,892 linear feet of stream will be enhanced and reestablished by the restoration work in the floodplain. Within the wetland floodplain 15.2 acres of off channel ponds will be enhanced for aquatic resources. In addition, there will be 16.8 acres of adjacent upland terrestrial habitat enhanced in upper Crooked Creek. A total of 109 acres of riparian uplands, and wetland buffers will be protected around the restored and enhanced floodplain wetlands. This PRM will be initiated concurrent with the start of MA construction.
- The Chuitna PRM Plan (Attachment E) will preserve 5,870 acres, including 3,269 acres of wetlands and ponds, and 418 acres of streams and rivers, totaling 3,687 acres of Waters of the United States (WOUS). It also protects 2,183 acres of upland riparian area and buffers, and 258,056 linear feet (48.8 miles) of streams in the Chuitna watershed. Donlin Gold will execute preservation of the parcel concurrently with work authorized in the DA application for the Project.
- Prior to initiating Project construction, Donlin Gold has secured and will purchase 9.80 wetland mitigation credits from the Great Land Trust (GLT). GLT received USACE approval in June 2018 for 229 mitigation bank credits within the Matanuska-Susitna Borough (MSB) boundaries. A portion of the permanent impacts from the PA are located within the GLT's service area.

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- Attachment A Pipeline Area Wetlands Impacts by HUC-10 (Acres) Before and After Construction
- Attachment B Hydrogeomorphic (HGM) Classification
- Attachment C Mine Area Restoration Plan
- Attachment D Upper Crooked Creek Permittee Responsible Mitigation Plan
- Attachment E Chuitna Permittee Responsible Mitigation Plan
- Attachment F Transportation Area Restoration Plan

Acronyms and Abbreviations

ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AMHT	Alaska Mental Health Trust Authority
amsl	above mean sea level
ANCSA	Alaska Native Claims Settlement Act
Angler	Angler Mining Pty, Ltd.
ARMP	Aquatic Resources Monitoring Plan
ATV	All-Terrain Vehicle
AWC	Anadromous Waters Catalog
AWI	Alaska Wetlands Initiative
BLM	Bureau of Land Management
BMP	Best Management Practice
BSW	Black Spruce Woodland
Calista	Calista Corporation
CAS	Closed Alder Shrub
CBM	Coal Bed Methane
Cells	Material Site Excavation Area
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIRI	Cook Inlet Regional Incorporated
CMP	Compensatory Mitigation Plan
CWA	Clean Water Act
DA	Department of the Army
Donlin Gold	Donlin Gold, LLC
DSSR	Disturbance-related shrub and sapling re-growth
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERDC	U.S. Army Engineer Research and Development Center
ESA	Endangered Species Act of 1973
FR	Federal Register
FVP	Field Verification Points
GPS	Global Positioning System
GLT	Great Land Trust
Hansen	Hansen Industries, Inc.
HDD	Horizontal Directional Drilling
HGM	Hydrogeomorphic
HMU	Habitat Mapping Unit
HUC	Hydrologic Unit Code
ILF	In-Lieu Fee
IR	Invasiveness Rank
LGL	LGL Alaska Research Associates, Inc.

LMP	Long-term Management Plan
LST	Low Shrub Tundra
m ²	meter-squared
MA	Mine Area
MH	Mesic Herbaceous
Michael Baker	Michael Baker International
MLRA	Major Land Resources Areas
MSC	Material Site Closure
MSB	Matanuska-Susitna Borough
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
OAS	Open Alder Shrub
OAWS	Open Alder Willow Shrub
OBSF	Open Black Spruce Forest
OWS	Open Willow Shrub
OWSF	Open White Spruce Forest
PA	Pipeline Area
PAF	Preservation Adjustment Factor
PJD	Preliminary Jurisdictional Determination
PRC	PacRim Coal
Preservation Area	Chuitna Preservation Area
PRM	Permittee Responsible Mitigation
Project	Donlin Gold Project
Refuge	Togiak National Wildlife Refuge
RHA	Rivers and Harbors Act of 1899
RPW	Relatively Permanent Waters
Rule	Mitigation Rule (33 CFR 325 and 33 CFR 332; 40 CFR 230)
SC	Stream Crossing (Points)
sq. mi.	square mile
SUA	Surface Use Agreement
TA	Transportation Area
TKC	The Kuskokwim Corporation
TNC	Tyonek Native Corporation
TNW	Traditional Navigable Waters
TSF	Tailings Storage Facility
UCG	Underground Coal Gasification
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WB	Waterbody (Points)

WBM	Water Balance Model
WBM	Water Balance Model
WD	Wetland Determination
WH	Wet Herbaceous
WMF	Woodland Mixed Forest
WOUS	Waters of the United States
WQS	Water Quality Standards
WRF	Waste Rock Facility
Y-K	Yukon-Kuskokwim

Compensatory Mitigation Plan

1.0 Introduction

Purpose

Donlin Gold, LLC (Donlin Gold) is proposing to mine and process gold ore at a site in the Crooked Creek watershed, which is part of the Kuskokwim River drainage in Alaska. Calista Corporation (Calista), an Alaska Native regional corporation, selected the mineral rights at the Donlin Gold site under the Alaska Native Claims Settlement Act (ANCSA) because of the site's known gold potential. The Kuskokwim Corporation (TKC), an Alaska Native village corporation, owns the majority of the surface estate at the Donlin Gold site. ANCSA mandates that Calista develop the mineral resources at Donlin Gold for the benefit of Calista's shareholders and the shareholders of other Alaska Native corporations which benefit from natural resource development through ANCSA 7(i) and (j) revenue distribution requirements. Donlin Gold operates the Donlin Gold Project (Project) under a mineral lease with Calista and a surface use agreement with TKC. This Compensatory Mitigation Plan (CMP) explains how Donlin Gold will compensate for the unavoidable losses of Waters of the United States (WOUS) including wetlands, streams, ponds, and creeks in the Project area.

On April 10, 2008, the United States Army Corps of Engineers (USACE) and the United States Environmental Protection Agency (EPA) published regulations (33 Code of Federal Regulations [CFR] 332; 40 CFR 230) entitled, "Compensatory Mitigation for Losses of Aquatic Resources" (Mitigation Plan, or Rule). The Rule emphasized the selection of compensatory mitigation sites on a watershed basis and established operating standards for mitigation providers and mechanisms: mitigation banks, ILF programs, and permittee responsible mitigation (PRM) plans. Prior to the Rule, EPA, USACE, United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) issued the Alaska Wetland Initiative (AWI) (EPA et al. 1994). This initiative clarified that "no net loss of wetlands" was not realistic or practicable in Alaska and there was minimal justification for comprehensively implementing a mitigation program designed for the Contiguous United States and not Alaska. The Rule recognizes the provisions of the AWI as valid and still applicable for mitigation planning in Alaska. This CMP follows the AWI guidance, and the recently released June 15, Memorandum of Understanding (2018 MOU) between USACE and EPA regarding Mitigation Sequence for Wetlands in Alaska under Section 404 of the Clean Water Act (CWA).

This CMP discusses the proposed Project and compensatory mitigation plans for permitting under the CWA Section 404 and the Rivers and Harbors Act of 1899 Section 10.

2.0 Proposed Project

The open pit, hard rock gold mine site is located 277 miles west of Anchorage, 145 miles northeast of Bethel, and 10 miles north of the village of Crooked Creek. The village of Crooked Creek is located on the banks of the Kuskokwim River. The proposed mining Project includes the following principal mine components:

- Mine Area (MA) – Includes an open pit mine, waste rock facility (WRF), processing facility, tailings storage facility (TSF), fresh water dams, contact water dams, a natural gas power generation facility, and personnel camps.

- Transportation Area (TA) – Includes a 5,000-foot gravel airstrip, Jungjuk (Angyaruaq) Port on the Kuskokwim River, and a 30-mile gravel road connecting the port and MA.
- Pipeline Area (PA) – Includes a 14-inch, 315-mile buried steel pipeline to supply natural gas to the mine power plant. The pipeline ties into Enstar’s gas distribution line near Beluga and traverses 315 miles through the Alaska Mountain Range to the power plant and processing facility as shown in Figure 1.

Project components are shown in Figure 1 and Figure 2. Additional details about the proposed Project can be found in the Project Description, Natural Gas Pipeline Plan of Development (SRK 2016) and the Department of the Army (DA) Permit and revisions (Donlin Gold 2012, 2014, 2015, and 2017).

3.0 Donlin Gold Section 404 and Section 10 Permitting

Donlin Gold initiated the permitting process by submitting a Preliminary DA Permit application package under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act of 1899 (RHA) to USACE on July 26, 2012. The package included an initial Preliminary Jurisdictional Determination (PJD) and the DA Permit application. Donlin Gold subsequently submitted a revised DA Permit application to USACE in December 2014. Another update to the application was submitted to USACE in August 2015, which was public noticed with the Draft Environmental Impact Statement (EIS). A revised PJD incorporating additional field work was submitted to USACE in January 2017. On February 27, 2017, USACE accepted the revised PJD, which refined the boundaries of the WOUS subject to USACE jurisdiction for the Project. In July 2017, Donlin Gold completed the North Route pipeline re-alignment and wetland mapping. Updated data reflecting the North Route were provided to USACE in August 2017, and accepted in October 2017. A further revision to the DA Permit application, including the North Route data and a CMP, was submitted to USACE in December 2017. The Final EIS was released in April 2018 along with a Special Public Notice (SPN) soliciting public comments on the 2017 CMP. This Final CMP responds to agency and public comments on the SPN. Table 1 summarizes the relevant Donlin Gold permit submittals

Table 1 Donlin Gold DA Permit Application Submissions and Supporting Documentation to USACE

Document Name	Submitted to USACE
Preliminary DA Permit Application (Engineer Form 4345) and Initial PJD	July 2012
DA Permit Application (Engineer Form 4345)	Updated December 2014 and August 2015
PJD Donlin Gold Project - December 2016	January 2017
North Route Addendum to the PJD Donlin Gold Project - August 2017	September 2017
DA Permit Application (Engineer Form 4345) including CMP	December 2017
Final CMP addressing agency and public comments	July 2018
PJD Chuitna Preservation Area	Scheduled Late July 2018

Figure 1 Mine Area and Transportation Area

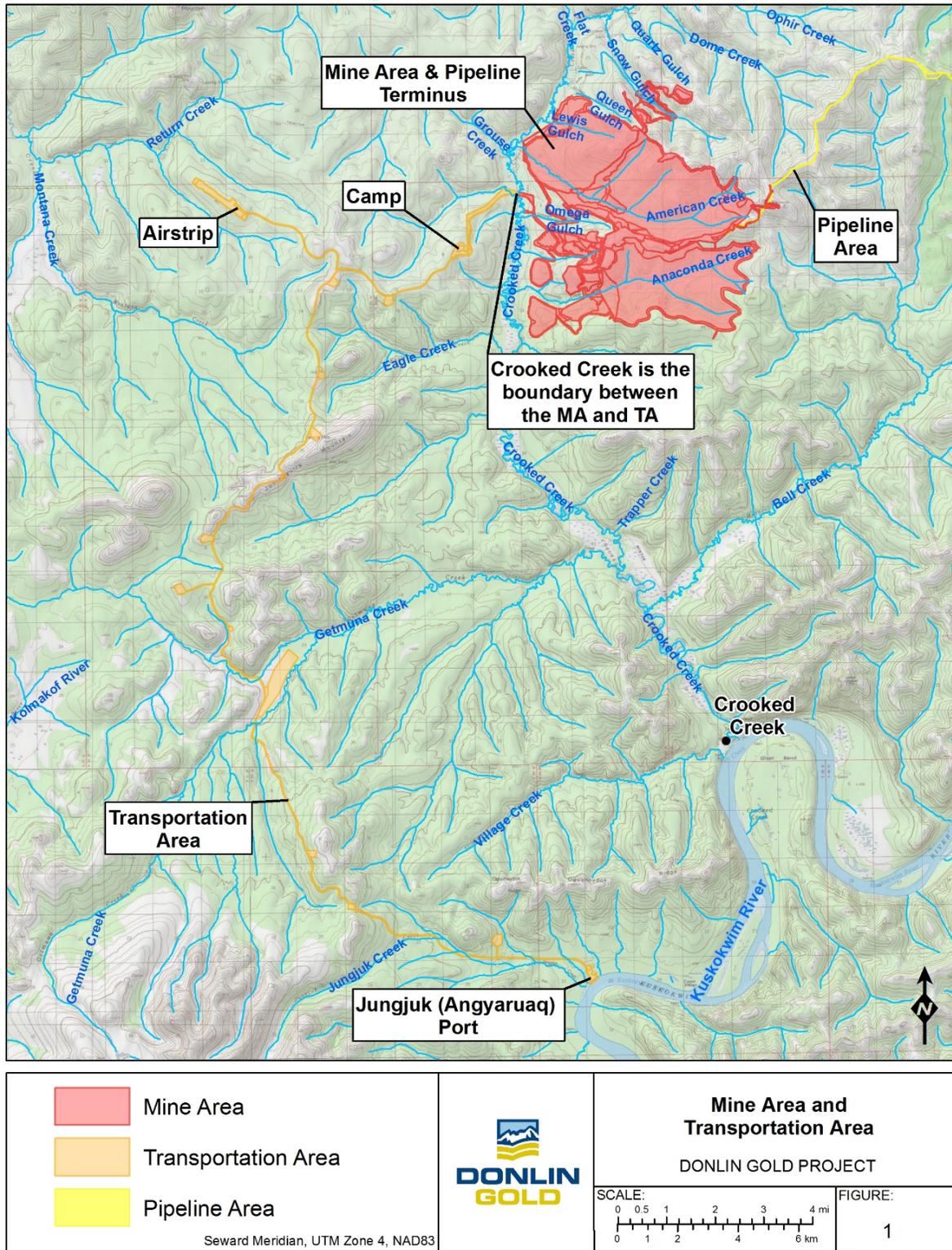
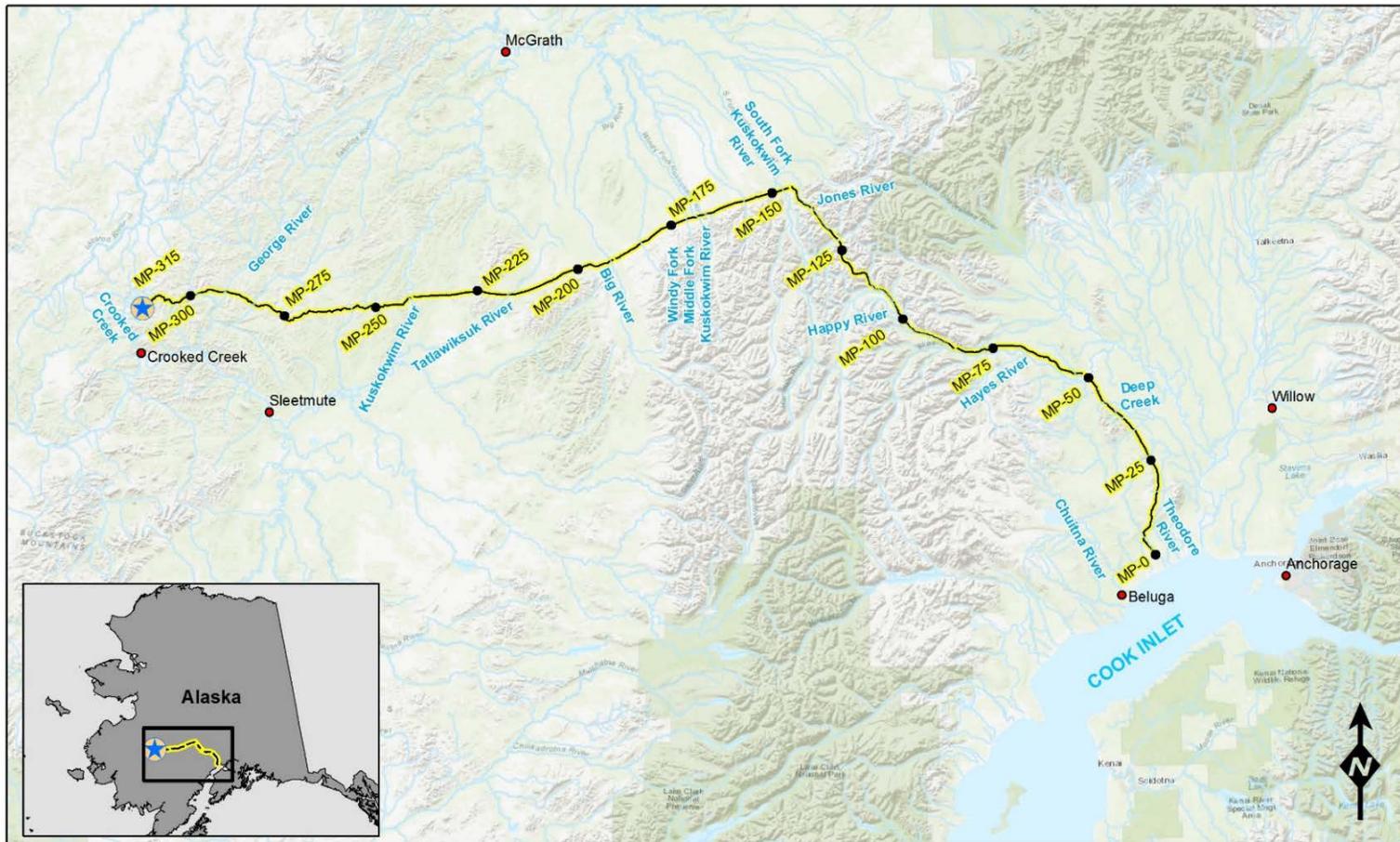
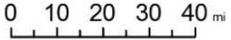


Figure 2 Pipeline Area



<ul style="list-style-type: none">  Donlin Gold  Communities  Proposed Natural Gas Pipeline Milepost (MP-)  Streams  Proposed Natural Gas Pipeline Alignment 	<p>SCALE:</p>  <p>Seward Meridan, UTM Zone 5, NAD83 World Topographic Map Esri Note: Updated to include North Route</p>		<p>Pipeline Area</p>	<p>FIGURE: 2</p>
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DG: CMP OverviewMap PipelineStreams.mxd, 12/15/17, R02

4.0 Wetland Fill Impacts from Proposed Project

The development of the Project will discharge fill that will result in permanent fill in wetlands and WOUS. The calculated Project wetlands disturbance and fill activities are in Blocks 21 and 22 of the December 2017 DA Permit.

The Project fill impacts are summarized into three areas: the MA, which includes all mine-related facilities east of Crooked Creek; the TA, which includes all transportation-related facilities west of Crooked Creek; and the PA, which includes the natural gas pipeline and ancillary facilities (see Figure 1 and Figure 2).

Wetland fills were calculated using geospatial data and geographic information systems data analysis tools. The data used included the Project PJD wetlands map, as accepted by USACE and the Project footprint. These datasets were overlain to calculate the Project fill impacts to WOUS. The results are described in the following sections.

Wetlands Fill Impact Types

Wetland fill impacts for the Project are grouped into two main categories: non-regulated and jurisdictional.

- *Non-regulated Impacts* – This impact category includes vegetation clearing, winter roads, and work areas where no fill placement is planned in wetlands or WOUS. These impact types are not addressed by this CMP.
- *Jurisdictional Impacts* – These impacts include the placement of fill into wetlands or WOUS that require approval by USACE through its permitting authorities. These fill impacts are addressed in the CMP.

The impact types are further divided in the DA permit application based on the duration of the fill:

- *Temporary Short-term Fill* – These are areas where fill is placed into wetlands or WOUS for a limited period during construction to facilitate activities, then removed concurrent with construction activities or as soon as construction is complete. This fill may be in place for a matter of days or up to three years. Donlin Gold has not proposed compensatory mitigation for temporary short-term fill impacts.
- *Temporary Long-term Fill* – This category represents cut and fill activities where the fill will be removed more than three years after initial placement. At the request of USACE, temporary long-term fill has been combined with permanent fill in calculating fill impacts for the Project.
- *Permanent Fill* – This category represents cut and fill activities at facility locations where the fill will not be removed from WOUS. This includes the open pit, TSF, and WRF. The fill cannot practicably be removed from the TSF and WRF because of the large volumes of fill in each facility. The open pit will be partially backfilled at mine closure, but cannot practicably be fully backfilled.

Wetlands and Aquatic Resource Fill Impacts

Wetlands and waters have been characterized by Hydrogeomorphic (HGM) classification (Brinson 1993); vegetation type based on a modified Viereck classification system (Viereck et.al. 1992); and Cowardin classification (Cowardin et al. 1979).

Mine Area and Transportation Area

Stream fill impacts¹ are presented in Table 2. Stream fills have been subdivided by stream channels filled that are anadromous or non-anadromous. The MA and TA permanent stream fills are 173,953 linear feet (32.9 miles). The MA and TA include a total of 2,676 acres of permanent wetland fill. Table 3 provides a summary of the MA, TA, and PA temporary and permanent wetland fill by area.

Pipeline Area

PA fill impacts account for pipeline crossings (open cut with stream diversions) and for temporary access across streams. All fill in streams is temporary because it is removed during reclamation and restoration. Wetland fill to streams is presented in Table 2. All the PA stream fills are short-term temporary and total 53,346 linear feet (10.1 miles). The PA includes 538 acres of temporary fill and 200 acres of permanent fill in wetlands. Table 3 provides a summary of the PA wetland fill by duration.

The PA traverses 28 Hydrologic Unit Code (HUC)-10 watersheds. The 200 acres of permanent wetland fill impacts from the pipeline are in 14 of those HUC-10 watersheds. These watersheds have very limited existing disturbance. The maximum permanent wetland fill impact from PA construction in any single HUC-10 watershed is 64 acres (Headwaters Tatlawiksuk River). For the PA construction, the maximum total wetland disturbance in a watershed is 0.03 percent of the total watershed area. Additional details on the PA fill impacts by HUC-10 watershed are provided in Attachment A.

¹ The stream impacts are measured along the channel centerline within the MA, TA, or PA and categorized by the duration. Stream length is measured in linear feet (miles) within the jurisdictional streams listed in Donlin Gold's 2016 PJD prepared by Michael Baker International.

Table 2 Project Mine Area, Transportation Area, and Pipeline Area Stream Fills in Linear Feet (Miles)

HGM	Cowardin Group	MA		TA		HGM	PA	
		Temporary	Permanent	Temporary	Permanent		Temporary	Permanent
Anadromous Stream Channel	Intermittent	0	0	0	0	Stream Channel	10,992 (2.1)	0
	Perennial	0	2,218 (0.4)	0	0		42,353 (8.0)	0
Non-Anadromous Stream Channel	Intermittent	0	37,901 (7.2)	0	774 (0.1)			
	Perennial	0	130,882 (24.8)	0	2,178 (0.4)			
Total		0	171,001 (32.4)	0	2,952 (0.5)		53,346 (10.1)	0

*Inconsistencies are due to rounding.

Table 3 Project Mine Area, Transportation Area, and Pipeline Area Wetlands Fill: HGM Class and Cowardin Group (Acres)

HGM	Cowardin Group	MA		TA		PA	
		Temporary	Permanent ¹	Temporary	Permanent ¹	Temporary	Permanent
Depressional	Palustrine Aquatic Bed (Pond)	0	0	0	0	0	0
	Palustrine Emergent	0	3	0	0	3	0
	Palustrine Forested	0	0	0	0	2	0
	Palustrine Scrub Shrub	0	0	0	0	3	0
	Palustrine Unconsolidated Bottom (Pond)	0	0	0	0	0	0
	Depressional Total	0	3	0	0	8	0
Flat	Palustrine Emergent	0	2	0	0	20	25
	Palustrine Forested	0	508	0	9	58	17
	Palustrine Scrub Shrub	0	1,052	0	53	220	109
	Flat Total	0	1,562	0	62	298	151
Riverine Non-Anadromous	Palustrine Emergent	0	4	0	2	4	0
	Palustrine Forested	0	35	0	1	1	0
	Palustrine Scrub Shrub	0	113	0	0	12	1
	Palustrine Unconsolidated Bottom (Pond)	0	0	0	0	0	0
	Riverine Non-Anadromous Total	0	152	0	3	17	1
Riverine Anadromous	Palustrine Emergent	0	1	0	0	2	1
	Palustrine Forested	0	3	0	0	2	0
	Palustrine Scrub Shrub	0	0	0	1	11	1
	Palustrine Unconsolidated Bottom (Pond)	0	0	0	0	0	0
	Riverine Anadromous Total	0	4	0	1	15	2
Slope	Palustrine Emergent	0	31	0	1	15	2
	Palustrine Forested	0	322	0	18	52	6
	Palustrine Scrub Shrub	0	496	0	21	133	38
	Slope Total	0	849	0	40	200	46
Total		0	2,570	0	106	538	200

*Inconsistencies are due to rounding.

1. Temporary long-term fill has been combined with permanent fill for purposes of determining compensatory mitigation requirements.

5.0 Evaluation of Compensatory Mitigation Options

The Rule specifically establishes a watershed-based framework for determining appropriate types of compensatory mitigation. Under the Rule, compensatory mitigation can be carried out through four methods:

1. Restoration of a previously existing aquatic site
2. Enhancement of an aquatic site's function
3. Establishment of a new aquatic site
4. Preservation of an existing aquatic site

In the Rule, the concepts of aquatic sites and resources are considered together. The key element is that proposed compensatory mitigation must relate directly to unavoidable fill impacts to aquatic resources. On a watershed level, Donlin Gold's unavoidable fill impacts are largely concentrated on aquatic resources (anadromous and resident fish) in the Crooked Creek watershed. Therefore, in determining what compensatory mitigation to propose, each option was evaluated in terms of how it could be directly compared to these watershed fill impacts to aquatic habitat for fish species. In addition, 33 CFR 332.3(a) recommends that larger contiguous tracts are preferred to help comply with the watershed approach for mitigation. Hence, Donlin Gold's search prioritized larger singular options rather than numerous small ventures spread over broad areas and numerous watersheds.

The Rule also establishes several distinct types of mitigation, including mitigation bank credits, ILF credits, and numerous forms of PRM. Throughout the U.S., compensatory mitigation is often provided through mitigation bank and ILF programs. In remote areas of Alaska, however, the availability of these programs is very limited. Donlin Gold evaluated the feasibility of purchasing credits from the existing organizations. The Conservation Fund's ILF program has been the only program that provided credits for the entire state. Advance credit transactions were suspended on May 19, 2017, and as of October 2017, The Conservation Fund could no longer offer any mitigation credits in Alaska.

Mitigation banks are assigned service areas and can generally only be used for developments with fill impacts within those established service areas. The only mitigation bank that is established and has a service area that overlaps any identified Project fill impacts for which Donlin Gold is seeking CWA Section 404 permit coverage is the Su-Knik Bank in the Matanuska-Susitna Borough (MSB). The Great Land Trust recently (June 2018) received approval of wetland mitigation program credits for wetland impacts within a service area that generally comprise the MSB boundaries. Donlin Gold has committed to acquire 9.8 wetland credits from the Great Land Trust for the permanent wetland fill impacts associated with the PA within the MSB. See Table 23 for the mitigation credits proposed for purchase.

As discussed above, the existing ILF programs and mitigation banks do not have service areas that cover most of the Project impact areas and cannot meet the mitigation needs for the permanent fill impacts associated with the MA and TA, and portions of the PA not within the MSB. This left Donlin Gold with only the PRM option under the Rule for achieving compensatory mitigation requirements via one or more of the four methods above: considering on-site and in-kind projects first, then expanding to out-of-kind and, if needed, off-site mitigation. Another key aspect involved determination of the amount of

mitigation. There is no accepted functional assessment for the wetlands impacted.² Under 33 CFR 332.3(f)(1), when no functional assessment is available, “a minimum one-to-one [1:1] acreage or linear foot compensation ratio must be used.” Under 33 CFR 332.3(f)(2), consideration on the amount of mitigation also needs to consider the method, likelihood of success, differences in functions (or type) of wetlands, temporal losses and the distance between the impact and mitigation site. Donlin Gold proceeded with these goals and guidance in mind (see Section 8.0).

On-Site Options

Donlin Gold evaluated numerous compensatory mitigation opportunities for the permanent fill impacts associated with the MA, TA, and PA. The most concentrated permanent, unavoidable Project fill impacts occur in the Crooked Creek HUC-10 watershed. In other watersheds associated with the PA, the permanent wetland and stream fill impacts comprise only very small percentages of HUC-10 watersheds (0.03 percent or less of the total watershed areas within each HUC crossed). Therefore, in evaluating mitigation options, and in keeping with 33 CFR 332.3(b)(4) (PRM) and 33 CFR 332.3(c) (watershed approach) relating to compensatory mitigation, Donlin Gold first focused on opportunities within the HUC-10 watershed of the MA (i.e., generally the Crooked Creek drainage) and then extended to the HUC-10s associated with the TA. The only existing developed areas in these hydrologic units are the village of Crooked Creek, the existing Donlin Gold camp supporting exploration activities, and the placer mining activity around the upper Crooked Creek and Donlin Creek confluence. Among these, the sole opportunity to provide immediate on-site and in-kind compensatory mitigation for Project fill impacts to aquatic resources is to restore past placer mining disturbances in upper Crooked Creek and several of its tributaries (Quartz, Snow, Ruby, and Queen Gulches). These restoration and mitigation activities are directly applicable to the MA and TA fill impacts because they represent in-kind wetland and stream channel restoration, enhancement, and long-term preservation within the HUC-10 of the MA and some of the TA activities.

The proposed Upper Crooked Creek PRM Plan is provided in Attachment D and is designed to:

- Restore geomorphically stable channels and floodplains in the lower reaches of Quartz, Snow, Ruby, and Queen Gulches and enhance the aquatic habitat.
- Remove barriers to fish passage and improve anadromous and resident fish-rearing habitat in the reaches of Snow, Ruby, and Queen Gulches fill-impacted by placer mining.
- Preserve restored wetlands and aquatic habitat by creating riparian buffers around the restoration areas.

Donlin Gold will implement the Upper Crooked Creek PRM Plan concurrently with the start of MA and TA development. The Upper Crooked Creek PRM Plan includes the enhancement, reestablishment, restoration, rehabilitation and preservation of wetlands, riparian areas, stream channels, and upland

² Donlin Gold generated a full functional assessment using the Hollands-Magee method in 2014, which was determined inappropriate by the U.S. Army Engineer Research and Development Center (ERDC). Donlin Gold proposed a second methodology in 2016 using Cowardin and a functional capacity index combined with an HGM method that was determined by USACE to be inappropriate for this situation.

buffers totaling 221.5 acres in Quartz, Snow, Ruby and Queen Gulches, and the Wash Plant Tailings Area. The PRM Plan will specifically restore 95.7 acres of degraded floodplains into 93.0 acres of wetlands and 2.7 acres of riverine channel. A total of 8,892 liner feet of stream will be enhanced and reestablished by the restoration work in the floodplains. A total of 109 acres of riparian uplands, and wetland buffers will be protected around the restored and enhanced floodplain wetlands.

Beyond the Upper Crooked Creek PRM Plan, Donlin Gold will restore areas within the MA and TA as wetlands to the maximum extent practicable when they are no longer needed for Project activities. This includes both material and stockpile areas as described in the MA Restoration Plan included as Attachment C, and the TA Restoration Plan included as Attachment F. The MA Restoration Plan provides for restoration of 556 acres of wetland and 6,363 linear feet of stream. The TA Restoration Plan provides for 34.7 acres of wetland restoration. Donlin Gold is not requesting compensatory mitigation credit for these Restoration Plans but is committing to those projects as part of the Project minimization efforts.

Donlin Gold broadly considered the current surface conditions/disturbances in the watersheds of the PA for potential mitigation opportunities for fill impacts from pipeline construction. Donlin Gold evaluated the viability of restoring locations in these watersheds previously impacted by development. An analysis by HUC of existing impervious cover was done to facilitate potential restoration areas. The pipeline crosses 28 HUC-10 watersheds over its 315-mile length. The analysis showed total impervious cover across all HUC-10s before pipeline construction comprises only 0.04 percent of the HUCs, and no HUC had any practicable, substantive restoration opportunities. Overall, there is little to no existing disturbance to restore in the proximity of the PA. See Attachment A for additional details on PA wetland impacts. Compensatory mitigation for the PA effects may not be required due to the very limited (<0.05 percent) effect within each HUC-10 watershed crossed. However, Donlin Gold has included this acreage in this plan to account for these impacts.

Off-Site Options

To further compensate for the Project fill impacts to achieve the minimum 1:1 ratio under the Rule, Donlin Gold considered additional off-site mitigation opportunities. Table 4 summarizes the specific off-site mitigation options Donlin Gold considered for the Project and describes the potential applicability of the mitigation option to this CMP. The following guidelines were applied to each off-site opportunity:

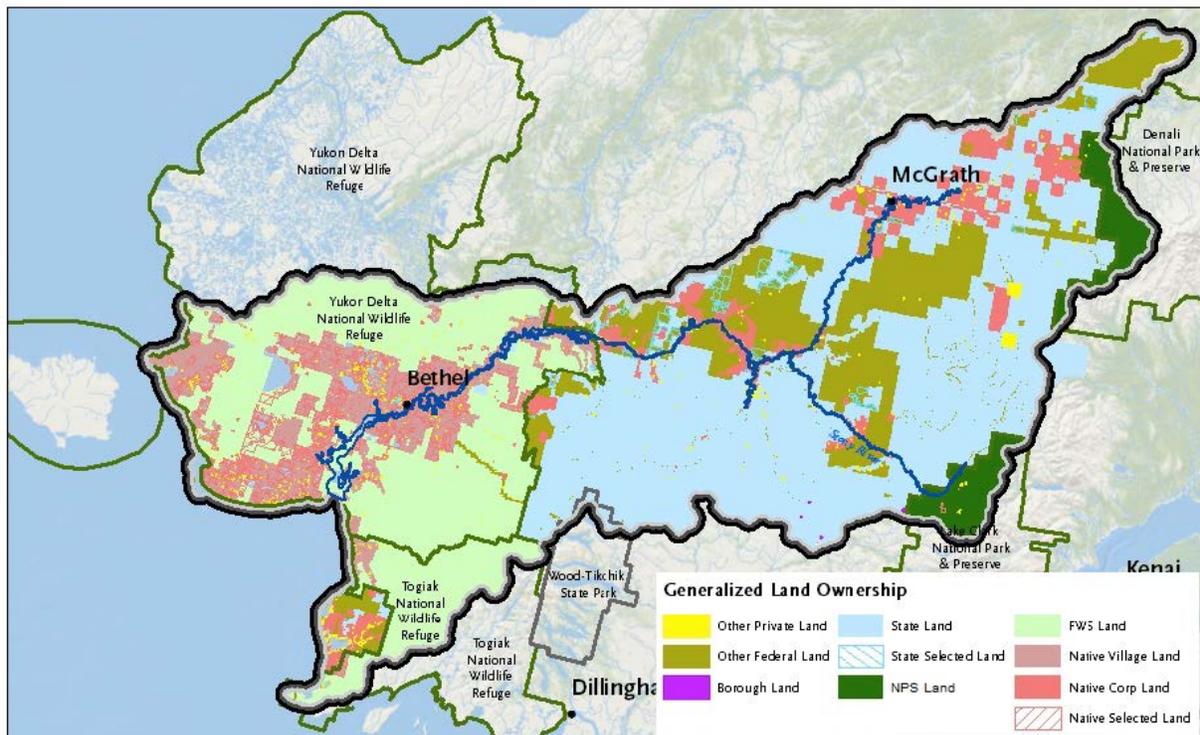
- Identify restoration and preservation opportunities that would yield watershed-level aquatic resource mitigation comparable to the MA and TA fill impacts; specifically, restoration and/or preservation of wetland acres and stream miles, with specific focus on anadromous and other important fish and wildlife populations.
- Identify any credits readily available from Mitigation Banks or ILF programs where Project impacts are within the service areas of the providers.
- For restoration opportunities, consider options that can be demonstrated to yield ecological “lift” (an increase in functions and services in the wetlands) in both a practicable and measurable manner.

- For preservation opportunities, show a clear threat of development and that the lands can be preserved over the long term.
- For all opportunities, determine whether the compensatory mitigation can be performed in a manner that generates benefits in an economically sound and reasonable manner, and can be maintained over the long term.
- Use the USACE definition (33 CFR 332.2) of “Practicable” in assessing options (“available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purposes”).

Donlin Gold followed USACE guidelines in considering the proximity of specific off-site opportunities to the impacted watershed, by first considering those within the middle Kuskokwim River watershed (HUC-08) and then expanding out concentrically, eventually extending to the entire Yukon-Kuskokwim (Y-K) region (HUC-06) and then, if needed, to other watersheds in Alaska. The Rule describes the general approach that permittees must follow in defining appropriate compensatory mitigation. In addition, as recognized by the 1994 AWI (EPA et.al. 1994), Alaska is unique because of its remoteness, lack of development, high percentage of wetland areas compared to the Contiguous United States and limited opportunities for off-site mitigation. The AWI and 2018 MOU acknowledge Alaska’s unique nature by encouraging flexibility in the levels and types of appropriate compensatory mitigation proposed.

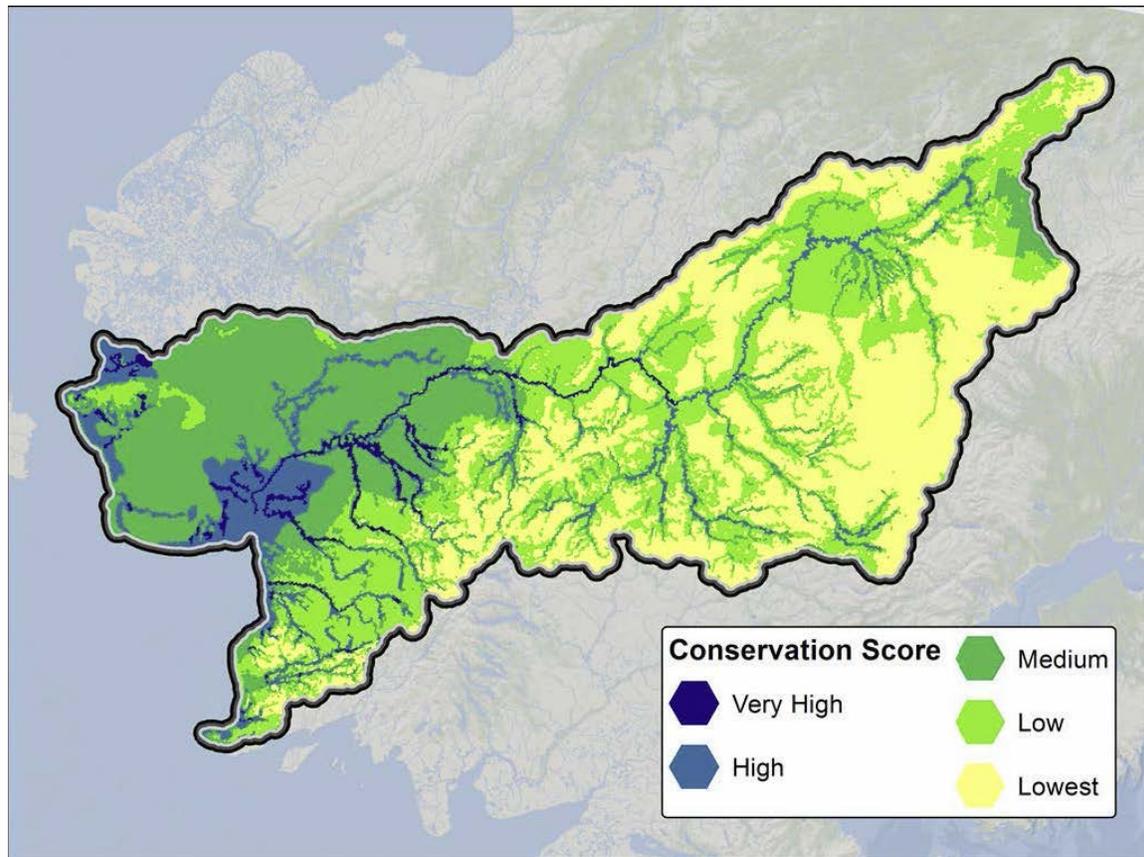
Land ownership is a key consideration when assessing potential mitigation ventures. The USFWS, in partnership with the Great Land Trust, Alaska Department of Fish and Game (ADF&G) Division of Subsistence, and the University of Alaska Anchorage (UAA) Alaska Center for Conservation and Science produced a report on the Kuskokwim River watershed dated November 30, 2017 (Hults and Geist 2017). The report provides information relevant to an evaluation of the entire Kuskokwim River watershed. The watershed contains approximately 43.5 million acres of land. Figure 3, from the USFWS report, shows the general land ownership. The watershed land base is 83 percent State and Federal lands. The Federal lands under National Park Service (NPS) and USFWS management encompass 25 percent of the HUC-06 watershed. These lands are already protected for conservation under land plans established and managed by those agencies and do not require further protection. Land managed by the Bureau of Land Management (BLM) and the State (53 percent of the watershed) are not available for restoration and preservation as neither agency/entity has a mechanism to encumber the lands with the required long-term protection instruments. This applies to both preservation and any restoration opportunities. Hence, the only lands generally available in the watershed are private lands, which encompass less than about 17 percent of the watershed. Most of these lands are lands granted through ANCSA with the intent of being developed for revenue generation. An exception to this classification involves Federal and State mining claims that are inholdings located within a refuge or park system boundary which may present viable mitigation options.

Figure 3 Land Ownership in the Kuskokwim River Watershed (Hults and Geist 2017)



Another consideration for assessing mitigation options is to identify key areas of concern. This was a focus of the USFWS report, which identified significant habitat areas and threatened and endangered species areas within the watershed (see Figure 7 and Figure 8 in the report). None are located near the proposed Project wetland impact areas except for a single raptor nesting polygon near the Jungjuk (Angyaruaq) Port site. The report's primary focus was to use a compilation of ecological factors to rank areas on a 5-point scale from "Very High" to "Lowest" conservation value (see Figure 14 in the report, provided as Figure 4 below). The Project areas were scored "Lowest" in conservation value, except for the area immediately adjacent to Crooked Creek, which was scored as "Low." Areas further away from the Project in the HUC-06 watershed, i.e., generally closer to the coast, were ranked as "High" to "Very High" values by USFWS; coinciding with the Yukon-Delta and Togiak National Wildlife Refuges.

Figure 4 Ecological and Conservation Values Scores (Hults and Geist 2017)



Watershed Level Mitigation Projects

The most viable opportunities capable of generating off-site mitigation credits of the scale and impact types associated with the Project at a watershed level involve stream restoration and preservation in mineralized areas. Much of the watershed-level development in the Kuskokwim River region has been associated with historical and modern mining districts. To evaluate potential compensatory mitigation at the scale of the Project fill impacts, Donlin Gold considered options of restoring watersheds impacted by mining operations at the: (1) Platinum Mining District, (2) Tuluksak/Nyac Mining District, (3) Red Devil Mine Area, and (4) Kolmakof Mine Area. Donlin Gold also considered preserving the Fuller Creek watershed from future placer and hard rock mining activity.

In each of these areas, Donlin Gold considered the opportunity in terms of practicability for restoration/preservation, including availability, feasibility and cost, land ownership and long-term durability, and the potential for ecological enhancement/lift to wetland areas, streams, and riparian areas. Many other smaller, historical placer mining areas are located within the region, e.g., in the George and Holitna river drainages. However, these often involve small, single prospects where development is limited to small acreages and stream sections. Given their remote and scattered locations, any restoration work at these sites would be costly and complex, and unlikely to yield the watershed level of mitigation credits needed for the Project. Finally, there is virtually no threat of more extensive future development, and often no mechanism to impose a durable protective instrument (i.e.,

State or BLM lands). Smaller placer mines were, therefore, eliminated as viable compensatory mitigation options.

The Red Devil and Komerof mine areas are not practicable options for compensatory mitigation. The reasons are as follows:

- Red Devil is not practicable because it does not meet the overall purposes for compensatory mitigation through generation of wetland acres and stream miles. In addition, decisions on the final remedial action plan among BLM and the landowners³ is an ongoing process. BLM does not expect to finalize a work plan for site clean-up until 2019 or beyond. This also makes it unavailable for Donlin Gold.
- Komerof restoration work is largely complete. The Project, like Red Devil, does not meet the overall purposes for compensatory mitigation acres through generation of wetland acres and stream miles.

This left the Tuluksak/Nyac and Platinum districts, and Fuller Creek watershed for detailed consideration. Significant effort was expended in investigating each of these options and the results are described below.

Platinum Mining District

The Platinum site is located along the southwest coast of Alaska – south of the Kuskokwim River delta, approximately 240 miles from the Donlin Gold MA. Platinum is in the same HUC-06 watershed as the Project MA and TA. The site generally consists of the Salmon River watershed, which flows into Kuskokwim Bay. In July 2017, Donlin Gold staff observed an abundance of sockeye and coho salmon moving upstream in the Salmon River to spawn. Other salmon species have also been observed and the river and tributaries provide key areas for juvenile salmon rearing. The area further includes significant avian and Steller sea lion habitat in and around the Togiak National Wildlife Refuge (Refuge).

The Platinum site includes mined and unmined mineral claims on BLM lands. A portion of the unmined claims in the lower Salmon River watershed extend onto the Refuge. Placer mining for platinum in the Salmon River watershed began in the 1920s and has occurred at various times through 2011 when XS Platinum ceased the most recent operations. Approximately 645,000 ounces of platinum have been produced to date. The residuals from past placer mining (tailings and overburden) fill large areas of the Upper Salmon River watershed; rough estimates suggest millions of cubic yards of these residuals. The excavation, washing, and placement of these materials have significantly changed the hydrology of the drainages in and around the mined areas.

Donlin Gold investigated a combined preservation and restoration PRM plan in the Salmon River watershed within and below the areas where mining has taken place. Preservation would have included claims situated within and outside the Refuge. Restoration, located entirely outside the Refuge, would have primarily focused on re-establishing stream connectivity to improve access to salmon habitat

³ BLM is in the process of developing several options on how to address the concerns related to possible future contamination of the Kuskokwim River from this site.

throughout the drainage. Figure 5 depicts the Platinum area with conceptual plans where restoration and preservation could potentially occur, it also shows where potential future placer mining might be conducted. The total wetland acreage of the combined plan would have been approximately 1,800 acres. Donlin Gold proceeded to further investigate this option to determine the remainder of the practicability components.

The majority of the mining claims are currently owned by a private family business, Hansen Industries, Inc. (Hansen). Hansen's stated goal is to sell all its claims at Platinum. The recorder's office shows an interest in some of these claims that were originally held by Harry Shippey and have been passed along to several heirs. Angler Mining Pty, Ltd. (Angler) has an option agreement in place and currently controls the entire claim block. Hence, the property is under the control of an active claim owner and not readily available. Initial offers to purchase an interest in the claims at market value were rejected.

The residual placer mining materials have been placed in very large piles with steep side slopes (angle of repose) along the Salmon River drainages. To remove these materials and restore the topography and hydrology associated with wetlands would involve re-locating several million cubic yards of materials into non-wetland areas. For example, the current stream width is approximately 20 to 30 feet wide with no riparian zone. With the geometry of the washed rock spoil piles (see Photo 1), it would necessitate the removal of between 3,630 and 7,300 cubic yards to create 20 feet of riparian zones/wetlands per 100 feet of stream length. This would provide 0.046 acres of restored wetlands. The estimated cost to generate 1 acre of wetlands through removal of material down to the water table, placement of at least 1 foot of soil (if available), and re-vegetation would be in the range of \$640,000 to \$1 million per acre.

A key physical challenge to restoring wetlands in the mined areas is the groundwater table lowered as a result of the past mining activity. The dredge used for mining had a reach of up to 60 feet below the water level in which the dredge was working. The sluicing process removed all the fines from the material being processed and they were washed downstream and out to the coastal waters. This resulted in changes to the water table hydrogeology that cannot be physically restored. The diagram below (Figure 6) is a graphical representation of the hydrogeologic changes. As such, these areas have been converted to uplands. Re-grading the surrounding spoils back to the original contours would only eliminate the existing stream and not restore wetlands (see bottom image in Figure 6).

Figure 5 Platinum Mining Claims

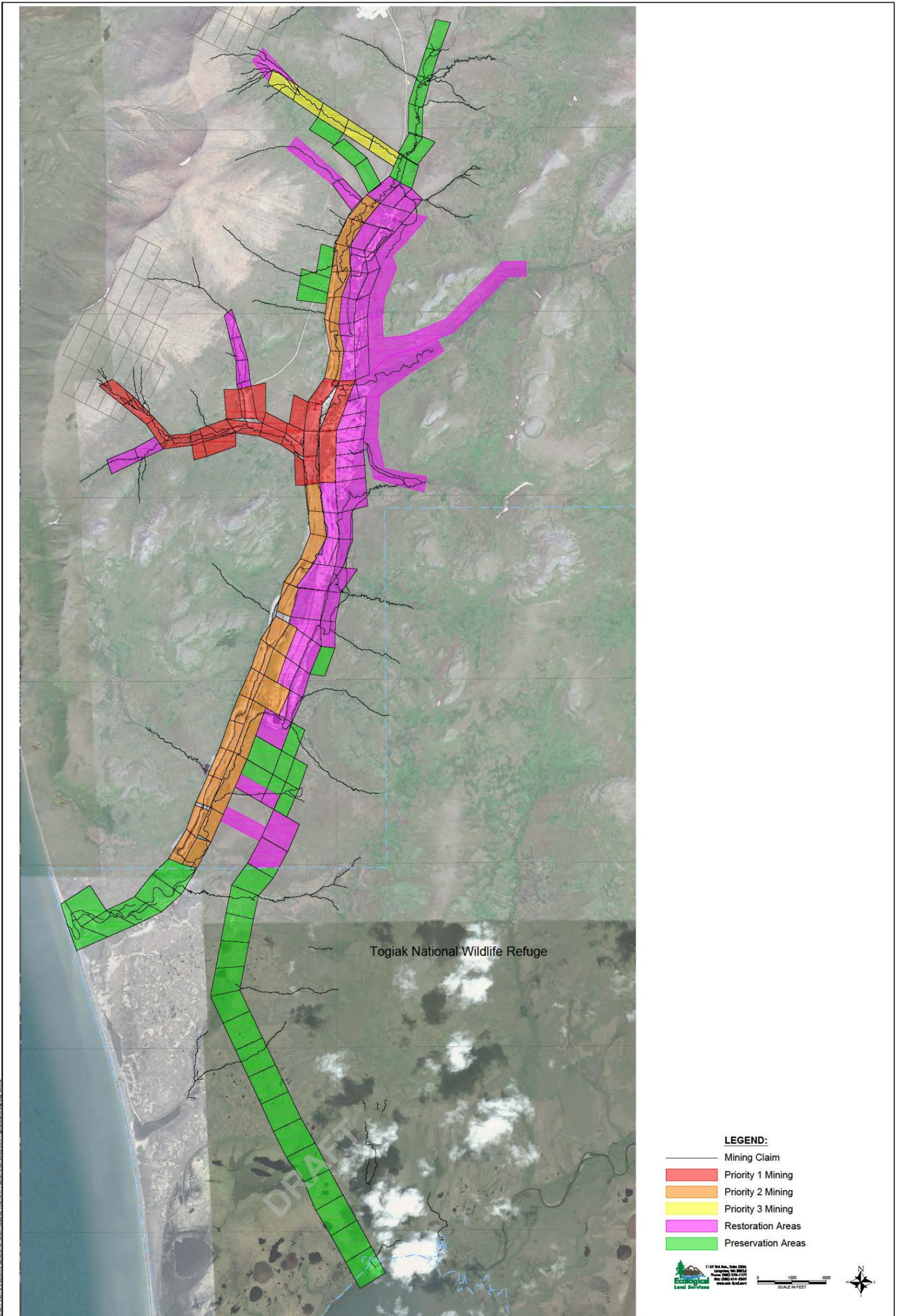
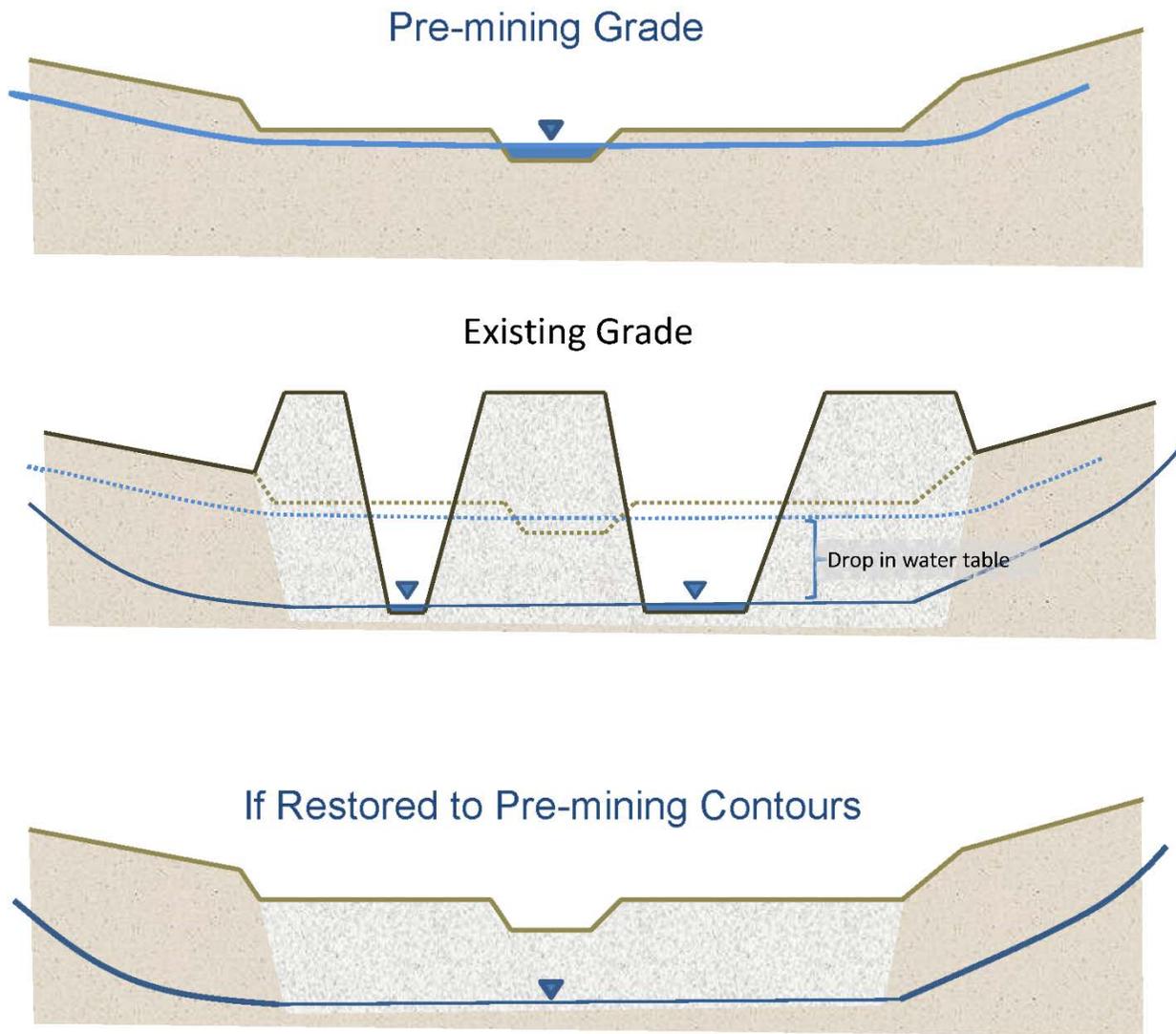


Photo 1 *Panorama of Spoil Piles at Platinum*



Figure 6 *Hydrogeologic Alterations at Platinum*



Logistically, two other issues affect practicability:

1. The excess material from the wetland creation discussed above would need to be stockpiled. Essentially all areas surrounding the previous mining activities are wetlands. If these materials are placed in the surrounding areas, then the creation of new wetlands would be offset by the filling of other wetlands. Alternatively, if the material is kept within the current disturbance footprint, then existing ponds in the surrounding valleys would be filled and the amount of wetland acres created would be substantially reduced.
2. To create wetlands, an estimated 1,600 cubic yards of soil would be needed for each acre of wetland to be established. In addition, BLM has stated that, if existing spoils are disturbed, the resulting reclamation would need to meet BLM's reclamation standards, which include at least 70 percent vegetative cover. This also would necessitate placement of soils over all reclaimed areas. Hence, to reclaim 1,000 acres as either wetlands or uplands would require 1.6 million cubic yards of soils. These quantities of soil do not exist at the site.

Based on availability, cost, technological, and logistical criteria, the results of this review show that restoration of wetlands in the previously mined areas at Platinum is not practicable to obtain compensatory mitigation credit.

With elimination of restoration as an alternative, potential preservation at Platinum consists of two parts: claims inside and outside the Refuge. For claims situated within the Refuge land control would revert to the USFWS upon claim abandonment. The Refuge claims comprise about 650 wetland acres and 200 additional upland buffer acres with high, watershed-level aquatic and avian habitat value. There is the potential threat of mineral development based on the valid existing rights in the mining claims, although to date no detailed mineral evaluation and mine planning has occurred with respect to these claims. These numbers fall well short of the target watershed-level acres sought for off-site compensatory mitigation credit by the Project. These claims also fail the availability requirement for the same reasons cited above.

Outside of the Refuge, BLM has expressed a desire to see the claims mined. Further, if Hansen and Angler agreed to relinquish their mining claims situated outside of the Refuge, Calista has a right to assume ownership. Considering the ANCSA mandate that lands selected for their mineral potential be developed for the benefit of Alaska Native shareholders, Calista may not be able to allow these lands to be preserved from development over the long-term. The complexity of the claim ownership and availability make it impractical to establish a preservation agreement for the unmined claims situated outside of the Refuge.

Based on all the above factors, the Platinum Mining District was eliminated as an off-site compensatory mitigation option.

Tuluksak/Nyac Mining District

The Tuluksak River watershed was selected as a potential compensatory mitigation opportunity based on its contributions to the Kuskokwim River salmon stock and its presently low production of Chinook and chum salmon returns. The Tuluksak River watershed is located within the lower Kuskokwim River

basin approximately 138 river miles upstream from the mouth of the Kuskokwim River. The Tuluksak River originates in the Kilbuck Mountains and flows approximately 86 miles through the Yukon Delta National Wildlife Refuge, entering the Kuskokwim River near the village of Tuluksak. The entire watershed is approximately 892 square miles and supports spawning populations of Chinook, chum, coho, and pink salmon. Resident species include Arctic grayling and Dolly Varden.

The Tuluksak/Nyac Mining District is known for its long history of mining activity dating back to 1907. Disturbance and stream alteration associated with more than a century of mining have resulted in decreased salmon production in the watershed, especially Chinook and chum salmon stocks. In September 2000, the Alaska Board of Fisheries identified Tuluksak River Chinook salmon within the “stocks of yield concern.” The designation was discontinued in 2007 after escapements returned to levels above the historical average. However, poor returns of Chinook salmon to the Tuluksak River since 2007 indicate it is still a stock of concern.

Existing dredge tailings and overburden are located throughout the historical Tuluksak River floodplain and form a circuitous maze of pools and low-flow waters. The high mounds of tailings and overburden left behind by dredge activity have forced the main Tuluksak River channel to the northern edge of the floodplain. Photo 2 shows the nature of the past mining activity and the current condition of the Tuluksak/Nyac site.

Photo 2 Tuluksak/Nyac Site



Donlin Gold investigated a restoration PRM plan in the Tuluksak River watershed within the areas where mining has occurred. Restoration would have primarily focused on increasing stream connectivity to the ponded areas to improve access to salmon habitat throughout the mined areas. The total wetland acreage of the combined projects would have been very small and primarily involved open water habitat. Despite this significant limitation, Donlin Gold further investigated the practicability of this option.

In the Tuluksak/Nyac District, the underlying claims are controlled by Calista. The placer mine operation is leased from Calista by Dr. J. Michael James/Nyac Gold, LLC, who assumed full management of the claims nearly 20 years ago after the death of his business partner. In recent years, Dr. James has continued mining activity in the district and has maintained the validity of his claims. Overall, Dr. James's total claim area comprises tens of thousands of acres. Because of the site control and active ownership status, securing the land for mitigation is difficult.

Donlin Gold conducted an evaluation of potential opportunities to conduct restoration work in the Tuluksak River watershed. Full-scale restoration of the river, riparian areas, and associated wetlands is not practicable given the nature of the disturbance, the lack of space available for tailings and overburden management to create wetlands from uplands, and the lack of soil available to support reclamation of the re-located materials. A key difference between the Platinum site, which has high spoil peaks and widely spaced valleys, and the Tuluksak/Nyac site is the wider, closer spaced valleys filled with ponds at Tuluksak/Nyac (see Photo 2). Creating wetlands from this configuration is physically and logistically problematic. There is very little working room for equipment, which would have to work along the narrow spoil ridges. There is no space readily available to dispose of the material if the goal is to create wetlands from the ridge areas. Re-grading the spoil ridges downward would fill the adjacent ponds, creating turbidity and reducing the open water habitat. The geometry is such that the grading could eliminate the ponds to achieve a material balance. This would eliminate the existing anadromous habitat – a detriment, not an improvement. As with Platinum, there is a lack of soil available to complete wetland creation. In addition, the spoils at Tuluksak/Nyac have re-vegetated and provided stable habitat. Therefore, creation of wetlands from the current configuration is not practicable based on logistics and available technology.

From a fisheries perspective, it would be more effective to focus on individual projects to improve stream hydrology, connectivity, and aquatic habitat from and within the existing network of ponds. Therefore, Donlin Gold identified specific projects that could benefit aquatic resources including: (1) targeted alterations of the main channel to approach the variety of geomorphology that supports a greater diversity of fish habitat; (2) the removal of fish passage barriers between the historical dredge pond maze and the main channel, thus opening up new fish spawning and rearing areas presently inaccessible from the mainstem of the Tuluksak River; and (3) removal of the partial fish passage barrier (culvert replacement) within Slate Creek, thereby opening all of Slate Creek to upstream spawning migration during all flow stages and providing free and unrestricted movement for rearing juvenile salmonids. Like Platinum, these projects would yield significant lift in the aquatic habitat but few, if any, wetland acre credits that are needed to meet the target mitigation needs. Therefore, while these projects would provide some desired environmental benefits, they do not accomplish restoration at a watershed level.

Donlin Gold's review determined this project is not practicable. The area is under active lease and not readily available. The Tuluksak/Nyac District mitigation option could result in tangible improvements in aquatic habitat and increased fish populations, but lacks potential to create significant wetland acre mitigation credits. Based on these factors, it was eliminated from further consideration as an off-site compensatory mitigation option.

Fuller Creek Parcel

Donlin Gold evaluated the permanent protection of a 10,873-acre parcel in the Fuller Creek watershed. The Fuller Creek parcel is in the middle Kuskokwim River watershed, approximately 0.5 miles south of the community of Red Devil, within the Vreeland Creek-Kuskokwim River HUC-10 watershed. The Vreeland Creek-Kuskokwim watershed is approximately 19 miles southeast from the Project MA, and is located within the same HUC-08 Aniak watershed as the MA and much of the TA.

The Fuller Creek parcel is large enough and contains sufficient wetlands (3,135 acres) and aquatic stream resources (50 stream miles) to offset the potential losses of aquatic resources associated with the Project. In addition, the parcel serves as a large buffer that further protects the Fuller Creek watershed and the physical, chemical, and biological functions of the parcel's wetlands and streams. The Fuller Creek parcel specifically includes 8 miles of coho salmon spawning and rearing stream reaches, supported by the physical, chemical, and biological functions of the adjacent wetlands. The presence of other anadromous species has not been documented in the Fuller Creek watershed.

The Fuller Creek placer prospect is located along Fuller Creek, about 3.1 miles south-southeast of the mouth of the creek. Placer gold deposits reportedly occur for about one mile in Fuller Creek, west of Barometer Mountain. Other mining prospects within the Fuller Creek parcel include McCally, Fairview, and an unnamed prospect southeast of Barometer Mountain. The bedrock geology of the area comprises shale and sandstone of the Upper Cretaceous, Kuskokwim Group, intruded by small Late Cretaceous to Early Tertiary mafic to felsic intrusions (Bundtzen and Miller 1997). This geology is quite similar to the geology of the Donlin Gold Project.

While mineral prospects exist in the Fuller Creek drainage, there is no indication that they will be developed in the foreseeable future (no current or pending leases or claims to demonstrate a threat of development). In western Alaska, placer deposits have generally been the most available sources of minerals due to their ready access in drainages and simple mineral recovery by relatively low-cost methods. Recently, development of new watershed-wide placer mine operations has been rare; instead the common practice is to mine existing placer areas where facilities and equipment are already in place. Within the Y-K region, placer mining activity in general has been declining. Development of the Fuller Creek deposits by placer mining would pose greater challenges than exist at other nearby areas that have been previously mined. Therefore, the threat of placer mining in the Fuller Creek parcel is considered very low in the foreseeable future.

As for hard rock mining opportunities, remote areas of Alaska present extraordinary challenges in developing mining projects. Deposits must be of the size and scale to support the excessive costs of developing and sustaining the infrastructure required to access, construct, operate, and close the projects. This often involves defining millions of ounces of resources at depths that typically extend hundreds and even thousands of feet below the ground surface. For example, serious advancement of this Project has been ongoing since 1989 with more than \$500 million already spent in exploration, design, and permitting costs. After six years of review under the National Environmental Policy Act, Donlin Gold has still not obtained the required permits that are necessary before it can make a construction decision. Moreover, Donlin Gold is recognized as one of the richest undeveloped, open pit gold deposits in the world. While having somewhat similar geology to Donlin Gold, there is no evidence

that Fuller Creek has comparable resources that could be mined. No detailed exploration work (e.g., drilling) has been conducted to characterize the hard rock mineral potential. As such, even if viable hard rock deposits are in the Fuller Creek parcel, they are realistically many decades away from potential development.

Because of the lack of existing placer mining activity in the Fuller Creek parcel and the fact that it is highly unlikely a large hard rock mine would be constructed in the foreseeable future, Donlin Gold considers the threat of development in the watershed to be very low.

As noted above, coho salmon are the only salmon species observed in the Fuller Creek drainage. While important, there is no evidence that there is a lack of coho salmon habitat within the Y-K Region. Specifically, preservation of the parcel would likely not yield any tangible benefits in terms of increased coho salmon populations in the Kuskokwim River. In addition, there is no evidence that subsistence use of coho salmon in any areas of the region is limited.

Finally, Donlin Gold entered into discussions with the interests that control the Fuller Creek parcel to ascertain its availability for preservation as compensatory mitigation. These interests had previously worked with the USACE to potentially establish a compensatory mitigation bank that would facilitate preservation of the Fuller Creek parcel specifically for the Project. Unfortunately, there were significant differences in the valuations placed on the Fuller Creek parcel by the various parties. The interests that control Fuller Creek asked for reimbursement several multiples in excess of the fair market value of lands and placer deposits in the region (generally \$500 to \$1,000 per acre). As a result, Donlin Gold determined it was impracticable to pursue preservation of the Fuller Creek parcel.

In summary, because of the low development threat in the reasonably foreseeable future, the documented presence of only coho salmon use, and the significantly above-fair-market-value requested for preservation, the Fuller Creek parcel was eliminated as an off-site mitigation option.

Other Mitigation Options Considered within the HUC-06

Many of the off-site options evaluated involve non-traditional mitigation opportunities, i.e., they do not directly include restoration or preservation of wetlands and streams. These included: (1) landfill and solid and hazardous waste management improvements, (2) community drinking water and sanitary system improvements, (3) erosion control along rivers and streams, (4) trail enhancements to minimize erosion, (5) reclamation of the Newtok Village site that is being re-located, and (6) invasive species control in the Crooked Creek watershed. These projects reflect specific environmental and human health needs in the Kuskokwim River watershed. While these projects can lead to indirect improvements in stream water quality and aquatic habitat, such results are not readily quantified into wetland acres or stream miles as required under the Rule. Therefore, they do not meet the overall Project need as it relates to compensatory mitigation. There generally is no quantitative method to describe how they would compensate for unavoidable Project impacts to aquatic habitat and fish in the watershed. Further, their long-term “performance” cannot be readily measured in terms of benefitting aquatic resources. Showing such measurable long-term performance is typically required to obtain compensatory mitigation credits for affected wetland acres and stream miles. Finally, there is essentially

no precedent for such non-traditional measures being accepted as compensatory mitigation in Alaska. The non-traditional compensatory mitigation options are therefore not included in the CMP.

Broader State-Wide Potential Mitigation

While it is typically not required, Donlin Gold continued to look beyond the HUC-06 watershed to determine if there were other areas or projects that may meet the general intent of the Rule, taking into consideration the flexibility provided by the 1994 AWI (EPA et.al. 1994). The following discussion addresses two projects Donlin Gold identified: (1) the Flat/Iditarod Mining District, a historical gold mining district in the Yukon River watershed, and (2) the Chuitna River watershed, which has a long history of coal, oil, gas, and timber activity, and is a highly productive salmon river in the populated Cook Inlet watershed.

Flat/Iditarod Mining District

The Flat/Iditarod Mining District is in the Flat Creek drainage. The area is approximately 40 miles north-northeast of the Donlin Gold MA, just over a ridge separating the drainage between the Yukon and Kuskokwim Rivers. Despite the proximity to the Project MA, Flat is outside the HUC-04 of the MA; it is located in the Lower Yukon River HUC-04. The Flat Creek area comprises thousands of acres of historically dredged/placer-mined streams and tributaries. The district is also of historical significance, and is part of the Iditarod Trail, although it is not included in the modern Iditarod Trail events and activities. The Flat area includes a functioning airstrip and some remnant roads which historically provided access to Iditarod and beyond.

The area is mostly situated in a parcel that was conveyed to Doyon Limited (Doyon) under ANCSA, although the mining rights remain under BLM control. BLM has expressed hope that restoration could be conducted on much of the area to facilitate full transfer to Doyon. It is not evident that the material needed, including topsoil, is available to complete reclamation. Much of the area is uplands. Several mining claims exist under private control, many held by the Miscovich family who were original residents and miners. Historical features are present throughout the landscape.

The Flat/Iditarod Mining District provides a large restoration area opportunity for compensatory mitigation. However, the complexity of the land issues makes it difficult to acquire all the claims and secure long-term durability. The comments related to reclamation of BLM lands at Platinum also apply to Flat. This includes the challenges associated with meeting current reclamation and revegetation standards and potential conflicts with ANCSA mandates. There are also significant and numerous historical features that would complicate efforts to perform large-scale reclamation of the area. Securing this area to conduct wetland restoration for wetland compensatory mitigation will require compliance with Section 106 of National Historic Preservation Act for potential impacts to cultural resources. Mitigation compliance costs are not typically determined until the end of the consultation process, which traditionally takes years to complete. This time constraint severely complicates logistics and planning. Therefore, the Flat/Iditarod Mining District was not considered further in this CMP.

Chuitna River Watershed

The Chuitna River watershed is a drainage located on the west side of Cook Inlet 45 air miles from Anchorage, the largest city in Alaska. This area has a unique mix of existing and potential future industrial activities that surround the Chuitna drainage. The area has two active ports – one at North

Foreland to the south, which includes a beach barge landing area and a pile supported trestle and dock; and a barge beach landing area to the north known as Grant's Landing. The ports have been used for the import of oil field pipe, equipment, fuel, and supplies for Tyonek and Beluga, two local communities. A series of connecting service trails and roads connect Tyonek and Beluga for local uses. Resource development roads are interspersed in the region to facilitate the harvest of timber, and for the development of the regional oil and gas industry. Temporary roads have been constructed for coal exploration and development. The Beluga coal field and the Beluga oil and gas basin are centered here. Gas from the region is collected and shipped to the Beluga natural gas power plant or into the regional gas supply system for distribution to Anchorage, the Matanuska-Susitna Borough, and the Kenai Peninsula for heating and power generation.

The Chuitna River area is used by Alaskans and non-residents for recreational and guided fishing. Offshore fisheries in Cook Inlet include salmon and halibut. The Chuitna River contains very productive salmon runs including Chinook salmon (listed as a species of concern by the ADF&G), coho, sockeye (minor use), chum, and pink salmon. These salmon provide an important food source for endangered Cook Inlet Beluga whales. While State and Federal permit programs strive to balance development with land, habitat, and wildlife protection, the proximity of the area to Anchorage places development and use pressures on the Chuitna River that merit special consideration for additional protection through preservation of portions of the watershed.

Donlin Gold entered into discussions with two of the key land owners in the watershed: the Tyonek Native Corporation (TNC), and the Trust Land Office (TLO), which manages lands for the Alaska Mental Health Lands Trust (AMHT) Authority. Both entities expressed an interest in preserving key critical habitat areas within the 95,000-acre Chuitna watershed while preserving their ability to generate revenues from the remaining lands in the area. Donlin Gold reached an agreement with both entities to obtain the preservation rights to nearly 6,000 acres of wetlands, highly productive salmon streams, and associated upland buffer areas.

Off-Site Options Conclusion

After conducting extensive review of all off-site mitigation options to supplement the reclamation and restoration of placer-mined areas in upper Crooked Creek and the post-mining restoration of wetlands in the MA, Donlin Gold proposes to preserve lands within the Chuitna watershed as a PRM Plan for the Project. The PRM Plan for the Chuitna Preservation Area (Preservation Area) is provided in Attachment E. Selection of these lands for preservation is based on:

- The ability to preserve extensive wetland acres and stream miles providing compensatory mitigation for the permanent and long-term fill impacts in the MA, TA, and PA. This includes several tributaries including headwaters, and much of the mainstem of the Chuitna River to the estuarine water of Cook Inlet. The proposed Preservation Area will set aside 5,870 acres, including 3,269 acres of wetlands and ponds, and 418 acres of streams and rivers, totaling 3,687 acres of WOUS. It also protects 2,183 acres of upland riparian area and buffers, and 258,056 linear feet (48.8 miles) of streams in the Chuitna watershed. The 2,183 acres of upland riparian and buffers, and 418 acres of stream serve a critical role in maintaining the watershed-level functions and values of the preserved wetlands.

- The watershed provides important spawning and rearing habitat for all five Pacific salmon species as well as having large populations of resident fish species. While not in the same HUC-10 as the MA and TA, the linear length of important salmon habitat in the Preservation Area is 36 times more than the areas that would be filled in the Crooked Creek watershed. As discussed in the Chuitna PRM Plan (Attachment E), observed salmon populations are much higher in the Chuitna watershed compared to Project drainages. The Chuitna watershed also overlaps with the critical habitat for endangered Beluga whales and salmon provide an important food source for these whales.
- There is a recent threat of development associated with coal resources throughout the watershed. The extent and potential value of the coal deposits are well-established and detailed mine plans have been advanced, including significant work to permit these deposits. In addition to the threat of coal mining, oil and gas development activities, timber harvest, and gravel extraction operations exist throughout the watershed with a long history of development of these in the area (see Attachment E for an expanded discussion of the development threats).
- Donlin Gold has reached agreements to establish secure, durable deed restrictions for the proposed mitigation areas.

Table 4 *Compensatory Mitigation Options Evaluated by Donlin Gold*

Mitigation Option	Description	Rationale for Elimination
<u>Banks and ILF Programs</u>		
Conservation Fund State-wide ILF Program	Instrument intended to provide mitigation credits for projects throughout Alaska.	No longer offering credits in Alaska per the USACE decision to terminate the program in October 2017.
Great Land Trust ILF Program	Instrument intended to provide mitigation credits for projects throughout Alaska, although primarily focused on the Anchorage area. Credits are currently available only for wetland impacts in the Matanuska-Susitna service area.	The service area for available credits is currently limited to the Matanuska-Susitna Borough. Hence, the Program cannot provide compensatory mitigation for most of the permanent Project impacts. However, Donlin Gold has made a commitment to purchase credits for the 5.0 acres of permanent PA impacts within the GLT service area.
State of Alaska ILF Program	Planned to provide credits associated with State lands.	In early stages of development; no guarantee credits will be available to Donlin Gold.
Su-Knik Bank	Offers compensatory mitigation credits associated with high-value preservation areas in the Matanuska-Susitna Borough. As of May 2018, the Bank had 1,700 credits available for purchase.	All but 5 acres of the permanent Project impacts to wetlands are outside of the Bank's primary and secondary service areas. Donlin Gold solicited a competitive bid offer from the Bank to provide credits for the PA impacts in their service areas. As a result of that process, Donlin Gold chose to secure the necessary credits from Great Land Trust, who has an overlapping service area with Su-Knik Bank..

Village Site Restoration

Mitigation Option	Description	Rationale for Elimination
Newtok Village Reclamation and Remediation	<p>Donlin Gold reached out to USFWS to identify potential mitigation opportunities. USFWS expressed interest in the Newtok Village reclamation and restoration. The village is located 94 miles north of Bethel at the confluence of the Ninglick and Newtok Rivers. Severe erosion along the Ninglick River is threatening the village and it is being relocated. Continued erosion could destroy the village, with infrastructure potentially slumping into the river creating waterborne hazards. Beyond erosion are threats of contamination associated within an old armory, Bureau of Indian Affairs school, landfill and waste storage areas, tank farms, other tanks, a generator facility, and other community and commercial facilities. The school and armory are on the State’s Contaminated Sites List.</p>	<p>While many of the Newtok facilities with potential contamination risk have been inventoried, detailed investigations and clean-up plans have not been developed or approved by State and Federal agencies. Given the number and extent of the sources and expectation of compliance with stringent state clean-up standards, remediation could take many years and costs are currently impossible to quantify due to the many unknowns. There is also the potential for significant long-term liability. The USFWS Hazardous Materials Inventory for the village acknowledges the most significant data gap is the extent of contaminated soil, ground and surface water. In addition, remediation activities likely have limited potential for wetlands restoration and thereby would not generate substantive wetland and stream mitigation credit. As a result, Newtok Village reclamation and remediation is not a practicable compensatory mitigation alternative for Donlin Gold.</p>

Mitigation Option	Description	Rationale for Elimination
<u>Mining/Mineral Development Area Restoration and Preservation</u>		
Flat/Iditarod Mining District Restoration	Gold was discovered in Flat in 1908, and the subsequent influx of miners and businesses created a town of about 6,000 by 1914. The area surrounding Flat Creek/Otter Creek in the Yukon River watershed has been thoroughly mined by placer activity, and miles of disturbed streams and un-reclaimed overburden/tailings dominate the landscape. The land is managed by BLM, which administers the various claims/leases in the area.	Multiple claim and lease holders made the likelihood of successfully negotiating required agreements low. Also, all restoration would likely have to meet current BLM reclamation standards, which is impracticable given the scale of the deposited material, availability of segregated soil to support re-vegetation, and changes to the baseline hydrology in the watershed. There would also be significant issues in protecting cultural resources in the District related to the historical mining activity and the Iditarod Trail.
Tuluksak/Nyac Mining District Restoration	The Nyac Mine is located on the Tuluksak River and its tributaries about 60 miles east/northeast of Bethel. The underlying claims and some of the land areas are controlled by Calista. The placer mine operation is leased from Calista by Dr. J. Michael James (Nyac Gold, LLC), who assumed full management of the claims nearly 20 years ago.	Because of its location in the Kuskokwim River watershed, Donlin Gold evaluated Nyac Mine restoration in detail. In the mined and other impacted areas, existing natural processes have resulted in restoration of stream and aquatic habitat. Salmon are present in the stream system and restoration activities may pose a risk to them. The volumes and arrangements of tailings and overburden left by the dredge activities make restoration of wetlands while protecting salmon impracticable. Opportunities for watershed-level ecological lift from restoration work are therefore limited.
Red Devil Mine Remediation	The Red Devil cinnabar/mercury mine is an abandoned historical mine on land managed by the BLM. The site is a very high-profile remediation/clean-up project; BLM has proposed a range of remedial actions to restore and protect Red Devil Creek and the Kuskokwim River.	Because of its location in the middle Kuskokwim River watershed, Donlin Gold evaluated Red Devil Mine remediation in detail. While the BLM has proposed specific remedial plans, there is disagreement on the scope among the EPA, the State of Alaska, and TKC, the landowner. These issues are likely to continue for years. Until a final resolution is agreed upon, it is unclear how Donlin Gold could contribute to restoration activities. In addition, the property does not lend itself to restoration and preservation of a significant amount of wetland acres as needed for the Project purpose. This makes Red Devil impracticable as a mitigation option.

Mitigation Option	Description	Rationale for Elimination
Kolmakof Mine Site Remediation	The Kolmakof Mine is a historical cinnabar/mercury mine east of Aniak on the north shore of the Kuskokwim River. The last known production was in 1970. The site has been substantially cleaned up and most contaminants removed in a coordinated effort between EPA and BLM. Some mercury/contaminated soils are still on-site and plans are in place to remove them.	The site is relevant because of its location in the middle Kuskokwim watershed. However, because clean-up has generally been completed at the site, there is little or no opportunity for additional restoration to create ecological lift and associated mitigation credit.
Platinum Mining District Restoration and Preservation	The Platinum Mine site is just south of Goodnews Bay, on Kuskokwim Bay, west of Bristol Bay on the Bering Sea. The mine site comprises nearly 200 BLM claims totaling just over 4,000 acres. Placer mining has occurred in the watershed since the 1930s, with the most recent mining in 2008. Extensive placer tailings and overburden are found in the watershed and the hydrology has been altered. Approximately 800 acres of largely undisturbed claims are situated within the Refuge. Angler has entered into an agreement with the current lease holder, Hansen, to access the claims and conduct additional placer mining.	Because of its potential for significant watershed-level restoration and preservation of important anadromous fish and avian habitat, Donlin Gold evaluated Platinum in detail. The restoration of the area has the potential to restore hydraulic connections and thereby enhance fish passage and habitat. However, with the large volumes of deposited tailings and overburden and the disturbance to the subsurface hydrology from large-scale dredge activity, restoration of wetlands is not generally practicable. It is unclear how mitigation credit would be acquired as it relates to acres of wetlands. Also, discussions with BLM suggest the mined material would have to meet current mine reclamation standards, such as 70 percent revegetation success. This is not practicable given the types of materials and how the bucket-line dredge materials were deposited. Restoration was judged to not be practicable. For undisturbed lands in the lower areas of the Salmon River drainage outside the Refuge, underlying, long-term land control issues (minimum three-party involvement) make preservation of these areas impracticable. Donlin Gold actively pursued preservation of the approximately 850 acres (650 wetland acres) in the Refuge. If the mining claims were relinquished, control would revert to the USFWS (for long-term preservation). Donlin Gold approached the owners to acquire this property, but these efforts were unsuccessful.

Mitigation Option	Description	Rationale for Elimination
Fuller Creek Watershed Preservation	The Fuller Creek watershed is approximately 20 miles upriver from the Crooked Creek/Kuskokwim River confluence in the same HUC-08 as the Donlin Gold MA. The USACE previously recognized the mineral development threat in the Fuller Creek watershed; although only limited prospecting has occurred to date. Fuller Creek is listed in the state's Anadromous Waters Catalog for coho salmon, including supporting juvenile rearing. The presence of other aquatic species has not been documented. The lands are owned by Calista.	Because of the potential for preservation of anadromous fish habitat, the potential for watershed-level development, and proximity to the MA and TA, Donlin Gold evaluated Fuller Creek preservation in detail. Wetlands encompass approximately 3,000 acres within the approximate 10,000-acre watershed. Donlin Gold approached the partners that hold the rights to the parcel (Calista and Earthbalance Corporation) but were unable to reach an agreement that would make this option practicable. In addition, the actual threat of placer or hard rock mining development in the foreseeable future is very low.

Non-traditional Mitigation Projects

Community Water and Wastewater System Improvements in the Y-K Region	Many communities in the Y-K Region, including the City of Bethel, have inadequate systems to provide safe drinking water and sanitary wastewater treatment. This presents both human health and environmental risks. In numerous cases, designs for improved systems are in place; however, they have not been implemented due to limited funding. Donlin Gold spoke to communities and the Yukon-Kuskokwim Health Corporation about opportunities to support such programs and gain compensatory mitigation credit.	Because these programs are non-traditional for compensatory mitigation, the benefits are not easy to quantify in terms of benefits to wetland acres or stream miles. Further, performance metrics are not readily quantified, and success cannot easily be demonstrated. There is essentially no precedent for acceptance of these measures for compensatory mitigation for large projects in Alaska. Therefore, they cannot reliably be shown to be able to provide the mitigation credits necessary for the Project.
Solid and Hazardous Waste Management	Many communities in the Y-K Region have landfills that do not meet minimum design standards. In addition, communities often have no viable and affordable options for management of hazardous materials and wastes. Both conditions pose significant risks to human health and the environment, including impacts to wetlands and streams.	Donlin Gold contacted communities about potential support for landfill improvements. In addition, Donlin Gold investigated options to facilitate backhaul of used hazardous materials and wastes to appropriate disposal facilities. For the reasons cited for community water and wastewater system improvements, these non-traditional options cannot be reliably shown to provide the mitigation credits necessary for the Project.

Mitigation Option	Description	Rationale for Elimination
Erosion Control Projects in the Kuskokwim River Watershed	Natural and man-made erosion is widespread throughout the Kuskokwim River watershed. Such erosion affects hydrology and water quality as well as aquatic resources. Erosion in some areas threatens villages. USACE completed a conceptual study of potential erosion control projects in the watershed. (This assessment was not done specific to the Project, but rather involved USACE’s mission related to navigable waterways).	Donlin Gold considered options to support erosion control projects. However, it is difficult to provide permanent erosion control in dynamic stream systems like the Kuskokwim River. Designs can be complicated, materials availability scarce, and the projects would require ongoing maintenance to be effective. As indicated, the USACE study was conceptual and did not include specific designs, costs, and expected performance. For the reasons cited for community water and wastewater system improvements, this non-traditional option cannot reliably be shown to provide the mitigation credits necessary for the Project.
All-terrain Vehicle (ATV) Trail Hardening Projects in the Y-K Region	Environmental impacts associated with the degradation of ATV trails have become a serious concern in many locations in Alaska, including in the Y-K Region. Where ATV trails cross wetlands, alpine areas, steep slopes, and other areas with sensitive soil conditions, trails can become mucky, rutted, and eroded. Environmental problems associated with ATV trail damage include removal of vegetation, disruption and compaction of the soil surface, and alterations to site hydrology.	While there is a broad need in the region to protect wetlands and riparian systems from degradation due to ATV traffic, likely benefits are difficult to predict and performance cannot be readily measured. For the reasons cited for community water and wastewater system improvements, this non-traditional option cannot reliably be shown to provide the specific mitigation credits necessary for the Project.
Non-native Species Plant Removal in the Crooked Creek Watershed	Non-native species have the potential to adversely impact watershed function. Donlin Gold conducted a reconnaissance survey and found a minimum of 123.6 acres of land in the Crooked Creek watershed near the MA colonized by non-native species.	While valuable ecologically, it is not possible to quantify how removal of invasive species would provide restoration or enhance wetland acres or streams. As a result, potential mitigation credits cannot be determined, and performance could not be readily measured. For the reasons cited for community water and wastewater system improvements, this non-traditional option cannot reliably be shown to provide the specific mitigation credits necessary for the Project.

6.0 Compensatory Mitigation

Donlin Gold proposes two PRM Plans and a limited purchase of mitigation bank credits to offset the Project permanent fill impacts. They are:

1. The Upper Crooked Creek PRM Plan (Attachment D) includes the enhancement, reestablishment, restoration, rehabilitation and preservation of wetlands, riparian areas, stream channels, and uplands within 221.5 acres. The PRM Plan will restore degraded acreage in Quartz, Snow, Ruby and Queen Gulches, and at the Wash Plant Tailings Area. The PRM Plan will restore 95.7 acres of degraded floodplains into 93.0 acres of wetlands and 2.7 acres of riverine channel. A total of 8,892 liner feet of stream will be enhanced and reestablished by the work in the floodplain. Within the wetland floodplains. This PRM will be initiated concurrent with the start of MA construction.
2. The Chuitna PRM Plan (Attachment E) will preserve 5,870 acres, including 3,269 acres of wetlands and ponds, and 418 acres of streams and rivers, totaling 3,687 acres of WOUS. It also protects 2,183 acres of upland riparian area and buffers, and 258,056 linear feet (48.8 miles) of streams in the Chuitna watershed. A deed restriction and Long-Term Management Plan will be in place prior to the start of Project construction.
3. Prior to initiating Project construction, Donlin Gold will complete the purchase 9.80 wetland mitigation credits from Great Land Trust's mitigation bank for the permanent impacts from the PA in the Program's service area.

HGM and Cowardin classification systems were specifically used to calculate the acres of wetlands and linear feet for PRM stream restoration and preservation areas.

Summary of the Upper Crooked Creek PRM Plan

The Upper Crooked Creek PRM Plan was selected to provide compensatory mitigation for the Project from a wide range of potential PRM options identified across the Lower Kuskokwim watershed and throughout western Alaska. The PRM Plan includes the enhancement, reestablishment, restoration, rehabilitation and preservation of wetlands, riparian areas and uplands within 221.5 acres. The PRM plan will restore degraded wetlands and floodplains in Quartz, Snow, Ruby and Queen Gulches, and at the Wash Plant Tailings Area, Table 5.

Table 5 Upper Crooked Creek PRM Plan Areas Protected under the Site Protection Instrument (Acres)

Restoration Area	Acres
Quartz Gulch	45.2
Snow Gulch	36.7
Wash Plant Tailings Area	29.3
Ruby and Queen Gulches	110.3
Total	221.5

The PRM Plan will restore 95.7 acres of floodplains into 93 acres of wetlands and 2.75 acres of riverine channel. A total of 8,892 liner feet of stream will be enhanced and reestablished by the restoration work in the floodplains. Within the wetland floodplains, 15.2 acres of off-channel ponds will be improved as

aquatic resource habitat. In addition, there will be 16.8 acres of adjacent upland terrestrial habitat enhanced. A total of 109 acres of riparian upland and wetland buffers will be preserved around the restored and enhanced wetlands and stream channels. The riparian upland and wetland buffers are designed to maintain the long-term viability of the proposed restoration. This plan will be initiated concurrent with the start of MA construction. Table 6 summarizes the Upper Crooked Creek PRM Plan.

Table 6 Acreage and Linear Feet of Resources Re-established, Enhanced, and Protected by the Upper Crooked Creek PRM

	Quartz Gulch	Snow Gulch	Wash Plant Tailings Area	Ruby and Queen Gulches	Total
Re-establishment of Stream Channel to Pre-mining Conditions (Linear Feet)	1,630	4,421	N/A	2,931	8,982
Re-establishment of Floodplain Habitat (Acres)	13.1	21.9	11.4	49.3	95.7
Enhancement of Off-channel Pond Habitat (Acres)*	N/A	2.7*	0.5*	12.0*	15.2*
Enhancement of Terrestrial Habitat (Acres)	2.5	3.4	2.4	8.5	16.8
Protection of Buffer Areas (Acres)	29.5	11.4	15.6	52.5	109.0
Total Protected under Site Protection Instrument (Acres)	45.2	36.7	29.3	110.3	221.5

*Acreage of enhanced off-channel pond habitat is included within the re-established floodplain habitat.

N/A: Not Applicable.

Note: Inconsistencies in sums are due to rounding.

Mitigation credits can include both wetlands and buffers. “District engineers may require the restoration, establishment, enhancement, and preservation, as well as the maintenance, of riparian areas and/or buffers around aquatic resources where necessary to ensure the long-term viability of those resources. Buffers may also provide habitat or corridors necessary for the ecological functioning of aquatic resources. If buffers are required by the district engineer as part of the compensatory mitigation project, compensatory mitigation credit will be provided for those buffers.” [33 CFR 332.3(h)(2)(i)].

As shown in (Table 7), The Upper Crooked Creek PRM was divided by wetland HGM types using Cowardin Classifications for both the restoration and preservation areas. The wetlands restored will be riverine. The wetlands within the preservation buffer areas include depressionnal, flat, riverine anadromous, and slope wetlands.

Table 7 Compensatory Mitigation Proposed for Upper Crooked Creek by HGM Class and Cowardin Group (Acres)

Classification		Upper Crooked Creek Restoration	Upper Crooked Creek Preservation
Wetland HGM (Cowardin Classes)	Depressional (PAB, PEM, PFO, PSS, PUB)	0	1.6
	Estuarine Fringe (E2EM, E2US)	0	0
	Flat (PEM, PFO, PSS)	0	32.7
	Riverine Non-Anadromous (PEM, PFO, PSS, PUB)	93.0	0
	Riverine Anadromous (PEM, PFO, PSS, PUB)	0	18
	Slope (PEM, PFO, PSS)	0	11.6
	Totals		
Wetlands and Ponds	93.0	63.8	
Stream and River Area	2.75	0.9	
Upland Riparian and Buffers	16.8	44.1	
Sub-Totals		112.5	109
Total Area		221.5	

Summary of the Chuitna PRM Plan

The Preservation Area in the Chuitna PRM Plan (Attachment E) will preserve 5,870 acres, including 3,269 acres of wetlands and ponds, and 418 acres of streams and rivers, totaling 3,687 acres of WOUS. It also protects 2,183 acres of upland riparian area and buffers, and 258,056 linear feet (48.8 miles) of streams in the Chuitna watershed. The wetland systems within the Preservation Area include large areas of slope HGM wetlands including ericaceous shrub bog-string bog wetlands, riverine HGM riparian wetlands adjacent to anadromous streams, estuarine fringe HGM wetlands, and a small number of depressional HGM wetlands. Ericaceous shrub bog-string bog wetlands, a type of slope HGM wetlands, are a unique wetland type to the area, and only occur in a few very specific places worldwide.

Table 8 *Preservation Area Resource Types (Acres)*

Resource Type	Acres
Wetlands and Ponds	3,269
Stream and River Area	418
Upland Riparian and Buffers	2,183
Total	5,870

Source: Field Verified Mapping, Michael Baker 2017

Uplands and wetlands in the Preservation Area surrounding the Chuitna River and its tributary, Lone Creek, were selected to maximize the protection of wetlands, floodplains, anadromous streams, and riparian areas using a watershed approach. The Chuitna River floodplain includes back water sloughs,

ponds, minor channels, riverine wetlands, and scrub and forested uplands in the bends of the river. The preservation boundaries on the mainstem of the Chuitna River were selected to maximize full protection of the floodplain flow channels, which support the anadromous stream system. This protection provides a diversity of habitat, vegetation types, and terrestrial and aquatic resources within uplands and wetlands while protecting anadromous waters.

The boundaries around Lone Creek were established to maximize the amount of unique ericaceous shrub bog-string bog wetlands. This created a large contiguous undeveloped parcel of the stream and its tributaries and wetlands interspersed with uplands. This unfragmented parcel in the lower Lone Creek watershed protects the wetlands, baseflow, streams, and anadromous fisheries of both Lone Creek and the Chuitna River from development.

Table 9 shows a comparison of the Preservation Area HGM wetlands preserved and MA/TA wetlands permanently filled.

Table 9 HGM Class Wetlands Comparison: Preservation Area and MA/TA (Acres)

HGM Class	Preservation Area Preserved Acres	MA/TA ¹ Permanent Fill Acres
Depressional	79	3
Estuarine Fringe	29	0
Flat	0	1,623
Riverine	500	160
Slope	2,661	888
Total	3,269	2,676

*Inconsistencies are due to rounding.

Notes: ¹DA (Donlin Gold 2017)

Compared to the MA/TA's low-flow streams and small associated floodplains, the Preservation Area preserves over four times the riverine HGM floodplains; these floodplains help support the salmon fisheries of the Chuitna River. Also associated with the wetland floodplains are 2,183 acres of adjacent riparian uplands included in the Preservation Area.

The streams and rivers in the Preservation Area provide habitat for Chinook, coho, chum, and pink salmon, as well as limited habitat for sockeye salmon, Dolly Varden, and rainbow trout. The mainstem of the Chuitna River includes Chinook, coho, chum, and pink salmon spawning habitat, and rearing habitat for all five Pacific salmon species. Tributaries to the Chuitna River that fall within the Preservation Area also have documented use by all five Pacific salmon species. The Chuitna River and Lone Creek, both anadromous streams, have 424 acres of associated riverine HGM floodplains as shown in (Table 10) while the MA and TA have 7.8 acres. Only 76 acres of riverine HGM wetlands in the Preservation Area are not associated with anadromous streams compared to 152.2 acres in the MA and TA.

Table 10 *Riverine HGM Class Wetlands Comparison: Preservation Area and MA/TA (Acres)*

HGM Class	Preservation Area ¹ Preserved Acres	MA/TA Permanent Fill Acres
Riverine, Anadromous	424	7.8
Riverine, Non-Anadromous	76	152.2
Total	500	160

¹Inconsistencies are due to rounding.

Source: See Attachment E

Table 11 summarizes the anadromous stream habitat preserved in the Chuitna River drainage and permanently filled in the Crooked Creek drainage.

Table 11 *Summary of Anadromous Stream Habitat: Chuitna River Drainage Preserved and Crooked Creek Drainage Permanent Fill (Linear Feet)*

Species	Spawning		Rearing		Total Anadromous Habitat	
	Chuitna River Drainage	Crooked Creek Drainage	Chuitna River Drainage	Crooked Creek Drainage	Chuitna River Drainage	Crooked Creek Drainage
	Habitat Preserved	Habitat Permanent Fill	Habitat Preserved	Habitat Permanent Fill ¹	Habitat Preserved	Habitat Permanent Fill ¹
	Linear Feet (miles)		Linear Feet (miles)		Linear Feet (miles)	
Chinook	77,616 (14.7)	0	133,214 (25.23)	0	133,214 (25.23)	0
Sockeye	0	0	101,006 (19.13)	0	133,214 (25.23)	0
Coho	70,541 (13.36)	0	148,632 (28.15)	2,218 (0.4)	148,632 (28.15)	2,218 (0.4)
Chum	44,088 (8.35)	0	12,514 (2.37)	0	131,789 (24.96)	0
Pink	106,128 (20.1)	0	13,253 (2.51)	0	133,214 (25.23)	0

*Inconsistencies are due to rounding.

Source: See Attachment E

On October 22, 2008, the NMFS listed the Distinct Population Segment of Beluga whale found in Cook Inlet as endangered under the Endangered Species Act of 1973, as amended (ESA). On April 11, 2011, NMFS designated critical habitat for the Cook Inlet Beluga whale under the ESA. Two areas were designated as critical habitat; both comprising 3,016 square miles of marine and estuarine environments considered essential for the whales' survival and recovery. The Preservation Area includes approximately 29 acres of estuarine fringe HGM wetlands at the mouth of the Chuitna River that overlap with critical habitat for Cook Inlet Beluga whales.

Summary of Proposed PRM Plans

Table 12 provides a summary of the linear feet of permanent stream loss from the Project compared to linear feet restored and preserved by the PRM Plans. With these PRM Plans, the overall linear feet of stream restored and preserved exceeds Project losses; there is a net gain of 93,085 linear feet (17.6 miles) of streams. The Project impacts predominantly non-anadromous streams in the MA and replaces this loss with restoration and preservation of anadromous stream. There is specifically a net gain of 194,074 linear feet (36.8 miles) of anadromous stream gains. Polylines were used to calculate the stream lengths. During the digital mapping process, all visible wetland, waters, and vegetation boundaries are delineated as polygons (mapped as an area) and classified as uplands, wetlands, ponds,

or streams. All streams are delineated as polylines (mapped as a linear feature). Stream impacts and credits have been calculated from the polylines in linear feet.

Table 12 Permanent Fill in Streams Compared to Restored and Preserved Stream Lengths, by Linear Feet (Miles)

HGM Class Stream Channel	Cowardin Group	MA and TA Permanent Fill in Streams	Upper Crooked Creek PRM Restored	Chuitna PRM Preserved	Total Restored and Preserved	Net
Linear Feet (Miles)						
Anadromous	Intermittent	0	0	161 (0.0)	161	161 (0.0) gain
	Perennial	-2,218 (0.4)	0	196,131 (37.1)	196,131 (37.1)	193,913 (36.7) gain
Total Anadromous		-2,218 (0.4)	0	196,292 (37.2)	196,292 (37.1)	194,074 (36.8) gain
Non- Anadromous	Intermittent	-38,675 (7.3)	0	6,615 (1.3)	6,615	32,060 (6.0) loss
	Perennial	-133,060 (25.2)	8,982 (1.7) ¹	55,149 (10.4)	64,131	68,929 (13.1) loss
Total Non-Anadromous		-171,735 (32.9)	8,982 (1.7)	61,764 (11.7)	70,746	100,989 (19.1) loss
Total		-173,953 (32.9)	8,982 (1.7)	258,056 (48.8)	267,038	93,085 (17.6) gain

*Inconsistencies are due to rounding.

¹ In Upper Crook Creek: anadromous fish use is expected in the restoration areas. However, the exact stream lengths that will provide for anadromous fish habitat cannot be accurately predicted. Post-restoration monitoring will verify presence or absence of anadromous and resident fish.

Table 13 shows wetland HGM classes and the Cowardin groups comparing permanent Project wetland losses to the gains from the two PRM Plans. Wetland and pond polygons from the mapping were used to calculate wetland and pond acres, while upland riparian buffers and stream polygons were mapped, and acres calculated separately. There are no upland riparian buffers or stream acreages included within Table 13. Table 13 is comparing wetlands and ponds. The major gains from the PRM Plans are in slope (1,737.6 acres) and riverine anadromous wetlands (434.9 acres). There is a loss of flat wetlands (1,742.3 acres). There is a net gain of 550 acres of all wetland classifications from the implementation of the PRM Plans.

Table 13 Compensatory Mitigation Proposed by PRM Plan for Wetlands by HGM Class and Cowardin Group (Acres)

	Classification	Chuitna Preservation Area	Upper Crooked Creek Restoration	Upper Crooked Creek Preservation	MA/PA loss	Net Loss or Gain
Wetland HGM (Cowardin Classes)	Depressional (PAB, PEM, PFO, PSS, PUB)	79	0	1.6	3	77.6 (gain)
	Estuarine Fringe (E2EM, E2US)	29	0	0	0	29 (gain)
	Flat (PEM, PFO, PSS)	0	0	32.7	1,775	1,742.3 (loss)
	Riverine Non-Anadromous (PEM, PFO, PSS, PUB)	76	93.0	0	156	13 (gain)
	Riverine Anadromous (PEM, PFO, PSS, PUB)	424	0	17.9 ¹	7	434.9 (gain)
	Slope (PEM, PFO, PSS)	2,661	0	11.6	935	1,737.6 (gain)
Totals	Wetlands and Ponds	3,269	93.0	63.8	2,876	550.75 (gain)

¹Riverine wetlands are adjacent to Crooked Creek.

*Inconsistencies are due to rounding.

7.0 Crooked Creek Watershed Analysis

Introduction

Regulations addressing wetland mitigation [33 CFR 332.3(c) and 40 CFR 230.93(c)] direct the district engineer to use a watershed approach to establish compensatory mitigation requirements. The goal of using a watershed approach is to maintain and improve the quality and quantity of aquatic resources within watersheds through strategic selection of compensatory mitigation sites. Most of the permanent fill to wetlands and streams from the Project will occur in the Crooked Creek watershed. Since a watershed plan has not been developed for Crooked Creek, Donlin Gold prepared this watershed analysis to provide additional information to the district engineer. The analysis includes descriptions of watershed characteristics, a summary of potential impacts to aquatic resources, and opportunities for mitigation.

Watershed Overview

The Crooked Creek HUC-10 watershed (Figure 7) is located within the Kuskokwim River basin in southwest Alaska and covers an area of 215,067 acres (approximately 0.67 percent of the Kuskokwim River watershed). The watershed is situated in a zone of discontinuous permafrost in the southwest portion of the Kuskokwim Mountains region (Pewe 1975). Crooked Creek, a tributary of the Kuskokwim River, is the largest stream in the watershed. As the name indicates, it is a sinuous stream, with a relatively low gradient, and channel widths ranging from approximately 50 feet in the upper reaches to 340 feet at its confluence with the Kuskokwim River.

The Crooked Creek watershed is predominantly undeveloped and includes large expanses of wetlands and streams that provide habitat for fish and wildlife. Historical placer mines, hard rock mining exploration areas, and the village of Crooked Creek are the only anthropogenic ground disturbing activities currently in the watershed. The village of Crooked Creek, located at the mouth of Crooked Creek along the north bank of the Kuskokwim River, is the only established community within the watershed.

Landcover

The Crooked Creek watershed landcover includes a mosaic of vegetated areas with a few barren locations, including disturbed areas. Landcover classification for the Crooked Creek watershed was derived from Landsat 7 ETM+ satellite imagery (2001-2002) and classified using the Alaska Vegetation Classification (Viereck et al. 1992) (Figure 8). The dominant vegetation is typical of Interior Alaska and includes needleleaf woodland and needleleaf forest, mixed wood forest, low shrub, and broadleaf forest/tall shrub. Table 14 provides a list and percentages of each landcover type found in the Crooked Creek watershed. At present, 3,579 acres (1.66 percent) of the Crooked Creek watershed are classified as barren. This includes approximately 164 acres (or 0.08 percent of the watershed) of anthropogenic ground disturbance that has resulted from historical placer mining, mine exploration activities, and the village of Crooked Creek.

Figure 7 Crooked Creek Watershed (HUC-10)

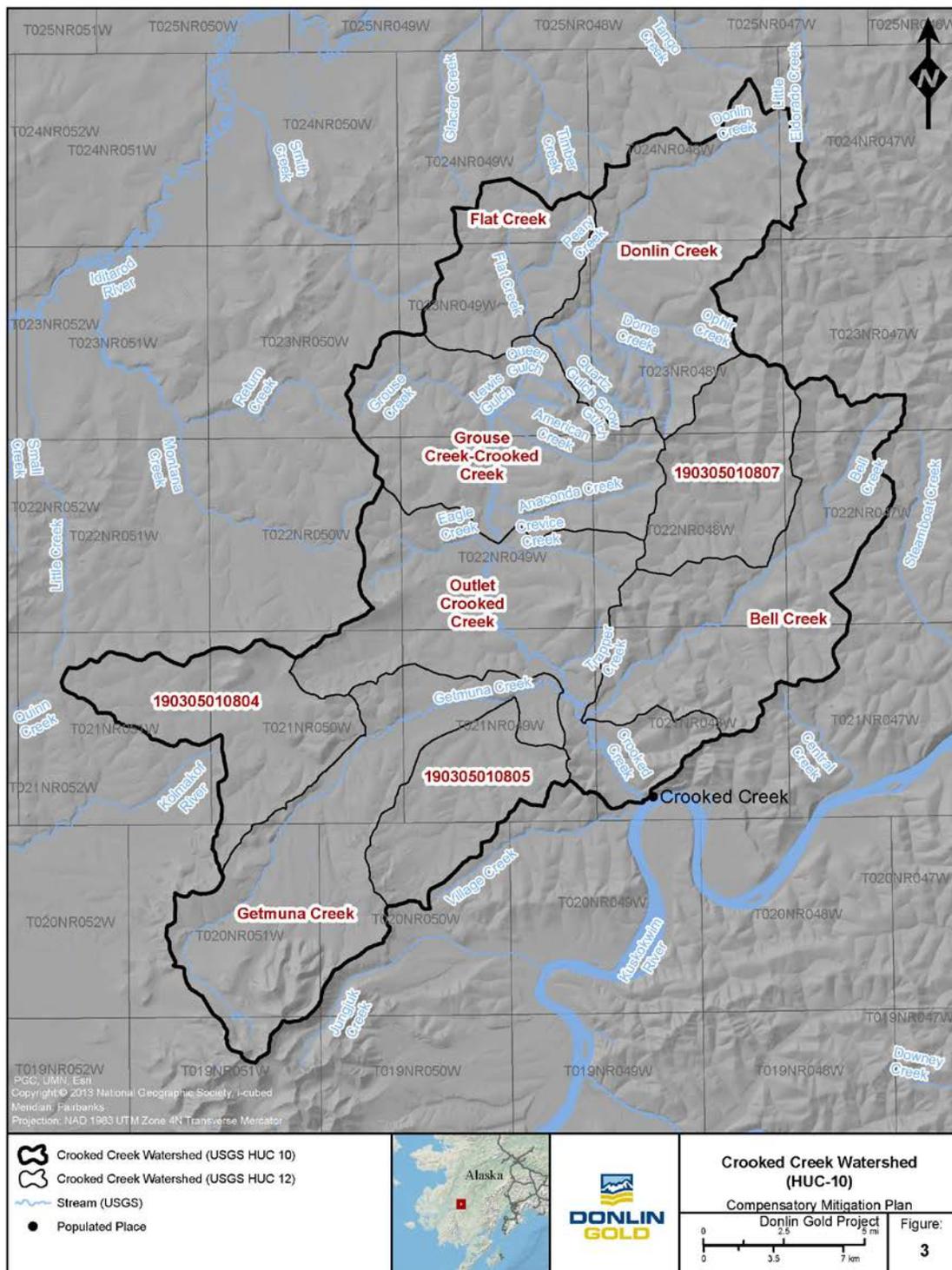
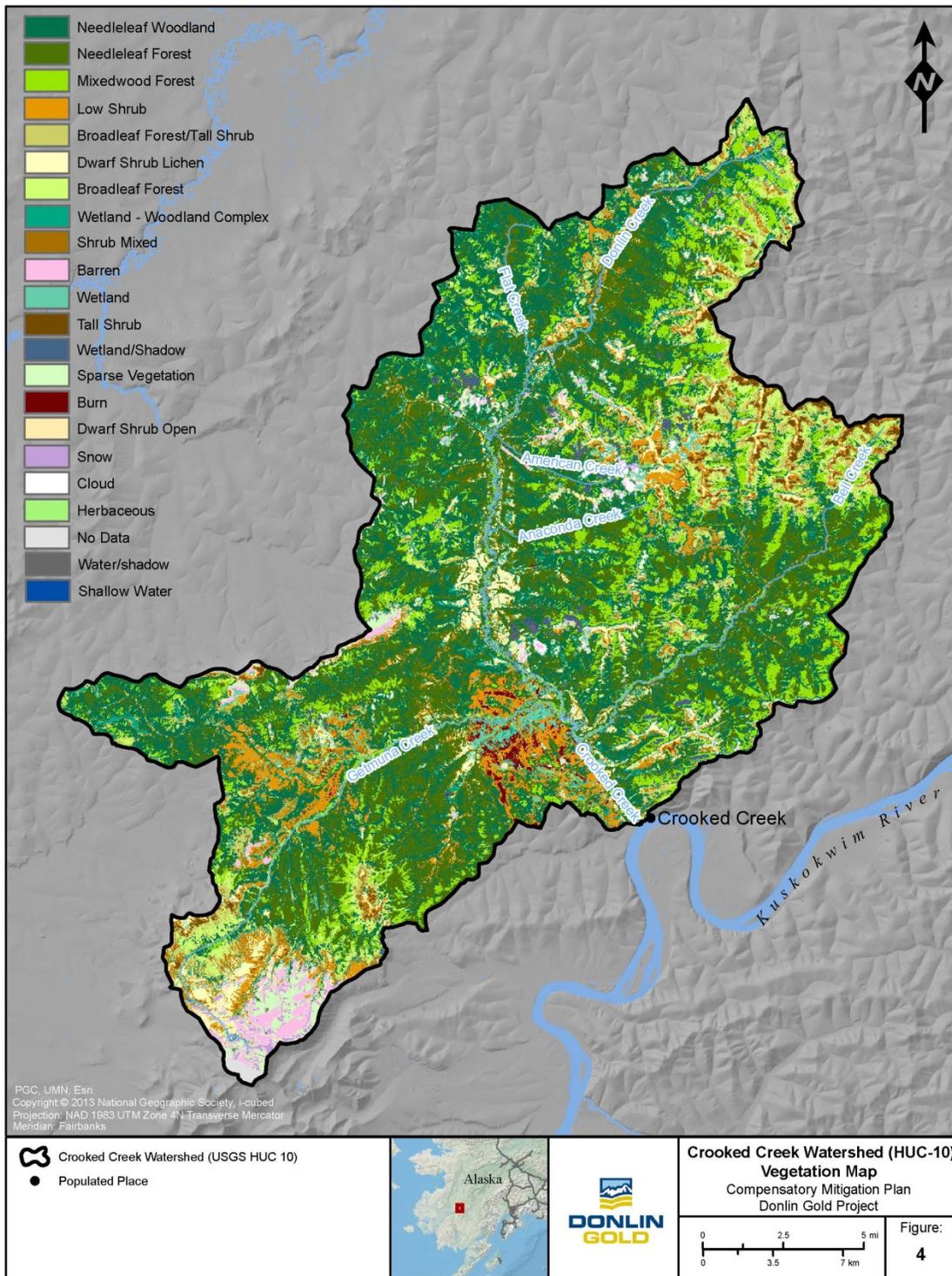


Figure 8 Crooked Creek Watershed (HUC-10) Vegetation Map



Land Ownership

The Crooked Creek land ownership in the watershed includes Federal and State public lands (58.8 percent), Alaska Native corporation lands (41.1 percent) (see Table 15 and Figure 9), and a small percentage of other private lands (0.1 percent). Alaska Native corporation lands are privately owned by TKC and Calista. TKC is the largest surface land owner in the watershed. Both Alaska Native corporations have the desire to realize economic benefits from their lands for their shareholders and other ANCSA corporations through responsible development. There are no established administrative boundaries within the watershed that would protect lands or wetlands from potential future development.

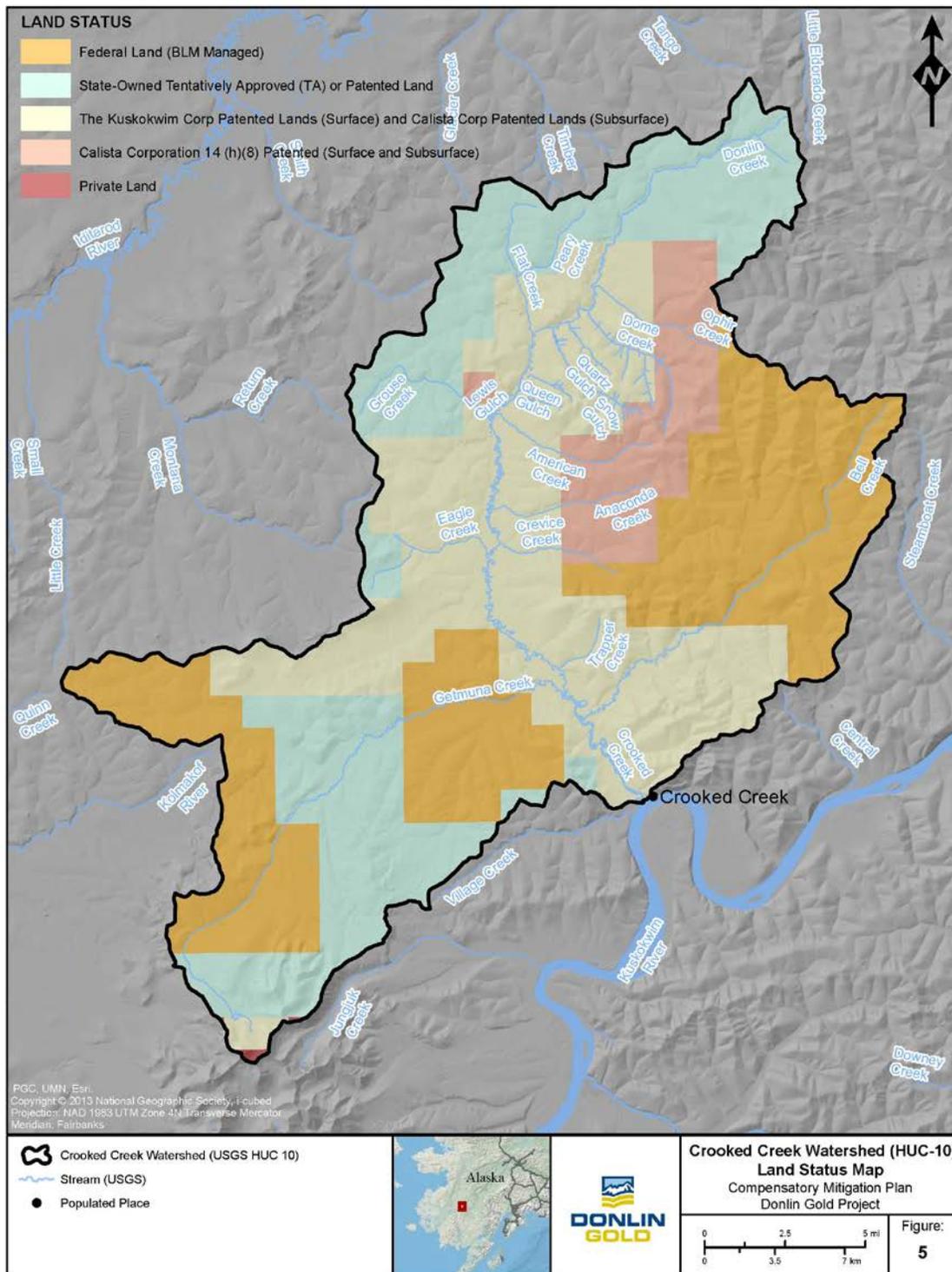
Table 14 Vegetation Type within Crooked Creek (HUC-10) Watershed (Percentage)

Vegetation Type	Watershed Percentage
Needleleaf Woodland	30.02
Needleleaf Forest	23.59
Mixedwood Forest	11.56
Low Shrub	6.64
Broadleaf Forest/Tall Shrub	5.27
Dwarf Shrub Lichen	4.63
Broadleaf Forest	4.33
Wetland – Woodland Complex	3.86
Shrub Mixed	1.76
Barren	1.66
Wetland	1.57
Tall Shrub	1.18
Wetland/Shadow	0.94
Sparse Vegetation	0.81
Burn	0.63
Dwarf Shrub Open	0.61
Snow	0.24
Cloud	0.20
Herbaceous	0.18
No Data	0.16
Water/shadow	0.12
Shallow Water	0.03
Total	99.99

Table 15 Land Ownership Status within the Crooked Creek (HUC-10) Watershed

Ownership Status	Area (Acres)	Percent of Land
Federal Land (BLM Managed)	68,421.9	31.8
State-owned.		
Tentatively Approved or Patented Land	58,071.9	27.0
The Kuskokwim Corp Patented Lands (Surface) and Calista Corp Patented Lands (Subsurface)	70,511.2	32.8
Calista 14(h)(8) Patented (Surface and Subsurface)	17,814.0	8.3
Other Private Land	248.6	0.1

Figure 9 Crooked Creek Watershed (HUC-10) Land Status Map



Wetlands

Wetlands data for the entire Crooked Creek watershed are provided by the USFWS National Wetlands Inventory (NWI) (USFWS 2018). A comparison of the areas mapped in detail for Donlin Gold using the USACE delineation approach with the NWI assessment indicates that the NWI likely overstates the extent of wetland area, but the NWI still provides a useful estimation of total wetland acres in the watershed. The NWI data indicate that wetlands occupy 45.8 percent (98,508 acres) of the Crooked Creek watershed. The dominant wetland type is freshwater forested/shrub wetlands which accounts for 99.2 percent. Freshwater pond and lake habitat are the least abundant wetland types in the watershed (less than 1 percent). A breakdown of the NWI wetland types observed in the Crooked Creek watershed is provided in Table 16.

Table 16 Summary of Wetland Types within the Crooked Creek (HUC-10) Watershed

NWI Wetland Type	Area (Acres)	Percent (%)
Freshwater Emergent Wetland	733	0.7
Freshwater Forested/Shrub Wetland	97,745	99.2
Freshwater Pond	10	0
Lake	20	0
Total	98,508	99.9

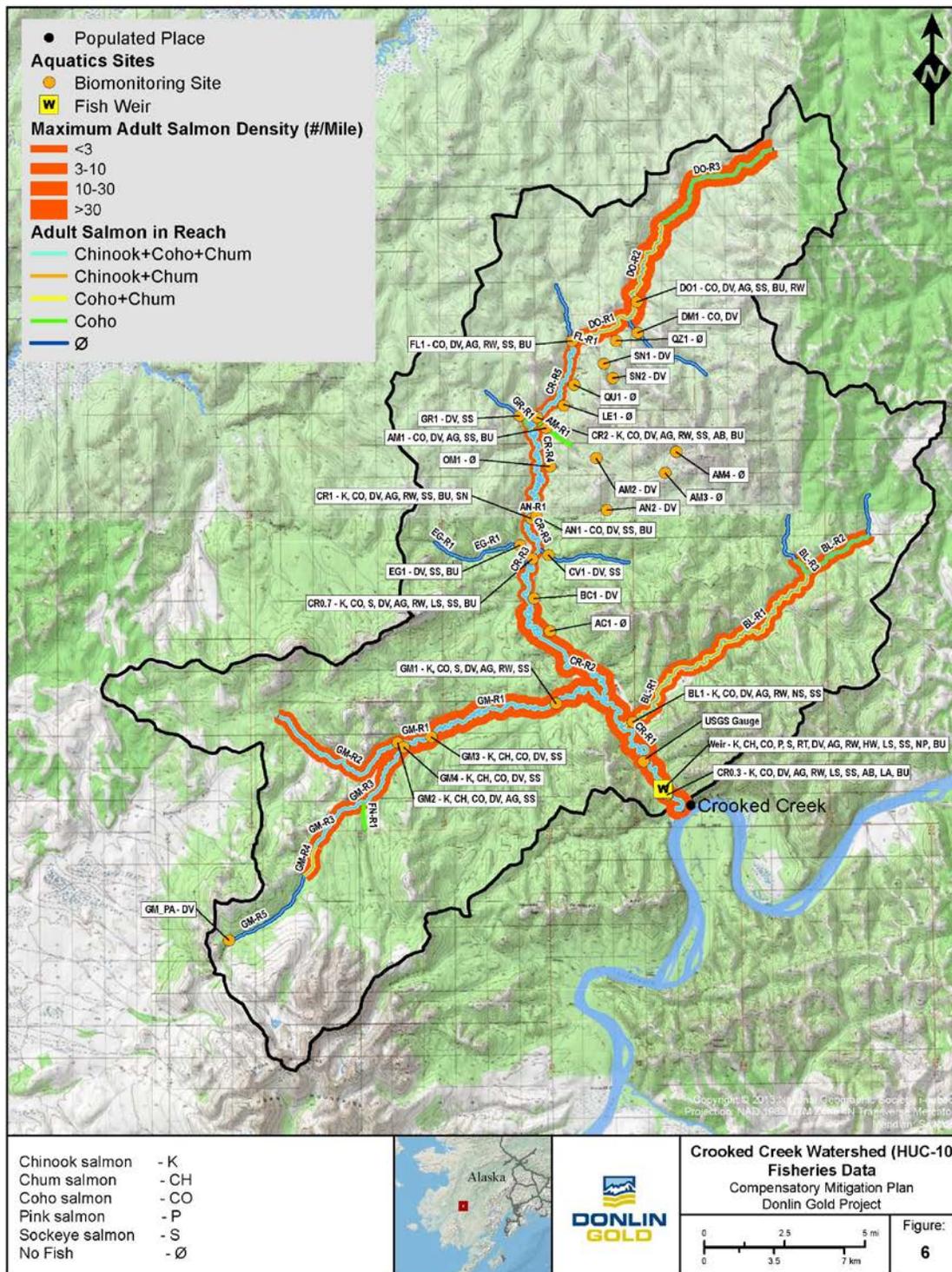
Source: USFWS 2018

Fish

Fish studies were conducted across the Crooked Creek drainage between 1996 and 2014 (OtterTail 2014a). In 2004, a comprehensive aquatic biomonitoring program was initiated as part of the Project which included general fish sampling (electrofishers and minnow traps), aerial salmon spawning surveys, fish tissue metals sampling and analysis, periphyton sampling, and aquatic macroinvertebrate sampling. In 2008, a resistance-board fish weir was constructed and installed near the mouth of Crooked Creek to better estimate salmon escapement. An intensive stream habitat survey was conducted in 2009 to document the aquatic habitat throughout the Crooked Creek mainstem. Although these studies have focused on the Project, they provide relevant information to the overall watershed.

Fish species identified within the Crooked Creek watershed are presented in Table 17 by HUC-12 where data are available. A fish distribution map for the Crooked Creek watershed is provided as Figure 10. Fish population assessments within the Crooked Creek drainage show that the system supports spawning populations of Chinook, chum, and coho salmon. Since 2008, when the fish weir was constructed, limited numbers of sockeye salmon and pink salmon have also been documented. Neither Chinook salmon nor chum salmon have been documented in tributaries to Crooked Creek, except for the larger Donlin Creek and Getmuna Creek drainages. In contrast, limited numbers of coho salmon have been reported in a number of tributaries. Aerial adult salmon surveys determined that the watershed includes a total of 464,136 linear feet of salmon spawning reaches (Table 18). The longest salmon spawning stream reach in the watershed is Crooked Creek, but Getmuna Creek, Bell Creek, and Crooked Creek downstream from Getmuna Creek support the majority of overall documented salmon spawning.

Figure 10 Crooked Creek Watershed (HUC-10) Fisheries Data



Other resident fish species are Dolly Varden, Arctic grayling, round whitefish, slimy sculpin, burbot, humpback whitefish, longnose sucker, northern pike, Alaska blackfish, Alaskan brook lamprey, and nine-spine stickleback.

Table 17 Fish Species Identified within the Crooked Creek Watershed (2004-2014)

Fish Species Family	Species	Common Name	Bell Creek	Donlin Creek	Flat Creek	Grouse Creek*	Getmuna Creek	Crooked Creek
Salmonidae	<i>Oncorhynchus tshawytscha</i>	Chinook salmon	X				X	X
	<i>Oncorhynchus keta</i>	Chum salmon	X	X			X	X
	<i>Oncorhynchus kisutch</i>	Coho salmon	X	X	X	X	X	X
	<i>Oncorhynchus gorbuscha</i>	Pink salmon						X
	<i>Oncorhynchus nerka</i>	Sockeye salmon	X				X	X
	<i>Oncorhynchus mykiss</i>	Rainbow trout						X
	<i>Salvelinus malma</i>	Dolly Varden char	X	X	X	X	X	X
	<i>Thymallus arcticus</i>	Arctic grayling	X	X	X		X	X
	<i>Prosopium cylindraceum</i>	Round whitefish	X	X	X		X	X
	<i>Coregonus pidschian</i>	Humpback whitefish						X
Catostimidae	<i>Catostomus catostomus</i>	Longnose sucker						X
Cottidae	<i>Cottus cognatus</i>	Slimy sculpin	X	X	X	X	X	X
Esocidae	<i>Esox Lucius</i>	Northern pike						X
Umbridae	<i>Dallia pectoralis</i>	Alaska blackfish						X
Petromyzontidae	<i>Lampetra alaskensis</i>	Alaskan brook lamprey						X
Gadidae	<i>Lota lota</i>	Burbot		X	X			X
Gasterosteidae	<i>Pungittius pungittius</i>	Nine-spine stickleback						X
Total			8	7	6	3	8	17

*The majority of MA facilities are located in the Grouse Creek HUC

Table 18 Adult Salmon Stream Reaches

Stream	Adult Salmon Reach (Feet)
Bell Creek	89,710
Crooked Creek	175,207
Donlin Creek	78,108
Flat Creek	449
Getmuna Creek	118,282
Grouse Creek*	2,380
Total	464,136

*The majority of MA facilities are located in the Grouse Creek HUC

Channel Habitat Classification

A classification of in-stream habitat for the entire Crooked Creek watershed is necessary to quantify the amount of fish habitat in the watershed. Donlin Gold completed a detailed in-stream habitat field survey in 2009 to document aquatic habitat, but the study was limited to the Crooked Creek mainstem (OtterTail 2015). Extending this field survey to the remaining areas of the watershed is not practical. Instead a separate rapid channel habitat classification model was completed as a desktop study to establish channel habitats suitable for fish in the Crooked Creek watershed.

Watershed Channel Habitat Classification Model

A rapid channel habitat classification model for the entire watershed was created using available data sources, and best professional judgement. The model used streamflow data, elevation data, and existing fish presence data to classify channel habitat for 1:63360 scale streams. Average streamflow for the month of July generally represents the lowest summer water elevation and is a good indicator for availability of aquatic habitat; elevation data were used as a surrogate for gradient, which typically affects fish passage; and fish presence data were used to determine the streamflow and elevation parameters where fish presence was not detected.

The rapid channel habitat classification model employed the following data inputs:

- **Streamflow** – Streamflow conditions in the watershed were characterized by estimating average July discharge at 375 locations. Locations were selected by taking the stream network and defining nodes where stream segments intersect. For each location, the upstream watershed area was calculated using an iterative ArcGIS script. The nodes have an average watershed area of 27 square miles (sq. mi.), with a range between 0.4 and 331 sq. mi. An average July runoff depth was then applied to estimate average July streamflow for each of the nodes. The average July runoff depth was estimated using the deterministic water balance model (WBM) developed by BGC (2011) for the Project mine site. This model is calibrated to site conditions based on regional climate data for the period 1940-2010. For this 71-year period, the average July runoff is 1.50 inches in the American Creek watershed. Streamflow data are also available near the mouth of Crooked Creek at a gaging station maintained by the U.S. Geological Survey (USGS). This station, identified as Crooked Creek near Crooked Creek, Alaska (#15304010), has been in operation since July 1, 2007. For the available period of record, the average July discharge is 432 cubic feet per second (cfs). Based on a watershed area of 330 sq. mi., this equates to a runoff depth of 1.53 inches, which is essentially identical to the American Creek estimate from the WBM.
- **Elevation** – The USGS National Elevation Dataset was used to determine elevation ranges for each stream within the watershed.
- **Fish Presence Data** – Fish presence was obtained from the aquatic biomonitoring program 2004-2014 and included fish presence data at 29 aquatic monitoring sites; aerial adult salmon survey data for the entire watershed; and individual upper reach fish presence determinations for American and Anaconda creeks, and Snow Gulch.

Using geographic information system spatial analysis techniques, the streamflow, elevation, and fish presence datasets were intersected, to create a stream database containing data from all inputs. The resulting stream dataset was then segregated into fish habitat suitability categories, in accordance with the parameters presented in Table 19. These parameters were determined as follows: streamflow values were segregated based on the Jenks natural breaks clustering method, and elevation limits were defined using a correlation of fish presence and elevation. Finally, the stream habitat classification was then adjusted where necessary to match known fish presence or absence in streams. For example, the model predicted that the upper reaches of Getmuna Creek were non-fish bearing, due to the elevation being greater than 250 meters and low streamflow, however, Getmuna Creek headwaters include unique high altitude deep water ponds where Dolly Varden presence is known.

The fish habitat suitability categories are:

- None – No fish habitat is predicted.
- Possible – Fish presence may be possible.
- Known or likely – Fish presence is known based on field survey data, or it is likely to include fish.

Table 19 Crooked Creek Watershed Stream Fish Habitat Suitability Determination

Stream Flow (cfs)	0.48 — 5		5—100		>100
Elevation Above Mean Sea Level (m)	>41.6	41.6 - 200	200 - 250	>250	41.6 — 200
Fish Habitat Suitability	None	Known or Likely	Possible	None	Known or Likely

Source: Rapid Channel Habitat Classification Model

Watershed Channel Habitat Classification

Results of the Crooked Creek watershed channel habitat modeling indicate 2,896,225 linear feet of streams. A total of 1,310,152 linear feet of streams are known to have fish or are expected to include fish, while 298,469 linear feet of streams could possibly have fish, and 1,358,327 linear feet of streams are not expected to have fish (Table 20). Primary fish species expected to use habitats within the known, likely, and possible categories can be predicted by stream reach relative location, either within the immediate historical floodplain of Crooked and Donlin Creeks, or those habitats upstream from the floodplain. Floodplain stream reaches are most likely to provide rearing habitat for juvenile coho salmon and some resident fish species such as slimy sculpin, Dolly Varden and Arctic grayling. Stream reaches upstream from the floodplain areas are most likely to provide habitat for Dolly Varden and slimy sculpin. The total length of streams identified in the analysis is less than those identified by the PJD (Michael Baker 2016) for similar areas. This is due to differences in the mapping scale. This would affect the smaller tributary streams in upper drainages that typically do not provide fish habitat. Thus, the total length of streams reported in the model should be considered underreported.

Figure 11 shows the results of the stream habitat model predictions.

Figure 11 Crooked Creek Watershed (HUC-10) Stream Habitat Model Results

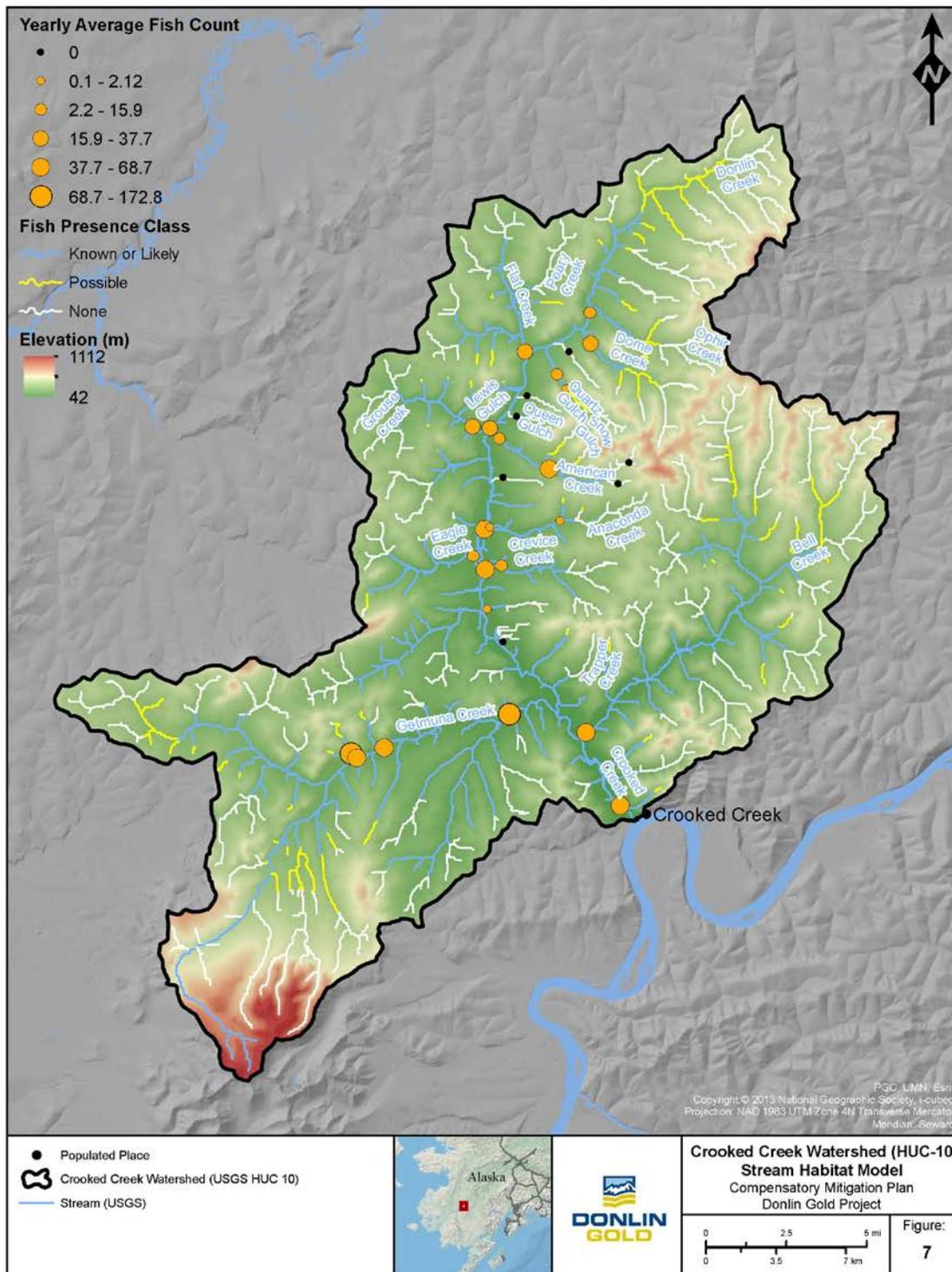


Table 20 *Crooked Creek Watershed Channel Habitats*

Fish Habitat	Linear Feet	Percent (%)
None	1,307,605	45
Possible	278,469	10
Known or Likely	1,310,152	45
Total	2,896,225	100

Source: Rapid Channel Habitat Classification Model

Aquatic Habitat Mapping

An aquatic habitat mapping study was conducted in 2009 along a 33-mile Crooked Creek mainstem reach from the confluence of Flat and Donlin creeks to the confluence with the Kuskokwim River (OtterTail 2012). The study mapped base flow habitat conditions and adult salmon spawning locations, and areas of fish rearing habitat were identified. A total of 840 habitat mapping units (HMUs) were mapped (Table 21).

Table 21 *Crooked Creek Watershed Habitat Mapping Summary, Wetted Surface Area (m²)*

Parameter	Run	Fast Run	Riffle	Pool	Glide	Backwater	Side Arm	Abandoned Channel	Total
Number of HMU	325	5	206	118	16	83	39	48	840
Percent of Total Wetted Surface Area	61.4	0.4	12.2	7.6	4.7	4.6	3	6.1	100
Total	568,638	3,793	112,729	70,587	43,433	42,553	27,375	56,587	925,696

Source: OtterTail 2012

Run habitat was the most abundant habitat type, riffle habitat was the second most numerous, and pool habitat was limited. Other documented habitat types were fast run, glide, backwater, side arm, and abandoned channels. Run habitat comprised 61.4 percent of the total wetted surface area and 325 of the 840 HMU types were mapped as runs.

Riffle habitat comprised 12.2 percent of the total wetted surface area and 206 of the 840 HMU types were mapped as riffles. Many of the riffle habitats were shorter than other HMU types and were often found to quickly transition into run or pool habitat. Abundant shallow margins with little flow made up 30.2 percent of all riffle habitat samples. While fish sampling was not part of this habitat mapping study, an abundance of juvenile fish was typically observed during the surveying of riffle margin areas. In addition, numerous juvenile salmonids from fish studies have been documented in these Crooked Creek riffle margin habitats.

Pool habitat made up 7.6 percent of the total wetted surface area and 118 of the 840 HMU types were mapped as pool habitat. Based on the habitat type criteria, much of what would also likely be considered run habitat at a higher flow rate was identified as pool habitat (OtterTail 2014). Substrates in the pool habitats were primarily sand and small cobble. Over 20 percent of all pools sampled contained abundant amounts of woody debris and/or shallow margins, which are considered prime habitat for juvenile salmon rearing. Juvenile coho salmon, in particular, almost entirely stay in pool habitat and avoid riffle areas (Morrow 1980) or areas with higher velocities.

Glide and fast run habitat were not very common due to the sinuous, meandering sections within the Crooked Creek mainstem, which are not suitable conditions for glide and fast run habitat. Observations of fast runs only occurred in the lower part of Crooked Creek where the stream is larger.

Backwaters, side arms, and abandoned channels were the most dynamic of the habitat types that were mapped during the survey. Backwater habitat made up 4.6 percent of the total wetted surface area and 83 of the 840 HMU types were mapped as backwater habitat. Much of the backwater habitat appeared nearly disconnected from the mainstem at the sampled low flows. Juvenile fish were captured in these backwater habitats during sampling, and well documented literature supports that rearing coho salmon prefer these areas of slower water that provide cover (Narver 1978, McMahon 1983, Raleigh et al. 1986, Morrow 1980, ADF&G 1986).

Side arm habitat was rare and made up approximately 3 percent of the total wetted surface area and 39 of the 840 HMU types were mapped as side arm habitat. Side arm habitat was observed to be surrounded by low elevation sediment bars next to the main channel, but not all sections of divided channel were classified as side arms based on the habitat type criteria. The majority of the side arm habitat contained abundant shallow margins, woody debris, and canopy cover, and was considered fair to good habitat for salmon.

Abandoned channels (disconnected habitat) made up 6.1 percent of the total wetted surface area and 48 of the 840 HMU types were mapped as abandoned channel habitat. Not all abandoned channels were mapped. Abandoned channels were considered excellent salmon habitat primarily due to observations of abundant fish (OtterTail 2015).

Watershed Conditions and Opportunities

Existing data indicate the Crooked Creek watershed is largely undeveloped and opportunities to restore wetlands and streams are limited due to the low total disturbance in the area. The following opportunities, however, do exist:

- Historical placer mining development in the Donlin Creek and Flat Creek areas created stream channel modifications, and exposed soils, that appear to be affecting water quality in the upper reaches of the Crooked Creek watershed. Fish passage to habitats upstream from the placer mining activity in both drainages has also been limited, or eliminated. The Snow Gulch and Ruby and Queen gulches historical placer mining areas present aquatic habitat creation and restoration opportunities in the watershed. Fish passage could also be restored to stream habitats upstream from the disturbed areas in each stream.
- The Crooked Creek watershed includes few freshwater pond and shallow lake habitats (less than 1 percent of the watershed area). However, analogous habitats do occur as backwaters to Crooked Creek (estimated to be only 4.6 percent of the HMU area) and have been documented to be productive for juvenile coho salmon (OtterTail 2014b). This indicates that these habitats are limited and the addition of ponds and/or backwater areas is a substantial opportunity for watershed enhancements.

Watershed Impacts and Mitigation

Wetlands

The long-term and permanent impacts caused by the Project include 2,876 acres of wetlands. The majority of these impacts are associated with the development of the MA and TA facilities (2,676 acres of wetland fill) most of which are in the Crooked Creek watershed.

These Project impacts are located in a watershed with large expanses of wetlands that have little risk of development. The wetland fill impacts would affect approximately 2.7 percent of the inventoried wetlands in the watershed. Currently, the Project is the only proposed development in the watershed, and it is extremely unlikely that other large developments will be proposed in the Crooked Creek watershed for the foreseeable future.

The dominant wetland types impacted by the Project are abundant in the watershed, and most impacts are confined to the American and Anaconda creek drainages. Palustrine forested/palustrine scrub-shrub wetlands impacted by the Project (2,632 acres) account for 99.2 percent of the wetlands in the entire watershed (the most common wetland type). The Project impacts would cause a reduction of 2.7 percent of this type of wetlands in the Crooked Creek watershed (Table 22). In contrast, palustrine pond wetlands are scarce in the watershed (less than 1 percent of the watershed wetlands). With the Upper Crooked Creek PRM, the net gain will be 15.2 acres of pond habitat; or an increase of 152 percent in the watershed. The other benefit is the restoration of 8,892 linear feet of stream which will connect pond habitats. The Project will cause a reduction of a combined 2,676 acres of palustrine emergent forested and palustrine scrub shrub wetlands. The Upper Crooked Creek PRM will restore 93.0 acres of degraded wetland stream floodplain to HGM riverine wetlands as palustrine emergent, and palustrine scrub-shrub wetland.

Table 22 Summary of Wetland Impacts in the Crooked Creek Watershed

Wetland Types	Crooked Creek Watershed (Acres)	MA/TA Permanent Fill (Acres)	Crooked Creek Watershed Wetlands Permanent Fill (Percent)	Proposed Upper Crooked Creek PRM Restored (Acres)	Crooked Creek Watershed Wetland Permanent Fill After Mitigation (Percent)
Palustrine Emergent, Palustrine Forested/ Palustrine Scrub-Shrub	98,478	2,676	-2.7 (Loss)	93	-2.6 (Loss)
Palustrine Pond	10	0	0	15.2	152 (Gain)
Lake	20	0	0	0	0
Total	98,508	2,676		108	

Channel Habitats

Construction of the Project would cause the permanent loss of 173,953 linear feet of streams. All these impacts are primarily associated with the development of the MA, and secondarily the TA facilities, in

the Crooked Creek watershed. This represents roughly 6 percent of all streams in the Crooked Creek watershed. It includes intermittent streams (only contain flowing water part of the year) “upper” watershed perennial streams. Generally, upper watershed perennial streams are defined as streams with low gradient and slow water velocity that carry some water flows throughout the year. Neither of these types of streams constitute significant losses in terms of aquatic habitat for fish other than their water and water quality contributions downstream to lower perennial streams where more suitable aquatic habitat exists. Adult spawning salmon reaches in the Crooked Creek watershed include mainstem Crooked Creek, and the largest upper perennial watershed streams like Getmuna, and Bell Creeks, or relatively small portions of upper perennial streams with sufficient flow and habitat like American, Anaconda, Flat, and Grouse Creeks. Intermittent streams, and most of the upper perennial streams are not currently used by adult spawning salmon.

Construction of MA facilities within the American Creek watershed would result in a loss of 21,648 linear feet of upper perennial aquatic fish habitat, of which approximately 2,640 linear feet are documented as anadromous habitat for coho salmon rearing. Additionally, construction and operation of the TSF within the Anaconda Creek watershed would result in a loss of 7,920 linear feet of aquatic habitat, including the potential to affect 865 linear feet of coho salmon rearing habitat. No spawning habitat will be directly impacted by these facilities (Owl Ridge 2017).

Although not a direct effect, and thus not the subject of this CMP, the loss of water contributions to Crooked Creek (because of the estimated permanent stream losses of intermittent and upper perennial streams, and the predicted water flow reductions in Crooked Creek because of mine dewatering activities) would result in the following habitat reductions from existing flow conditions below the MA at the maximum predicted drawdown period (year 20 of the mine life) (OtterTail 2015).

- Summer
 - 3 percent (3.17 acres) of overall aquatic habitat
 - 6 percent (0.87 acres) of riffle habitat
 - 3 percent (2.11 acres) of run habitat
 - 2 percent (0.19 acres) of pool habitat
- Winter
 - 6 percent (4.2 acres) of overall aquatic habitat
 - 11 percent (1.03 acres) of riffle habitat
 - 5 percent (2.91 acres) of run habitat
 - 3 percent (0.26 acres) of pool habitat

The direct losses as a result of the permanent fill to streams are 173,953 linear feet of streams, including 29,568 linear feet of fish bearing streams. The loss of 29,568 linear feet of fish bearing streams represents approximately a 1.9 to 2.3 percent loss of fish habitat in the entire watershed. While up to 2.3 percent of modeled fish-bearing stream habitat would be eliminated via the loss of the fish bearing portions of American and Anaconda creeks, the habitats being eliminated have low overall fish use, and low contributions to overall numbers of fish identified in baseline sampling. The aquatic baseline biomonitoring program sampling from 2004 through 2014, which did not include Donlin Creek tributaries upstream from Dome Creek, calculated the annual average fish captured by species among

all of the 300-foot reaches sampled: The average annual juvenile coho count was 400 fish, and American and Anaconda Creeks contributed on average 6 and 0.1 (only one juvenile coho was captured in Anaconda in 2011 over the nine years surveyed) juvenile coho respectively. Resident fish species contributions from American and Anaconda Creeks were similarly low: The average slimy sculpin captured for all reaches sampled was 2,185 fish, and the combined American and Anaconda Creeks annual average contribution was 53.4 slimy sculpin; and the average Dolly Varden captured for all reaches samples was 200 fish, while the combined American and Anaconda Creeks annual average contribution was 13 Dolly Varden. As noted above, the annual baseline program did not include resident fish sampling in tributaries upstream from Dome Creek, which according to the rapid channel modelling effort are predicted to contain additional fish habitat for these species. Overall, loss of the habitat used by fish in American and Anaconda Creeks is unlikely to affect overall fish populations in the drainage because similar habitat is available for fish that would be displaced.

Connected backwater habitats were investigated primarily in the middle reaches of Crooked Creek over a two-year period by sampling 100-foot reaches by electrofishing and sampling with minnow traps. The data suggest that for juvenile coho salmon, these habitats are probably some of the most productive in the drainage. Electrofishing produced 144.5 juvenile coho per 100 feet on average and minnow trap reaches, though variable in length and number of traps, produced an annual average of 132.5 juvenile coho per backwater tested (OtterTail 2014b). While baseline and backwater sampling methods are not directly comparable, connected backwater habitats considering electrofishing results are estimated to produce 433.5 juvenile coho per 300 feet of sampling. When factoring in minnow trapping results, this number increases. In total, this limited habitat type has the potential to function as highly productive fish habitat, particularly for juvenile coho salmon. In comparison to the coho salmon contributions from American and Anaconda Creeks, slow moving backwaters and ponds are likely to have considerably more fish production potential than those lost in the two creeks.

Data from other studies supports the findings related to the importance of backwater habitat. For example, voluntary restoration of disturbed stream habitats in the upper Fish Creek drainage at the Fort Knox Gold Mine in Interior Alaska created wetland, stream, and shallow pond habitats analogous to existing backwater habitats in the Crooked Creek drainage as well as those proposed in the Upper Crooked Creek PRM Plan. The mitigation successfully created spawning habitat and highly productive rearing habitat for Arctic grayling and burbot (Ott and Morris 2005). Age 0 Arctic grayling residing within the created wetlands habitats were nearly twice as large as age 0 fish from colder stream reaches in the drainage, illustrating increased productivity and likely increased probability of future survival provided by the created habitats (Ott and Morris 2005).

Because of the direct loss of known fish bearing habitat in American and Anaconda Creeks, Donlin Gold has proposed mitigation through restoration that will create the highest potential for fish habitat and aquatic productivity lift in the drainage. The low overall availability of backwater habitats in the drainage, and the near complete lack of pond habitats provide an opportunity for habitat enhancements. Review of coho salmon juvenile numbers encountered in the backwater habitats along Crooked Creek and the resident fish benefits observed in shallow constructed wetlands at the Fort Knox Mine indicate that addition of shallow ponds and backwaters in previously disturbed habitats in the drainage will be beneficial to overall drainage productivity.

Habitat enhancements proposed for the Ruby and Queen Gulches disturbed areas would create approximately 2,931 feet of relatively low gradient stream habitat primarily within the historical floodplain of Crooked Creek. Modelling and fish sampling data show these habitats are the most utilized within the small tributaries to Crooked Creek. The enhancements would also restore fish passage to approximately 7,048 feet of upstream stream habitat, which is currently unavailable to fish. Perhaps most significantly, the proposed Upper Crooked Creek PRM Plan will create about 15.2 acres pond and backwater habitats, those documented to be considerably more productive for juvenile coho salmon than habitats that would be eliminated in American and Anaconda Creeks.

Similarly, habitat enhancements proposed within the disturbed areas of Snow Gulch would create 4,421 feet of stream habitat within the historical floodplain of Crooked Creek and upstream within the Snow Gulch floodplain. Low gradient habitats would be created within the floodplain of Crooked Creek while higher gradient stream habitat would be created through enhancement of the Snow Gulch area to help restore access to the upper drainage and to stabilize the existing constricted channel configurations. While these habitats are upgradient from the Crooked Creek floodplain, they are within areas documented to have some periodic fish use during baseline sampling, and within the area of the stream that modelling suggests would be fish habitat. The new stream habitats would also create improved access to 12,672 linear feet of upstream habitat that would be restored. The proposed Upper Crooked Creek PRM Plan would further create backwater and pond habitat within the Crooked Creek and Snow Gulch floodplains. Depending on the winter flows, post construction and filling of the Snow Gulch Reservoir, there is additional potential that viable spawning habitat for coho salmon will result from the PRM proposed in Snow Gulch.

Restoration work proposed in Quartz Gulch would add potential backwater and stream habitats where none currently exists. Restoration would create 1,630 linear feet of stream habitat largely within the Crooked Creek historical floodplain that could be used by juvenile coho salmon and resident fish species. An additional 6,258 linear feet of possible fish bearing stream habitat would be made accessible to fish through the PRM Plan. Stream habitats upstream from the Crooked Creek floodplain would be possible habitat primarily for resident fish species such as Dolly Varden and slimy sculpin.

Summary and Conclusion of Watershed Impacts to Wetland and Channel Habitats

The Project will discharge fill that will result in the permanent loss of 2,676 acres and 173,953 linear feet of WOUS in the Crooked Creek watershed. This will result in adverse effects to the aquatic ecosystems within the American and Anaconda Creek drainages. However, because of the abundance of similar wetland types, and the limited fish habitat contribution of the impact areas to the overall watershed, this will not create significant adverse effects to the aquatic ecosystem and diversity of the overall Crooked Creek watershed.

Approximately 2.7 percent of the wetlands, and less than 6 percent of the streams in the Crooked Creek watershed, will be lost as a result of the Project. Impacts will be primarily confined to the American and Anaconda Creek drainages, and the type of palustrine forested/palustrine scrub-shrub wetlands and functions that will be permanently lost are abundant in the Crooked Creek watershed. After implementation of the Upper Crooked Creek PRM Plan, the percent of impacted wetlands will decrease to 2.6 percent and rarely occurring, yet highly productive, palustrine ponds will increase 152 percent.

Therefore, significant adverse effects to the aquatic ecosystem, including wetlands in the Crooked Creek watershed are not anticipated.

Losses of fish habitat because of elimination of American and a portion of Anaconda Creeks will have negligible effect on both resident fish and salmon species in the overall Crooked Creek drainage. While up to 2.3 percent of fish habitat will be lost, baseline fish data document these habitats are some of the lowest producing fish habitats in the Crooked Creek watershed. The most important salmon spawning habitats occur either upstream or downstream from the Project. Greater than 90 percent of Chinook and chum salmon spawning occurs downstream of the Project and greater than 80 percent of coho spawning occurs either upstream or downstream from the Project. Indirect effects of pit dewatering and the loss of perennial drainages on Crooked Creek flows will be primarily limited to the middle reaches of the creek between Snow Gulch and Crevice Creek where primary fish use is for juvenile rearing. Despite the potential reductions in stream flow, primary habitat loss during rearing periods will total approximately 3 percent within the potentially impacted area and will not reduce or degrade habitat in a manner that population level effects are anticipated. Significant adverse effects to important spawning habitats are thus not anticipated.

As described in Section 6.0 and Attachment D, high value aquatic habitat proposed for restoration as part of the Upper Crooked Creek PRM Plan, especially in Ruby/Queen and Snow Gulches, will reduce the percentage of overall linear stream fish habitat loss by 32 percent. The proposed palustrine wetlands would act as backwaters, which are important for juvenile coho, and would increase backwater habitats in Crooked Creek. Overall, the limited effects associated with the losses of American and Anaconda Creeks are expected to be more than offset by the net gains in available fish habitat and productivity from the PRM.

Finally, Donlin Gold is committed to ensuring no significant adverse effect of the aquatic ecosystem in the Crooked Creek watershed throughout Project construction, operation, and after closure. To accomplish this, Donlin Gold will implement a comprehensive Aquatic Resources Monitoring Plan (ARMP) under the provisions of its Title 16 fish habitat permits administered by the Alaska Department of Fish and Game (ADF&G). The ARMP will include aquatic resource monitoring throughout Crooked Creek and its tributaries upstream and downstream from the Project area. In addition to adult, juvenile, and spawning fish surveys, the program will also include habitat, sediment, fish tissue, and flow monitoring. Flow monitoring will specifically address both summer and winter flow conditions. Monitoring will be initiated before the start of construction to continue to provide baseline data, as needed. The ARMP will provide for detailed data analysis and reporting to ADF&G on monitoring results. It will also require specific action by Donlin Gold if the data show variability from the predicted effects on aquatic resources. The data can also be used to assess potential opportunities for creating additional ecological lift in the watershed.

8.0 Rationale for Proposed Compensatory Mitigation Credit/Impact Ratio

The Rule provides that mitigation/impact ratios greater than 1:1 should be required where preservation is proposed to satisfy compensatory mitigation requirements. In determining the appropriate higher ratio, the district engineer “must consider the relative importance of both the impacted and the preserved aquatic resources in sustaining watershed functions.” In addition, consideration is given to the likelihood of success, functional (or in this case, qualitative) differences between the impact and mitigation sites, and impacted versus preserved resource values. Donlin Gold is proposing mitigation ratios of approximately 2.2:1 for acres (including both wetlands and upland riparian buffers) and 1.6:1 for streams, considering the Upper Crooked Creek and Chuitna PRM Plans. This includes the Upper Crooked Creek and Chuitna PRM. Donlin Gold also purchased 9.8 mitigation credits to be secured from Great Land Trust. The credit calculation used a 2:1 ratio for preservation. These purchased credits are not considered or included in the ratios listed above for acres and stream length.

Within the Crooked Creek watershed, compensatory mitigation options are limited by the extent of past disturbance. While the acreages and linear feet of streams restored by the proposed Upper Crooked Creek PRM are relatively low on a quantitative basis compared to MA and TA impacts, they provide in-watershed restoration of high aquatic resource values and functions. Specifically, they provide important stream, pond, and backwater habitat for anadromous and resident fish species. In addition, the proposed stream restoration activities will be initiated immediately upon the start of construction, with streams and wetlands meeting performance standards within 3 to 5 years after construction has finished. Therefore, the restored streams and wetlands are expected to become fully functioning within the timeframe that MA and TA impacts are occurring. This is documented in the watershed assessment included in Section 7.0. Hence, they provide for local, in-watershed mitigation as well as timely mitigation to eliminate temporal losses.

After accounting for the in-watershed mitigation provided, along with the limited purchased mitigation credits that are applicable, the remaining mitigation is almost entirely provided by off-site PRM. Under Donlin Gold’s CMP, the preponderance of mitigation acres and linear feet of streams are provided by the Chuitna PRM Plan. The distance from the watersheds that will be primarily impacted by the Project could be considered in limiting the credit values. However, all other factors that USACE recognizes for credit generation support a high value for the proposed Preservation Area. Specifically:

- As summarized in Section 7.0, the Project will not significantly impact aquatic resources at the watershed level. The in-watershed restoration, when considered with the associated monitoring plans, protects the Crooked Creek watershed from significant degradation.
- The Preservation Area represents a large, contiguous interconnected area that protects important wetland and stream aquatic resources at the watershed level.
- The Preservation Area encompasses important aquatic habitat for all five Pacific salmon and additional resident fish species. The presence of the Pacific salmon species in the Preservation Area is much more diverse and abundant than that found in the Crooked Creek and tributary watersheds that will be affected by the Project.

- A portion of the Preservation Area overlaps with critical habitat for endangered Beluga whales. The salmon protected in the Preservation Area are an important food source for these whales.
- The Preservation Area represents an almost entirely pristine area that is under documented threat of near-term oil and gas, coal, and timber-related development.

To further support the high credit value of the Preservation Area, it is illustrative to consider the Debit-Credit Methodology (Methodology) adopted by USACE's Alaska District in September 2016. Donlin Gold has not specifically used this Methodology primarily because its use is optional and no functional assessment approach was accepted for the Project. However, the Methodology concepts are appropriate to consider in generally determining credit values for the Preservation Area for both wetland acres and linear feet of streams.

The initial input to the Methodology is the result of a functional assessment or other metric of the "value" of the proposed mitigation. The impacts are typically assigned a score of 1.0 and the proposed mitigation a level less than 1.0 based on these values. Since there is no approved functional assessment approach for the Project, the assigned value is subjective for the Preservation Area. However, considering the above factors, Donlin Gold believes that a functional score approaching 1.0 is justified.

The second input into the Methodology is based on the difference or delta between the anticipated condition of the Preservation Area with and without preservation. As indicated above and documented in the Chuitna PRM Plan, the Preservation Area is almost entirely pristine. With the existing, near-term threat of watershed-level degradation, it is reasonable to assume full elimination of wetland and stream function. As a result, like the functional score, a difference or delta factor approaching one is justified for undisturbed, pristine wetlands within the Preservation Area.

The final input into the Methodology is the Preservation Adjustment Factor (PAF). The PAF is calculated based on two components: threat (0.3 or 30 percent of the calculation) and ecological significance (0.7 or 70 percent of the calculation). In terms of threat, the full score of 30 percent is appropriate for the Preservation Area since there are both:

- Demonstrated threat of mining activities through extensive prospecting, which indicates there are economically recoverable reserves and commodities; and
- Demonstrated threat of oil and gas activities through exploration activities, which indicate there are economically recoverable reserves.

The ecological significance score is divided into the following four components:

- *Aquatic resources that are adjacent to or connect regionally important publicly held lands, such as: National Marine Sanctuaries, National Seashores, National and State Parks, Forests, Refuges and Wildlife Management Areas (0.10 of the overall PAF).* The Preservation Area is adjacent to the Trading Bay State Game Refuge and Susitna Flats State Game Refuge. Therefore, the full score (0.10 of the PAF) is justified for the Preservation Area.

- *Site contains aquatic resources that have been identified as significant or productive within a specified Ecoregion. Such as: Alaska's Wildlife Action Plan or Anadromous Waters Catalog (AWC), ADF&G; Aquatic Resource of National Importance.* A major portion of the Preservation Area encompasses highly productive anadromous waters. Therefore, the full score (0.30 of the PAF) is justified for the Preservation Area.
- *Aquatic resources that provide habitat important to species that have some special (Federal, State, or local) designation or importance.* The Preservation Area supports the viability of endangered Cook Inlet Beluga whales. In addition, the five Pacific salmon species are abundant in the Chuitna watershed and have special status at the State and Federal levels. Therefore, the full score (0.20 of the PAF) is justified for the Preservation Area.
- *Scarcity of Aquatic Resource Type. Such as: specific preservation to maintain diversity of habitat type within islands systems removing the threat of habitat fragmentation for fish and wildlife species (Alexander Archipelago Islands (Southeast Alaska) Kodiak and the Aleutian Chain).* Donlin Gold assumes that, while high value, the Preservation Area does not provide scarce aquatic resources or habitat. Therefore, a score of zero is assumed for this factor.

In summary, a PAF of 0.9 is justified for the Preservation Area. There is no time lag or risk associated with the Preservation Area as the land is currently available for preservation and required preservation instruments would be put in place prior to construction. This value along with scores approaching 1.0 for both the value of the Preservation Area and the difference/delta between the preserved versus existing conditions, demonstrates that using USACE's Methodology would result in credits of approximately 0.9 for every acre of preservation.

In addition, Donlin Gold is also proposing immediate restoration of high value wetlands and stream channels through the Upper Crooked Creek PRM Plan that would create lift of wetland and stream functions in-watershed. As a result, the proposed wetland mitigation and impact ratios of approximately 2.2:1 for acres (including both wetlands and upland riparian buffers) and 1.6:1 for streams, considering the Upper Crooked Creek and Chuitna PRM Plans provide more than sufficient compensatory mitigation for the Project impacts.

9.0 Summary of Mitigation Program Credits

Wetland mitigation credits will be purchased from Great Land Trust. There are just under 5 acres of permanent wetland fill impacts associated with the PA in the Matanuska Susitna Borough (in Great Land Trust's service area). Using methods approved by the Alaska USACE District the acres of wetland impact in the MSB have been converted to 9.8 credits needed from Great Land Trust. Donlin Gold has secured an option to purchase these. The 9.8 credits to be provided are summarized in Table 23. Donlin Gold will submit a receipt proving purchase of the wetland credits to USACE prior to the start of construction authorized by the DA Project permit. An example receipt is included in Figure 12. Donlin will provide a letter of credit availability to the USACE PM prior to rendering a permit decision (expected by the end of July 2018).

Table 23 Summary of Wetland Credits for Purchase from the Great Land Trust

HGM Wetland Credit Type	Credits
Riverine	3.6
Slope	6.2
Total	9.8

10.0 Conclusion

Donlin Gold proposes this CMP to compensate for unavoidable permanent fill impacts to wetlands and streams within the MA, TA, and PA. This CMP includes an in-kind, in-watershed PRM Plan in the Upper Crooked Creek watershed. The Upper Crooked Creek PRM Plan includes the enhancement, reestablishment, restoration, rehabilitation and preservation of 221.5 acres of wetlands, riparian areas, stream channel, and uplands. The PRM Plan will restore degraded wetland acreage in Quartz, Snow, Ruby and Queen Gulches, and at the Wash Plant Tailings Area. The PRM Plan will restore 95.7 acres of degraded floodplains into 92.3 acres of wetlands and 2.7 acres of riverine channel. A total of 8,892 linear feet of stream will be enhanced and reestablished by the restoration work in the floodplains. Within the wetland floodplains, 15.2 acres of off channel ponds will provide improved aquatic resource habitat. In addition, 16.8 acres of adjacent upland terrestrial habitat will be created. A total of 109 acres of riparian uplands and wetland buffers will be preserved around the restored and enhanced floodplain wetlands. This PRM Plan will be initiated concurrent with the start of MA construction. Through the Upper Crooked Creek PRM Plan, and more broadly Donlin Gold's efforts to confine all MA activities to two drainages that support limited aquatic habitat and fish populations, there will be no significant impacts to aquatic resources at the watershed level. The Upper Crooked Creek Permittee Responsible Mitigation Plan is included in Attachment D.

A small portion of project impacts along the natural gas pipeline fall within the service area of at least 2 mitigation credit providers. Donlin Gold has committed to secure 9.8 credits from the GLT to offset the 5 acres of permanent impacts to wetlands identified in their service area.

Donlin Gold conducted an extensive process to identify and pursue off-site, in-kind compensatory mitigation options to provide additional wetland acres and stream feet mitigation credits. Each option was considered in terms of wetland and stream values, feasibility of land acquisition and long-term protection, and, for restoration, likelihood of success, and, for preservation, threat of development. The results of the evaluation led to the Chuitna Preservation Area. Under this PRM Plan, Donlin Gold will ensure protection of 5,870 acres, including 3,269 acres of wetlands and ponds, and 418 acres of streams and rivers, totaling 3,687 acres of WOUS. It also protects 2,183 acres of upland riparian area and buffers, and 258,056 linear feet (48.8 miles) of streams in the Chuitna watershed. The Chuitna Preservation Area includes: 29 acres of estuarine fringe HGM wetlands, 70 acres of depressionnal HGM wetlands, 500 acres of riverine HGM wetlands, and 2,661 acres of HGM Slope wetlands. Within the Slope HGM wetlands there are 802 acres of ericaceous shrub bog-string bog wetlands which are a unique wetland type to the area, and only occur in a few very specific locations worldwide. The Preservation Area includes protection of important anadromous and resident fish habitat protection at the watershed level from

near-term threats of natural resource development. The PRM Plan will also help to protect critical habitat of the endangered Cook Inlet Beluga whale. The Chuitna PRM Plan is included in Attachment E.

For the PRM Plans, the proposed compensatory mitigation for wetlands by HGM class and Cowardin group is shown in Table 24. The compensatory mitigation proposed for streams is shown in Table 25. Overall, Donlin Gold's has proposed a compensatory mitigation ratio for long-term and permanent fill impacts of 2.2:1 for acres (including both wetlands and upland riparian buffers) and 1.6:1 for streams. This does not include the 9.8 mitigation credits to be provided by Great Land Trust's mitigation credit Program (see Table 26).

Based on the USACE regional and national guidance; current regulations; wetlands and streams proposed for restoration, enhancement, and preservation; the compensatory mitigation proposed by Donlin Gold is sufficient to support DA permit issuance.

Table 24 *Compensatory Mitigation Proposed for Wetlands by HGM Class and Cowardin Group (Acres)*

	Classification	Chuitna Preservation Area	Upper Crooked Creek Restoration	Upper Crooked Creek Preservation
Wetland HGM (Cowardin Classes)	Depressional (PAB, PEM, PFO, PSS, PUB)	79	0	1.6
	Estuarine Fringe (E2EM, E2US)	29	0	0
	Flat (PEM, PFO, PSS)	0	0	32.7
	Riverine Non-Anadromous (PEM, PFO, PSS, PUB)	76	93.0	0
	Riverine Anadromous (PEM, PFO, PSS, PUB)	424	0	17.9 ¹
	Slope (PEM, PFO, PSS)	2,661	0	11.6
Totals	Wetlands and Ponds	3,269	93.0	63.8
	Stream and River Area	418	2.7	0.9
	Upland Riparian and Buffers	2,183	16.8	44.1
	Total of Parcel	5,870	112.5	109

¹Riverine wetland are adjacent to Crooked Creek.

*Inconsistencies are due to rounding.

Table 25 *Compensatory Mitigation Proposed for Streams in Linear Feet (Miles)*

HGM	Chuitna Preservation Area	Upper Crooked Creek Restoration	Upper Crooked Creek Preservation
Anadromous Stream Channel	196,292 (37.2)	0	0
Non-Anadromous Stream Channel	61,746 (11.7)	8,982 (1.7) ¹	4,036 (0.8)
Total	258,056 (48.9)	8,982 (1.7)	4,036 (0.8)

¹The return of anadromous salmon to restored streams is expected but cannot be accurately predicted in terms of specific stream length. Post-restoration monitoring will verify presence or absence of anadromous and resident fish.

*Inconsistencies are due to rounding.

Table 26 *Wetland Credits to be Purchased from the Great Land Trust*

HGM Wetland Credit Type	Credits
Riverine	3.6
Slope	6.2
Total	9.8

Figure 12 Credit Purchase Receipt.



**US Army Corps
of Engineers** ®
 Alaska District

CREDIT PURCHASE RECEIPT	
Compensatory Mitigation Type: Mitigation Bank () In-Lieu-Fee Program ()	
Mitigation Provider (Sponsor):	
Service Area or Name of Mitigation Site:	
Permit Number: POA-20	USACE Project Manager:
Waterway:	
Project:	
Impact Type:	
Impact Site Location: Latitude , Longitude	
CREDITS PURCHASED	
Credit Type	Number of Credits
TOTAL CREDITS PURCHASED	0.00

 Permittee's Name/Company & Signature

 Date

 Mitigation Provider's Name/Signature

 Date

Upon completion of the fulfillment of the mitigation required by the permit, please email a copy of this signed Receipt to mitigationmanager@usace.army.mil (RIBITS Administrator) and to USACE Project Manager above.

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Attachment A
Pipeline Area Wetlands Impacts by HUC-10 (Acres)
Before and After Construction

Pipeline Area Wetlands Impacts by HUC-10 (Acres)

Before and After Construction

HUC-10	Watershed Acres	Existing Disturbed Wetland Acres	Existing Percent Disturbed	PA Permanent Impact Acres	Percent Disturbed After Pipeline Construction
Unnamed HUC 1903040510	127,053	0	0.00	0	0.00
Alexander Creek	210,480	1	0.00	0	0.00
Beluga River	211,588	134	0.06	0	0.06
Crooked Creek	215,234	1115	0.52	0	0.52
East Fork George River	262,717	0	0.00	0	0.00
George River	285,127	98	0.03	2	0.04
Happy River	224,527	2	0.00	0	0.00
Headwaters Middle Fork Kuskokwim River	232,387	2	0.00	36	0.02
Headwaters Tatlawiksuk River	239,536	0	0.00	64	0.03
Johnson Creek	96,681	7	0.01	1	0.01
Jones River	81,749	0	0.00	0	0.00
Khuchaynik Creek	94,198	0	0.00	22	0.02
Little South Fork	75,851	0	0.00	0	0.00
Lower Skwentna River	241,346	100	0.04	2	0.04
Lower South Fork Kuskokwim River	214,958	186	0.09	5	0.09
Middle Big River	128,994	0	0.00	25	0.02
Middle Skwentna River	236,827	0	0.00	0	0.00
Middle South Fork Kuskokwim River	177,205	23	0.01	0	0.01
Moose Creek	132,086	0	0.00	0	0.00
North Fork George River	93,624	0	0.00	0	0.00
Nunivak Bar-Kuskokwim River	245,153	14	0.01	1	0.01
Nunsatuk River	154,841	0	0.00	0	0.00
Pitka Fork Middle Fork Kuskokwim River	189,005	24	0.01	17	0.02
Sheep Creek	170,686	186	0.11	17	0.12
Susitna River-Frontal Cook Inlet	322,859	113	0.04	1	0.04
Tatina River	144,282	1	0.00	2	0.00
Theodore River	81,093	88	0.11	0	0.11
Windy Fork Middle-Fork Kuskokwim River	226,059	3	0.00	3	0.00
Total	5,116,147	2097*	0.04	200*	0.04

*Column is rounded to the nearest whole number.

Attachment B
Hydrogeomorphic (HGM) Classification

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Attachment B Hydrogeomorphic (HGM) Classification

The hydrogeomorphic (HGM) classification of wetlands was developed by the United States Army Corps of Engineers (USACE) Waterways Experiment Station (Brinson 1993). It is based on a wetland's (1) position in the landscape or geomorphic setting, (2) dominant source of water, and (3) hydrodynamics of the water in the wetland (Brinson 1993). The purpose of the HGM classification is to provide a mechanism to account for the inherent natural variation of wetlands, particularly when wetland functions are being assessed. For example, a riverine wetland will generally have a much higher ability to export organic carbon than a confined depressional wetland, based on the riverine wetland's landscape position and hydrodynamics.

In Alaska, HGM regional guidebooks are developed for Interior Alaska precipitation-driven (flat) HGM wetlands [Alaska Department of Environmental Conservation (ADEC) and USACE 1999], slope/flat HGM wetland complexes in the Cook Inlet Basin ecoregion (Hall et. al 2003), and riverine and slope HGM river proximal wetlands in coastal Southeast and Southcentral Alaska (Powell et. al 2003).

The HGM classification of the Donlin Gold Project (Project) Area is presented in the 2016 Preliminary Jurisdictional Determination (PJD) (Michael Baker 2016), which reports on the wetland and waters of the United States (WOUS) acres within the Project Area. HGM wetland classes identified in the Project Area include:

- Flat
- Depressional
- Estuarine (Coastal) Fringe
- Riverine
- Slope

HGM Descriptions

Flat (Organic Soil) Wetlands

Flat wetlands are found in areas of high terrain located between valleys of adjacent waterways (interfluves), relic lake bottoms, and abandoned floodplain terraces above the zone of river flooding. The dominant water source is precipitation; flats are unique because they typically lack significant groundwater inputs. Flats can be further classified as mineral soil flat wetlands or organic soil flat wetlands based on the accumulation of organic matter. Organic soil flats differ from mineral soil flats, in part because their elevation and topography are controlled by vertical accretion of organic matter (Brinson et al. 1995). They occur commonly on flat interfluves, but also where depressions have become filled with peat to form a large level surface. Flats lose water by evapotranspiration, overland flow, and seepage to underlying groundwater. Flats are characterized by low lateral drainage, usually due to low hydraulic gradients (ADEC and USACE 1999).

In Alaska, flats cover vast areas where shallow permafrost tables hold precipitation at or near the surface. These flats can occur on sloping terrain, such as the millions of acres of tussock tundra dominated by tussock cotton-grass on the low, rolling hills of the North Slope region. Black spruce dominated hillside forests and woodlands in Interior Alaska are generally considered to be organic soil flat wetlands when permafrost occurs at a shallow depth. Large, flat wetlands also can be found on glacial outwash terraces and in parts of valley bottoms characterized by broad, shallow basins not exhibiting lateral water movement (ADEC and USACE 1999).

Flat HGM wetlands in the Project Area are almost exclusively organic soil flats. Vertical fluctuations are the dominant hydrodynamic in flat HGM wetlands. Photo 1 and Photo 2 are examples of flat HGM wetlands.

Photo 1 Black Spruce Flat (Organic Soil) HGM Wetland on Hillside, Mine Site, Crooked Creek Watershed



Photo 2 Low Shrub Tundra Flat (Organic Soil) HGM Wetland, Lower South Fork Kuskokwim River Watershed



Depressional Wetlands

Depressional wetlands occur where water accumulates in depressions; they occur on geomorphic surfaces with closed elevation contours. Depressional wetlands can have a variety of inlets and/or outlets or can lack them completely. Water sources include precipitation, groundwater discharge, inlets and surface flow, and interflow from neighboring uplands. Typically, water flows toward the center of the depressional wetland from surrounding upland areas. Seasonal vertical fluctuation is the primary dominant hydrodynamic. Depressional wetlands lose water from an outlet (temporary and permanent), evapotranspiration, or vertical movement to deeper groundwater (ADEC and USACE 1999).

Depressional HGM wetlands occur as small bog or pond features embedded within large flat wetlands dominated by scrub black spruce. In the Project Area, they are evenly spaced, small shallow depressional features on terraces adjacent to Crooked Creek and other waters. Photo 3 and Photo 4 are examples of depressional wetlands.

Photo 3 Wet Herbaceous Depressional HGM Wetland, Headwaters Tatlawiksuk River Watershed



Photo 4 Open Water Depressional HGM Wetland, Middle Big River Watershed



Estuarine (Coastal) Fringe Waters

Estuarine fringe wetlands are found along ocean or sea coastlines and in estuaries. The dominant source of water is bi-directional flow from tides, either through flooding or groundwater. Additional inputs can come from groundwater and precipitation. Water loss in estuarine fringe wetlands comes from tidal exchange, overland flow, or evapotranspiration. Organic matter can accumulate in the absence of erosive forces (ADEC and USACE 1999). Photo 5 shows a coastal fringe HGM wetland.

Photo 5 Open Water Coastal Fringe HGM Wetland, Old Tyonek Creek – Frontal Cook Inlet Watershed



Riverine Wetlands

Riverine wetlands are found within active floodplains and along the banks of river and stream channels (riparian corridors). Dominant water sources are subsurface hydraulic connections or overbank flow from nearby river and stream channels and wetlands. Groundwater discharge from surficial aquifers, overland flow from neighboring uplands and small tributaries, and precipitation may contribute additional inputs. Riverine wetlands lose surface water by flow returning to the channel after flooding or precipitation events. Subsurface water loss generally occurs through discharge to nearby active channels, evapotranspiration, and vertical migration to deeper groundwater (ADEC and USACE 1999).

In Alaska, riverine wetlands range from broad floodplains along large meandering river channels, such as the Yukon, Tanana, and Kuskokwim Rivers, to narrow, temporarily flooded zones bordering higher gradient rivers and streams. Extremely large riverine wetland complexes are found on deltas, such as the Yukon-Kuskokwim Delta, the Copper River Delta, and the Stikine River Delta.

Photo 6 and Photo 7 are examples of riverine HGM wetlands.

Photo 6 Wet Herbaceous Riverine HGM Wetland, Johnson Creek Watershed



Photo 7 Open Willow Shrub Riverine HGM Wetland, Middle South Fork Kuskokwim River Watershed



Slope Wetlands

Slope wetlands are usually dominated by scrub black spruce with an understory of ericaceous shrubs and a dense mat of sphagnum moss. Black spruce forested wetlands are found at the base of slopes where hillsides become wetter. The Cowardin functional class includes both stunted scrub and full-size trees. Slope HGM wetlands include patterned fens, hillside seeps, spring-fed wetlands, and wetlands at the base of bluffs or hills where groundwater is discharged near the surface, and also includes flooded bottomland slope wetlands and string bogs in the Cook Inlet Basin. Slope HGM wetlands have downslope, unidirectional flow of water.

Slope wetlands are normally found where groundwater is discharged to the surface (ADEC and USACE 1999). They occur on sloping land; elevation gradients may range from steep hillsides to slight slopes. Slope wetlands are usually incapable of water storage because they lack closed contours. Principal water sources are usually groundwater return flow and interflow from surrounding uplands, as well as precipitation. Hydrodynamics are dominated by downslope unidirectional water flow. Slope wetlands can occur in nearly flat landscapes if groundwater discharge is present. Slope wetlands lose water through subsurface saturation and surface flows, and through evapotranspiration.

Photo 8 and Photo 9 are examples of slope HGM wetlands.

Photo 8 Open Willow Shrub Slope HGM Wetland, Happy River Watershed



Photo 9 Ericaceous Bog – String Bog, Slope HGM Wetland, Beluga River Watershed



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Attachment C
Mine Area Restoration Plan

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Attachment C Mine Area Restoration Plan

Objectives

Donlin Gold, LLC (Donlin Gold) has developed a Restoration Plan (Plan) to address wetlands lost by the Mine Area (MA) facility development from the Donlin Gold Project (Project). The Plan provides restoration and rehabilitation of wetlands in impacted watersheds with in-kind restoration. The Donlin Gold MA is in the Crooked Creek HUC-10 watershed. The actions are designed to exceed reclamation requirements required by the State of Alaska [Alaska Department of Natural Resources (ADNR) 2014] upon mine closure in this watershed. The Plan provides additional habitat diversity in this black spruce dominated area. Donlin Gold is not requesting compensatory mitigation credits for the mine area wetland restoration plan.

Site Selection Criteria

Each facility in the Donlin Gold MA was considered for wetland restoration potential at facility closure; they were reviewed based on the wetland mapping and the expected occurrence of wetlands-supporting hydrology at mine closure. All MA facility boundaries were examined in the context of the final facility boundary and the 2016 Preliminary Jurisdictional Determination (PJD) [Michael Baker International (Michael Baker) 2016]. Facilities, such as the open pit, waste rock facility (WRF), and tailings storage facility (TSF), are permanent features that cannot be restored to wetlands at mine closure. The fill cannot be practicably removed, the wetlands restored, or the area re-filled for rehabilitation. However, restoration opportunities were identified in the MA where hydrology will be available. Restoration of wetlands in the MA can be accomplished at growth media stockpiles, overburden stockpiles, material sites, and at the Snow Gulch freshwater reservoir. Five sites were chosen based on the potential for hydrology to remain or return to the site following mine closure.

Figure 1 depicts the sites considered for wetlands restoration within the MA. The North overburden stockpile, shown on Figure 1 was eliminated as a restoration site because of its proximity to the open pit and its location within the predicted post-closure drawdown area. Figure 2 illustrates the post-closure drawdown area and the restoration sites. Table 1 lists the sites targeted for restoration, acres of wetlands to be restored, and the re-establishment of the Snow Gulch stream within the MA. Figure 3 through Figure 7 are maps and photos of each restoration site.

Table 1 MA Wetland and Stream Restoration Sites, Acres and Linear Feet to be Restored

MA Site	HUC-10	Wetland Acres	Linear Feet
TSF Stockpile 1	Crooked Creek	113	0
South Overburden Stockpile	Crooked Creek	70	0
TSF Material Site-06/TSF Stockpile 2	Crooked Creek	114	0
TSF Material Site-07/TSF Stockpile 3	Crooked Creek	217	0
Snow Gulch Freshwater Reservoir	Crooked Creek	42	6,363
Total		556	6,363

*Totals were rounded to the nearest whole number.

Figure 1 Wetland Impact Restoration Areas Considered at the MA

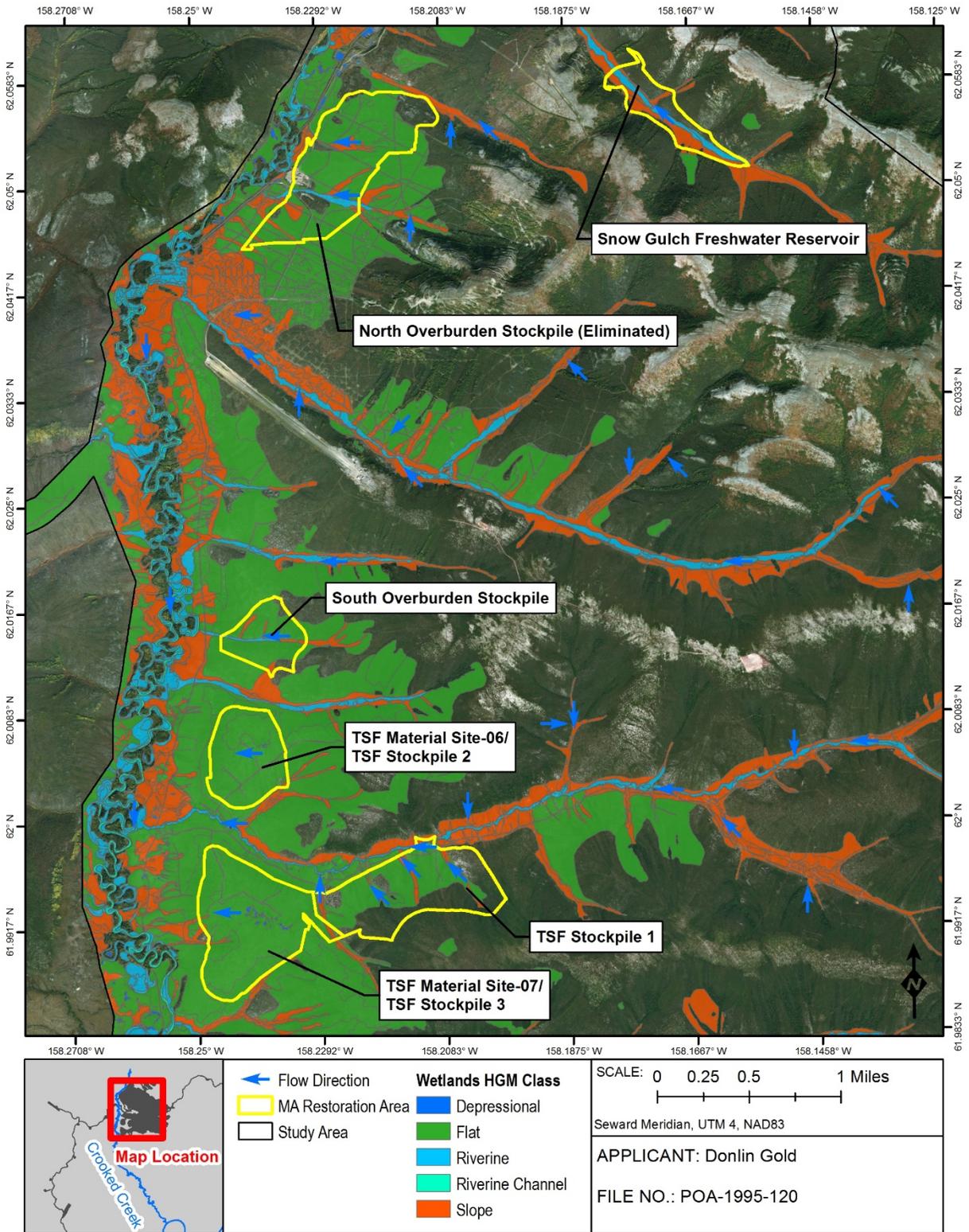


Figure 2 Groundwater Drawdown and Wetlands in the MA

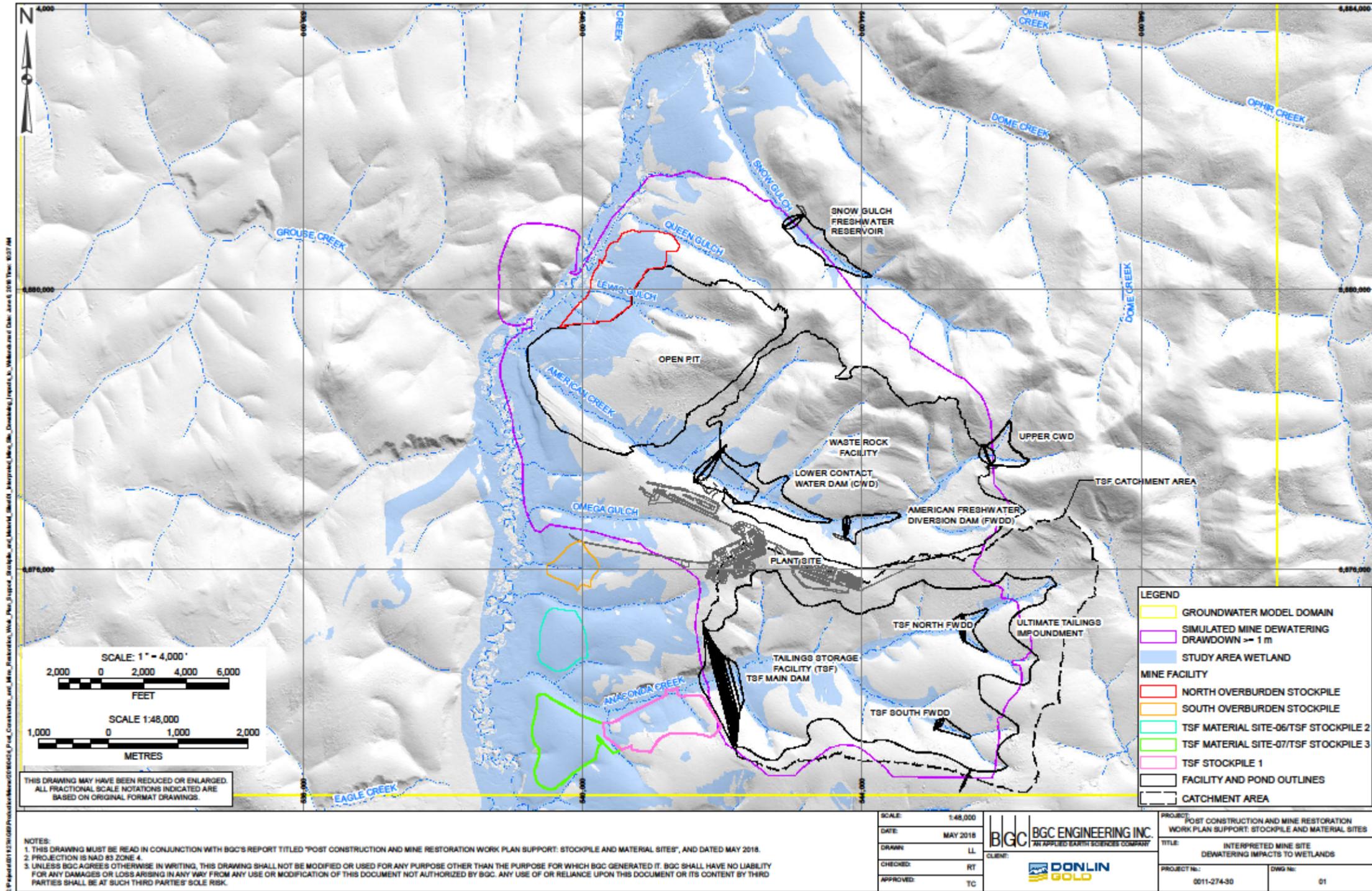


Figure 3 MA TSF Stockpile 1 Map and Site Photos

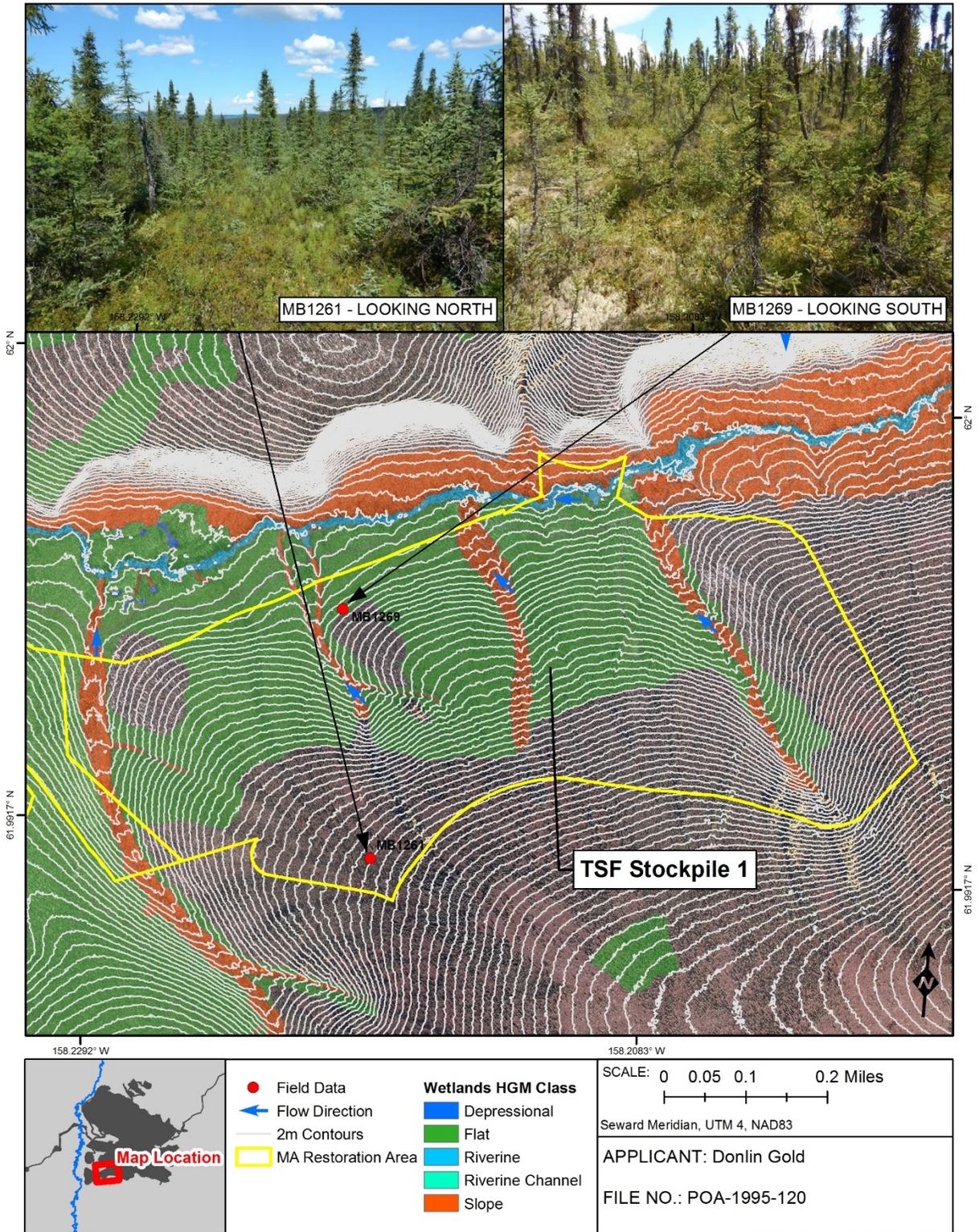
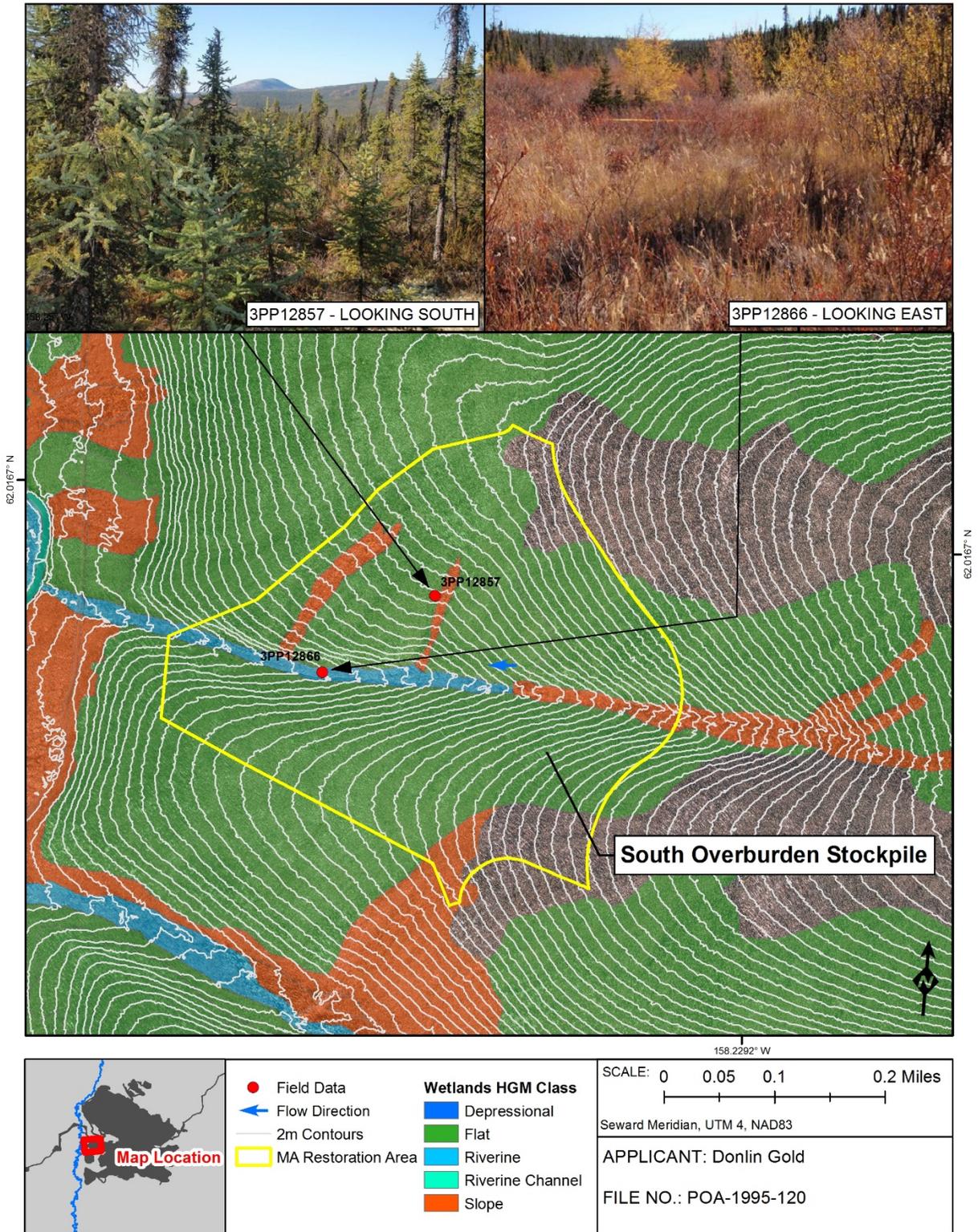


Figure 4 MA South Overburden Stockpile Map and Site Photos



DG: South_Overburden_Stockpile.mxd, 03/16/2018, R01

Figure 5 MA TSF Material Site-06/TSF Stockpile 2 Map and Site Photos

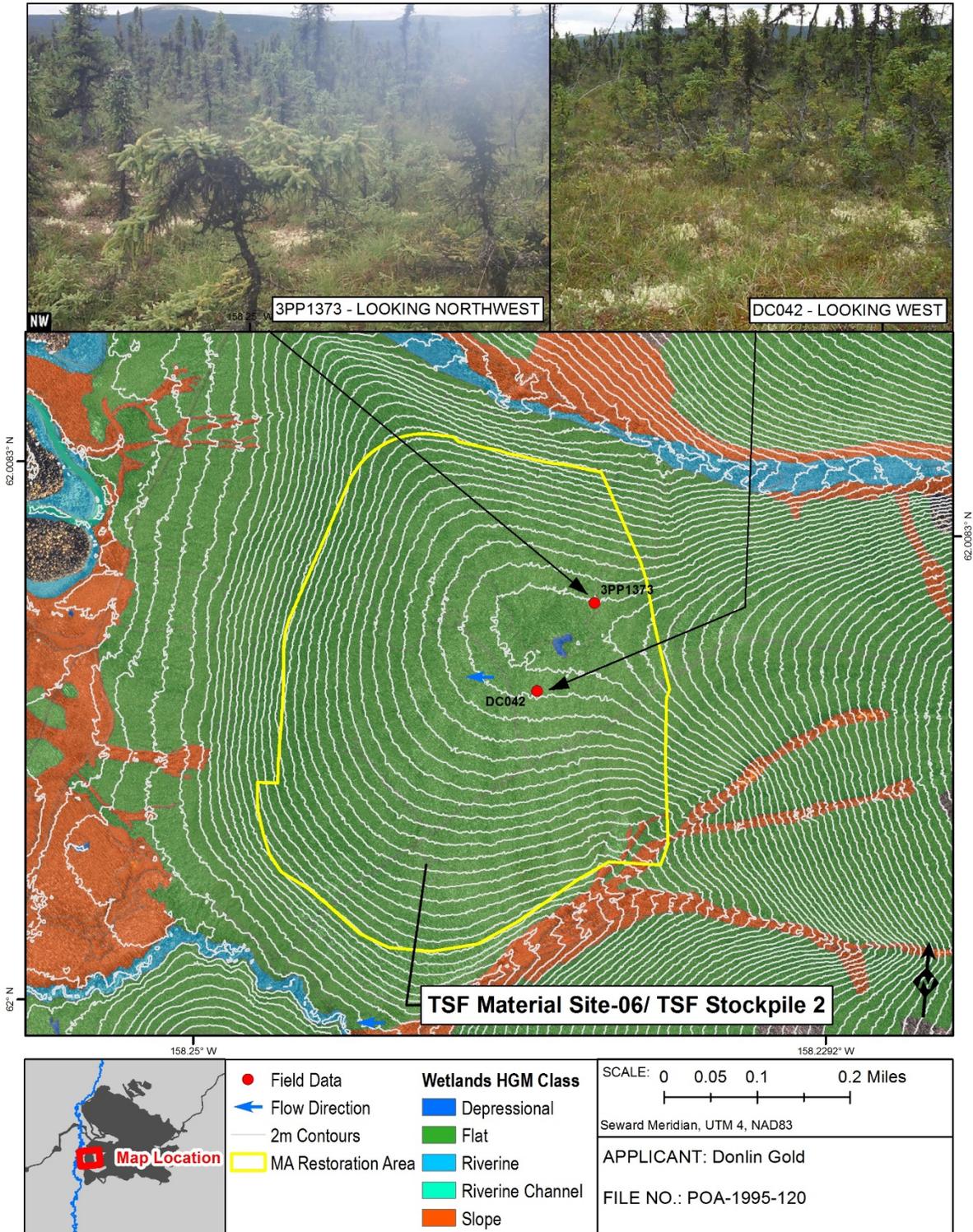
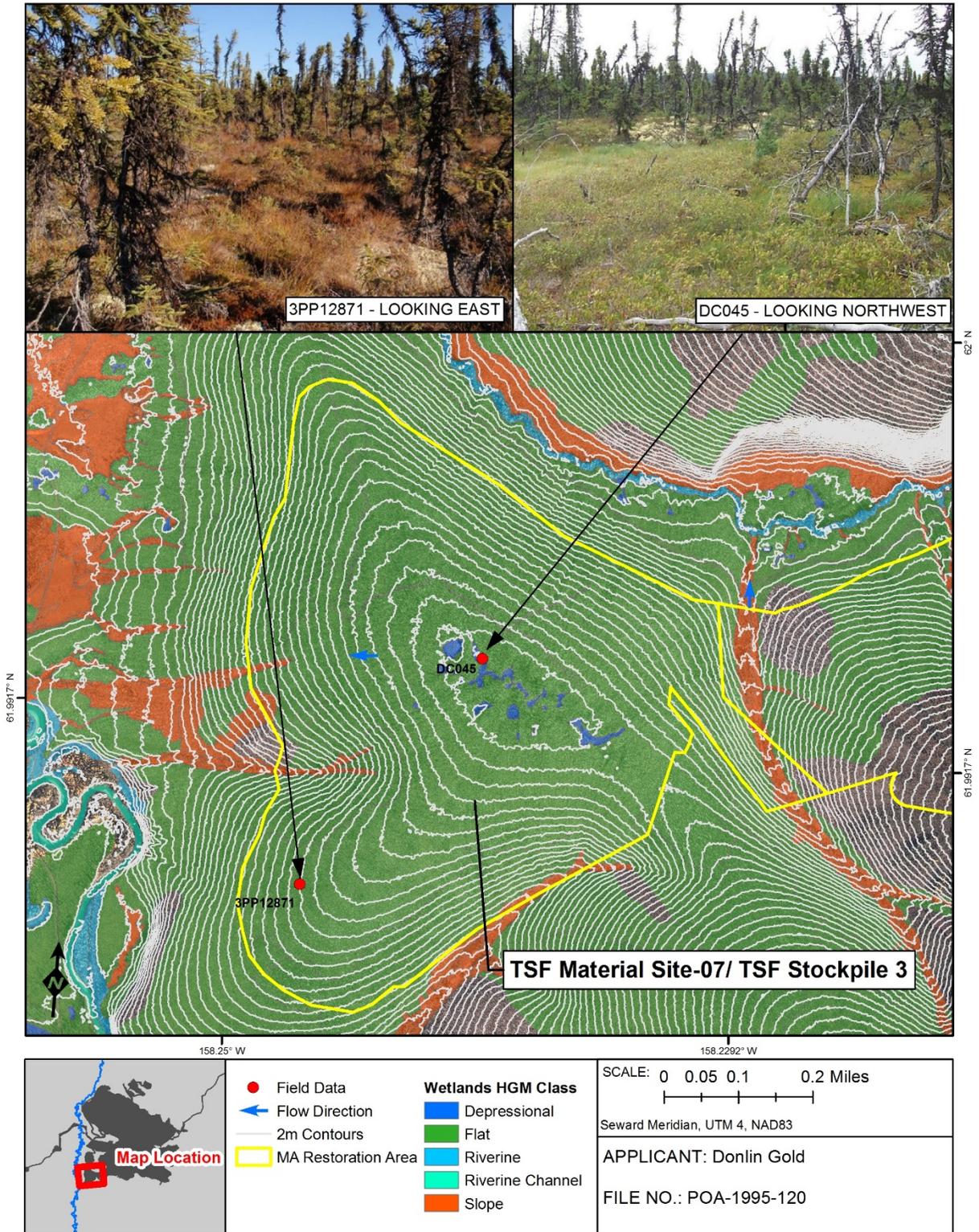
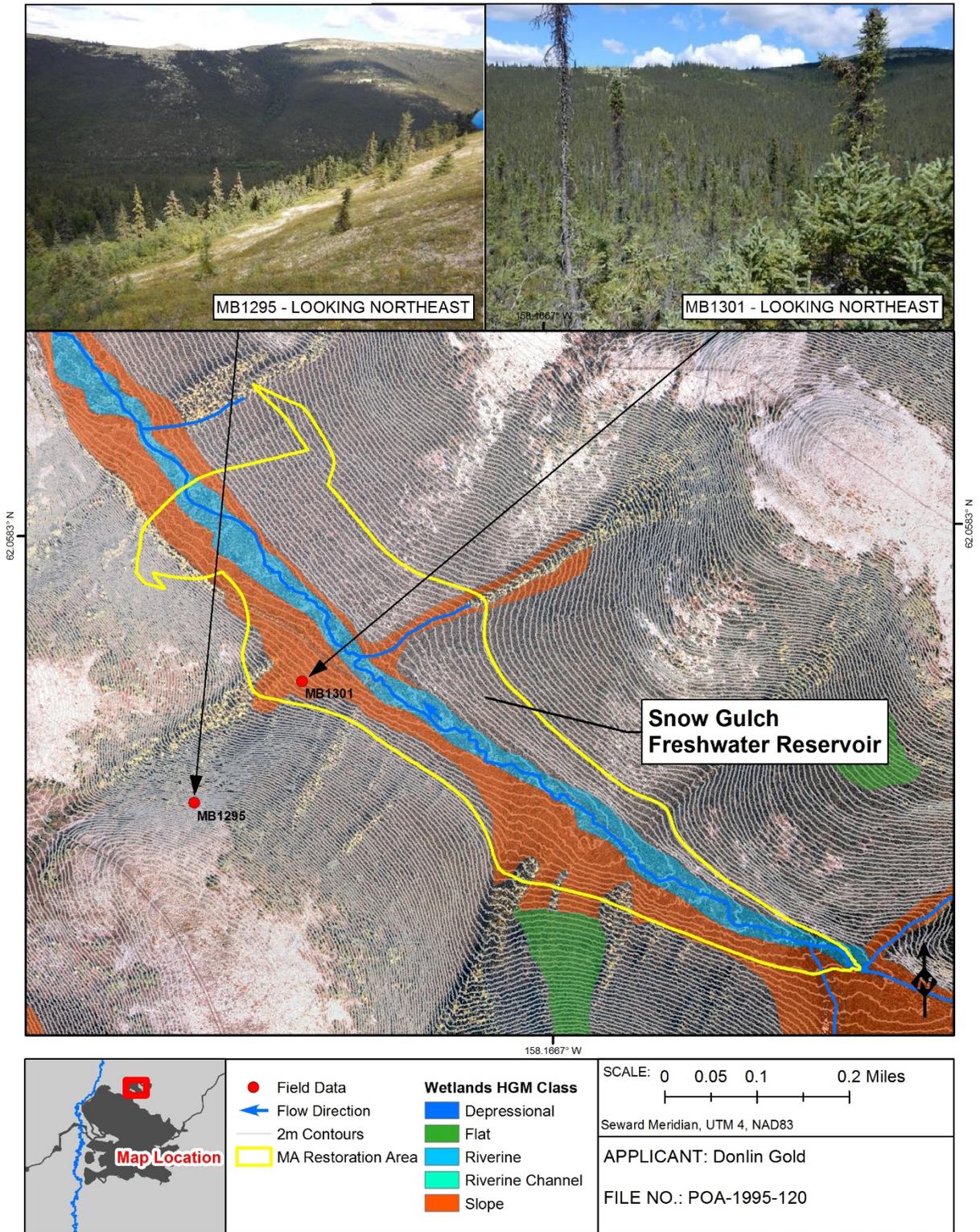


Figure 6 MA TSF Material Site-07/TSF Stockpile 3 Map and Site Photos



DG: TSF_Material_Site_07.mxd, 03/16/2018, R01

Figure 7 MA Snow Gulch Freshwater Reservoir Map and Site Photos



Once mine construction in the MA begins, TSF Stockpile 1 and the South Overburden Stockpile will be established for long-term storage of overburden and growth media (native soil material) collected during construction of other mine facilities. In addition, two material sites, TSF Material Sites 06 and 07, will be developed to source gravel for the construction of MA facilities. Once the gravel extraction is complete, these material sites will be used for long-term storage of overburden and growth media (as TSF Stockpiles 2 and 3).

At mine closure, the overburden and growth media will be removed and used for mine closure per State standards in other locations of the facility footprint. After removal of the stockpiles, the four storage areas will be restored to wetlands. Two of the stockpile locations (the former material sites) will be re-contoured as concave, depressional features, which will hold water. The other two stockpiles are located on precipitation-driven wetlands [flat hydrogeomorphic (HGM)] wetlands; see the Donlin Gold Compensatory Mitigation Plan (CMP) Attachment B for HGM information. In flat HGM wetlands, water perches on shallow frozen soils, creating saturated conditions. Water drawdowns in the MA will not affect these sites; permafrost found at these sites will remain after removal of the stockpiles and wetland vegetation will re-establish [BGC Engineering, Inc. (BGC) 2018].

During mine operation, a freshwater reservoir is proposed for the upper reaches of Snow Gulch. Upon mine closure, the dam associated with the reservoir will be breached and removed. Snow Gulch, a perennial stream, will flow freely again. The wetland floodplains will be naturally restored as the water levels drop. Natural surface and groundwater flows will resume in Snow Gulch.

Vegetation

Wetlands in the MA are dominated by open black spruce forest (OBSF) and black spruce woodland (BSW) vegetation types that are classified as flat HGM wetlands. OBSF is characterized by the presence of an open canopy of trees and saplings dominated by black spruce (*Picea mariana*), with a predominantly ericaceous shrub understory. Understory species commonly found in both upland and wetland OBSF plots include alpine blueberry (*Vaccinium uliginosum*), marsh labrador-tea (*Rhododendron tomentosum*), black crowberry (*Empetrum nigrum*), swamp birch (*Betula nana*), northern mountain-cranberry (*Vaccinium vitis-idaea*), Bigelow's sedge (*Carex bigelowii*), woodland horsetail (*Equisetum sylvaticum*), and cloudberry (*Rubus chamaemorus*).

Typical OBSF forested Cowardin classifications (Cowardin et al. 1979) include PFO4/SS1B and PSS4/1B (Photo 1) (all photos and Cowardin classifications are from the 2016 PJD; Michael Baker 2016). The BSW vegetation type is characterized by a sparse canopy (cover, 10 to 25 percent) of trees and saplings dominated by black spruce. Dominant understory species are typically the same as for OBSF. Typical spruce woodland Cowardin classifications include PSS1/FO4B and PSS1/4B (Photo 2).

Photo 1 Open Black Spruce Forest Vegetation Type



Photo 2 Black Spruce Woodland Vegetation Type



Post Restoration Vegetation

The stockpile and material sites will be either depressional or flat HGM wetlands upon restoration, based on hydrological inputs.

After removal of the stockpiles, initial vegetation types will be the wet herbaceous (WH) vegetation type. This vegetation type is characterized by a sparse canopy of tree and saplings (cover, less than 10 percent), and an overall shrub cover of less than 25 percent (Photo 3). Dominant species for this vegetation type in the Crooked Creek watershed include leafy tussock sedge (*Carex aquatilis*), pumpkin-fruit sedge (*Carex rotundata*), purple marshlocks (*Comarum palustre*), water horsetail (*Equisetum fluviatile*), cottongrass (*Eriophorum* spp.), and bluejoint (*Calamagrostis canadensis*). These plots typically have a Cowardin classification of PEM1C. Restoration to the WH vegetation type will provide additional diversity within the black spruce forests of the area. WH vegetation types within the Crooked Creek watershed account for 0.7 percent of the 24,178 acres mapped (Michael Baker 2016).

Photo 3 Wet Herbaceous Vegetation Type



Areas flooded by the Snow Gulch freshwater reservoir will restore as open alder willow shrub (OAWS) and open willow shrub (OWS) vegetation types, similar to the understory of the existing valley bottom. Species commonly found in wetland OAWS plots include speckled alder (*Alnus incana*), Sitka/green alder (*Alnus viridus*), diamond-leaf willow (*Salix pulchra*), Steven's Meadowsweet (*Spiraea stevenii*), alpine blueberry, and bluejoint (Photo 4). Species commonly found in wetland OWS plots include several species of willow depending on landscape position, including diamond-leaf willow, felt-leaf willow (*Salix alaxensis*), and little-tree willow (*Salix arbusculoides*). Understory shrubs include swamp birch and alpine blueberry. Understory herbaceous species include bluejoint and purple marshlocks (Photo 5). Typical Cowardin classifications for OWS and OAWS are PSS1 and PSS1/EM1 with an A or C water regime.

Photo 4 Open Alder Willow Shrub Vegetation



Photo 5 Open Willow Shrub Vegetation



Hydrology

Interior Alaska wetlands, including the MA, are dominated by flat HGM precipitation-driven (i.e., rain and snowmelt) wetlands, many on discontinuous permafrost. Precipitation-driven wetlands are the result of either loamy mantle layers or restricting permafrost that perches water at or near the surface during the growing season. Precipitation is the main hydrologic input to these wetlands, and evapotranspiration is the primary output. Flat HGM wetlands in the MA restoration area are almost

exclusively organic soil flat HGM wetlands as seen in Figure 1. Flat HGM wetlands systems are described in CMP Attachment B.

Establishing hydrology in the MA restoration area is the foundation for re-establishing wetlands at mine closure. When the hydrology is returned to baseline conditions, hydrophytic vegetation will establish quickly from wetland seed mixes and the native seed bank. Hydrology is also the basis for hydric soils of new wetlands.

The MA is located within an area of discontinuous permafrost, with isolated masses in coarse-grained soils, and moderately thick to thin permafrost in fine-grained soils (Ferrians 1965, 1994). Permafrost has a mean depth of approximately 19 feet in the MA, ranging from 7.5 to 105 feet near Anaconda Creek (BGC 2006).

Field data within the restoration areas were analyzed to determine baseline hydrology as presented in Table 2. BGC data (2018) show permafrost present in core samples excavated from the restoration areas in the MA.

Sites After Restoration

Based on field plot hydrology data (Table 2) and groundwater hydrology modeling from BGC (2018), mine dewatering drawdown will not have an effect on the hydrology of the MA restoration sites or the ability of wetlands to return through restoration. The areas outside of the mine dewatering drawdown, including the flat HGM precipitation-driven wetlands, will see successful restoration of hydrology [Figure 2; (BGC 2018)]. BGC (2018) documents that the restoration targets are not groundwater-dependent as indicated by modeling, field data, and flat HGM wetlands hydrologic inputs. Core sampling by BGC and wetland field plot data (Table 2) indicate permafrost is present in the MA.

Flat HGM wetlands are not affected by dewatering drawdown; hydrology inputs are precipitation from rain and snow. The wetlands stay saturated because the surface water entering the site remains perched on the underlying discontinuous permafrost. The permafrost barrier holds the water in the top 24 inches of the soil. Thick organic mats retain subsurface water in the wetlands. These sites are outside the drawdown area; but in any case, the removal of groundwater does not adversely affect this type of wetland.

TSF Stockpile 1

Groundwater modeling for the TSF Stockpile 1 site shows available water for this site will not be impacted by mine site dewatering; groundwater conditions and surface runoff at closure will be comparable to current conditions (BGC 2018). Many of the holes drilled in this site's footprint encountered permafrost (BGC 2018). The wetlands within this site are flat HGM on the hillsides, and slope HGM in minor swales (Michael Baker 2016).

The TSF Stockpile 1 wetlands will undergo compression from the stockpiled materials. This will compact the existing wetland soils, but not affect the frozen layer below. The frozen material will remain as an aquitard, protected by the insulating vegetative mat and overlying overburden.

Permafrost is expected to remain after restoration, which will allow for precipitation-driven wetlands to re-form. In addition, when contours are re-established, the minor swales will re-form as minor drainages, with OWS and OAWS type wetland vegetation re-establishing. Swales and the concave areas at the bottom of the hillside adjacent to Anaconda Creek are expected to re-establish quickly, while the hillsides will take longer as precipitation collects, saturates, and reduces the soil horizons.

South Overburden Stockpile

Groundwater modeling for the South Overburden Stockpile shows available water for this site will not be impacted by mine site dewatering; groundwater conditions and surface runoff after restoration will be comparable to current conditions (BGC 2018). Many of the holes drilled in this footprint may have encountered permafrost (BGC 2018). The wetlands within this site are flat HGM on the hillsides, and slope and riverine HGM down the center swale (Michael Baker 2016).

Table 2 MA Restoration Sites Field Data; HGM and Cowardin Classifications and Hydrology Notes

Plot Number	HGM Classification	Cowardin Classification	Restoration Site	Hydrology Notes
3PP14908	Slope	PFO4/SS1B	TSF Stockpile 1	Saturation at 4", surface water, water table 14"
DC077	Flat	PFO4/SS1B	TSF Stockpile 1	Saturation at 5", Water table at 13"
DC088	Flat	PSS4/1B	TSF Stockpile 1	Saturation at 5", Water table at 12"
DC089	Flat	PSS1/FO4B	TSF Stockpile 1	Saturation at 10"
3PP12855	Flat	PSS4B	TSF Material Site-07/ TSF Stockpile 3	Saturation at 8"
3PP12868	Flat	PSS4B	TSF Material Site-07/ TSF Stockpile 3	Saturation at 4"
3PP12869	Flat	PSS4B	TSF Material Site-07/ TSF Stockpile 3	Saturation at 12"
3PP12871	Flat	PSS4B	TSF Material Site-07/ TSF Stockpile 3	Saturation at 11", Permafrost at 14"
3PP2046	Flat	PSS4B	TSF Material Site-07/ TSF Stockpile 3	Saturation at 0", Water table at 3"
MB4346	Flat	PSS1/4B	TSF Material Site-07/ TSF Stockpile 3	Saturation at 10", Water table at 17"
3PP12862	Flat	PSS4/1B	TSF Material Site-06/ TSF Stockpile 2	Saturation at 13"
3PP1372	Flat	PSS1/4B	TSF Material Site-06/ TSF Stockpile 2	Water table at 12", seasonal frost at 13", Saturation at 0"
3PP1373	Flat	PSS1/4B	TSF Material Site-06/ TSF Stockpile 2	Saturation at 0", Water table at 21"
MB3304	Flat	PSS4B	TSF Material Site-06/ TSF Stockpile 2	Saturation at 4"
MB3308	Flat	PSS4B	TSF Material Site-06/ TSF Stockpile 2	Saturation at 4", Water table at 13"
3PP12857	Flat	PSS4B	South Overburden Stockpile	Saturation at 8"
3PP12866	Riverine	PSS1/EM1A	South Overburden Stockpile	Water table 24", Saturation at 15"
MB0283	Flat	PSS4/1B	South Overburden Stockpile	Saturation at 9", Water table at 14"
MB0322	Flat	PFO4B	South Overburden Stockpile	Saturation at 14", Water table at 17"
MB1401	Flat	PSS4B	South Overburden Stockpile	Saturation at 4", Restrictive layer at 4"
3PP12837	Slope	PSS4B	Snow Gulch Freshwater Reservoir	Saturation at 4", Impeding layer at 3"
3PP12840	Slope	PSS4/1B	Snow Gulch Freshwater Reservoir	Shallow Permafrost
3PP2124	Slope	PFO4/SS1B	Snow Gulch Freshwater Reservoir	Saturation at 0", Water table at 2"

The South Overburden Stockpile wetlands will undergo compression from the stockpiled materials. This will compact the existing wetland soils, but not affect the frozen layer below. The frozen material will remain as an aquitard, protected by the insulating vegetative mat and overlying overburden.

Permafrost is expected to remain after restoration, which will allow for precipitation-driven wetlands to re-form. The main swale down the middle of the wetland will continue to funnel surface and groundwater. The small floodplain will re-establish as a slope HGM wetland at the top, and riverine HGM towards the bottom with OWS and/or OAWS vegetation types.

Material Sites (Material Site-06/TSF Stockpile 2 and Material Site-07/TSF Stockpile 3)

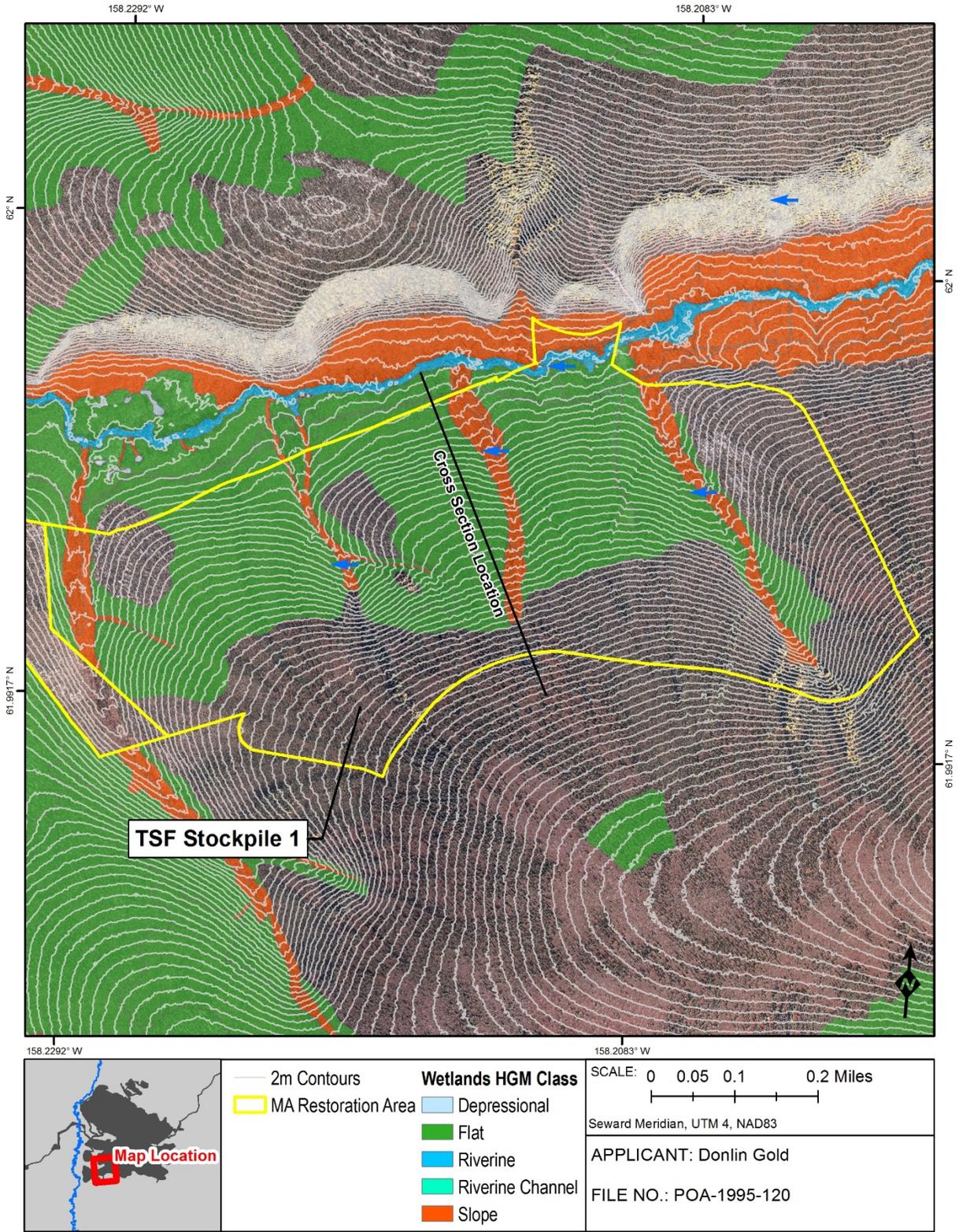
Material sites will be excavated 75 to 100 feet into the hillsides. The material sites are within discontinuous permafrost (BGC 2018) that would intersect subsurface water and possibly groundwater at the depth of excavation. Groundwater will enter the excavation through seepage faces (BGC 2018). Surface runoff is expected to be comparable to current conditions.

Berms have been incorporated into the design of TSF Material Sites 06 and 07. They have been placed around the outside edges of the downslope sides of the sites. These berms will be left in place following mining, during use of the sites as overburden stockpiles, and during restoration. During restoration, the material sites will be re-contoured as concave, depressional features. Following restoration, the berms will act as barriers to movement of water; increasing the amount of water supporting restored wetlands.

Hydrologic drainage will be restored upslope and will return as depressional HGM palustrine emergent wetlands. The material sites are not within the post-closure mine dewatering drawdown area (BGC 2018).

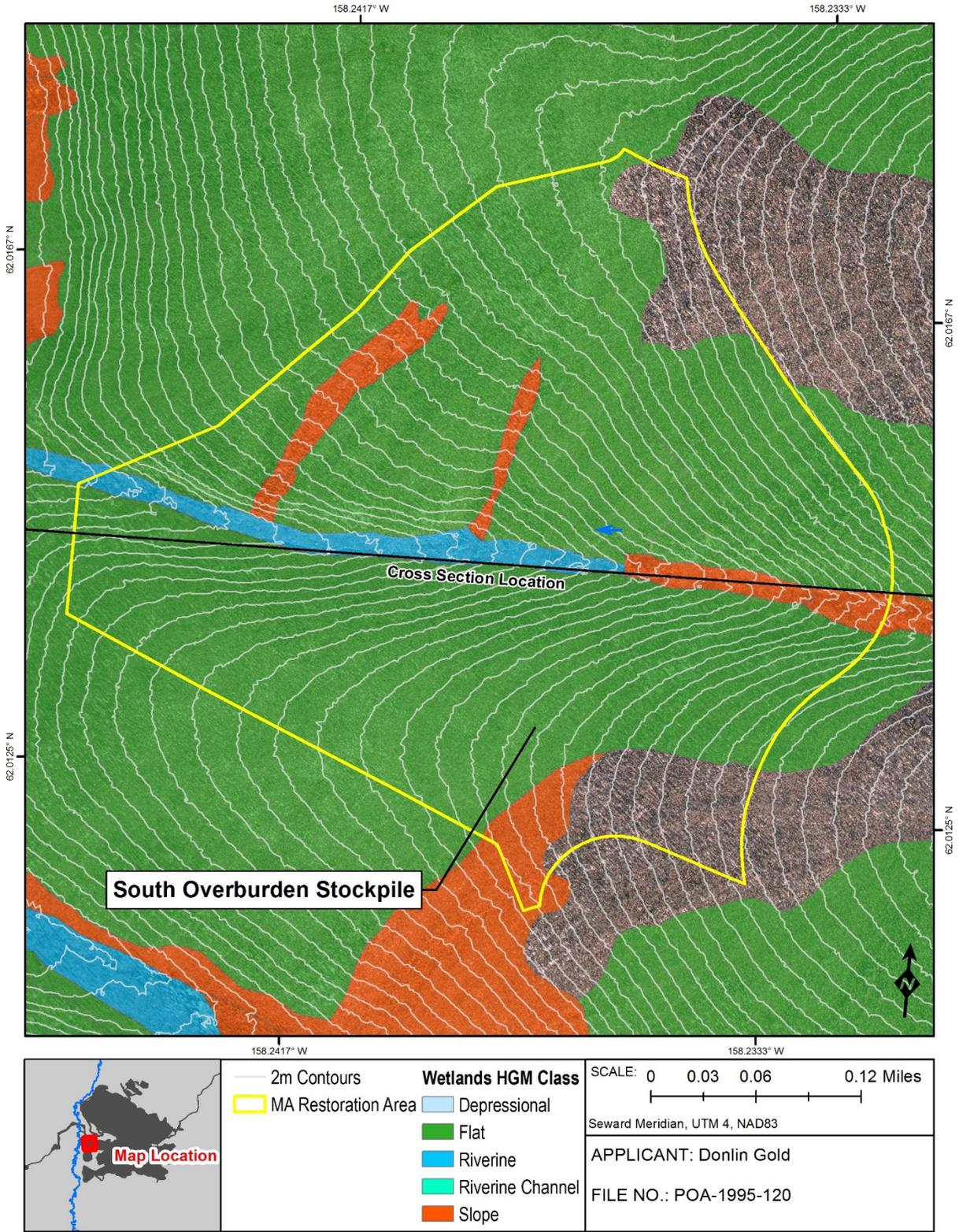
Figure 8 through Figure 12 are maps of the restoration sites post-mining. Cross-sections are provided for planning purposes (Figure 13 through Figure 16); the locations of the cross-sections are shown on the corresponding map figure.

Figure 8 TSF Stockpile 1 MA Restoration



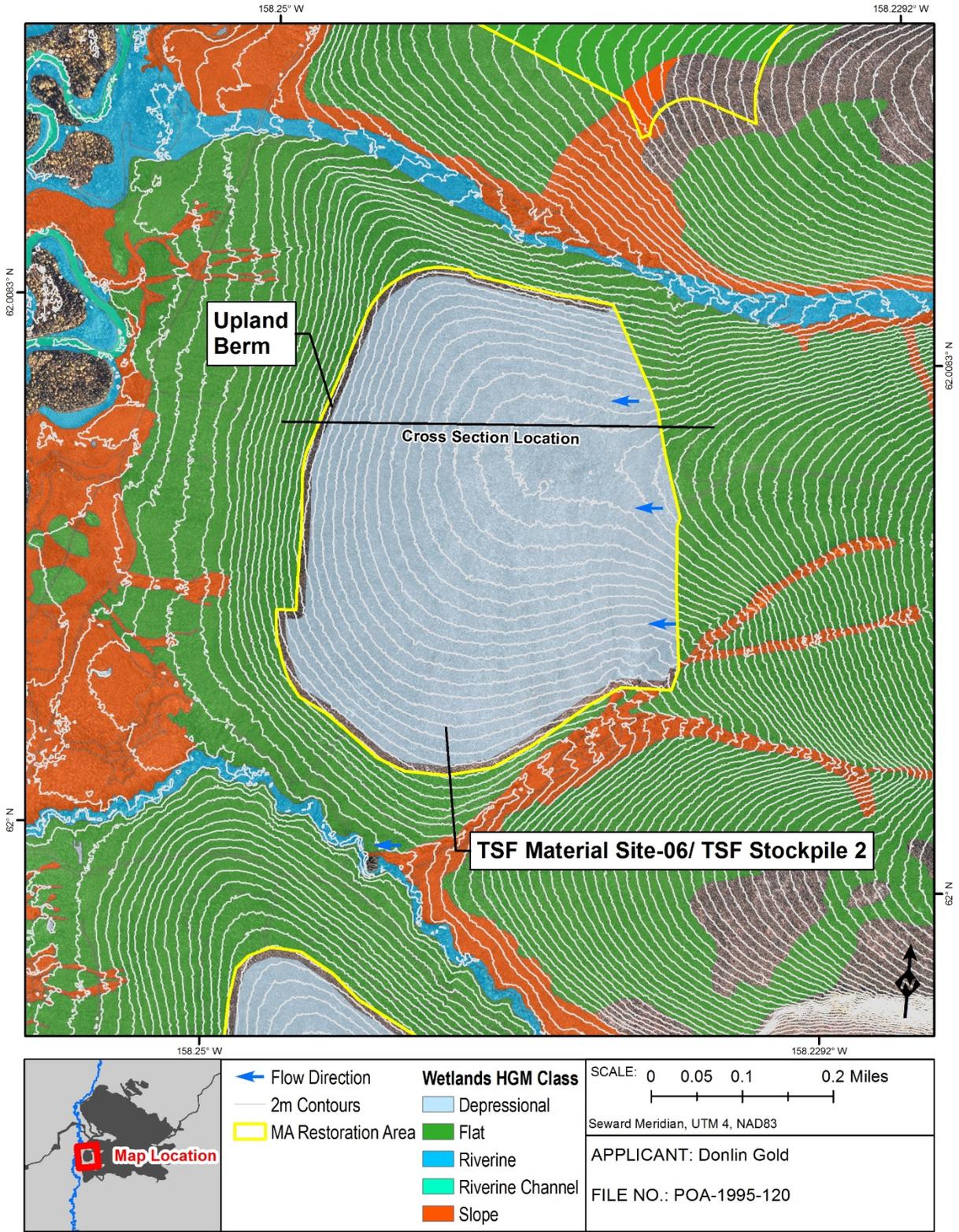
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Figure 9 South Overburden Stockpile MA Restoration



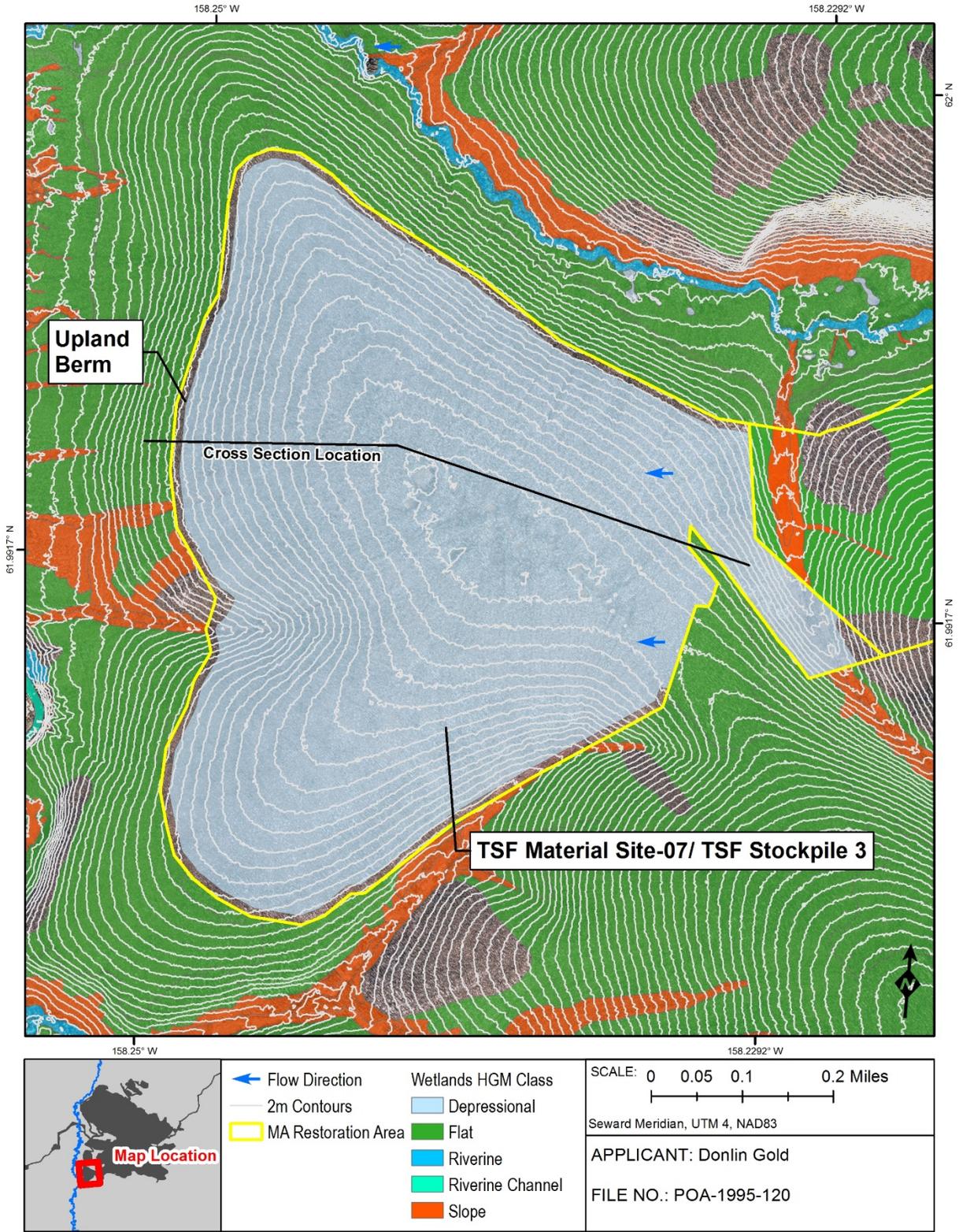
DG: SouthOverburden.mxd, 05/21/2018, R00

Figure 10 TSF Material Site-06/TSF Stockpile 2 MA Restoration



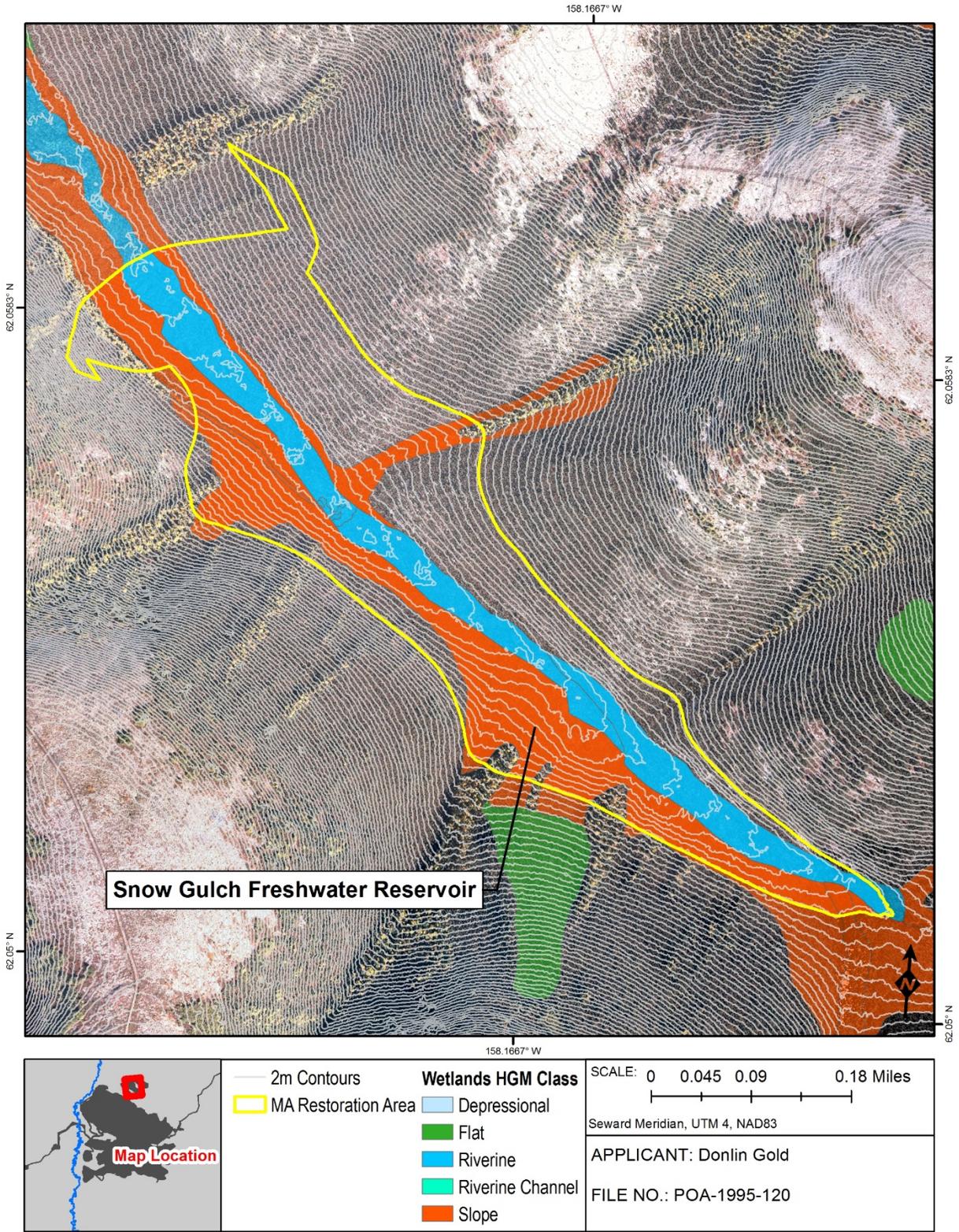
DG: Material_Site_06_Post.mxd, 04/12/2018, R00

Figure 11 TSF Material Site-07/TSF Stockpile 3 MA Restoration



DG: Material_Site_07_Post.mxd, 04/12/2018, R00

Figure 12 MA Snow Gulch Freshwater Reservoir



DG: Snow Gulch_Post.mxd, 05/21/2018, R00

Figure 13 MA TSF Stockpile 1 Cross-Section

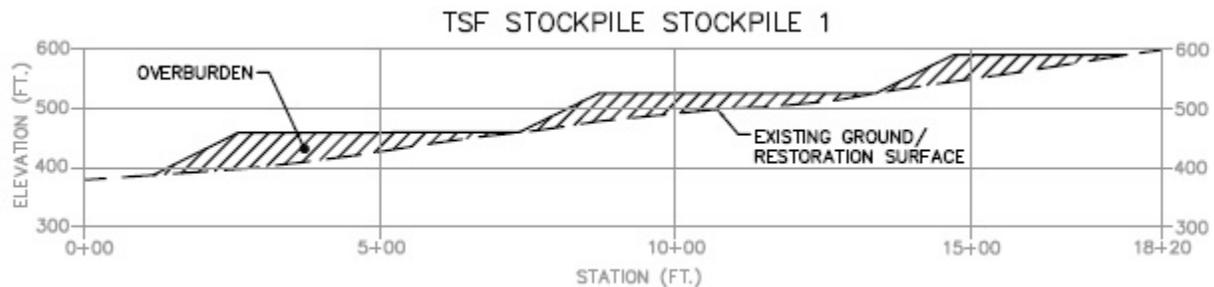


Figure 14 MA South Overburden Stockpile Cross-Section

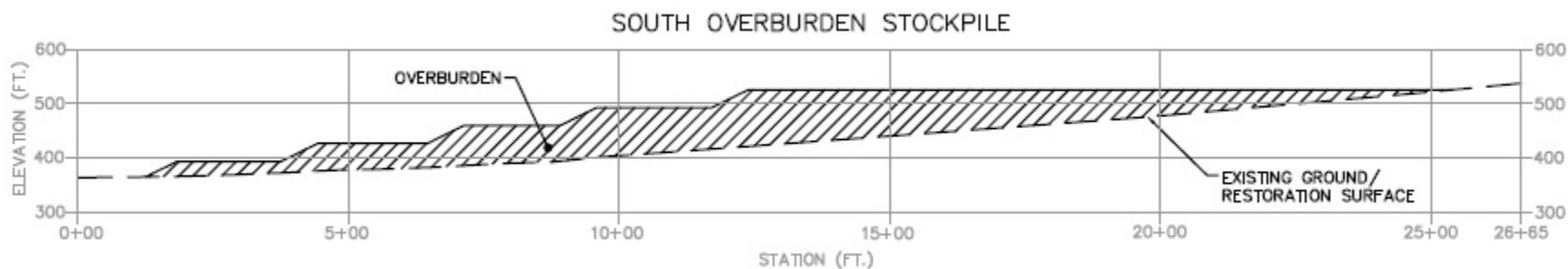


Figure 15 MA TSF Material Site-06/TSF Stockpile 2 Cross-Section

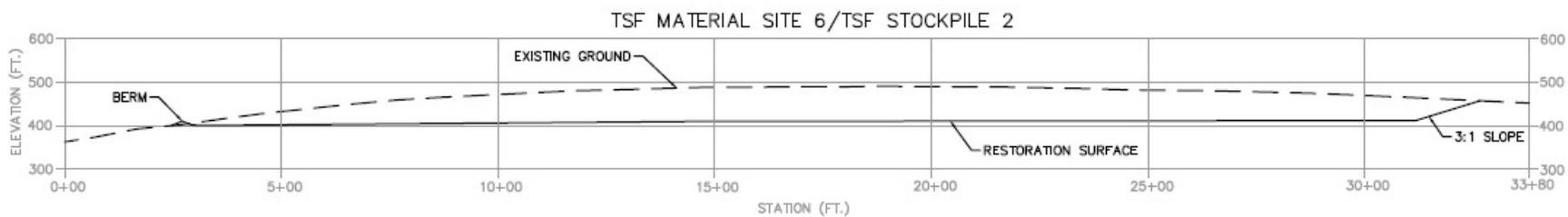
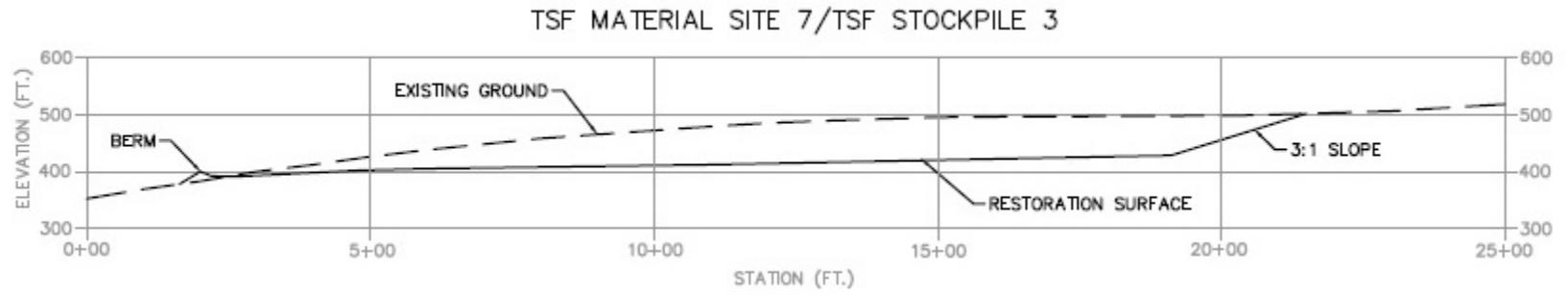


Figure 16 MA TSF Material Site-07/TSF Stockpile 3 Cross-Section



Restored Wetlands

The total wetland acres of HGM and Cowardin groups after the MA restoration are shown in Table 3.

Table 3 Completed MA Restoration HGM Classifications and Cowardin Groups (Acres)

HGM Classification	Cowardin Group	Acres
Depressional	Palustrine Emergent	331
Flat	Palustrine Scrub Shrub	159
Riverine	Palustrine Scrub Shrub	19
Slope	Palustrine Scrub Shrub	47
Total		556

Table 4 is a comparison of the vegetation types and HGM classifications of the wetlands impacted and restored for the restoration sites. Flat HGM wetlands are the dominant class that will be impacted within the MA restoration sites. Post-mine restoration will return the TSF material sites to concave surfaces, creating depressional, emergent wetlands. Depressional, emergent wetlands will diversify wetland classes and increase wetland values and functions. Depressional emergent wetland acreage is increased by 329 acres after restoration.

Table 4 MA Wetland Types: Comparison of Permanent Fill Acres and Restored Acres, by Site

Facility	HGM Class	Cowardin Group	Permanent Fill Acres	Restored Acres	Acres Change	
TSF Stockpile 1	Flat	Scrub-Shrub	97	97	0	
	Riverine	Scrub-Shrub	1	1	0	
	Slope	Scrub-Shrub	16	16	0	
	Total		114	114	0	
South Overburden Stockpile	Flat	Scrub-Shrub	62	62	0	
	Riverine	Scrub-Shrub	3	3	0	
	Slope	Scrub-Shrub	5	5	0	
	Total		70	70	0	
TSF Material Site-06/ TSF Stockpile 2	Depressional	Emergent	0	114	114	
		Scrub-Shrub	0	0	0	
	Flat	Forested	0	0	0	
		Scrub-Shrub	120	0	-120	
	Slope	Emergent	1	0	-1	
	Total		121	114	-7	
TSF Material Site-07/ TSF Stockpile 3	Depressional	Emergent	2	217	215	
		Forested	32	0	-32	
	Flat	Scrub-Shrub	191	0	-191	
		Slope	Emergent	1	0	-1
			Forested	1	0	-1
		Scrub-Shrub	3	0	-3	
	Total		229	217	-12	
Snow Gulch Freshwater Reservoir	Riverine	Scrub-Shrub	16	16	0	
	Slope	Scrub-Shrub	26	26	0	
	Total		42	42	0	
Grand Total¹			576	556	-20²	

¹Sums may differ due to rounding.

² The 20 acre change is due to 50-foot upland berms included in TSF Material Sites 06 and 07.

Restoration Plan

Restoration activities will begin in the targeted sites after the closure of the mine. This is projected to be approximately 27 years after mining operations commence. The restoration activities will consist of planning and sequencing the loading, hauling, dumping, grading, and restoring of the excavated material sites. All overburden material will be removed from the stored locations and be used throughout the MA for restoration purposes. The proposed wetland restoration steps are summarized in Table 5. Throughout all phases of this Plan, water and erosion control structures will be maintained to protect water quality in adjacent wetlands, streams, and rivers.

Table 5 MA Wetland Restoration Sites and Proposed Restoration Sequence

Wetlands Restoration Sequence						
Site (Impact Type)	Planning and Design	Fill Removal	Return to Original Contours	Grade to Increase Water Retention	Site Preparation	Re-vegetation
TSF Stockpile 1 (cut and fill)	x	x		x	a	x
South Overburden Stockpile (fill)	x	x	x		a	x
TSF Material Site-06/TSF Stockpile 2 (cut and fill)	x	x		x	a	x
TSF Material Site-07/TSF Stockpile 3 (cut and fill)	x	x		x	a	x
Snow Gulch Freshwater Reservoir (fill/pond)		x	x		a	a

Notes: x – Planned restoration activity; a – If required

The following is a synopsis of wetland restoration activity at each targeted site.

- **Planning and Design** – Includes planning the activity and functions, surveying, data collection, analysis, and the final engineering design of roads, work fill pads, required site grades for overburden and growth media deposition, and mine facilities for materials storage necessary to meet the final overburden placement requirements.
- **Fill Removal** – Removal of fill with the use of mechanized equipment. Fill removed will be used for mine reclamation at other facilities. The overburden and growth media will be loaded into haul trucks and moved along mine roads to final deposition locations.
- **Return to Original Contours** – The area topography and elevations will be returned to pre-construction contour conditions. Ditches will be filled or blocked. Overland surface drainage connectors will be re-established. Roads will be scarified and removed.
- **Cut Down Snow Gulch Reservoir Dam** – The Snow Gulch reservoir dam will be cut down to allow natural drainage to return. The Snow Gulch stream bed and bank will return as the reservoir is drawn down and the dam breached.
- **Grade Material Sites to Increase Water Retention** – The former material site topography and elevations will be deeper than pre-construction conditions. In these cases, the terrain will be modified to store the overland and precipitation flow, and for water retention. Drainages will be restored if they were previously diverted away from these areas. New drainage connectors to existing swales or streams will be established. Material sites will be graded with a 50-foot berm on the downslope side for water retention.

- Site Preparation – The substrate will be prepared for re-vegetation. This will include layering the restoration site, or portions of the restoration site, with growth media and/or mulch. Mechanized equipment will be used to create micro-environments and conditions that provide favorable seed germination and seedling growth. Detailed site preparation techniques are included in the Interior Alaska Re-vegetation and Erosion Control Guide (Czapla and Wright 2012). Seed mixes will be cultivated from both the seedbank in stockpiled wetland topsoil (growth media) and from commercially available native wetland seed mixes. Species present in currently available wetland and upland seed mixes are listed in Table 6. Egan American Sloughgrass (*Beckmannia syzigachne*), a primary component of the seed mix, has been shown to be successful for revegetation in wetlands in Interior Alaska (Czapla and Wright 2012).

Table 6 Wetland and Upland Seed Mixes

Species Name	Latin Name	NWI Indicator Status	Upland Mix, Percent	Wetland Mix, Percent
Arctic Red Fescue	<i>Festuca rubra</i>	Facultative	50	20
Tundra Glaucous Bluegrass	<i>Poa glauca</i>	Not Listed	20	0
Gruening Alpine Bluegrass	<i>Poa alpina</i>	Facultative Upland	20	0
Nortran Tufted Hairgrass	<i>Deschampsia caespitosa</i>	Facultative	10	40
Egan American Sloughgrass	<i>Beckmannia syzigachne</i>	Obligate	0	40

- Re-vegetation – Plant cover will be re-established by means of seeding, or natural re-colonization. If necessary, fertilizer will be added to promote re-vegetation. Uplands will be re-vegetated to control sediment and nutrient loading to wetlands. Detailed re-vegetation techniques are included in the Interior Alaska Re-vegetation and Erosion Control Guide (Czapla and Wright 2012). Depressional, palustrine emergent wetlands will be the primary established wetland type in the two former material sites. Over time, native seeds will germinate from the growth media seed bank or from natural colonization from adjacent vegetation. Black spruce and shrubs will return to the restoration areas over time as palustrine scrub shrub and forested wetlands.

Reclamation Criteria

Performance criteria are modified from General Permit (GP) POA-2014-55: Mechanical Placer Mining Activities within the State of Alaska [United States Army Corps of Engineers (USACE) 2014]. Vegetation and hydrology performance criteria are included. Soil performance criteria are not included in this Plan; development of hydric soils typically progresses behind the other two parameters following creation or restoration of wetlands.

Vegetation Criteria

Vegetation performance criteria ensure restored and revegetated wetland areas and upland berms are following a trajectory to be stable and functioning biologically. Table 7 contains the vegetation performance criteria and timing.

Table 7 MA Vegetation Performance Criteria, including Timing

Restoration Area	Performance Criteria
Upland Berms	Achieve 30% live plant cover of the upland berm by the end of three (3) growing seasons.
	Achieve 70% live plant cover of the upland berm by the end of five (5) growing seasons.
	Cover of invasive species is no more than 10%.
Wetlands	Achieve 30% live plant cover of restored wetland areas by the end of three (3) growing seasons.
	Achieve 70% live plant cover of constructed wetland areas with the vegetation community meeting the Dominance Test or Prevalence Index for hydrophytic vegetation by the end of five (5) growing seasons.
	Cover of invasive species is no more than 10%.

Wetland Hydrology Criteria

Wetland hydrology indicators as described in the Alaska Regional Supplement (USACE 2007) will be used as evidence of sufficient hydrology to support wetland and pond formation and function. However, only three of the four groups of the available indicators as described in the Regional Supplement will be used during the monitoring period. The fourth group, Group D – Evidence from Other Site Conditions or Data, will not be used to monitor hydrologic conditions within the restored wetland areas because landscape variables for the group were derived for natural settings and are not applicable for use in recently restored wetlands. Additionally, the indicator Sparsely Vegetated Concave Surface will be excluded because it is counter to the vegetation performance criteria.

The wetland hydrology performance criteria are shown in Table 8. One primary indicator from any group is sufficient to conclude that wetland hydrology is present. Secondary indicators have been excluded. Monitoring for hydrologic indicators will occur within 10-meter-squared (m²) plots coinciding with the vegetation monitoring.

Table 8 MA Wetland Hydrology Performance Indicators

Group	Indicator
Group A – Observations of Surface Water or Saturated Soils	A1 – Surface Water
	A2 – High Water Table
	A3 – Saturation
Group B – Evidence of Recent Inundation	B1 – Water Marks
	B2 – Sediment Deposits
	B3 – Drift Deposits
	B4 – Algal Mat or Crust
	B5 – Iron Deposits
	B6 – Surface Soil Cracks
	B7 – Inundation Visible on Aerial Imagery
Group C – Evidence of Current or Recent Saturation	B15 – Marl Deposits
	C1 – Hydrogen Sulfide Odor
	C2 – Dry-season Water Table

Monitoring

Wetland monitoring will include periodic inspections, once a year for five years following restoration. The inspections will occur during the growing season. The purpose of the monitoring will be to assess the success of the restored habitats using the performance criteria described above and to determine whether additional remedial actions are necessary to assure the criteria are met.

Monitoring of restored wetlands and ponds will consist of collecting and evaluating quantitative data on the hydrology and plant communities within the restored wetlands. Monitoring points will be established to monitor trends in plant communities. Transects at monitoring points will be established to determine vegetation cover across the restoration areas.

Monitoring point locations will be monumented with GPS and physically using rebar stakes and flagging to facilitate revisit. At shrub vegetation sampling points, the percent cover of shrub species, bare ground, and open water, as well as the number of species, will be recorded within a 10-m² plot. Herbaceous species and percent cover will be recorded within a 1-m² quadrat placed at random in the plot area. Hydrology will be characterized at wetland and pond sampling points. All non-native plant species and their relative cover will be recorded. Non-native plant recruitment data will be used to determine the need for active measures to remove non-native plants from restoration areas.

Monitoring reports will be produced annually and submitted USACE by December 31 of each year until the areas meet the performance criteria.

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*Attachment D Upper Crooked Creek Permittee
Responsible Mitigation Plan*

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Attachment D Upper Crooked Creek Permittee Responsible Mitigation Plan

Introduction

The proposed Donlin Gold, LLC (Donlin Gold) Project (Project) mine site is located within the Crooked Creek watershed (United States Geological Survey [USGS] 10-digit Hydrologic Unit Code [HUC] watershed 1903050108). The Crooked Creek watershed is remote and predominately undisturbed, with minimal development occurring on its landscape. The majority of existing disturbances within the watershed are in two distinct locations: the village of Crooked Creek on the Kuskokwim River, and the upper reaches of the watershed near the proposed Project area.

The disturbed areas near the proposed Project in the upper Crooked Creek watershed are concentrated in the Grouse Creek-Crooked Creek (12-digit HUC 190305010803) and Donlin Creek (12-digit HUC 190305010801) watersheds. Disturbances in these areas are primarily the result of two activities: Donlin Gold's ongoing exploration operations and historical placer mining. Placer mining has resulted in landscape-scale alterations to topography and impacts to aquatic resource functions. Placer mining impacts in the upper Crooked Creek watershed, specifically the Quartz, Snow, Ruby, and Queen Gulches, have rerouted streams from their historical channels into linear excavated ditches with no floodplains and excavated floodplains down to bedrock. Ponds, ditches, excavations, overburden fill, and side castings have all contributed to the impacts in these drainages, which include disrupted/ disconnected floodplains, lowered water tables, steep and unstable stream channels, poor water quality, steep eroding stream side slopes, loss of overlying soils, loss of vegetative cover, and narrowed hydraulic conveyances.

Based on Crooked Creek watershed fisheries habitat assessments and using the Function Based Framework for Stream Assessment and Restoration Projects (Harman et al. 2012), Donlin Gold has selected the restoration of these heavily impacted drainages as part of the Compensatory Mitigation Plan (CMP) for the Project. Using a Functional Pyramid approach from Harman et al, this Upper Crooked Creek Permittee Responsible Mitigation (PRM) Plan (Plan) defines how re-establishing the 15 functions critical to stream and riparian ecosystems will be achieved. The Functional Pyramid Approach builds on a hierarchy of processes starting with basic watershed hydrology, ascending through hydraulic processes dictated by channel, floodplain and stream sediment parameters which in turn drive geomorphic processes, sediment transport, large woody debris, and riparian vegetation to create bed form diversity and dynamic equilibrium. These building blocks are the focus of the restoration work and when accomplished correctly recreate the parameters for healthy physiochemical and biological habitats. Simply put, a correctly reconstructed stream with natural gradients, sinuosity, and properly sized and revegetated substrate, channel and floodplains will reproduce healthy aquatic and fisheries habitats.

Four distinct restoration projects are described within the 221.5 acre Upper Crooked Creek PRM Plan (Plan) boundary:

- Restoration of lower Quartz Gulch

- Restoration of lower Snow Gulch
- Restoration of the wash plant tailings area along Crooked Creek, between Snow and Ruby Gulches
- Restoration of lower Ruby and Queen Gulches

These areas are shown on Figure 1.

These restoration projects will increase the function and sustainability of the watershed and its fisheries because they:

- Re-establish and rehabilitate historical stream and wetland functions present prior to placer mining;
- Re-establish historical and establish new stream, pond, and off-channel anadromous and resident fish habitat; and
- Have a high likelihood of success to restore naturally occurring, self-sustaining systems within the Crooked Creek watershed because they are based on a stream functional framework.

All four restoration projects are located in the same 10-digit HUC watershed as the majority of the long-term and permanent aquatic resources impacts from the Project.

Objectives

The objective of this Plan is to return naturally occurring, self-sustaining wetland and stream functions to the upper Crooked Creek watershed. The Plan fulfills this objective by re-establishing floodplains and stream channels to pre-placer mining parameters using a stream functional framework and reference reaches upgradient of the impacted areas. The total benefits from this plan are presented in Table 1.

Figure 1 Upper Crooked Creek Permittee Responsible Mitigation Plan Area Overview

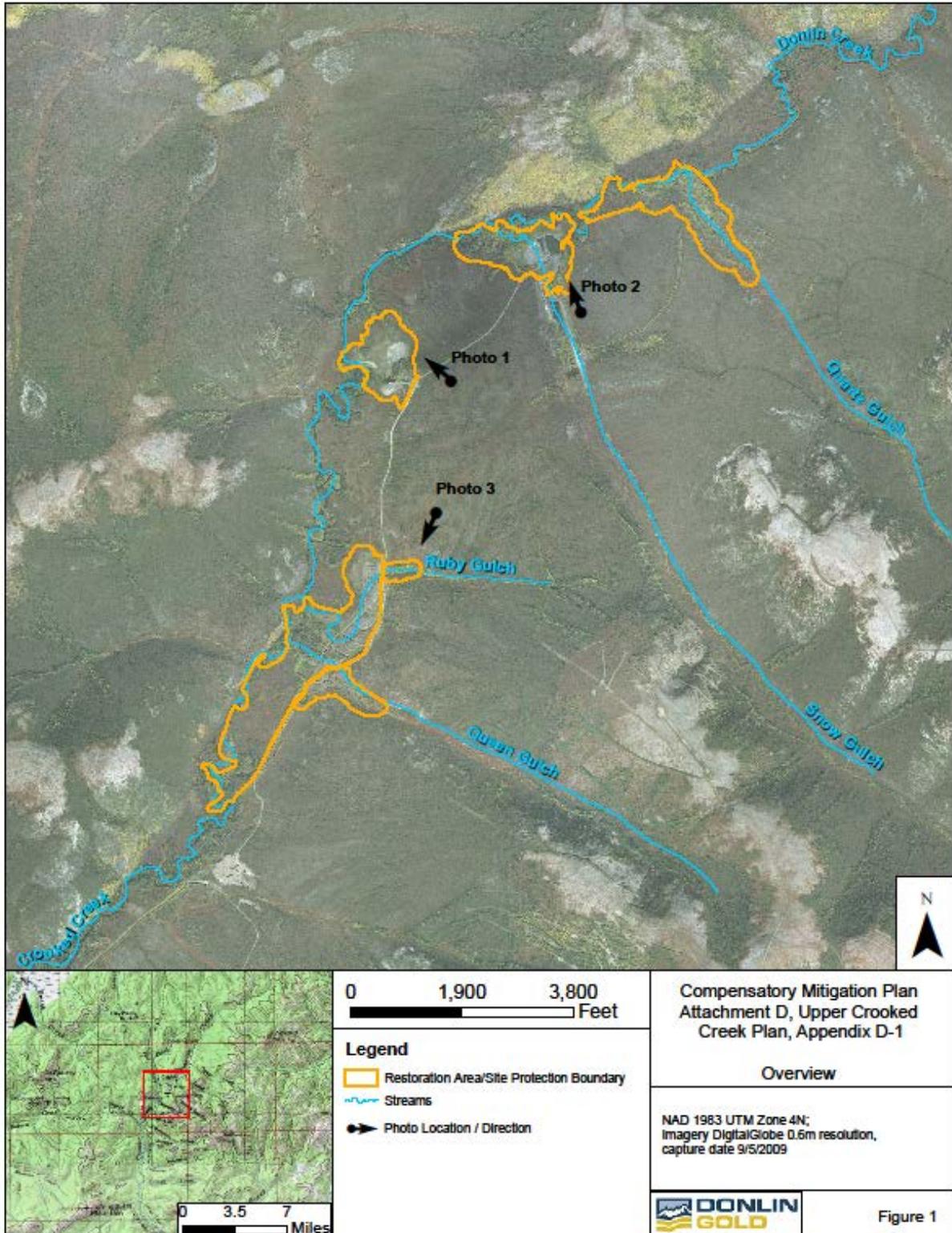


Table 1 Overview of Objectives for the Upper Crooked Creek PRM Plan Area

Restoration Activity	Expected NWI Classes	Habitat Type	Activity Description	Linear Feet	Acres
Re-establish	R3UBH, R3USC, R2UBH, R2USA	Stream Channel	Stream channels will be re-created within their natural alluvial setting to natural dimensions, patterns, and profiles.	8,982	-
Re-establish	PSS1A, PSS1C, PSS1/EM1C, PEM1C	Wetland Floodplain	Wetland floodplains will be reshaped and re-contoured into natural pre-mining configurations. These areas will be revegetated with native plant species.	-	95.7
Enhance	PUBH, PABH, PEM1H, PEM1F	Off-channel Pond (these are areas within the wetland floodplain habitat above)	Existing mining ponds will be converted into productive habitat through the creation of littoral zones and deep overwintering habitat.	-	15.2*
Enhance	U	Terrestrial	Tailings and other areas outside of the floodplain that need to be re-graded and re-contoured to support the re-establishment of floodplains will be revegetated with native species.	-	16.8
Protect	U, PSS1C, PSS1/EM1C, PEM1C, PSS1/EM1B, PSS1/4B, PSS4B, PSS4/1B, PEM1B	Buffer	Areas within a restoration buffer, plus the habitats above, will be placed under a site protection instrument to ensure the long-term performance of the restoration projects.	-	109.0
Total for the PRM Plan Area				8,982	221.5

*Enhanced off-channel pond habitat is within the re-established wetland floodplain habitat and not included in the total acres.

“-“ Not Applicable.

Historical placer mining in the Quartz, Snow, Ruby, and Queen Gulches represents a significant portion of the existing aquatic resource impacts within the Crooked Creek watershed. Restoration of these streams; floodplains; and associated wetland, upland, and buffer areas will provide a portion of the compensatory mitigation required by the United States Army Corps of Engineers (USACE) under a Department of the Army (DA) permit for the Project.

Site Selection Criteria

The Upper Crooked Creek PRM Plan were selected to provide compensatory mitigation for the Project from a wide range of potential PRM Plans identified across the Lower Kuskokwim watershed and throughout western Alaska (6-digit HUC 190305). Among all projects considered, the potential PRM Plans identified within the Crooked Creek watershed (10-digit HUC 1903050108), where the proposed Project is primarily located, were ranked highest during the site selection process. These projects were ranked highly because they restore aquatic functions and contribute to the ecological sustainability of the impacted watershed, have a high likelihood of feasibility and success, and will require limited long-

term maintenance to achieve sustainability. The Upper Crooked Creek PRM Plans and restoration of some disturbed mine areas as wetlands at mine closure (see Attachment C of the CMP), were the only opportunities for mitigation identified in the Crooked Creek 10-digit HUC watershed. See Section 7.0 of the CMP for a discussion of how this Plan specifically enhances aquatic resources in the watershed.

The suitability of the PRM sites in the upper Crooked Creek watershed to provide compensatory mitigation for the proposed Project was determined based on the following factors:

1. *Hydrologic conditions, soil characteristics, and other physical and chemical characteristics (33 CFR 332.3 (d)(i))*

Previous placer mining has drastically altered the physical, hydrologic, and soil characteristics of the Crooked Creek watershed. Placer mining activities have, over time, altered the location and character of multiple tributaries to Crooked Creek. Former natural stream channels have been relocated, ditched, and diverted, and associated riverine wetland and riparian corridors have been subsequently altered or removed. These PRM Plans will reshape the altered drainages to approximate historical natural conditions in existence prior to placer mining. The projects will be supported by the natural hydrologic conditions, physical characteristics, and soil characteristics of the surrounding areas. The projects have high likelihood of success because the depth of disturbance to the hydrologic system is shallow and limited and the designs are based on pristine reference reaches within the same stream systems within the Crooked Creek watershed.

2. *Watershed-scale features, such as aquatic habitat diversity, habitat connectivity, and other landscape scale functions (33 CFR 332.3(d)(ii))*

The Upper Crooked Creek PRM Plans were selected, in part, because of the opportunity they provide to restore aquatic functions to a large hydrologically connected area and are in very close proximity to the impacts that they are targeted to offset. The projects will re-establish and re-connect the floodplains of Crooked Creek, Donlin Creek, Quartz Gulch, Snow Gulch, Ruby Gulch, and Queen Gulch, as well as restore hydrologic and ecologic connectivity between undisturbed areas upgradient and downgradient of the sites. The sizes and locations of the sites relative to each other and the larger Crooked Creek watershed contribute to their likelihood of success and long-term sustainability.

3. *The size and location of the compensatory mitigation site relative to hydrologic sources and other ecological features [33 CFR 332.3(d)(iii)]*

The hydrologic sources of these sites are perennial streams and their associated drainage basins, relying on natural existing hydrology patterns. The projects do not require active engineering devices to provide the site hydrology, increasing the likelihood of success.

4. *Compatibility with adjacent land use uses and watershed management plans [33 CFR 332.3(d)(iv)]*

While there is no watershed management plan for the Plan area, the proposed sites are consistent with the Alaska Department of Natural Resources (ADNR) Kuskokwim Area Plan for State Lands (1988), a goal of which is to: “protect the hydrologic, habitat, and recreational values of important public wetlands.”

5. *Reasonably foreseeable effects the compensatory mitigation project will have on ecologically important aquatic or terrestrial resources, cultural sites, or habitat for federally- or state-listed threatened and endangered species (33 CFR 332.3(d)(v))*

The upper Crooked Creek watershed contains streams, wetlands, floodplains, and riparian resources that have been adversely impacted by historical placer mining. If these areas are not restored, they will continue to be sources of sediment and erosion, and a likely place for invasive plant species to establish. These PRM Plans will restore natural vegetation, increase aquatic habitat diversity and connectivity, establish floodplain habitat, provide habitat for ecologically important wildlife species (e.g., salmonids), and maintain water quality.

6. *Other relevant factors including, but not limited to, development trends, anticipated land use changes, habitat status and trends, the relative locations of the impact and mitigation sites in the stream network, local or regional goals for the restoration or protection of particular habitat types or functions (e.g., re-establishment of habitat corridors or habitat for species of concern), water quality goals, floodplain management goals, and the relative potential for chemical contamination of the aquatic resources [33 CFR 332.3(d)(vi)]*

The PRM Plans will re-establish floodplain habitat and reduce the current sedimentation impacts to downstream aquatic ecosystems. Connection of naturalized stream and floodplain habitats to natural conditions upgradient and downgradient of the projects will result in a higher functioning and more resilient watershed. These sites are within the Crooked Creek watershed, which is the same 10-digit HUC watershed as the primary long-term aquatic resource impacts from the Project.

Site Protection Instrument

Donlin Gold will supply a detailed site protection instrument through a deed restriction acceptable to the USACE in advance of restoration activities. Donlin Gold has the concurrence of the surface landowner (The Kuskokwim Corporation), the subsurface landowner (Calista Corporation), and the leaseholder (the Lyman Family) to establish a site protection instrument following restoration activities. The following activities will be strictly prohibited by the site protection instrument:

- Any excavation of soils, sediments, and other substrates with the exception of any that may be related to approved habitat enhancement projects (i.e., building additional wetland or fish habitat);
- Construction of durable structures, both permanent and temporary;
- Disturbance of soil, sediment, and other substrates by mechanical equipment and transportation vehicles, except on the existing access roads;
- Mining and mining-related activities;
- Vegetation removal, clearing, cutting, or other impacts, except for subsistence food uses; and

- Storage, abandonment, stockpiling, or disposal of any earthen materials, debris, refuse, supplies, durable materials, or other manmade objects.

The Plan area, which totals 221.5 acres, will be protected under the site protection instrument (Table 2). The site protection instrument will cover the areas directly impacted by the proposed re-establishment, establishment, and rehabilitation activities as well as buffer areas to help maintain the long-term viability of the proposed projects.

Table 2 Upper Crooked Creek PRM Plan Areas Protected Under the Site Protection Instrument (Acres)

Restoration Area	Acres
Quartz Gulch	45.2
Snow Gulch	36.7
Wash Plant Tailings Area	29.3
Ruby and Queen Gulches	110.3
Total	221.5

Baseline Information

Historical Placer Mining

Historical gold placer mining has occurred in the proposed restoration areas since the early twentieth century. Placer tailings and overburden have been deposited in several locations within the various floodplains, causing adverse impacts to aquatic resources (Photo 1). Water diversion ditches were constructed, resulting in the channeling of surface and shallow groundwater flow from the original stream paths. An estimated 8,700 linear feet (1.64 miles) of stream channels have been mined and the abutting wetlands degraded. No placer mining is currently ongoing in any of the drainages. Photo 2 and Photo 3 show placer disturbance in lower Snow, Ruby, and Queen Gulches.

Photo 1 Placer Mining Wash Plant Tailings Area (View toward Northwest)



Photo 2 Lower Snow Gulch Placer Disturbance (View toward North)



Photo 3 Lower Ruby and Lower Queen Gulches Placer Disturbance (View toward Southwest)



Hydrology

Hydrology at the proposed restoration sites is controlled by Crooked Creek, Donlin Creek, and the following tributaries: Quartz Gulch, Snow Gulch, Ruby Gulch, and Queen Gulch. Quartz and Snow Gulches flow into Donlin Creek. Donlin Creek, Ruby Gulch, and Queen Gulch flow into Crooked Creek. Quartz, Snow, Ruby, and Queen Gulches have been extensively degraded in their lower reaches from placer mining activity. Watershed characteristics of these streams are included in Table 3.

Table 3 Watershed Characteristics of Crooked Creek Watershed Streams

Drainage Basin	Crooked Creek Watershed (Percent)	Drainage Area (Square Miles)	Channel Length (Miles)	Slope (Percent)	Sinuosity	Dominant Rosgen Type	Dominant Substrate in Riffles	Average Wetted Width (Feet)
Quartz Gulch	0.35	1.2	4	3.2	1.03	G3g	gravel/cobble	8
Snow Gulch	1.01	3.4	2.6	1.9	1.04	G6	sand	4.4
Ruby Gulch	0.15	0.34	1	4.2	1.16	G3g	gravel/cobble	6
Queen Gulch	0.21	0.7	1.6	2.6	1.01	G3g	sand/gravel	6.6
Donlin Creek	9.09	30.5	16.7	0.4	1.82	B5c	gravel	19.9
Crooked Creek	100	335.5	33.4	0.2	1.62	C4	gravel/cobble	~60

Sources: OtterTail 2012, Rosgen and Silvey 2006, USGS 2017

Quartz Gulch is a small, high-gradient drainage with an area of 1.2 square miles. This drainage has been extensively placer mined in its lower end, and silt from this area continues to be transported into Donlin Creek during high storm events.

Snow Gulch is a small tributary of Donlin Creek. The Snow Gulch drainage area is 3.4 square miles with a main channel length of 2.6 miles and mean basin elevation of 1,015 feet. The lower end of the Snow Gulch drainage has been extensively placer mined and rerouted, but above the existing mined area the stream is essentially undisturbed (OtterTail 2012). The upgradient undisturbed portion of Snow Gulch Creek varies from a deeply incised channel with silt substrates to meandering sections with gravel substrates and beaver activity.

Ruby Gulch is the smallest drainage in the Plan area, draining 0.34 square miles. The downstream end has been extensively placer mined. All the flow from Ruby Gulch flows into a series of ponds, which also receive flows from Queen Gulch, formed from previous mining.

Queen Gulch drains an area of 0.7 square miles. The lower end of Queen Gulch has been severely disturbed by placer mining. Above the mined area, the Queen Gulch stream channel is small and the gradient is relatively steep (OtterTail 2012). The lower end of the stream flows over tailings, dropping approximately 8 feet onto the Crooked Creek floodplain. All the flow from the series of ponds fed by Ruby and Queen Gulches is directed into a ditch that flows parallel to Crooked Creek for 2,400 feet before its confluence with Crooked Creek.

Donlin Creek and its tributaries drain an area of 30.5 square miles. Donlin Creek joins Flat Creek to become Crooked Creek between Snow and Ruby Gulches. Donlin Creek has a moderate gradient and relatively high sinuosity, resulting in classic riffle-run-pool habitat types. Although heavy icing during winter results in some sections of the stream freezing solid, pool depth is generally sufficient to provide fish overwintering habitat, or at a minimum egg incubation for coho salmon. Gravel and cobble are the dominant substrates in riffles throughout much of the Donlin Creek mainstem.

The upstream end of Crooked Creek is at the confluence of Donlin and Flat Creeks. The Crooked Creek watershed covers 336 square miles and ranges in elevation from 135 feet to 3,610 feet, with a total basin relief of approximately 3,475 feet and a mean basin elevation of 856 feet. The main channel length is approximately 49 miles. The morphology of Crooked Creek between Anaconda Creek and the Donlin Creek-Flat Creek confluence is typical of a low gradient sinuous stream, characterized by riffle-pool channel types. Channel bed material in the steeper riffle sections is predominately coarse gravel and sand, and in the lower gradient pool sections is predominately sand and silt. The upper Crooked Creek tributaries that have been impacted by placer mining include Quartz, Snow, Lewis, Ruby, and Queen Gulches (OtterTail 2012).

Fisheries

Populations of Chinook, chum, and coho salmon as well as limited numbers of sockeye and pink salmon have been recorded in Crooked Creek. Additionally, Dolly Varden, Arctic grayling, slimy sculpin, burbot, and round whitefish are present in Crooked and Donlin Creeks. Surveys in Snow Gulch have documented the presence of Dolly Varden and occasionally adult coho salmon in the lower reaches attempting to migrate upstream. Surveys in Crooked Creek have documented presence of Chinook, coho, and chum salmon above Queen Gulch, and coho and chum salmon above Snow Gulch. In aerial surveys of the mainstems of Crooked and Donlin Creeks, over 90 percent of chum and Chinook salmon adults documented were present in the lower drainage downstream from Eagle Creek (approximately 6 miles downstream from Queen Gulch), while 67 percent of coho salmon adults documented were identified in upstream areas in the drainage, in Donlin Creek. Table 4 lists fish species present by drainage.

Table 4 Summary of Fish Presence 2004 – 2014

Drainage	Salmon Species					Resident Fish Species					
	Chinook	Chum	Coho	Sockeye	Pink	Dolly Varden	Rainbow Trout	Arctic Grayling	Burbot	Slimy Sculpin	Round Whitefish
Quartz Gulch	-	-	-	-	-	-	-	-	-	-	-
Snow Gulch	-	-	X	-	-	X	-	-	-	-	-
Ruby Gulch	-	-	-	-	-	-	-	-	-	-	-
Queen Gulch	-	-	-	-	-	-	-	-	-	-	-
Donlin Creek	-	X	X	-	-	X	-	X	X	X	X
Crooked Creek	X	X	X	X	X	X	X	X	X	X	X

Sources: ADF&G 2010; OtterTail 2012, 2014

“-“ Not Applicable.

Figure 2 shows the resident fish species present and the adult salmon densities in the Crooked Creek watershed, including in the upper Crooked Creek drainages. The section of Crooked Creek receiving input from placer mining-impacted tributaries has reduced salmon densities compared to upstream and downstream reaches. Fish surveys have also documented reduced fisheries use numbers at sampling locations downstream of Snow Gulch compared to upstream points.

OtterTail Environmental, Inc. (OtterTail) conducted habitat research and baseline fish and aquatic invertebrate sampling from 2004 through 2014 (OtterTail 2014). They found that Crooked Creek exhibited a similar composition but lower abundance of fish and invertebrate species compared to other similarly sized tributaries to the Kuskokwim River. They attributed this finding to the naturally high siltation rates and cobble embeddedness in Crooked Creek, which appeared to be higher on average than other similarly sized tributaries (OtterTail 2014). These results may be partial evidence that the long-term placer mining activity has influenced the fisheries habitat in the downstream reaches of Donlin and Crooked Creeks. Sedimentation and siltation may have degraded downstream fish habitat. Historical aerial photographs taken during active mining in the early 1950s clearly show high volumes of sediments entering the mainstem streams and suggest likely impacts to substrate gravels and siltation. Additionally, fish presence is limited in the lower reaches of the Plan area drainages due to obstacles created from previous placer mining. Alteration and degradation of floodplains have contributed to steep and unstable stream channels and narrowed hydraulic conveyances that are susceptible to beaver activity, resulting in loss of fish passage.

Soils

Crooked Creek is within the Western Interior Rivers Soil Survey Area based on Soil Survey Geographic Database mapping by the United States Department of Agriculture, Natural Resources Conservation Service (NRCS 2008). The restoration sites are underlain by two soil map units: 1) the Yukon-Kuskokwim Highlands, Boreal Floodplains, and Terraces (R30FPA); and 2) the Yukon-Kuskokwim Highlands, and Boreal and Subalpine Mountains (R30MTC). Unit R30FPA is located in the floodplain of Donlin and Crooked Creeks. Soil organic depths are typically 0 to 4 inches, composed of peat and other organic matter for boreal scrub, silty terraces. Unit R30MTC is located on the slopes east of Donlin and Crooked Creeks, including Quartz, Snow, Ruby, and Queen Gulches. Soil organic depths are typically 0 to 7 inches, composed of stratified peat to silt loam for boreal scrub, silty colluvial slopes. The dominant mineral soil texture is silt loam. Additional soils information is provided in the 2016 Preliminary Jurisdictional Determination (PJD) Report prepared for the restoration sites (Michael Baker 2016).

Vegetation Types

The disturbed areas within the Plan area are currently dominated by open willow shrub (OWS) and open alder willow shrub (OAWS) communities in wetland areas, and disturbance-related shrub and sapling re-growth (DSSR) in upland areas. OWS and OAWS communities contain limited to no tree cover and an open canopy of shrubs (25 to 74 percent cover) in which willow (*Salix* spp.) and/or alders (*Alnus* spp.) are dominant. DSSR communities contain young re-growth of tree species (e.g., birch [*Betula neolaskana*], spruce [*Picea* spp.], aspen and balsam poplar [*Populus* spp.]) and ericaceous shrubs on previously disturbed areas. The vegetation types present in the restoration sites were described in the 2016 PJD (Michael Baker 2016).

Wetlands

Wetland mapping and descriptions of wetland types present in the Plan area were provided in the 2016 PJD (Michael Baker 2016). Table 5 shows acreages of each resource type within the four restoration areas.

Table 5 Upper Crooked Creek PRM Plan Restoration Areas Current Resource Types, by Site (Acres)

Resource Type	Area (Acres)
Quartz Gulch Restoration Area	
Wetland	25.2
Disturbed Wetland	8.7
Disturbed Waterbody	0.4
Disturbed Upland	8.5
Upland	2.2
Quartz Gulch Restoration Area Total	45.2
Snow Gulch Restoration Area	
Wetland	17.8
Waterbody	0.9
Disturbed Wetland	1.7
Disturbed Waterbody	1.7
Disturbed Upland	14.6
Snow Gulch Restoration Area Total	36.7
Tailings Restoration Area	
Wetland	12.2
Disturbed Wetland	4.9
Disturbed Waterbody	0.7
Disturbed Upland	7.9
Upland	3.3
Wash Plant Tailings Area Total	29.3
Ruby/Queen Gulch Restoration Area	
Wetland	56.6
Waterbody	1.2
Disturbed Wetland	4.7
Disturbed Waterbody	4.7
Disturbed Upland	31.4
Upland	11.7
Ruby/Queen Gulch Restoration Area Total	110.3
Total Area	221.5

Note: Inconsistencies in sums are due to rounding.

Non-native Plant Species

Not all non-native species are considered invasive and a risk to natural ecosystems. To prioritize species management tasks, Alaska Natural Heritage Program staff, in cooperation with other agencies, developed a system to summarize the risk a non-native species poses to natural habitats in Alaska as a numerical score with a corresponding invasiveness ranking (Carlson et al. 2008). A score greater than 70 is considered “Highly Invasive,” indicative of a species likely to pose a serious threat to natural ecosystems in Alaska. Species with scores of 60 to 69 and 50 to 59 are considered “Moderately Invasive”

and “Modestly Invasive,” respectively, while those with scores between 40 and 49 are considered “Weakly Invasive,” and scores below 40 are considered “Very Weakly Invasive” (Carlson *et. al.* 2008, Nawrocki *et al.* 2011).

Surveys of the Project area in 2014 found eight non-native plant species present in the vicinity of the Lyman yard and airstrip in Snow Gulch (Moody 2015, Table 6). No Highly Invasive species were found. A survey of non-native plant species presence and extent will be conducted within all of the Plan area prior to initiation of mitigation activities.

Table 6 Non-native Plant Species in Snow Gulch

Species	Invasiveness Score	Invasiveness Ranking
<i>Matricaria discoidea</i> (pineapple-weed)	32	Very Weakly Invasive
<i>Stellaria media</i> (common chickweed)	42	Weakly Invasive
<i>Plantago major</i> (common plantain)	44	Weakly Invasive
<i>Poa pratensis ssp. pratensis</i> (Kentucky bluegrass)	52	Modestly Invasive
<i>Trifolium hybridum</i> (alsike clover)	57	Modestly Invasive
<i>Taraxacum officinale</i> (common dandelion)	58	Modestly Invasive
<i>Leucanthemum vulgare</i> (oxeye daisy)	61	Moderately Invasive
<i>Hordeum jubatum</i> (foxtail barley)	63	Moderately Invasive

Sources: Moody 2015, Carlson *et. al.* 2008, Nawrocki *et al.* 2011

Determination of Credits

For this Plan, watershed restoration mitigation credits are measured in acres of wetland floodplain habitat and off-channel stream habitat restored and enhanced, while mitigation credits for stream restoration are measured in linear feet of stream channel restored. The Plan will produce 95.7 wetland acre credits and 8,982 linear feet of stream credits. The reshaping of the watersheds and stream channels will allow for proper hydrologic functioning and re-establishment of natural wetland floodplain habitat. Placer mining ponds will be deepened to create overwintering habitat and littoral zones will be added. Littoral zones are productive areas of aquatic ecosystems, allowing for nutrient retention and cycling of elements, shoreline and sediment stabilization, aquatic vegetation growth, refuge for juvenile fish, and organic material inputs (Peters and Lodge 2009). Table 7 shows the acreage and linear feet of re-established and enhanced aquatic resources and associated habitats. Table 1 contains the expected mitigation credits by NWI classification associated with this Plan.

Buffers around the reestablished and enhanced habitats will also be protected under the site protection instrument to maintain the long-term viability of the aquatic resource. These buffers will provide protection of the restored aquatic habitats from future disturbance, including sedimentation, and will maintain permanent connections to Crooked Creek. Buffer areas function to maintain water quality, limit sediment loads, maintain thermal processes, maintain microclimatic conditions, filter particulates and metals from remaining placer stockpiles, filter nutrients, provide organic matter inputs, maintain habitat for wildlife, and serve as corridors for wildlife movement. Buffer areas process pollutants and

prevent the areas from serving as a source of pollution by slowing surface flow and allowing for infiltration before water reaches downslope wetlands and streams.

Table 7 Acreage and Linear Feet of Resources Re-established, Enhanced, and Protected by the Upper Crooked Creek PRM

	Quartz Gulch	Snow Gulch	Wash Plant Tailings Area	Ruby and Queen Gulches	Total
Re-establishment of Stream Channels to Pre-mining Conditions (Linear Feet)	1,630	4,421	-	2,931	8,982
Re-establishment of Wetland Floodplain Habitat (Acres)	13.1	21.9	11.4	49.3	95.7
Enhancement of Off-channel Pond Habitat (Acres)*	-	2.7*	0.5*	12.0*	15.2*
Enhancement of Terrestrial Habitat (Acres)	2.5	3.4	2.4	8.5	16.8
Protection of Buffer Areas (Acres)	29.5	11.4	15.6	52.5	109.0
Total Protected under Site Protection Instrument (Acres)	45.2	36.7	29.3	110.3	221.5

*Acreage of enhanced off-channel pond habitat is included within the re-established wetland floodplain habitat.

"-" Not Applicable.

Note: Inconsistencies in sums are due to rounding.

These acreages are further broken down, for application of mitigation credits, into aquatic resource types and HGM categories in Table 8.

Table 8 Upper Crooked Creek HGM Summary

Aquatic Resource Type	HGM	Acres
Wetland	Depressional	1.6
	Flat	32.7
	Riverine (non-anadromous)	93.0
	Riverine (anadromous)	18.0
	Slope	11.6
Stream	Riverine Channel	3.6
Upland	N/A	61.0
Total		221.5

The 100-foot buffer size for this Plan was selected using guidance from the ADNR Kuskokwim Area Plan for State Lands (1988). ADNR’s plan states that a 100-foot buffer on wetlands with an outlet will minimize adverse impacts on the important functions of wetlands. ADNR’s information represents the best available information in this region of Alaska for protecting and maintaining the ecological functions associated with aquatic resources. Upstream of restoration areas, buffers are 100 feet, while downstream of restoration areas they are expanded to include all surface and subsurface hydrologic connections to Crooked and Donlin Creeks. The size of the buffers are reduced at Snow Gulch site due to land ownership restrictions associated with the homestead at the Lyman property. Overall, approximately 109 acres of upland and wetland buffer area (in addition to the re-established and enhanced areas) will be protected under the site protection instrument (Figure 1).

Mitigation Work Plan

Site-specific preliminary work plans have been prepared for each of the four restoration areas. These work plans are provided in the following sections. Restoration design parameters will be finalized based on detailed field surveys of the sites, which will serve as a final refinement of the restoration plans that will include timing, grading plans, overburden removal, revegetation design plans, erosion control, and dewatering, as well as stream plan/profile form and function and stream diversion plans for stream work. This design effort will address and finalize the functional hydrologic and geomorphic parameters, and serve as a basis for restoration construction management, inspection, and quality control. Final design documents shall be subject to USACE approval.

At this time, there are limited reference reach studies for the restoration sites. Much of the data collected on reference reaches are, by default, the areas upstream and downstream of the disturbed portions of these gulches. The actual mined areas proposed for mitigation are associated with the transition zones where the steep side gulches flatten out as they meet the Donlin Creek and Crooked Creek floodplains. These are where the gold placers were deposited over time and where subsequent mining caused the most disturbances. The following preliminary hydraulic and habitat functional designs for each area are proposed. These designs are based on existing information as follows:

1. High resolution aerial photography of the area, and ground surveyed topography augmented with Light Detection and Ranging (LiDAR) digital elevation mapping.
2. Stream surveys, cross sections, profiles, vegetation typing, and other field data collected by Three Parameters Plus, Inc., (3PPI) in 2013–2014 (Donlin Gold 2014).
3. Hydrologic analyses of stream flows, both of existing conditions and with potential impacts from the Project, performed by BGC Engineering. These analyses utilized surface and groundwater modeling to assess existing flows as well as USGS regression analysis of projected flood flows. The values used in these restoration designs are based on 2-year and 100-year flood flows without the potential drawdown in groundwater associated with mine development or potential attenuation effects of the planned water reservoir in the upper reaches of Snow Gulch.
4. Extensive fisheries work performed by OtterTail Environmental, Inc. from 2004 through 2014 (OtterTail 2004), and Owl Ridge Resource Consultants in 2016–2017. This work catalogued the current usage of streams in the upper Crooked Creek watershed by anadromous and resident fish populations and made site-specific recommendations for habitat restoration in the upper Crooked Creek placer mining areas. Recommendations included the reclamation habitats best suited to each drainage considering fish species most likely to benefit from the restoration.

Prior to final submittal of design documents, a more detailed stream and topographic survey of these and adjacent unmined gulches will be conducted to establish baseline reference reach parameters to guide the designs. Determination of a full suite of geomorphic measurement parameters will be made and incorporated into both the design and performance standards. These parameters will ensure the appropriateness of the design and measure the performance of the completed restoration over time.

Although reference reach information will help guide the design process, some of the proposed restoration work involves creation of significant ponded features that are not natural features of this watershed. As such, these features will rely more heavily on the experience of fisheries, wetland, and stream reconstruction specialists. Enhancement of fisheries habitat is the design goal of these non-stream enhancements.

Restoration Timing

Construction of the four restoration projects is planned to occur over four consecutive years, with the potential for some to occur simultaneously. Work at each restoration area will require one construction season. A general schedule for a restoration area is shown in Table 9.

The restoration areas will be revegetated promptly after completion of earth-disturbing activities to reduce the potential for erosion, sedimentation, and invasive species colonization. Revegetation will be conducted no later than the beginning of the first growing season after construction is completed. Revegetation activities will be performed in accordance with the final revegetation design plan, which will identify targeted vegetation communities for each revegetation area. The final revegetation design plan will be part of the final design package and will be provided to USACE prior to implementation.

Revegetation will be conducted using guidance from the Interior Alaska Revegetation and Erosion Control Guide (Czapla and Wright 2012) and the Streambank Revegetation and Protection Guide (ADF&G 2005). Methods and techniques will be determined by site conditions, including soils, hydrography, slope, and aspect, but may include seeding grasses, planting willow cuttings or other shrubs, spreading charged overburden, and allowing natural re-colonization. Mulches, topsoil, and fertilizer will be placed as conditions warrant. Certified weed-free seed mixes will be used.

Table 9 Typical Construction Schedule for a Restoration Area

Season	Activity
Year 1	
Summer	Conduct stream channel work during this low-flow period. Reshaping of floodplains, regrading of tailings areas, filling of ditches, and pond construction activities may also occur in late summer.
Fall and Winter	Conduct continued reshaping of floodplains, regrading of tailings areas, filling of ditches, and pond construction activities, which may occur in wet or flooded areas.
Year 2	
Spring	Conduct post-construction survey after break-up; plant willow cuttings to stabilize stream banks.
Early Summer	Perform revegetation activities.
Winter	Submit design criteria monitoring report.
Years 3-6	
Summer	Conduct monitoring activities; perform any required management activities to ensure performance standards are met.
Winter	Submit monitoring report.
Year 7	
Summer	Conduct monitoring activities.
Winter	Submit final monitoring report and monitoring closeout report (for entire Plan area assuming performance standards are met).

Quartz Gulch

Quartz Gulch Existing Conditions

Historical placer mining in Quartz Gulch has left a heavily impacted, but partially revegetated, stream valley (Appendix D-1, Figure 2). The gulch bottom was stripped of vegetation and mined, and spoils piles were pushed to the sides of the valley floor. Some of these disturbed areas have had significant time to

revegetate. Much of the lower portion of the gulch has been re-contoured, leaving a series of ditches, spoils piles, and an impacted stream channel. At the upper end of the previously mined area, the gulch and stream channel have been cut with a cross ditch that collects groundwater and surface waters and re-directs flow along the west side of the gulch for approximately 1,100 linear feet. In the existing condition, this lateral ditch leaks water downslope, and fish passage can be blocked during low flow periods. In its present location, the stream is above the water table and loses flow to groundwater, a significant loss during low flow conditions.

Although the main course of the stream follows the mining ditch along the west side of the gulch, a secondary stream has re-established in the bottom of the valley, fed by surface water from the east side of the watershed as well as groundwater seepage from the perched mining ditch on the west side of the gulch. Historical aerial photographs show the original stream followed the path of the secondary stream fairly closely in the upper portion of the gulch. Lower in the gulch, the ditch discharges back to the valley floor and follows the original valley bottom in a less confined channel, through what appears to be an adequate and substantially revegetated floodplain. Where the stream enters the Donlin Creek floodplain, it has created a small back water stream along the mainstem. The stream eventually enters a second, long diversion ditch that bypasses a section of the Donlin Creek floodplain, including an abandoned oxbow, and discharges to Donlin Creek approximately 900 feet downstream. This ditch lowers the water table in the bypassed portion of the Donlin Creek floodplain and creates a potential bypass risk for the mainstem of Donlin Creek. A mainstem bypass of this type would result in substantial loss of natural aquatic habitat.

Existing conditions in Quartz Gulch are depicted in Appendix D-1, Figure 2.

Quartz Gulch Restoration

The proposed restoration activities include filling the diversion ditch features in Quartz Gulch and the Donlin Creek floodplain, directing the flows in the upper portion of Quartz Gulch to the secondary stream channel along the original stream path, and allowing the backwatered flows to return to Donlin Creek via the abandoned oxbow in the lower end of the system. Elimination of the mining ditch in the upper portion of the gulch will re-establish the historical channel along the valley floor. This movement of the main channel should return the stream to a more stable hydrologic regime and remove the hydraulically losing reach from the system. The removal of both ditch sections will result in expanded floodplain overbank flow function for the re-established stream sections in Quartz Gulch and Donlin Creek.

A preliminary estimate of the stream restoration parameters for Quartz Gulch is included in Table 10. As the engineering design progresses, further refinements will be made based on reference reach parameters where available, or Rosgen and regional functional parameters for drainages with similar watershed characteristics.

Table 10 Preliminary Design Parameters for Quartz Gulch

Parameter	Preliminary Design Value
Basin Area	1.18 square miles
Stream Type (Rosgen)	G3
Q2	22.8 cubic feet/second, 3.9 feet/second
Q100	125 cubic feet/second, 3.6 feet/second
Valley Slope (average)	Less than 5%
Channel Slopes	Upper Reach 4.7% Mid Reach Step 16% Lower Reach 2.8%
Bank Full Width	7–12 feet
Ordinary High Water Width	3–8 feet
Floodplain Width	35–70 feet (narrower in steeper sections)
Bank Height Ratio (BHR)	Less than 1.2
Entrenchment Ratio (ER)	Greater than 3
Width:Depth Ratio	Stable
Profile Form	Riffle-Pool or Riffle-Run-Pool Step Pools (step section)
Sinuosity	1.35; straighter in steeper sections
Belt Width	20-25 feet
Channel Depth	1.0 foot in riffles 1.8 feet in pools
Riffle Spacing	+/- 20 feet
Grade Control	Large wood debris, roots of bank vegetation, larger rock substrate

Subject to final design refinement, the following work plan sequence is proposed for Quartz Gulch. Appendix D-1, Figure 3 illustrates the components of this work plan. Appendix D-1, Figure 4 illustrates the proposed outcome of the restoration. The work plan includes:

1. Backfill diversion ditch in the Donlin Creek floodplain, utilizing the side cast spoils pile left from the original excavation. Return the ground contours to elevations consistent with the surrounding floodplain and revegetate this area with native species per the revegetation design plan. This work will increase surface and groundwater elevations in the surrounding floodplain, divert Quartz Gulch flows back to Donlin Creek via the abandoned oxbow upstream of the ditch, restore natural hydrology allowing for natural re-establishment of wetlands, and provide a settlement area for runoff from any subsequent restoration work further upstream in Quartz Gulch.
2. Survey the historical stream channel area in the upper gulch to determine if this channel contains the necessary hydraulic form and habitat functional components for re-watering. This channel will be assessed based on the finalized design parameters. Any augmentation of this existing channel will be carried out prior to re-watering. It is anticipated that work in this area will be minimally

invasive to preserve the revegetated portions of the mined areas as much as possible. Appendix D-2, Sheets 1 and 2 show the preliminary cross section and profile of the restored stream channel.

3. Refill the cross gulch and lateral slope ditch with existing onsite spoils, and return the full flow to the gulch floor channel. Filling the ditch will return pre-mining ground and surface flows to a sustainable and more habitat-diverse channel in the valley floor. This is also expected to increase flows in the rerouted section across a wide range of hydraulic conditions, especially during low and winter flow conditions.

Table 11 is a summary of the Quartz Gulch Restoration Area restoration activities.

Table 11 Summary of Re-established, Enhanced, and Protected Areas within the Quartz Gulch Restoration Area

Restoration Activity	Habitat Type	Linear Feet	Acres
Re-establish	Stream channels	1,630	-
Re-establish	Floodplain habitat	-	9.7
Re-establish	Floodplain habitat (includes revegetation)	-	3.4
Enhance	Terrestrial habitat (includes revegetation)	-	2.5
Protect	Buffer	-	29.5
Total		1,630	45.2*

*Entire area will be covered under the site protection instrument.

“-“ Not Applicable.

The results of these proposed hydraulic and geomorphic functional restorations on the fisheries resources are as follows:

- An increase in rearing habitats for resident fish and coho salmon juveniles in the lower reaches of Quartz Gulch, and the adjacent Donlin Creek floodplain and oxbow.
- Improved low water and slightly improved winter flows within Quartz Gulch, improving summer rearing opportunities and year-round resident fish habitat.
- Better temperature regimes for resident and rearing fisheries populations resulting from the replacement of ditched flows with more natural and better shaded valley floor stream channels.
- Long-term reduction in substrate embeddedness and potential spawning habitat improvements in Crooked Creek through improved water quality and reductions of suspended solids in Quartz Gulch and downstream reaches of Donlin Creek, especially at higher flows.

Snow Gulch

Snow Gulch Existing Conditions

Lower Snow Gulch has been impacted by disturbance that began in 1910 and continued through 2016. Mining has resulted in several changes that have impacted the aquatic resources, both in Snow Gulch and the adjacent Donlin Creek floodplain. In addition to the release of large quantities of suspended sediments into the watershed, as evidenced by historical imagery, placer mining activities have left three areas of excavated ponds (upper, middle, and lower) connected by the stream, which has been diverted and channelized in several areas. The remnant stream, ponds, and valley bottom exhibit steep

unstable side slopes, filled wetland areas, unsustainable stream channel gradients, little or no floodplains, disconnected groundwater and surface waters, and denuded erosional features that occasionally contribute sediment during high flow events.

The primary obstacle to overcome at this site is that the excavated ponds have created flat sections in the post-placer mining valley stream profile, resulting in an unnaturally steep gradient for the remaining portions of the stream profile. The pre-mining valley slope is approximately 2 percent from above the upper pond to the outfall into the lowest excavation pond. Portions of the existing channelized stream slope approach 10 percent. A second challenge is the lack of any significant overbank floodplain along the current excavated stream channel. The resultant steepened and confined channel exhibits high velocity scour from flood flows, which results in unstable banks and suspended sediment, especially during high flow events.

Existing conditions in Snow Gulch are depicted in Appendix D-1, Figure 5.

Snow Gulch Restoration

Restoration of Snow Gulch will involve restoration of a sustainable stream channel as well as restoration and revegetation of the floodplain in the lower gulch, modification of the excavated ponds to create shallow and deep water (greater than 6 feet) aquatic habitats, and re-connection of groundwater and surface waters to the Donlin Creek floodplain.

To restore this stream system, a new channel will be constructed between the lower and middle ponds from the substrate materials that originally formed the historical channel. The new channel will exhibit scour and sediment transport properties consistent with the original sediments, geometry, gradients, and resultant flood flow velocities. The new channel will be designed to mimic the parameters of the pre-mining system based on calculations from undisturbed sections of Snow Gulch and from analysis of flood flow hydraulics. Portions of the regionally rare and productive habitat provided by the middle ponds will be retained.

In Snow Gulch, the upper and middle excavated ponds will be enhanced to create additional fish and quiescent water habitat. A portion of the northern end of the middle pond will be filled to gain additional length for the proposed re-constructed channel. Additional length is needed for the created channel to approach the gradient parameter of the original system in the sections that are now flat open water ponds. A sinuous channel routing will be chosen to minimize cut and fill requirements, following a detailed survey of the area prior to construction. Stream channel substrate will be locally available fill materials with sufficient fines (greater than 20 percent) to sustain surface flows, and may be augmented with larger rock and woody debris features as needed to provide aquatic invertebrate substrate, hydraulic cover, low flow channelization for fish, and grade control to maintain channel stability.

A fish passage conveyance may be required on at least one access route linking the Lyman airstrip, which runs along the east side of Snow Gulch, with the facilities on the southwest side of the middle pond. If the structure is located in the backwater between the middle ponds, a simple, large diameter, round culvert will be sufficient. If this structure is located along the stream channel, the final design will contain provisions for a stream simulation designed conveyance with width equal to 120 percent of the stream bank full width.

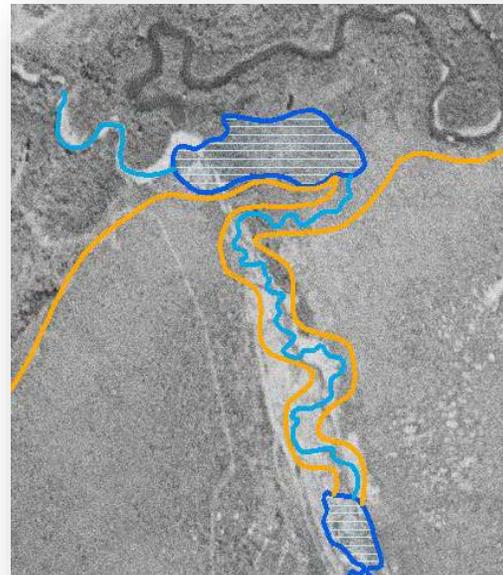
The historical connection from Snow Gulch to Donlin Creek is currently blocked by a berm on the west side of the lower pond. The historical channel feature, while difficult to see from current aerials, shows up prominently in black and white aerial photographs from 1953 (Figure 3). To re-establish the connection with the Donlin Creek floodplain, the berm surrounding the west and north ends of the lowest pond will be removed and the current connection from the pond to Donlin Creek will be filled. Removal of the berm will funnel stream flow back into the historical channel west of the pond, and re-water off-channel habitat. The lower pond will be excavated and provide additional settlement area to improve downstream water quality.

Figure 3 Comparison of Recent and Historical Aerial Imagery for Snow Gulch Outlet to Donlin Creek

2016 Aerial Photography



1953 Aerial Photography
(USGS EarthExplorer)



Note: Post-construction stream channel and ponds shown on both images.

A portion of the historical connection between the lower pond and Donlin Creek will have to be re-excavated to remove placer tailings, but the remaining oxbow channel will be re-watered in its present condition. Reintroduced stream flows are expected to reform a small thalweg within the oversized and vegetated channel. These historical channels are typically incised less than 1.5 to 3 feet into the surrounding floodplain, which makes it difficult for beavers to completely block fish passage. Inclusion of historical channels in the completed channel design should protect the system from blockage by beavers, a problem that currently exists in the narrow, deeply incised ditch exiting the middle and lower ponds. The pond margins themselves will be returned to an elevation approximately equal to the surrounding floodplain, making blockage of fish passage by beaver dams difficult. It is assumed that the original floodplain vegetated mat will be encountered as the placer mining tailings are removed, which will both serve as a vertical indicator for excavation and provide substrate for the revegetation efforts.

A short section of the existing berm will be retained on the east side of the lower pond to prevent Donlin Creek from meandering through the pond at flood flows. Once established as a semi-natural feature, the pond will be allowed to return to the natural morphology of the surrounding floodplain and will not be artificially maintained.

A preliminary estimate of the stream restoration parameters for Snow Gulch is included in Table 12. As the engineering design progresses, further refinements will be made based on reference reach parameters where available, or Rosgen and regional functional parameters for drainages with similar watershed characteristics.

Table 12 Historical and Preliminary Design Parameters for Snow Gulch

Parameter	Historical (Pre-Mining) Value	Preliminary Design Value
Basin Area (Square Miles)	3.41	3.41
Stream Type (Rosgen)	G3	G3
100-year Flood Flow Q100 (Cubic Feet/Second)	271	271
100-year Flood Velocity (Feet/Second), Floodplain	N/A	4.0
2-year Flood Flows Q2 (Cubic Feet/Second)	55	55
2-year Flood Velocity (Feet/Second), Bank Full	N/A	4.0
Valley Slope (Percent)	Upstream of upper pond: 3.8* Lower gulch: 1.7**	1.7%
Channel Slope	Less than 2%	Less than 2%
Bank Full Width (Feet)	Upper gulch: 7 feet* Below middle pond: 20 feet	16 feet
Ordinary High Water Width (Feet)	Upper gulch: 5 feet* Existing ditch below middle pond: 8 feet	12 feet with low flow channel
Floodplain Width (Feet)	100 feet**	86-foot minimum
Bank Height Ratio		Less than 1.2
Entrenchment Ratio		Greater than 3
Width:Depth Ratio	Stable	Stable
Stream Substrate Sizing for 2-year In-channel and 100-year Floodplain Stability	N/A	D100 = 6 inches D85 = 4 inches D50 = 2 inches D30 = ½ inch D15 = #10 sand
Profile Form	N/A	Riffle-Run-Pool
Sinuosity	1.19* 1.33**	1.33
Belt Width	50	50
Channel Depth	N/A	1.0 foot in riffles 1.8 feet in pools
Riffle Spacing	N/A	+/- 20 feet
Grade Control	N/A	Large wood debris, roots of bank vegetation, larger rock substrate

*Historical values determined by 3PPI (Donlin Gold, LLC 2014).

**Historical values determined using LiDAR

N/A - Not Available.

Subject to final design refinement, the following work plan sequence is proposed for Snow Gulch. Appendix D-1, Figure 6 illustrates the components of this work plan. Appendix D-1, Figure 7 illustrates the proposed outcome of restoration. The work plan includes:

1. Remove overburden piles from Donlin Creek floodplain, reshape lower pond, and move pond outfall to historical channel west of the lower pond. The abandoned oxbow will be reutilized as the connection to Donlin Creek, mimicking the original hydraulic configuration of the floodplain prior to mining. It is anticipated that no disturbance will be required in the area of the old oxbow and that the historical floodplain vegetated mat will be uncovered by the removal of overburden. Excess overburden materials and side cast will be stockpiled or used to shape the new gulch stream channel, as required. All disturbed areas will be revegetated with native upland and wetland species.
2. The northern third of the middle ponds will be filled to create added stream channel length needed to overcome gradient constraints. A new stream channel at the proposed gradient and geometry will be constructed to join the middle ponds with the lower pond. Construction will be to the parameters of the final design. Materials will be selected from available overburden piles, with larger rock components imported from the wash plant tailings area or from Donlin Gold mining activities. Stream diversion and dewatering/re-watering of the existing and proposed channel will be per the stream diversion/dewatering plan prepared with the final design. Reshaping work within the ponds will be facilitated by cordoning off active work areas from stream flow with silt fence separators. Appendix D-2, Sheets 9 through 12 show the preliminary plan, profile and design details of the stream channel. Appendix D-1, Figure 7 shows the location of a selected cross-section. Appendix D-2, Sheet 11 shows a profile of the proposed stream alignment.
3. The outlet of the upper pond will be reinforced with larger rock to maintain the grade of this feature in perpetuity. This material will be a mixture of coarser rock components having a D50 of 6 inches, combined with finer materials to create an armored stream substrate. Areas of the middle and upper ponds will be reshaped and/or excavated to create open water diversity, with shallow and deeper water aquatic habitats. Disturbed areas will be revegetated.

Table 13 is a summary of the Snow Gulch Restoration Area restoration activities.

Table 13 Summary of Re-established, Enhanced, and Protected Areas within the Snow Gulch Restoration Area

Restoration Activity	Habitat Type	Linear Feet	Acres
Re-establish	Stream channels	4,421	-
Re-establish	Floodplain habitat	-	18.5
Re-establish	Floodplain habitat (includes revegetation)	-	3.4
Enhance	Off-channel pond habitat*	-	2.7*
Enhance	Terrestrial habitat (includes revegetation)	-	3.4
Protect	Buffer	-	11.4
Total			36.7**

* Enhanced off-channel pond habitat is within the re-established floodplain habitat.

**Entire area will be covered under the site protection instrument. An additional 617 linear feet of stream channel, 6 acres of floodplain habitat, and 2.7 acres of off-channel pond habitat will be restored, but will not be covered under the site protection instrument because long-term protection cannot be fully ensured within the Lyman homestead area.

“-“ Not Applicable.

The results of these proposed hydraulic and geomorphic functional restorations on the fisheries resources are as follows:

- Significant increase in productive pond habitats in the lower reaches of Snow Gulch, and in accessible habitat throughout Donlin Creek.
- Removal of opportunities for beaver dam blockages in channelized sections of streams, and at the narrow outfall from the lower pond to Donlin Creek.
- Increased fish passage to habitats upstream of the restoration area.
- Lowered gradient access to the middle ponds for enhanced rearing, and possibly coho spawning, habitat along this reach.
- An increase in off-channel rearing habitats for resident fish and coho salmon juveniles in the lower reaches of Snow Gulch and the adjacent Donlin Creek floodplain and oxbow.
- Raised water levels in the lower pond for improved deep water and potential overwintering habitats.
- Provision of littoral habitats in the lower pond and attendant increases in aquatic vegetation, aquatic invertebrates, water quality, and habitat diversity.
- Reduced side slopes and improved vegetative cover for improved water quality to provide additional shading and cover for fish along stream and pond margins.
- Better temperature regimes for resident and anadromous fish species resulting from the replacement of ditched flows with more natural and better shaded stream channels.
- Long-term reduction in substrate embeddedness and potential spawning habitat improvements in Crooked Creek through improved water quality via reductions of suspended solids in Snow Gulch and downstream reaches of Donlin Creek, especially at higher flows.

Wash Plant Tailings Area

Wash Plant Tailings Area Existing Conditions

Placer gravels were historically processed at a wash plant in an area between Snow and Ruby Gulches. The outlet of the wash plant was allowed to discharge to the Crooked Creek floodplain just downstream of the confluence of Donlin and Flat Creeks, with separate stockpile areas for coarse- and fine-grained materials. Coarse-grained tailings were stockpiled mostly in uplands immediately adjacent to the Crooked Creek floodplain, while fine-grained tailings were discharged into wetlands adjacent to and within the Crooked Creek floodplain, forming an alluvial fan-type deposit. In historical wetland areas at the lowest elevations of the fan, hydrophytic vegetation has re-established in the fine-grained materials. An artificial berm designed to dike off the settlement area from the mainstem of Crooked Creek remains in place and raises backwater levels in this area.

Off-channel habitats appear to have been minimally impacted by the wash plant effluent. Historical aerials show little connected open water areas.

Existing conditions at the Wash Plant Tailings Area are depicted in Appendix D-1, Figure 8.

Wash Plant Tailings Area Restoration

The Crooked Creek floodplain under the effluent discharge fan will be reshaped and re-contoured into a condition to restore wetlands back to the area. Materials will be removed down to the underlying organic layers that mark the original vertical extent of the floodplain. The berm along the settlement area will be left to maintain water levels in the restored areas. The coarse-grained tailings pile and other areas will be regraded and re-contoured for stability (minimum 2:1 slopes), and augmented with finer materials to promote vegetation growth. Disturbed areas will be revegetated.

Subject to final design refinement, the following work plan sequence is proposed for the Wash Plant Tailings Area. Appendix D-1, Figure 9 illustrates the components of this work plan. Appendix D-1, Figure 10 illustrates the proposed outcome of restoration. The work plan includes:

1. The coarse-grained tailings pile will be re-contoured and topped with fine-grained materials to promote slope stability and vegetation establishment. The coarse-grained tailings pile can be re-contoured at any time as it is mostly an uplands feature. It may be most expedient to do this work prior to the removal of fine-grained material as this material will be needed to cover the coarse-grained material and provide a growth medium for revegetation.
2. Fine-grained material covering wetlands in the Crooked Creek floodplain will be excavated in winter, and the area will be revegetated with herbaceous hydrophytes. Removed material will be utilized at the coarse-grained tailings pile and at other places in the restoration to facilitate development of hydric soils and growth of hydrophytic vegetation.

Table 14 is a summary of the Wash Plant Tailings Area restoration activities.

Table 14 Summary of Re-established, Enhanced, and Protected Areas within the Wash Plant Tailings Area Restoration Area

Restoration Activity	Habitat Type	Acres
Re-establish	Floodplain habitat (includes revegetation)	10.8
Enhance	Off-channel pond habitat*	0.5*
Enhance	Terrestrial habitat (includes revegetation)	2.4
Protect	Buffer	15.6
Total		29.3**

* Enhanced off-channel pond habitat is within the re-established floodplain habitat.

** Entire area will be covered under the site protection instrument.

The results of these proposed hydraulic and geomorphic functional restorations on the fisheries resources are as follows:

- Fisheries improvements from these restorations are related to reductions in suspended solids entering the mainstem of Crooked Creek. This will positively impact spawning area and smolt production.
- Some pond habitats will be produced and/or maintained in the re-established floodplain.

Ruby and Queen Gulches

Ruby and Queen Gulches Existing Conditions

The most downstream disturbance in the Plan area is at Ruby and Queen Gulches, where significant areas of excavation, overburden deposition, and dewatering ditches have altered the landscape and impacted hydraulic function.

The lower 800 feet of Ruby and Queen Gulches have been mined extensively. Ruby Gulch has been mined more recently. There is a 3-foot head cut at the upper end of Ruby Gulch where the original stream channel spills out of a forested area into the placer mining scar. Removal of the floodplain, riparian habitat, and stream channel have left a wide, poorly contained channel running on a mostly bedrock substrate. Areas of steeper slopes and unconsolidated and unvegetated substrate result in ongoing erosion and siltation of the downstream during high flow events.

In Queen Gulch, the majority of the stream flow is routed from the historical channel into a mining ditch along the south side of the gulch for approximately 500 feet. Lower in the gulch the stream flows through two excavated ponds and under a mining access road before flowing into a long diversion ditch in the Crooked Creek floodplain. Considerable time has elapsed since Queen Gulch was mined and areas of the lower gulch have revegetated.

Once in the Crooked Creek floodplain, Ruby and Queen Gulch empty into a series of large excavated ponds and ditches. Ruby Gulch provides water at the north end of this system where it flows into the northern-most pond. A small unnamed drainage enters the system between Ruby and Queen Gulches, and at the south end of the system Queen Gulch enters from the east just below the “square pond.” Groundwater from the adjacent hill slope also feeds into the system throughout its length.

This system is below the elevation of the floodplain of Crooked Creek, lowering the water table, degrading aquatic habitat and restricting fish access. Steep sided back and subsurface pond slopes are unstable, contributing to sediment and erosion, especially during high flow conditions. Overburden stockpiles in the Crooked Creek floodplain block surface and groundwater flows into Crooked Creek and impact adjacent wetland areas. Narrow hydraulic conveyances between ponded areas contribute to fish passage blockage by beaver activities. South of the square pond, the system flows into a long ditch that parallels Crooked Creek for 2,400 feet. This ditch both lowers the elevations of the water in the ponds below the Crooked Creek floodplain and intercepts groundwater from the hillsides east of the creek. Steep sides along the ditch contribute to erosion and degraded water quality. The ditch lowers the water table and separates upslope groundwater and surface water flows from the Crooked Creek floodplain. Side cast overburden along the ditch degrades adjacent wetlands.

Existing conditions in Ruby and Queen Gulches are depicted in Appendix D-1, Figure 11.

Ruby and Queen Gulches Restoration

Restoration activities for Ruby and Queen Gulches will include restoring portions of the Ruby Gulch stream channel, removing overburden stockpiles in the Crooked Creek floodplain, filling the drainage ditch in upper Queen Gulch to reroute the stream to the valley floor, reshaping the ponds to provide increased shallow water and deep water habitats, removing constricted areas where beaver activity can easily block fish passage, restoring a floodplain elevation outlet from the ponded area through abandoned oxbows into Crooked Creek, and filling in the long drainage ditch currently connecting the ponded area to Crooked Creek. Disturbed areas will be re-contoured into shallow slopes running down to the ponds, allowing re-establishment of the floodplain and diverse aquatic habitats. Disturbed areas will be revegetated.

Restoration of Ruby Gulch will be similar to that of Snow Gulch except on a smaller scale. Re-establishing the historical floodplain gradient will involve refilling the area with appropriate substrate, shaping an appropriately sized channel, adding habitat features and grade control, and revegetating disturbed areas. Fish passage structures may be required where Ruby and Queen Gulches are crossed by the existing mining access road.

Reconnection of Ruby and Queen Gulches to the Crooked Creek floodplain is more complex than at Snow Gulch. The pond system fed by the gulches is separated from the Crooked Creek floodplain by a steep-sided berm constructed from the overburden materials removed from placer mining operations. North of the dogleg at the north end of the berm is a large deposit of overburden tailings that will be left substantially intact to prevent the main Crooked Creek channel from shortcutting through the ponds. At the dogleg, additional water is added to the system from a shallow, surface water basin and the tailings deposit is reduced to a simple berm separating the ponds from the floodplain. This berm would be substantially removed south of the dogleg so the pond features would be joined hydraulically with the existing natural oxbows along Crooked Creek. The average elevation of these oxbows (382 feet) appears consistent with the proposed water level in the ponds.

Restoration of Queen Gulch has been developed while considering the predicted drawdown effects from the proposed open pit. Rerouting of flow in Queen Gulch will be similar to Quartz Gulch with available side cast used to refill the ditch, rerouting the flows to the old stream channel location and revegetation of disturbed areas. Expansion of two small ponded areas in the lower reach will enhance resident fisheries habitats. The flows from Queen Gulch will be re-directed into the square pond. A fish passage conveyance or low water ford will be provided at the road crossing. Berms around the south and west sides of the square pond will be removed to re-connect this pond with the floodplain and the pond margins will be regraded similar to the more northern ponds. An outfall will be established to an existing oxbow in the northwest corner of the square pond.

Finally, the ditches connecting the northern ponds to the square pond and the diversion ditch, which connects the pond system to Crooked Creek, will be refilled with the side-cast materials and revegetated.

A preliminary estimate of the stream restoration parameters for Ruby Gulch is included in Table 15. As the engineering design progresses, further refinements will be made based on reference reach parameters where available, or Rosgen and regional functional parameters for drainages with similar watershed characteristics.

Table 15 Historical and Preliminary Design Parameters for Ruby Gulch

Parameter	Historical (Pre-Mining) Value	Preliminary Design Value
Basin Area (square miles)	0.34	0.34
Stream Type (Rosgen)	G3	G3
100-year Flood Flow (Cubic Feet/Second)	50	50
100-Year Flood Velocity (Feet/Second)	N/A	3.5
2-Year Flood Flows Q2 (Cubic Feet/Second)	8	8
2-Year Flood Velocity (Feet/Second), Bank Full	N/A	3.3
Valley Slope	Less than 5%	Less than 5%
Channel Slope (Percent)	4.17	4.19
Ordinary High Water Width (Feet)	2.4	6
Bank Full Width (Feet)	9	10
Floodplain Width (Feet)	82	50
Stream Substrate Sizing for 2-year In- Channel and 100-year Floodplain Stability	Soil gradation needed	D100 = 4 inches D85 = 3 inches D50 = 1 inches D30 = 0.4 inches D15 = #10 sand
Bank Height Ratio (BHR)		
Entrenchment ratio (ER)		
Width:depth Ratio	Stable	Stable
Profile Form	N/A	Step-Pool
Sinuosity	1.16*	1.16
Belt Width	30	30
Channel Depth	N/A	1.0 foot in riffles 1.8 in pools
Riffle Spacing	N/A	+/- 20 feet
Grade Control	N/A	Large wood debris, roots of bank vegetation, larger rock substrate

*Historical values determined by 3PPI (Donlin Gold, LLC 2014).
 N/A – Not Available.

Subject to final design refinement, the following work plan sequence is proposed for Ruby and Queen Gulches. Appendix D-1, Figure 12 illustrates the components of this work plan. Appendix D-1, Figure 13 illustrates the proposed outcome of restoration. The work plan includes:

1. Reshape the excavated ponds in the Crooked Creek floodplain to create shallow and deep water habitat areas. This would be done while the water table is still artificially depressed by the drainage ditch.
2. Remove the overburden berms around the south and west sides of the square pond and along the west sides of the northern ponds to the point where the berm transitions to a larger overburden deposit at the dogleg. Breach the square pond in the northwest corner and connect the other excavated areas to the abandoned oxbows to the west. Appendix D-2, Sheet 13 shows a typical section through this area.

3. Fill the mining ditch in upper Queen Gulch and re-establish the stream within the historical channel. Re-contour excavated ponds to provide enhanced off-channel habitat. Reroute the Queen Gulch stream channel in its lower section and install a fish passage structure under the existing road (or create a low water crossing) to connect Queen Gulch to the square pond.
4. Re-build the lower section of Ruby Gulch to hydraulic functional parameters as refined in final design. Add a fish passage conveyance at the mining access road as needed. Appendix D-2, Sheet 12 shows the preliminary design section of the stream channel.
5. Fill the drainage ditch extending south to Crooked Creek to restore floodplain water levels and groundwater continuity. Appendix D-2, Sheet 14 shows a typical section of this ditch fill.
6. Revegetate all disturbed areas per the revegetation design plan.

Table 16 is a summary of the Queen and Ruby Gulches Restoration Area restoration.

Table 16 Summary of Re-established, Enhanced, and Protected Areas within the Queen and Ruby Gulches Restoration Area

Restoration Activity	Habitat Type	Linear Feet	Acres
Re-establish	Stream channels	2,931	-
Re-establish	Floodplain habitat	-	46.7
Re-establish	Floodplain habitat (included revegetation)	-	2.6
Enhance	Off-channel pond habitat*	-	12.0*
Enhance	Terrestrial habitat (includes revegetation)	-	8.5
Protect	Buffer	-	52.5
Total		2,931	110.3**

* Enhanced off-channel pond habitat is within the re-established floodplain habitat.

**Entire area will be covered under the site protection instrument.

“-“ Not Applicable.

The results of these proposed hydraulic and geomorphic functional restorations on the fisheries resources are as follows:

- Significant increase in productive pond habitats in the lower reaches of Ruby and Queen Gulches and in accessible habitat throughout Crooked Creek.
- Removal of opportunities for beaver dam blockages in areas of narrow conveyance, including ditches and pond inlets and outlets, which create a blockage to fish passage.
- Lowered gradient access to the lower reaches of Ruby Gulch for enhanced resident fish and juvenile coho passage and habitats along this reach.
- An increase in off-channel rearing habitats for resident fish and coho salmon juveniles in the Crooked Creek floodplain and oxbow.
- Raised water levels in the ponds for improved deep water and potential overwintering habitats.
- Provision of littoral habitats in the ponds and attendant increases in aquatic vegetation, aquatic invertebrates, water quality, and habitat diversity.
- Reduced side slopes and improved vegetative cover to improve water quality and provide additional shading and cover for fish along stream and pond margins.

- Better temperature regimes for resident and anadromous fish species resulting from the replacement of ditched flows with more natural and better shaded stream channels.
- Long-term reduction in substrate embeddedness and potential spawning habitat improvements in Crooked Creek through improved water quality and reductions of suspended solids in Queen and Ruby Gulches, especially at higher flows.

Final Design, Monitoring, and Performance Standards

Final Design

Establishing and implementing the final design, which will provide the basis for the final performance standards for the PRM, is expected to be a multi-step process, as follows:

1. Donlin Gold will perform additional field work to assess and determine the final reference reach and design parameters. In using a reference reach, Donlin Gold will be able to compare to other streams being sampled, whereby “success” will be measured as the new stream reaches fall within the natural variability of other sample sites in the monitoring program.
2. At least 6 months prior to initiating Project construction, Donlin Gold will submit to USACE a final restoration design (modifying the plans contained herein as appropriate) based on specific hydrologic, hydraulic, geomorphic, revegetation, and construction sequencing parameters.
3. USACE will approve the final design, and the final performance standards, prior to the start of Project construction.
4. Donlin Gold will construct the proposed PRM as designed and provide as-built documentation to verify that the restorations meet the design specifications.

After the completion of the constructed restoration and acceptance of the as-builts by USACE, the PRM will enter the monitoring phase to demonstrate compliance with the performance standards.

Monitoring Program

Project monitoring will be conducted to demonstrate that the PRM is meeting its performance standards, provide a basis for USACE acceptance of the work, determine if adaptive management actions are necessary, and document the aquatic resource health of the area. Donlin Gold will monitor to gauge progress against the performance standards for stream channels, wetlands, terrestrial vegetation, and fish use. Additionally, Donlin Gold will also monitor stream flow. The types of monitoring to be performed are described below. A more detailed monitoring program with locations and protocols will be submitted to USACE for review and approval, along with the final performance standards, at least 6 months prior to the start of the Project construction.

Stream Channel Monitoring

Monitoring of physical stream channel (hydraulic and geomorphic) parameters will be conducted annually for at least 5 years after construction or longer if performance standards are not met. Monitoring will take place during the same time period each year in early June, timed to coincide after spring breakup flows and before the mid-summer low water period. Obvious failures of the channel design or excessive erosion will be addressed with USACE (in coordination with ADF&G), and corrective actions will be developed by Donlin Gold and approved by USACE prior to initiation of in-stream work. If site conditions fail to meet

performance standards during monitoring, the design and mitigation work plan will be reviewed and adjusted to implement solutions. After the fifth year, monitoring would only continue to be performed in those specific areas where the performance standards are not being met.

Biological monitoring of the stream channels and near pond outlets for macroinvertebrates and periphyton communities will also be conducted annually for at least five years after construction or longer if performance standards are not met. Monitoring will be conducted in mid- to late July to maintain consistency with baseline sampling and capture the period of peak abundance and species diversity.

Aquatic invertebrate sampling will be conducted using the methods Donlin Gold followed for baseline data collection. Five replicate samples will be collected to reduce sampling variability within a single site and to increase statistical power. Samples will be collected each year from the same riffle(s) using a Surber sampler (1 ft², 600 µm mesh). The Surber sampler will be placed on the stream bottom with its opening perpendicular to stream flow. Substrates within the 1 ft² (0.09 m²) Surber base will be scrubbed with a nylon brush to remove invertebrates and organic matter. Organic matter retained by the net will be drained onto a 600 µm sieve, placed in plastic bags, and preserved in 70 percent isopropyl alcohol. In the laboratory, samples will be lightly rinsed with water in a 600 µm (standard #30) sieve.

Macroinvertebrates will be removed by hand under magnification, identified to the lowest possible taxonomic level (typically genus), and counted. Large samples (>300 individuals) will be sub-sampled using a white tray subdivided into four quadrants. Samples will be evenly distributed across the tray, and each quarter picked until a minimum of 300 individuals is reached (typically ¼ or ½ of the original sample). Large samples will also be viewed in their entirety before sub-sampling; large and/or rare taxa found in this search will be removed and added to the sample total.

The analysis will include identifying taxa present; estimating aquatic invertebrate density and taxa richness; and calculating ratios of mayflies, stoneflies, and caddis flies versus all other aquatic invertebrate taxa. Multiple sampling sites will be established in the restored drainages and ponds (excluding the Wash Plant Area).

Lower trophic level sampling for periphyton standing crop would be conducted in concert with aquatic invertebrate sampling. Periphyton sampling sites will be established within newly created stream reaches, 10 rocks per site will be sampled. Samples will be processed to measure chlorophyll a, b, and c concentrations to produce an estimate of periphyton standing crop and basic community structure determination. Chlorophyll analysis will show overall productivity of the community as well as potential shifts in community structure over time by examining the relative ratios of chlorophyll a, b, and c.

Fish monitoring will be conducted annually for at least five years after construction or longer if performance standards are not met. Monitoring will occur in both pond and stream habitats within the PRM areas (excluding the Wash Plant Area) beginning in the first open water season after construction. A combination of fyke nets in pond habitats and minnow traps in stream habitats will be employed to provide documentation of fish using the mitigation habitats. Sampling will be timed to document various important life history phases for fish anticipated to use the habitats. For example, some sampling will occur each spring to detect spawning grayling, and some sampling will occur each fall to document

spawning coho salmon. Generally, most fish sampling efforts will be during mid-summer to identify peak uses by all species. Monitoring timing will be consistent from year to year for comparability of results.

Wetland Monitoring

Monitoring of wetland hydrology and wetland revegetation will be conducted annually for at least 5 years after construction. The wetland monitoring will occur during the same period each year before July 1. Monitoring timing may be adjusted for yearly variations in the onset of the growing season. One monitoring point will be sited for every 5 acres that are revegetated to adequately monitor trends in establishing plant communities. Point locations will be monumented with a Global Positioning System (GPS) device as well as physically, using rebar stakes and flagging to facilitate revisit. At these locations, a pit will be dug (unless surface water is present) to observe hydrology, and the percent coverage of individual plant species (native and non-native), bare ground, and surface water will be recorded. Vegetation data will be compiled within a 10-square-meter (m²) plot for shrub communities and a 1-m² plot for herbaceous communities. Wetland monitoring data will be compared to the performance standards to determine if additional management actions are necessary. Non-native plant recruitment data may specifically lead to active measures to remove non-native plants from restoration areas.

Terrestrial Habitat (Revegetation) Monitoring

Monitoring of terrestrial revegetation will be conducted on the same schedule as the monitoring of wetlands. The inspections will occur during the growing season. One monitoring point will be sited for every 5 acres that are revegetated to adequately monitor trends in establishing plant communities. Point locations will be monumented with a GPS device as well as physically, using rebar stakes and flagging to facilitate revisit. At these locations, the percent coverage of individual plant species (native and non-native) and bare ground will be recorded. Vegetation data will be compiled within a 10- m² plot for shrub communities and a 1-m² plot for herbaceous communities. Monitoring data will be compared to performance standards to determine if additional management actions are necessary. Non-native plant recruitment data may specially lead to active measures to remove non-native plants from restoration areas.

Additional Monitoring

In addition to the monitoring necessary to verify compliance with the performance standards, Donlin Gold will also monitor stream flows. A stream flow gage with a documented stage-flow relationship will be established on one or more of the streams as a surrogate for stream flows in all restored streams. These gauges will be established upstream of the restoration work on the restored tributaries and will serve as a baseline for assessing the performance of the restoration channels across different flow regimes. The gauges will be established within the stable cross-sections of natural channels. They will be monitored via recording water level sensors (i.e. pressure transducers) during the open water season beginning in the first season after construction and continuing for the duration of the stream channel monitoring program.

Monitoring Reports

Monitoring reports will be produced for each year of post-construction monitoring and submitted to USACE by the end of January of the following year. The results of all stream channel, wetland, terrestrial habitat, stream flow, and fish monitoring will be summarized. Each monitoring report will specifically

include a description of each performance standard and identify if the standard has been achieved. If performance standards are not progressing as anticipated, adaptive management actions will be provided to USACE for approval as necessary.

At the end of all monitoring activities, a monitoring closeout report will be completed for the entire PRM area for review and acceptance by USACE. The monitoring closeout report will briefly summarize the findings of the monitoring activities and describe how the PRM has met the performance standards. In addition, the monitoring closeout report will formally request closure of the post-construction monitoring period.

Performance Standards

The following is a discussion of the performance standards that will be used to judge the functional performance of the Upper Crooked Creek PRM. These standards are broken out into three categories targeting restored stream channels, restored wetlands, and restored terrestrial habitats. In specifically using reference reaches, Donlin Gold will compare the PRM to other streams, whereby “success” will be measured as the new stream reaches fall within the targeted design parameters, considering the natural variability of other sample sites in the monitoring program.

Stream Channel Performance Standards

The primary basis of these performance standards is the United States Environmental Protection Agency (EPA) framework for stream function assessment (Harman et al. 2012) Appendix A-d Performance Standards Table. This table lists specific performance standards that can be used to assess stream restoration projects. Each parameter is measured and assigned a score of Functioning, Functioning-At-Risk, or Not Functioning. Functioning-At-Risk can be further classified as degrading toward Not Functioning or improving toward Functioning. Not all parameters in Harman et al. 2012 are appropriate for any specific reconstruction project, and a number are duplicative. Table 17 identifies the parameters and initial proposed performance standards for the Upper Crooked Creek PRM. The final performance standard parameters and values will be approved by USACE along with the final restoration design prior to construction. The EPA standards for stream function contain some parameters for riparian area revegetation that overlap with the wetland and terrestrial revegetation performance standards listed in other criteria.

For compliance, the monitoring of these parameters must show that the stream and floodplain values fall within the categories of Functioning or Functioning-At-Risk (improving) as specified by the EPA criteria. These values must be attained for 3 consecutive years. Additionally, a Functioning score must be achieved in the last of the 3 years for compliance to be attained.

Table 17 Upper Crooked Creek PRM Plan Stream Performance Standards

Hydraulic				
Parameter	Measurement Method	Performance Standard		
		Functioning	Functioning-At-Risk	Not Functioning
Flood Plain Connectivity	Bank Height Ratio (BHR)	1.0 to 1.2	1.3 to 1.5	>1.5
	Entrenchment Ratio	>2.2	2.0 to 2.2	<2.0
Geomorphic				
Parameter	Measurement Method	Performance Standard		
		Functioning	Functioning-At-Risk	Not Functioning
Large Woody Debris	Large Woody Debris Index (LWDI)	LWDI of project reach equals LWDI of reference reach	LWDI of project reach does not equal LWDI of reference reach, but is trending in that direction	LWDI of project reach does not equal LWDI of reference reach and is not trending in that direction
Channel Evolution	Simon Channel Evolution Model Stages	Sinuuous, pre-modified, quasi-equilibrium	Aggrading	Degrading, channelization, widening
Lateral Stability	Meander Width Ratio	>3.5 based on reference reach survey	3.0 to 3.5 as long as sinuosity is >1.2	<3.0
Riparian Vegetation	Buffer Density (stems/acre) Buffer Age, Composition, Growth Canopy Density	Parameter is similar to reference reach condition, with no additional maintenance required	Parameter deviates from reference reach condition, but the potential exists for full functionality over time or with moderate additional maintenance	Significantly less functional than reference reach condition; little or no potential to improve without significant restoration effort
	NRCS Rapid Visual Assessment Protocol	Natural vegetation extends at least one to two active channel widths on each side, or if less than one width, covers entire floodplain	Natural vegetation extends at least one-half to one-third active channel width on each side, or filtering function moderately compromised	Natural vegetation less than one-third active channel width on each side, or lack of revegetation, or filter function severely compromised
Bed Material Characterization	Bed Material Composition	Project reach is not statistically different than reference reach	Not applicable	Project Reach is statistically different (finer) than reference reach

Bed Form Diversity	Percent Riffle	60-70	70-80 40-60	>80 <40
	Pool-to-Pool Spacing Ratio (Slope between 3-5%)	2-4	4 to 6	>6
	Depth Variability (gravel bed streams)	>1.5	1.2 to 1.5	<1.2

Biologic*

Parameter	Measurement Method	Performance Standard		
		Functioning	Functioning-At-Risk	Not Functioning
Fisheries	As listed in the paragraph above	Fish presence		Fish not present
Macroinvertebrate and Periphyton Communities	As listed in the paragraph above	Exceptional to or similar to reference reach	Impaired showing improvement	Impaired no improvement

*Not based on Harman et al.

Wetland Performance Standards

All floodplain habitat areas addressed by this Plan are expected to become wetlands and meet wetland vegetation and hydrology performance standards.

Wetland Vegetation Performance Standards

Vegetation performance standards have been developed to ensure that revegetated areas are on a trajectory to achieve stability and ecological functionality. Vegetation performance standards will be met at each restoration area. A restoration area will be considered to have achieved the vegetation performance standards when at least 85 percent of monitoring locations satisfy the standards.

The vegetation performance standards are outlined in Table 18. These vegetation performance standards are based on the Draft Oregon Department of State Lands Routine Monitoring Guidance for Vegetation (ODSL 2009). It may be necessary to modify the performance standards for vegetation response to match similarities with reference vegetation communities near the Project. Any proposed modifications will be detailed in the annual monitoring report and submitted to USACE for approval.

Table 18 Wetland Vegetation Performance Standards

- Cover of native and/or revegetation hydrophytic* plant species is at least 60 percent.
- Cover of invasive species is no more than 10 percent.
- Cover of bare substrate is no more than 20 percent.

*Plant species with and indicator status of FAC, FACW, or OBL

Wetland Hydrology Performance Standards

Wetland floodplain habitat will additionally be required to meet wetland hydrology performance standards. The performance standard for hydrology is that the area must meet the wetland hydrology indicators as outlined in the 2008 Alaska Regional Supplement. Wetland hydrology indicators as described in the Alaska Regional Supplement (USACE 2007) will be used as evidence of sufficient hydrology to support wetland habitat formation and function. However, only a subset of the available indicators as described in the Regional Supplement will be used to gauge performance. This subset includes three of the four groups of indicators presented in the supplement (see Table 19). The fourth group, Group D – Evidence from Other Site Conditions or Data, will not be used to gauge hydrologic conditions within the PRM area because landscape variables for the group were derived for natural settings and are not applicable for use in recently constructed wetlands.

One primary indicator from any group is sufficient to conclude that wetland hydrology is present. In the absence of a primary indicator, two or more secondary indicators from any group are required to conclude that wetland hydrology is present. Monitoring for hydrologic indicators will occur within 10-m² plots coinciding with the vegetation monitoring. Table 19 lists wetland hydrology indicators to be used for the Upper Crooked Creek PRM.

*Table 19 List of Wetland Hydrology Indicators for Alaska**

Indicator	Category
Group A – Observation of Surface Water or Saturated Soils	
A1 – Surface water	Primary
A2 – High water table	Primary
A3 – Saturation	Primary
Group B – Evidence of Recent Inundation	
B1 – Water marks	Primary
B2 – Sediment deposits	Primary
B3 – Drift deposits	Primary
B4 – Algal mat or crust	Primary
B5 – Iron deposits	Primary
B6 – Surface soil cracks	Primary
B7 – Inundation visible on aerial imagery	Primary
B8 – Sparsely vegetated concave surface	Primary
B9 – Water-stained leaves	Secondary
B10 – Drainage patterns	Secondary
B15 – Marl deposits	Primary
Group C – Evidence of Current or Recent Soil Saturation	
C1 – Hydrogen sulfide odor	Primary
C2 – Dry-season water table	Primary
C3 – Oxidized rhizospheres along living roots	Secondary
C4 – Presence of reduced iron	Secondary
C5 – Salt deposits	Secondary

* Source: USACE 2007.

Terrestrial Habitat Performance Standards

Revegetated and regraded terrestrial habitat areas are expected to meet only terrestrial revegetation performance standards for compliance.

Terrestrial Revegetation

Vegetation performance standards have been developed to ensure that revegetated areas are on a trajectory to achieve stability and ecological functionality. Vegetation performance standards will be met at each restoration area. Achievement of vegetation performance standards will be assessed at locations established after the first full growing season (year 1). An entire restoration area will be

considered to have achieved the performance standards when at least 85 percent of monitoring locations satisfy the standards.

The vegetation performance standards are outlined in Table 20. These vegetation performance standards are based on the draft Oregon Department of State Lands Routine Monitoring Guidance for Vegetation (ODSL 2009). It may be necessary to modify the performance standards for vegetation response to match similarities with reference vegetation communities near the Project. Any proposed modifications will be detailed in the annual monitoring report and submitted to USACE for approval.

Table 20 Terrestrial Habitat Vegetation Performance Standards

Cover of native and/or revegetation plant species is at least 60 percent.
Cover of invasive species is no more than 10 percent.
Cover of bare substrate is no more than 20 percent.

Maintenance Plan

The mitigation restoration work plans are designed to eliminate the need for regular maintenance. No artificial structures will be used to regulate hydrology so change should follow the natural evolution and geomorphic process of the watershed. Any failures or deficiencies noted during the monitoring period or the review period associated with the long-term management plan (LMP) will be reported and addressed as part of the Adaptive Management Plan.

Long-term Management Plan (LMP)

As part of finalizing the site protection instrument (deed restriction) for this Plan, Donlin Gold will prepare a LMP for the upper Crooked Creek PRM site. The LMP will be implemented as soon as USACE concurs that performance standards have been achieved in each restoration area. The LMP will be applied by a third party to conduct inspections and provide reports to demonstrate long-term compliance with the deed restriction. Selection of the third party will be subject to USACE review and approval based on their qualifications to serve in this role.

Donlin Gold will submit the LMP to USACE at least 6 months prior to the start of Project construction. Project construction will not be initiated until the deed restriction is in place and the LMP is approved by USACE.

Specifically, the LMP will be designed to ensure that the upper Crooked Creek PRM site is monitored, managed, and maintained for the long-term sustainability and preservation of its restored conditions. The LMP will be intended to extend for the duration of the deed restriction. The LMP will also specifically describe the mechanism by which the proposed third party's inspections and reporting will be funded over the term of the restriction.

To support preparation of the LMP (and finalize the deed restriction), Donlin Gold will complete a metes and bounds survey of the upper Crooked Creek restoration site according to methods acceptable to the USACE. The survey is expected to closely resemble the boundaries represented within this Plan and will

be used to establish the exact property boundaries for the deed restriction and LMP. Under the provisions of the LMP, the third party and the landowners will implement methods to limit access to, and restrict activities in, the upper Crooked Creek restoration site where appropriate.

Donlin Gold shall implement the approved LMP for the purposes stated above. The LMP will require annual monitoring site visits by the third party to qualitatively monitor the general conditions of the upper Crooked Creek restoration site and compliance with the terms of the deed restriction. The conditions of the upper Crooked Creek restoration site will be evaluated, documented, and mapped during the site visits. The third party will be responsible for preparing annual monitoring reports detailing the conditions of the upper Crooked Creek PRM site, and any recommended management actions. In the annual reports, the third party will specifically describe if there have been any anthropogenic changes to the status of the upper Crooked Creek PRM site functional values including: waters of the United States (wetlands and streams). The annual monitoring reports will be available to USACE upon request.

As described in the LMP, the landowners will not be responsible for changes to the site conditions attributable to natural catastrophes such as flood, fire, drought, disease, regional pest infestation, and others that are beyond their reasonable control. Active management will not be required for ecological changes that come about because of processes such as climate change, fluctuating river levels, and sedimentation due to overbank flood deposits that may affect the upper Crooked Creek PRM site's streams and wetlands. Over time, natural successional and geomorphic processes could occur that may affect wetland and stream functions or total wetland acreages or linear feet of stream.

Finally, the LMP will describe how Donlin Gold and the third party will work with the landowners to ensure that any activities proposed to occur in the upper Crooked Creek PRM site comply with the requirements of the deed restriction. This will include preventing any activities that are specifically prohibited by the deed restriction, see the Site Protection Instrument Section.

In summary, Donlin Gold proposes that the LMP include the following specific sections:

1. Introduction and Purpose
2. Third party and Responsibilities
3. PRM Area Description
 - a. Location and boundaries
 - b. Ownership
 - c. Land (to be updated after restoration completion)
 - d. Baseline conservation values, including wetlands, streams, and WOUS (to be updated after restoration completion)
4. Management and Monitoring
 - a. Annual Site visits, including Scope, Documentation, and Action Items
 - b. Security, safety, and public access
 - c. Limits of responsibility, including exclusions for natural events
5. Allowable Improvements and Activities
 - a. Permitted and prohibited actions

b. Third party and landowner coordination

6. Adaptive Management
7. Reporting and Administration
8. Amendments, Transfer, Replacement/Termination, and Notice Provisions
9. Funding
10. USACE Rights, Responsibilities, and Authorities
11. Signatures

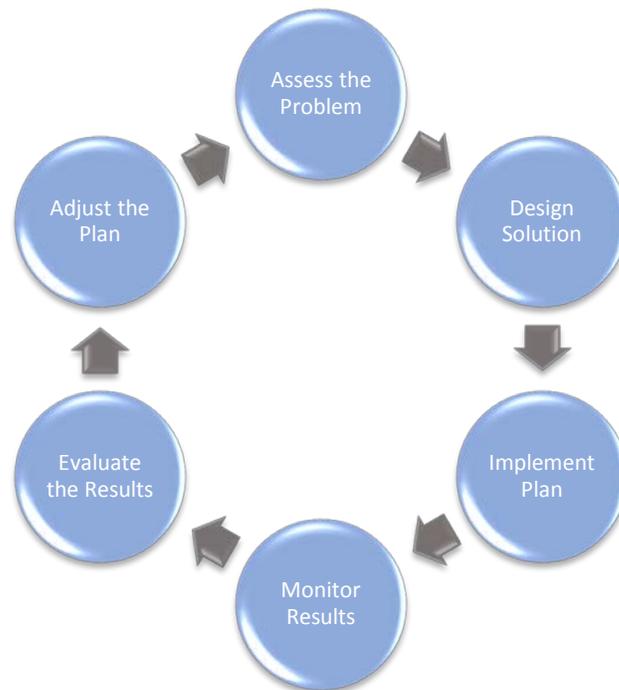
Adaptive Management Plan

There are two stages of adaptive management: (1) adaptive management of the restoration sites to meet performance standards and (2) adaptive management under the LMP to enforce the site protection instrument conditions.

During restoration activities, the adaptive management plan will work toward successful restoration by adjusting and adapting to issues with implementation and onsite conditions. The adaptive management process is designed to deal with the uncertainty of the PRM field program and allow for problem solving and adjustments during design, implementation, and long-term PRM management. To have a successful PRM Plan, Donlin Gold understands it will be necessary to follow six steps in an adaptive management process (Figure 4). Within each step, several essential elements will be completed. Adaptive management is a process of connecting and linking the information from the PRM design, implementation, construction, monitoring, and evaluation phases to ensure that the initial design functions and meets the intended standards and objectives. If monitoring demonstrates that a corrective action is needed, Donlin Gold will adjust the work plan to meet the performance standards of the Plan. Adaptive management continually evaluates the results and adjusts work elements to meet the overall objective (Ministries of Forests and Range 2008). Donlin Gold is fully committed to this framework for a successful PRM Plan.

After restoration is completed and the performance standards are met, adaptive management will be conducted as described in the LMP. As discussed above, annual monitoring reports will be completed documenting updated site conditions. The annual reports will identify any areas of concern (i.e., occurrence of prohibited activities) along with any necessary corrective or remedial actions.

Figure 4 Adaptive Management Cycle



Source: Ministries of Forests and Range 2008

Financial Assurances

Donlin Gold is committed to providing a full financial assurance estimate for the restoration work when the final design is submitted for USACE approval¹. Once a value is agreed upon, Donlin Gold will cover that amount with a bond instrument acceptable to USACE prior to commencing work authorized by the Department of Army Permit. Further details of the financial assurance estimate and instrument for the Upper Crooked Creek PRM are described below.

Donlin Gold is fully responsible for providing financial assurance for activities related to the restoration, construction, and monitoring work. The mitigation rule states that *“In determining the assurance amount, the district engineer shall consider the cost of providing replacement mitigation, including costs for land acquisition, planning and engineering, legal fees, mobilization, construction and monitoring”* [33 CFR 332.3(n)(2)]. However, the guidance provided to the district engineer explains that *“Not all component costs listed above might be applicable in every case. Land cost, which is often the single largest project cost component in many areas of the country, may or may not be relevant for determining assurance amounts....If it is believed that the mitigation project remediation would be desirable and likely to be successful (e.g., the mitigation site is an excellent candidate for a successful restoration project), then there would be no need to include component costs for land purchase when*

¹ Donlin Gold requests that this be included as a special condition to the permit and that a final assurance amount along with an accepted financial instrument will be approved and in place prior to construction

setting assurance amounts.” With this background, Donlin Gold provides the following information as the basis for the financial assurance estimate.

Donlin Gold does not propose that land costs be included in the financial assurance for the following reasons:

1. The project sites have all of the elements required to provide an excellent candidate for a successful restoration project;
2. Donlin Gold being a mining company, located adjacent to the proposed restoration site, will have the equipment, resources and expertise to not only maintain the sites during the monitoring period, but will have the capacity to revise designs and reconstruct should the need arise;
3. The land owners have concurred with preserving the areas being considered for wetlands and stream restoration and preservation, and have extensive additional land holdings in the HUC-10 if the need arises to relocate the project sites as contemplated by the Rule.

Based on the above reasons, Donlin Gold does not propose any amount for land acquisition in the financial assurance estimate. Donlin Gold has included engineering redesign fees as one of the indirect cost components to allow for re-engineering the sites, if the need arises, prior to meeting performance standards (discussed in further detail below).

For the construction costs of building the restoration sites, Donlin Gold will follow standard cost estimation procedures for reclamation-type activities. BLM has a publically available spreadsheet program² that Donlin Gold used to provide the financial assurance estimate to the State of Alaska for the full mine site reclamation and closure activities; the spreadsheet program is known as SRCE (Standardized Reclamation Cost Estimator). This program has been widely used by industry and accepted by regulatory agencies for generating small and large reclamation project cost estimates. The approach used, in compliance with the requirements of the Rule, is to ensure that USACE, through a third party, has access to the funds to hire a contractor to complete the proposed restoration work, if necessary.

The construction component of the estimate will contain the elements described below. Donlin Gold proposes to apply the same inputs used for the existing reclamation cost estimate for the mine site that have been reviewed and approved by the Alaska Department of Natural Resources – Division of Mining, Land and Water’s Mining Section and the Alaska Department of Environmental Conservation – Division of Environmental Health’s Solid Waste Program. These agencies review and implement reclamation project cost estimates in all regions of the state for large and small mine projects and have extensive experience in this subject. Their preference for estimating project costs is to use SRCE.

² Available for download at https://nrbond.org/srce_downloads/

Table of Inputs

- Labor rates – Alaska Davis Bacon wages (Pamphlet 600) latest update
- Equipment hourly rates – based on quotes and cost sheets from equipment suppliers in the region
- Fuel and material costs – based on local quotes delivered to site

Earthworks and Direct Costs

Material excavation: The current estimate of excavation requirements for the combined restoration sites is 430,000 cubic yards (CY). The majority of this work will be done via a track mounted excavator. Some excavation may be conducted by wheel loader. For the final cost estimate, each site will be examined to determine a more refined excavation rate (CY per hour) for that specific portion of the project. The final cost estimate then becomes a calculation of the volume of material divided by the excavation rate to determine the number of equipment hours needed. The hours will be multiplied by the hourly cost (equipment plus labor plus fuel) to determine the estimated excavation cost. The site details to generate final volumes and productivity rates are not currently available at this level of design. However, a preliminary estimate has been made by multiplying the volume times the typical bid tab³ rate for that activity managed by the State of Alaska’s Department of Transportation and Public Facilities (ADOTPF). Excavation rates are roughly \$0.50 per CY, making the engineering estimate for this component \$215,000.

Loading and hauling costs (for excess material): The current designs indicate that there will be 258,000 CY of excess material that will need to be loaded and hauled offsite for storage. There is ample capacity in the overburden stockpiles identified in the mine permit’s footprint for this material. Cost estimating for this component follows similar reasoning to the excavation calculation, but adds the costs of trucks and bull dozers. A detailed estimate requires an analysis of the haul route and distance to determine how many trucks will be required for a given production rate. A fully loaded cost for the fleet is multiplied by the number of fleet hours estimated to arrive at an overall cost for loading and hauling of excess material. For the preliminary engineering estimate, Donlin Gold applied a unit rate of \$3.00 per CY to the 258,000 CY of excess material to calculate a cost of \$774,000 for this cost component.

Processing and importing of select sized material (if needed): Construction of the stream channels will likely require the import and placement of appropriately sized gravel material for construction of the pool-riffle-run sequences. The amount of this material has not been defined at this level of design but would be included in the final designs to be provided to USACE for approval. The remnants from the past placer mining activity provide an ample source supply for gravel. This component would include screening of the material located near the site to generate the correct volume and size requirements of material for placement into the stream channel beds. No preliminary estimate of this amount is

³ A bid tab is short for bid tabulation; this is a historic tracker spreadsheet ADOT manages that shows the bid cost by contractors for different projects throughout the state, broken down by bid component. These bid tab costs are often used to generate an engineering estimate for projects before they go out for bid

available at this time. An estimate for 8,982 feet of channel, 1 foot thick and 6 feet wide would require roughly 2,000 CY of sized stream bed material.

Stream construction activities (placement of bank protection): The construction of the stream sections will entail special consideration to the stream banks. This may include temporary waddles with willow plantings, embedding woody debris roots into the stream bank, or sections with boulders or rip rap armoring. The details for this level of cost estimating are not available at this time but will be included in the final cost estimate. For the preliminary engineering estimate, Donlin Gold assumed \$60 per lineal foot of stream multiplied by 8,982 feet of stream channel to calculate a component cost of \$224,550.

Other project elements (e.g., culverts): The only other project elements (structure) identified at this time are two culvert crossings for the access road between the mine area and the restoration areas. A full fish passage culvert design will be provided for the final design approval and included in the final cost estimate. For the preliminary engineering estimate, Donlin Gold has assumed 60 feet of culvert at an installed rate of \$100 per lineal foot, or \$6,000 for this cost component.

Topsoil placement: Restoration of the area will require importation and placement of topsoil in the reclaimed areas. The current design identifies 59 acres of upland and wetland area that will require soil placement. This number will be refined in the final design as additional details are available. The cost of placement is estimated similar to the loading and hauling component above. The fleet would include a loader at the source, trucks to haul topsoil to placement sites, and a bull dozer to spread the material. Scrapers could be used in lieu of the loader and trucks. Assuming an average of 18 inches of soil placement, this would require 142,780 CY of soil. Applying a unit rate of \$2.50 per CY placed, the preliminary estimate for this cost component is \$356,950.

Re-vegetation (both seed and seedlings as required): The final step in the construction process is applying seed and transplanting seedlings in the restored areas. This includes the cost of labor, equipment (spreaders, planters) and materials (seed, seedlings). The current Donlin Gold SCRE model estimates this to be \$340 per acre for similar sized areas. Based on the 59 acres identified for revegetation needs, the preliminary estimate for this component is \$14,750.

Summing the components identified above, the subtotal for the preliminary engineering estimate for direct costs for the restoration area work is \$1,596,560.

Indirect Cost Items (generally a percentage of direct costs)

Mobilization/demobilization of equipment and crews to/from site: While equipment will be on site to support mine activities, the cost estimate will assume that a contractor would need to mobilize and demobilize equipment to and from the project site. Current freight rates from Anchorage to the Jungjuk Port site are estimated at \$265 per ton. Applying a 10 percent cost to the direct cost (on the high side of a typical range, accounting for the remote location), the preliminary estimate includes \$159,656 for mobilization and demobilization. This would provide for 300 tons of equipment to be transported to and from the site. A more detailed breakdown will be provided with the final estimate when a full equipment list is available.

Contingency (typically 4 to 8 percent): The Donlin Gold SRCE model identifies a range of suggested contingency values that are a function of the overall project cost. They recommend 10 percent to be used for small projects (<\$500,000) ranging down to 4 percent for large projects (>\$50 million). Donlin Gold used the recommended 8 percent for this estimate (<\$5,000,000).

Construction management (2 to 4 percent): This covers the cost for the contractor site foreman and other administration staff to support the field efforts. The Donlin Gold SRCE modeling approved by the agencies has a 1.1 percent cost for this component, but it is for a much larger project. Donlin Gold increased this to 5 percent, allowing for \$79,828 for site construction management.

Engineering redesign fee (typically 4 to 8 percent, depending on complexity): This cost component allows for engineering support in the event that the restoration project is not performing as planned and adjustments need to be made. Due to the small size of the project and the level of engineering design expected for the final design, Donlin Gold has included a 4 percent engineering contingency, which is \$63,862.

Contractor profit (10 percent): This is a typical, standard cost component rate to allow for profit for the contractor. For this project, a \$159,656 profit has been included.

Management fee for agency/third party (4 to 6 percent): This is money available to the third party administrator to cover their costs to oversee the contract on behalf of USACE for completing the scope of work. Donlin Gold has included 5 percent of the direct costs, which is \$79,828.

Overall, the indirect costs are \$670,555, or 42 percent of the direct costs. This is at the high end of what indirect costs typically add to a reclamation cost estimate and should be sufficient for accomplishing the construction phase of the project.

A detailed cost estimate will be provided based on the final design approved by USACE prior to construction. For planning purposes, a preliminary engineering cost estimate prepared using the current volumes from the design contained in this Plan totals \$2,267,115, including \$1,596,560 in direct costs and \$670,555 in indirect costs.

Long-Term Monitoring and Reporting: Donlin Gold will provide a separate estimate for the ongoing maintenance, monitoring, and reporting as prescribed in the LMP. Donlin Gold has not provided a preliminary estimate for these at this time, since the LMP has yet to be prepared and approved.

Form of Financial Assurance: The form of financial assurance will comply with those mechanisms identified in the IWR March 2016 report, "Implementing Financial Assurance for Mitigation Project Success," Section 2.5, Instruments. The most likely form will be a letter of credit, performance bond, or escrow agreement. Donlin Gold will also establish an agreement with a third party to be approved by USACE that will be the beneficiary of the financial assurance instruments to carry out any construction corrections and to assure the monitoring and reporting are conducted out as required. This can take the form of a trust agreement with the chosen third party. Donlin Gold requests that the details of that be

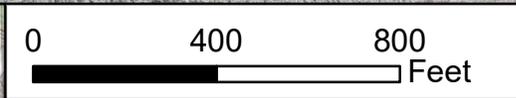
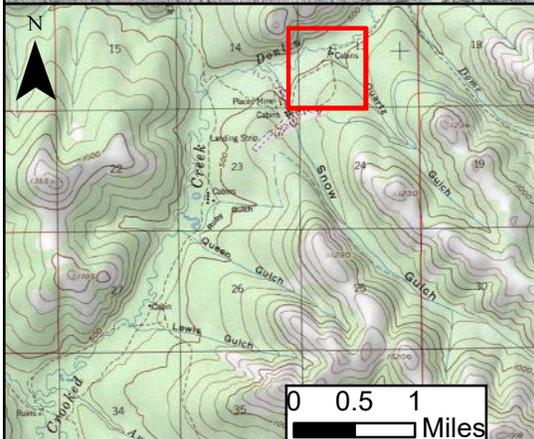
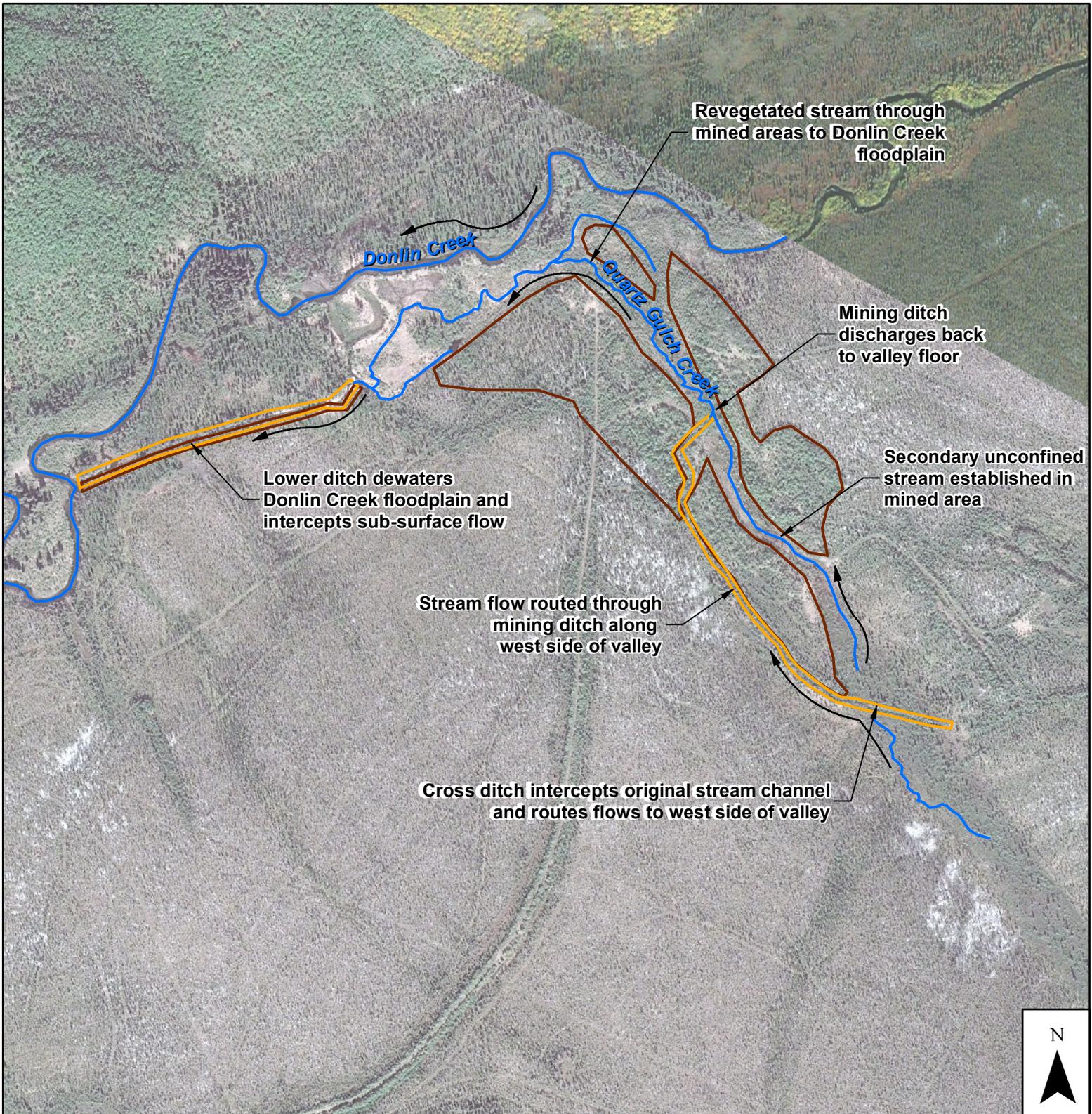
provided for in a special condition of the DA permit to allow time for those details to be worked out prior to construction.

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Appendix D-1, Figures 2 – 13



Existing Site Features

-  Ditch
-  Overburden
-  Existing Streams
-  FlowPath

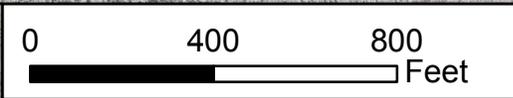
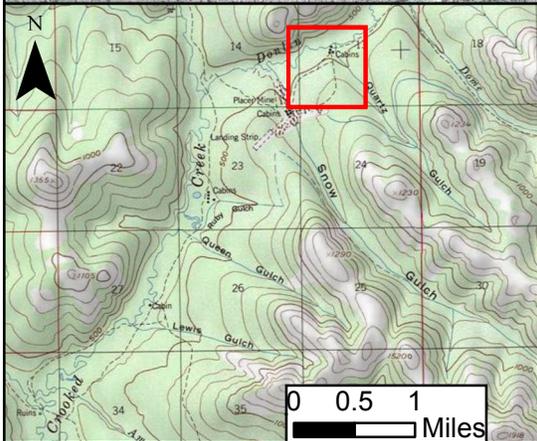
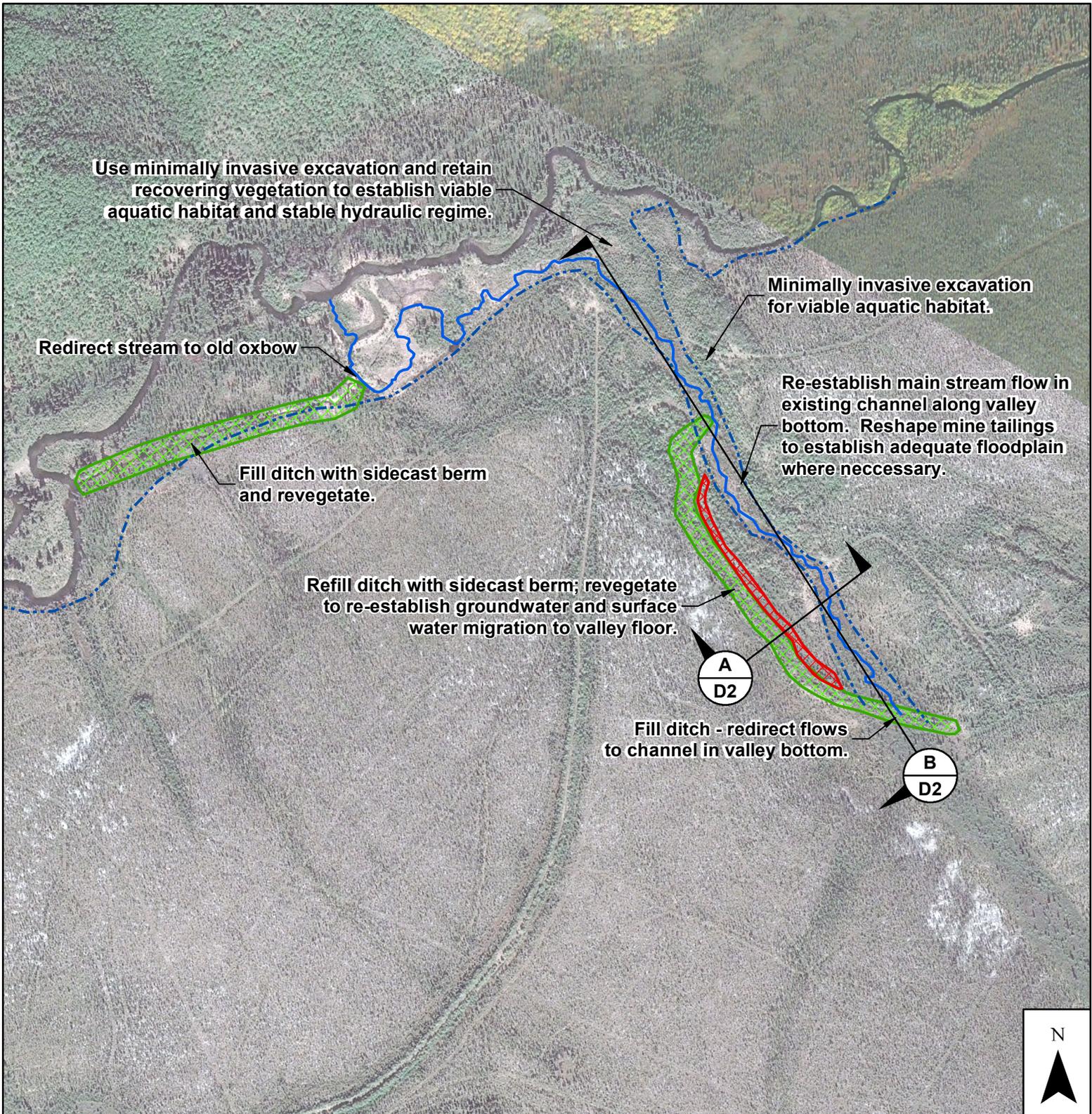
Compensatory Mitigation Plan
Attachment D, Upper Crooked
Creek PRM Plan, Appendix D-1

Quartz Baseline Conditions

NAD 1983 UTM Zone 4N;
Imagery 0.5 m resolution, capture date 5/29/2016



Figure 2



- Grading Plan**
-  Regrade Cut
 -  Regrade Fill
 -  Proposed Floodplain Boundary
 -  Proposed Stream Thalweg

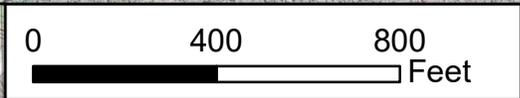
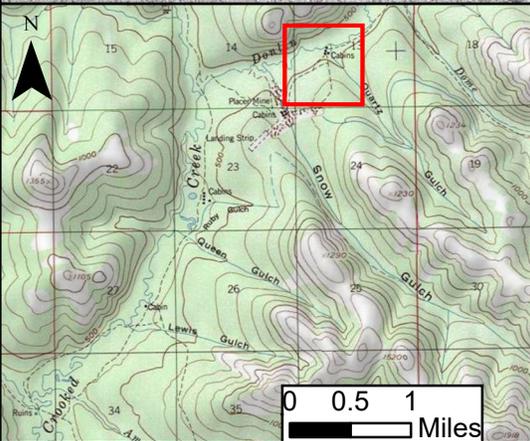
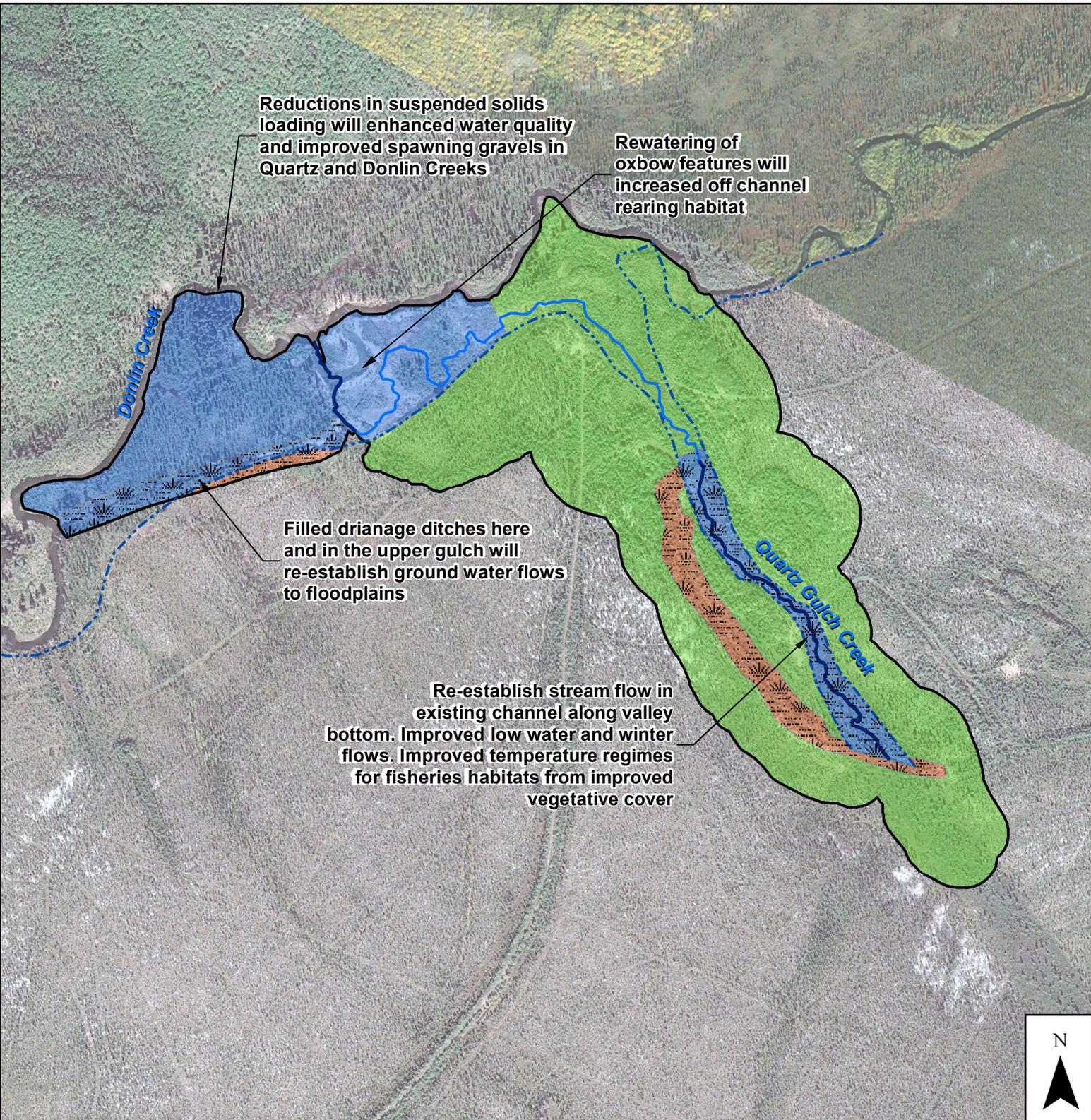
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Attachment D, Upper Crooked
Creek PRM Plan, Appendix D-1

Quartz Construction Plan

NAD 1983 UTM Zone 4N;
Imagery 0.5 m resolution, capture date 5/29/2016



Figure 3



Compensatory Mitigation Plan
Attachment D, Upper Crooked
Creek PRM Plan, Appendix D-1

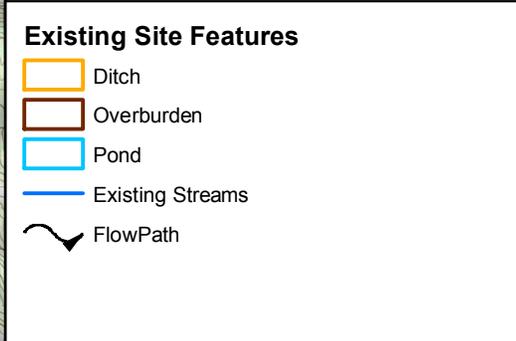
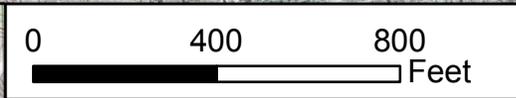
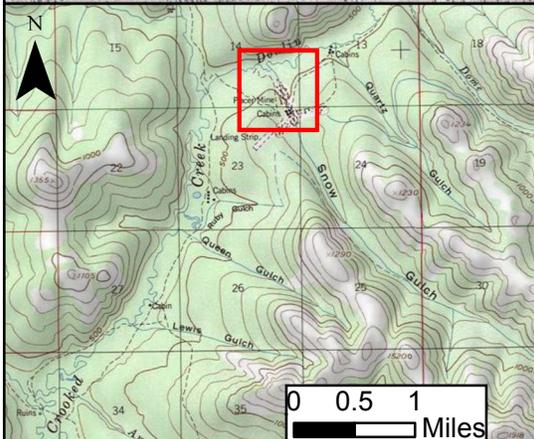
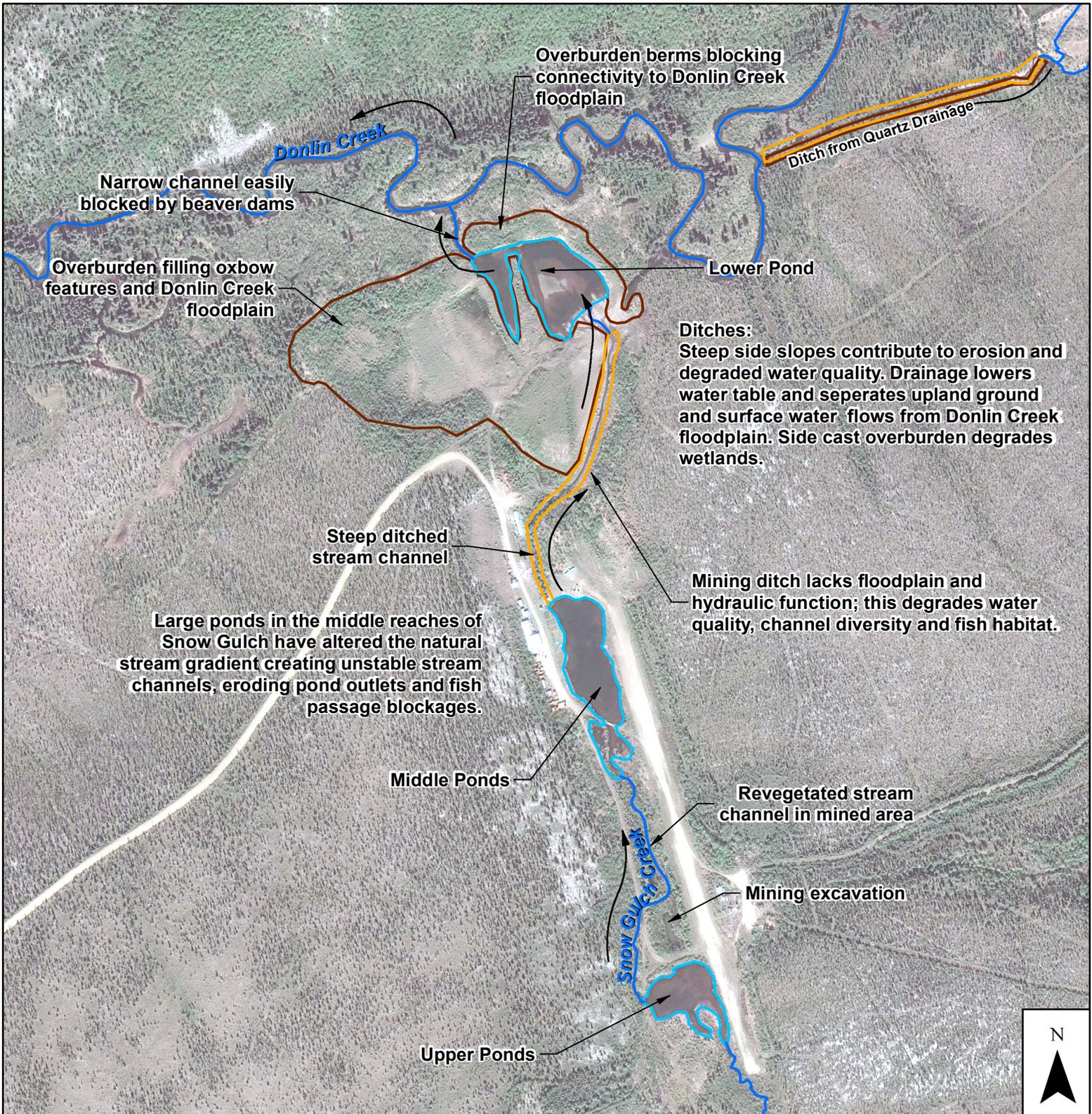
Quartz Post-Construction

NAD 1983 UTM Zone 4N;
Imagery 0.5 m resolution, capture date 5/29/2016

- Floodplain Boundary
- Stream
- Restoration Activity**
- Re-established Stream Channel
- Re-established Floodplain
- Enhanced Terrestrial Habitat
- Protection Buffer
- Revegetation Area



Figure 4



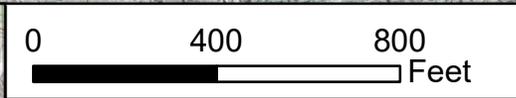
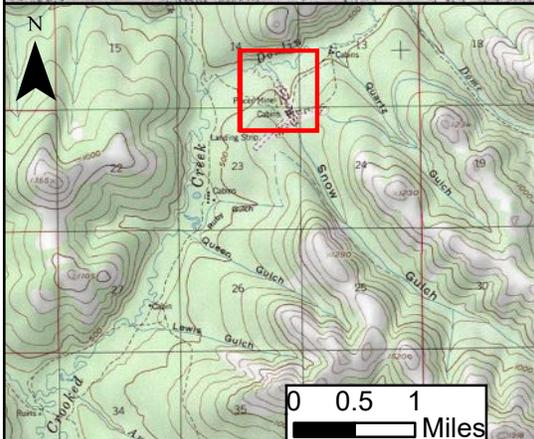
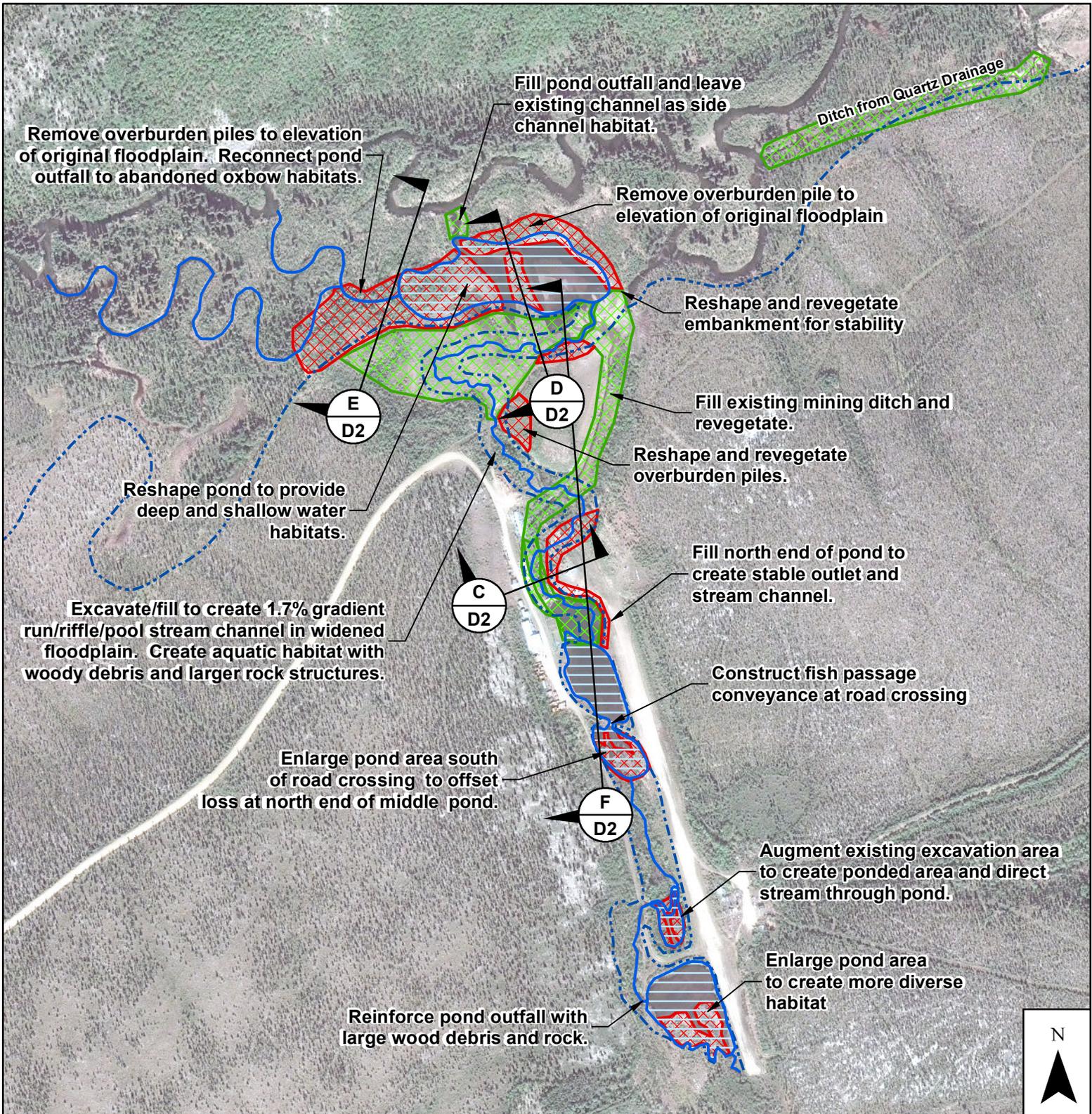
Compensatory Mitigation Plan
Attachment D, Upper Crooked
Creek PRM Plan, Appendix D-1

Snow Baseline Conditions

NAD 1983 UTM Zone 4N;
Imagery 0.5 m resolution, capture date 5/29/2016



Figure 5



- Grading Plan**
- Regrade Cut
 - Regrade Fill
 - Proposed Pond
 - Proposed Floodplain Boundary
 - Proposed Stream Thalweg

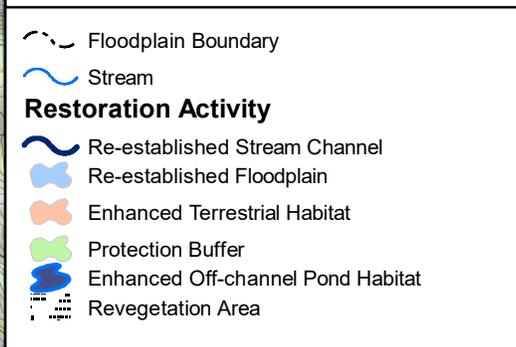
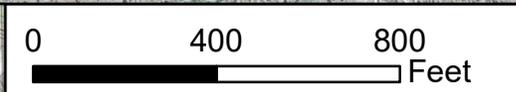
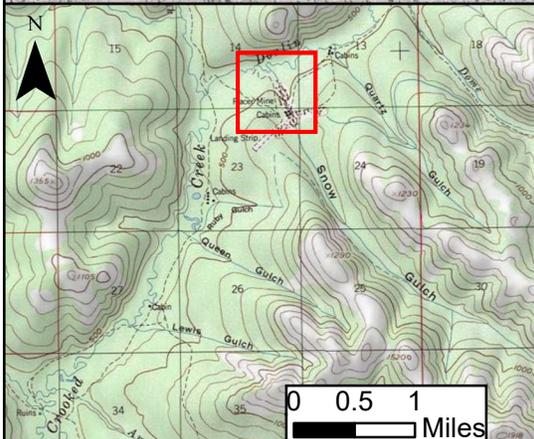
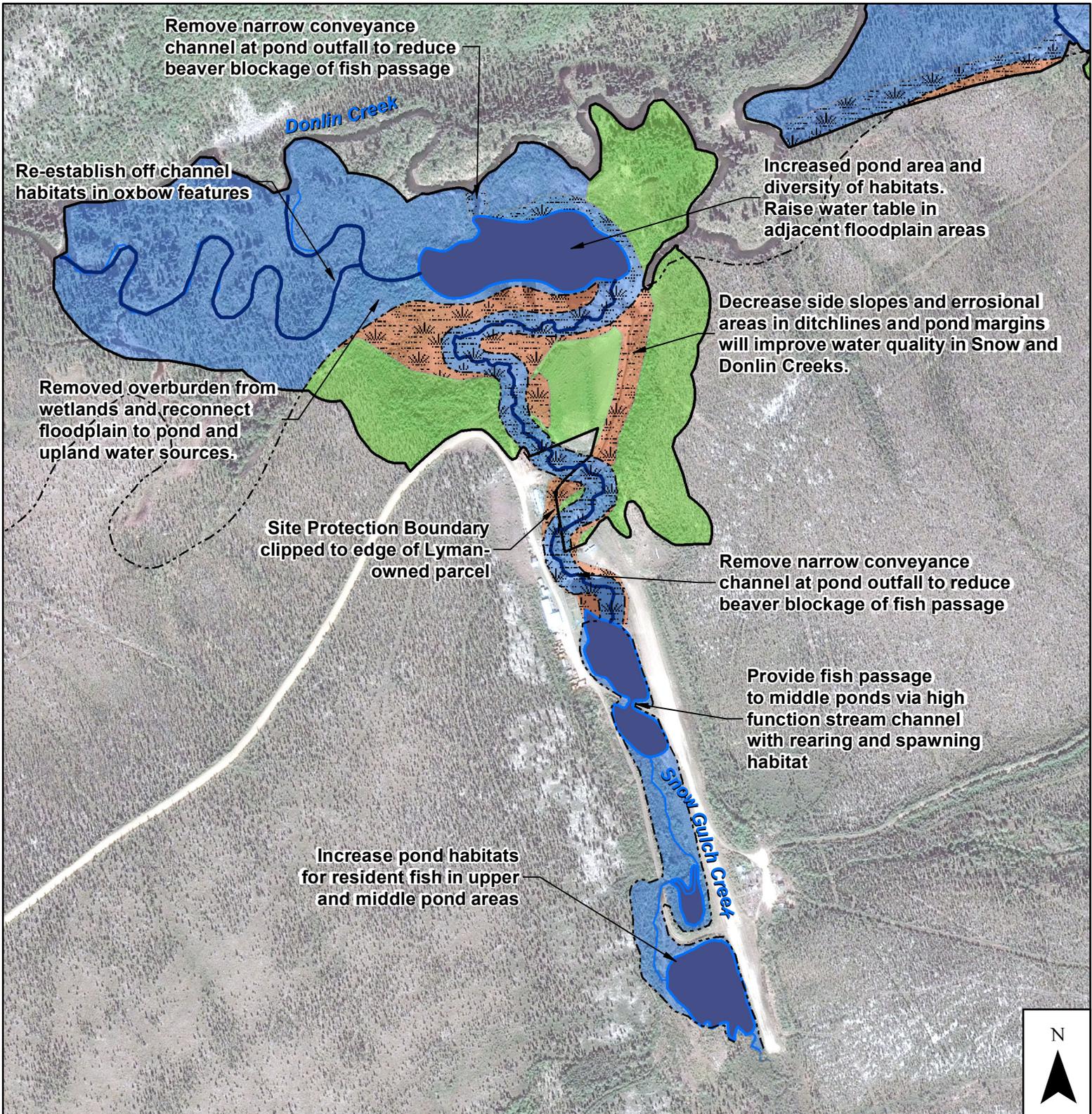
Compensatory Mitigation Plan
Attachment D, Upper Crooked
Creek PRM Plan, Appendix D-1

Snow Construction Plan

NAD 1983 UTM Zone 4N;
Imagery 0.5 m resolution, capture date 5/29/2016



Figure 6



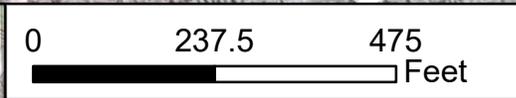
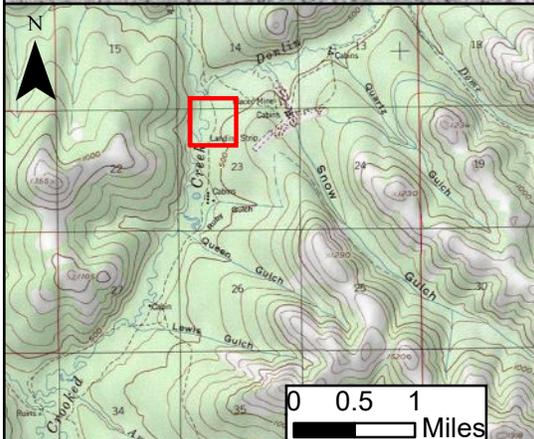
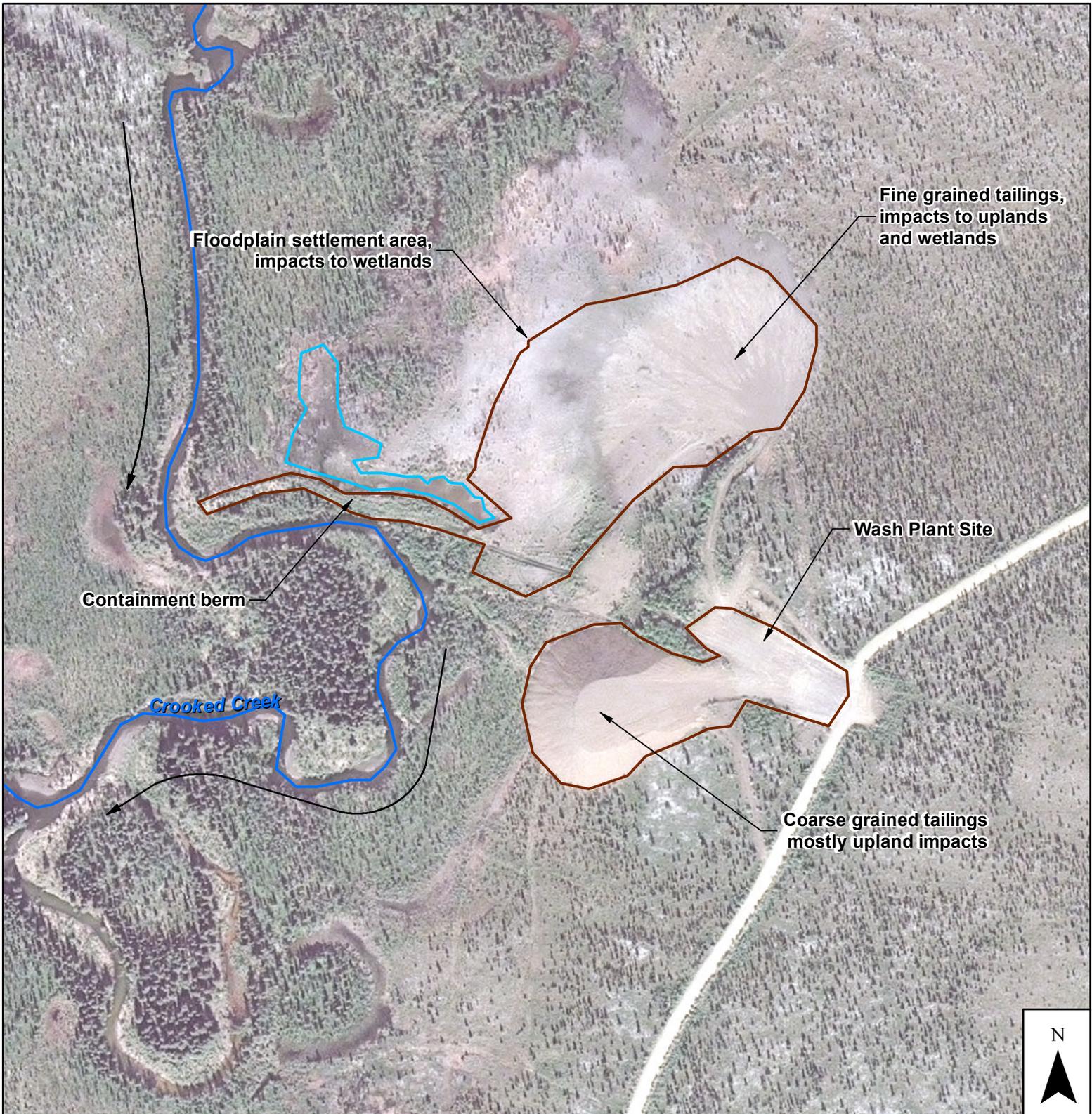
Compensatory Mitigation Plan
Attachment D, Upper Crooked
Creek PRM Plan, Appendix D-1

Snow Post-Construction

NAD 1983 UTM Zone 4N;
Imagery 0.5m resolution, capture date 5/29/16



Figure 7



Existing Site Features

-  Ditch
-  Overburden
-  Pond
-  Existing Streams
-  FlowPath

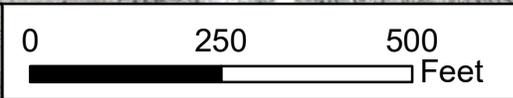
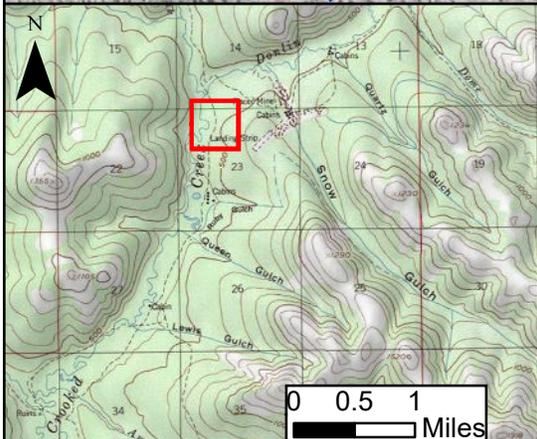
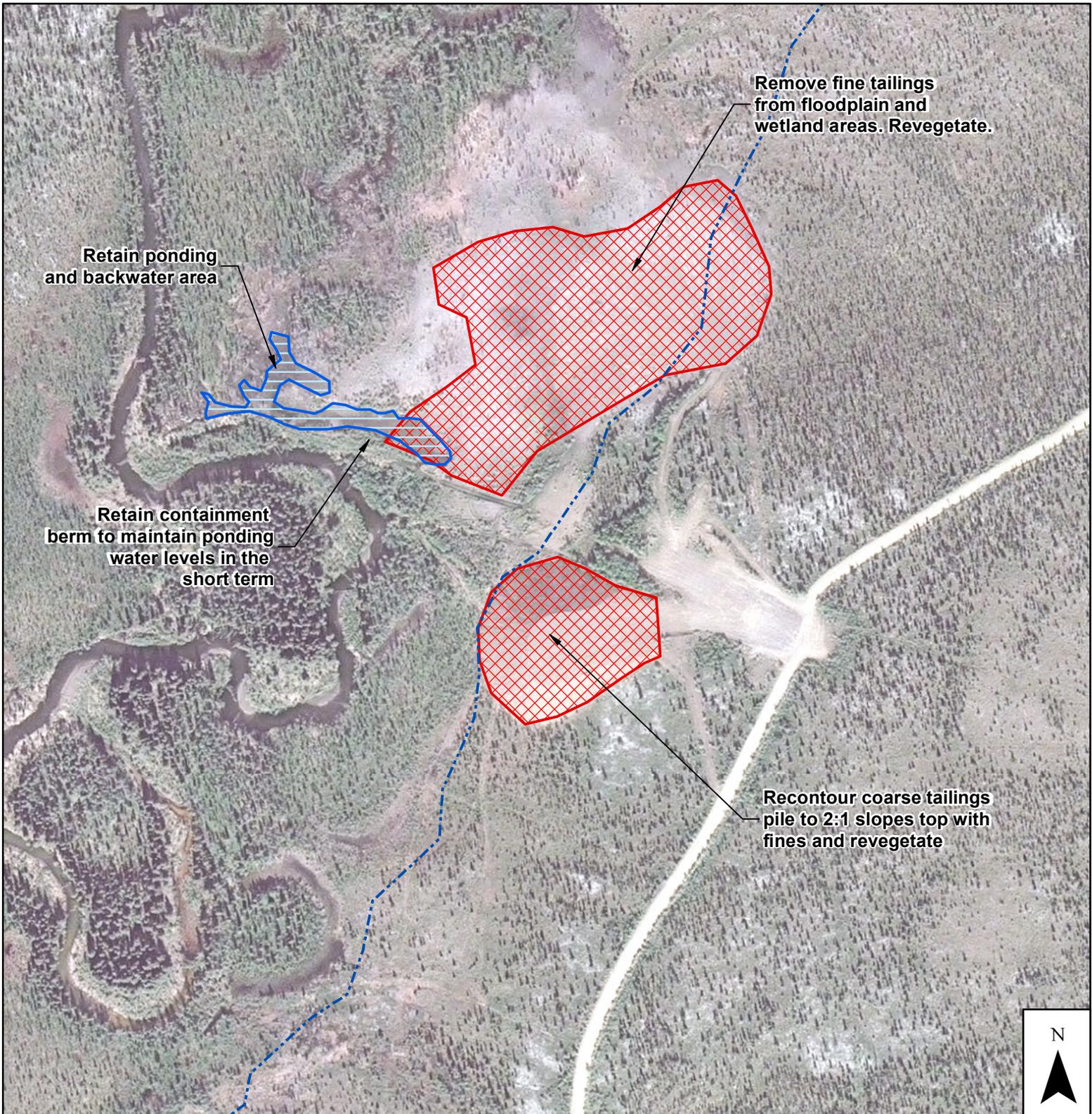
Compensatory Mitigation Plan
Attachment D, Upper Crooked
Creek PRM Plan, Appendix D-1

Wash Plant Tailings
Baseline Conditions

NAD 1983 UTM Zone 4N;
Imagery 0.5 m resolution, capture date 5/29/2016



Figure 8



- Grading Plan**
-  Regrade Cut
 -  Proposed Flood Plain Boundary
 -  Pond

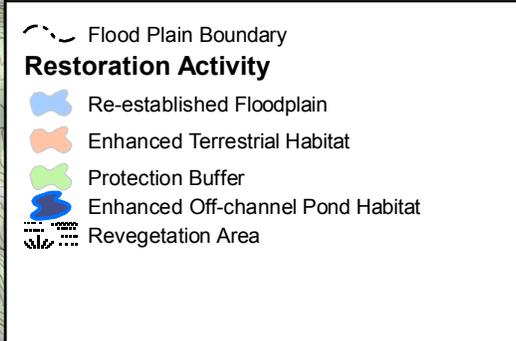
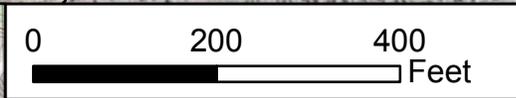
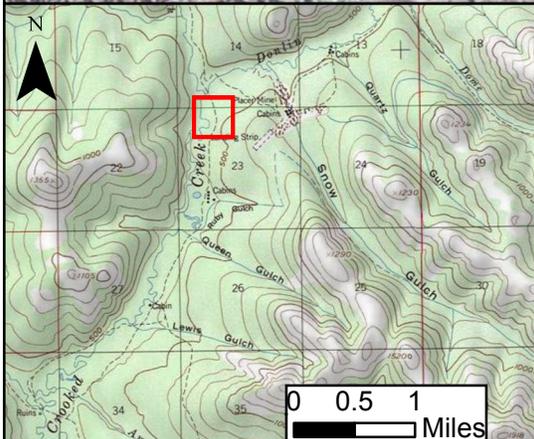
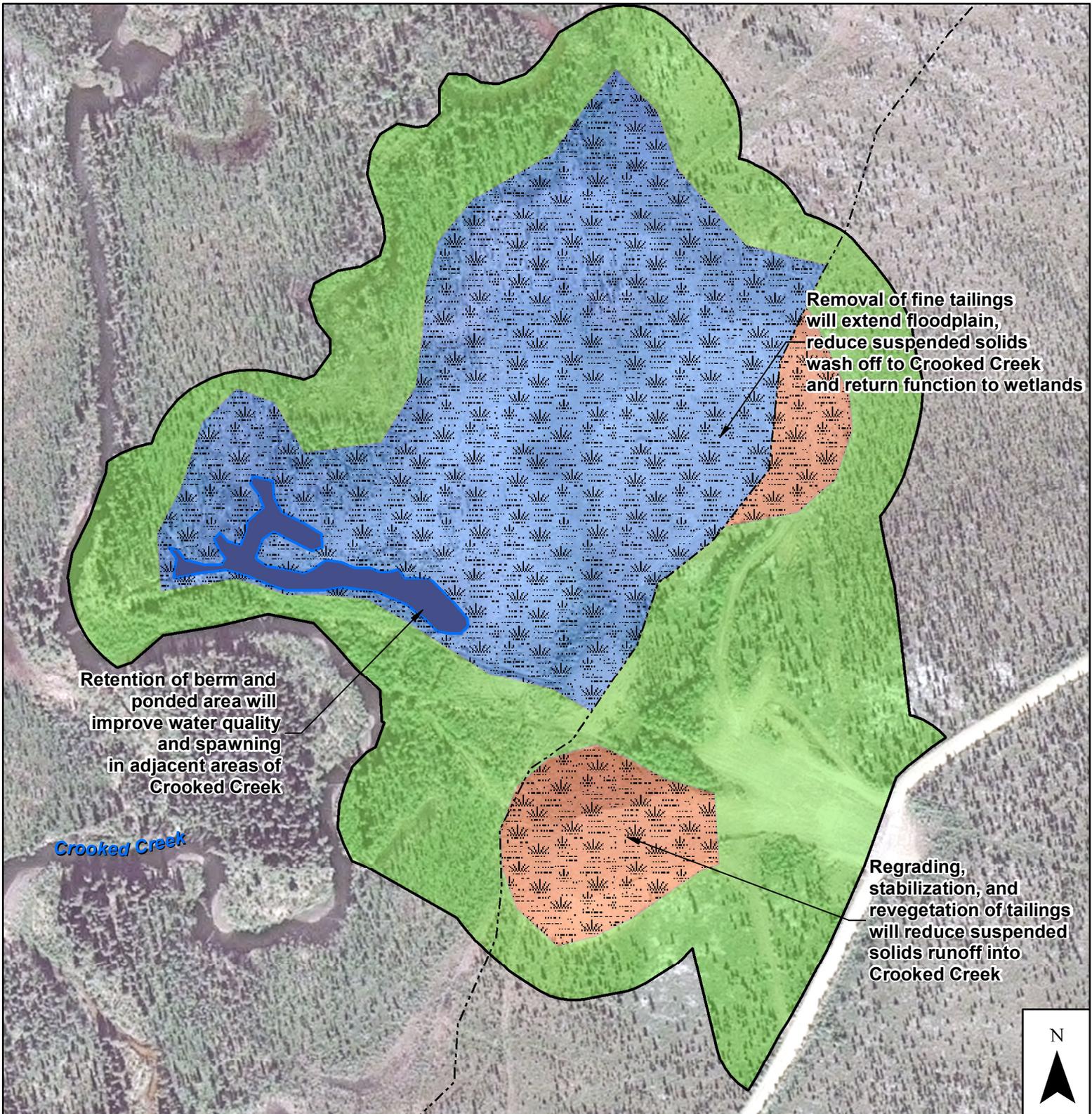
Compensatory Mitigation Plan
Attachment D, Upper Crooked
Creek PRM Plan, Appendix D-1

Wash Plant Tailings Construction Plan

NAD 1983 UTM Zone 4N;
Imagery 0.5 m resolution, capture date 5/29/2016



Figure 9



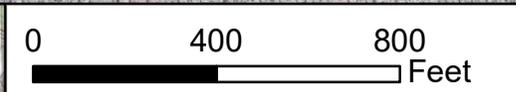
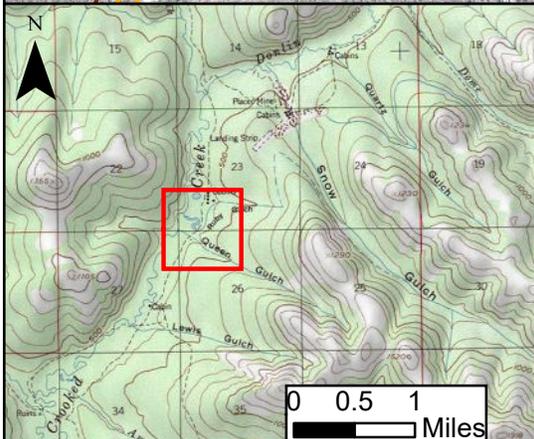
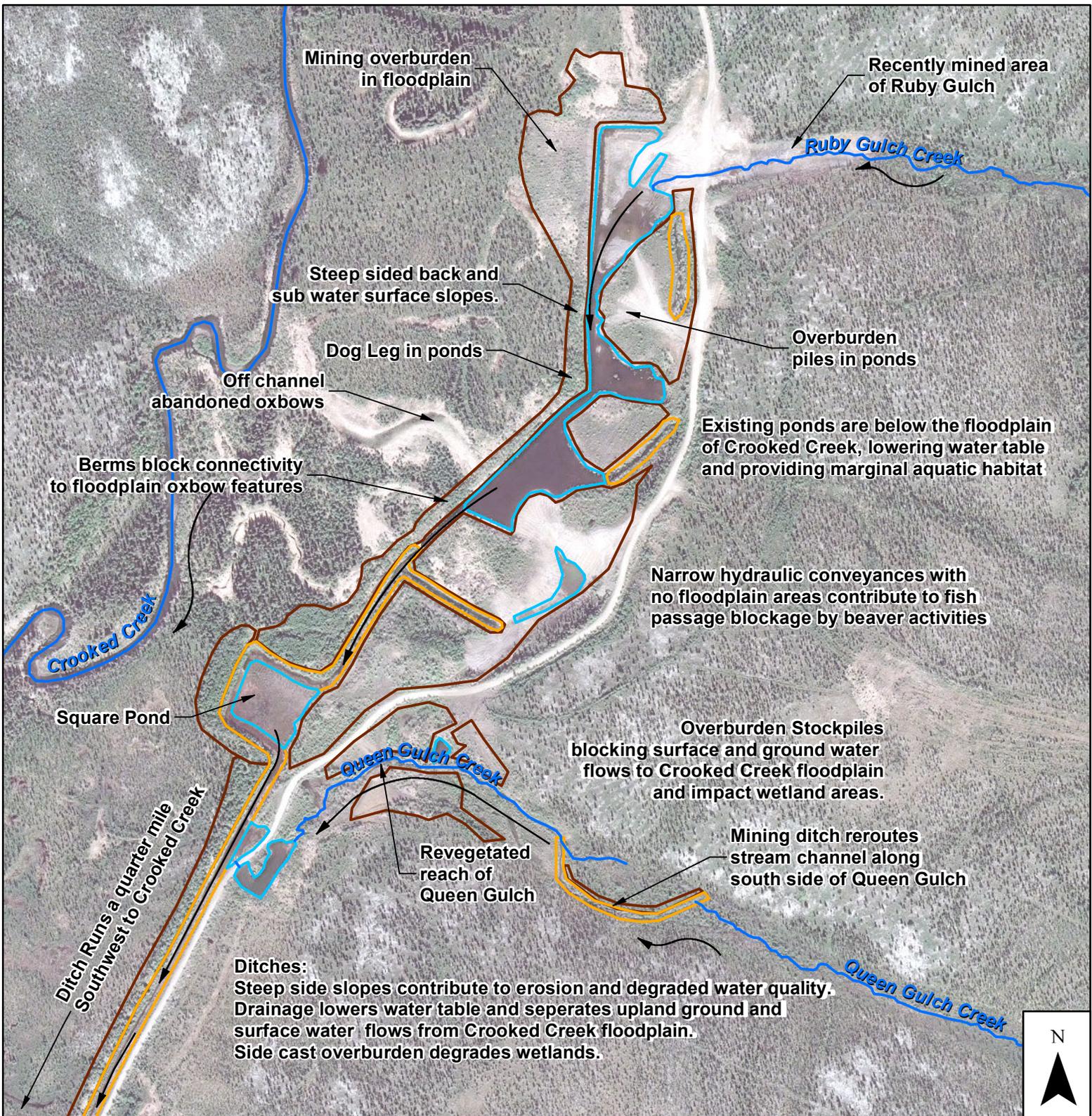
Compensatory Mitigation Plan
Attachment D, Upper Crooked
Creek PRM Plan, Appendix D-1

Wash Plant Post-Construction

NAD 1983 UTM Zone 4N;
Imagery 0.5 m resolution, capture date 5/29/2016



Figure 10



- Existing Site Features**
- Ditch
 - Overburden
 - Pond
 - Existing Streams
 - FlowPath

Compensatory Mitigation Plan
Attachment D, Upper Crooked
Creek Plan, Appendix D-1

Ruby Queen Baseline Conditions

NAD 1983 UTM Zone 4N;
Imagery 0.5 m resolution, capture date 5/29/2016



Figure 11

Fill and reshape Ruby Gulch stream to original 4.2% gradient and floodplain. Create step pool channel with larger woody debris and larger rock features and revegetate banks.

Reshape and revegetate overburden piles for stability.

Remove overburden berm to original floodplain elevation.

Reshape ponds to provide deep and shallow water habitats and stable side slopes

Fill and revegetate ditch

Fill and revegetate ditch

Create pond outlet connection to historic oxbows.

Fill and revegetate ditch

Fill and revegetate ditch

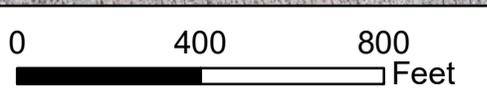
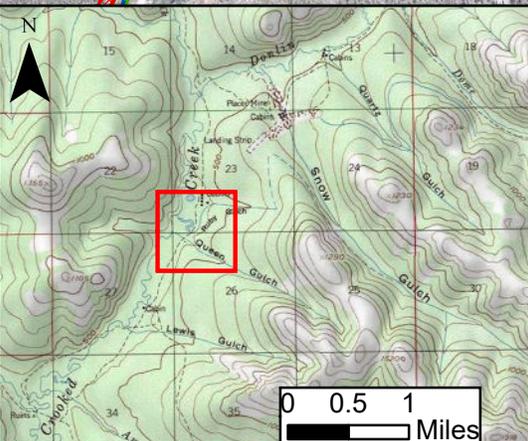
Remove overburden pile on west and south sides of pond. Reshape pond to provide deep and shallow water habitat. Provide connection to abandoned oxbow from NW corner of pond.

Deepen and reshape small ponds

Fill ditch and re-establish stream in historic channel

Provide fish passage conveyance at road crossing or remove to create low water crossing

Fill long North to South ditch with overburden pile. Re-establish historic ground water table.



- Grading Plan**
- Regrade Cut
 - Regrade Fill
 - Proposed Flood Plain Boundary
 - Proposed Stream Thalweg
 - Proposed Pond

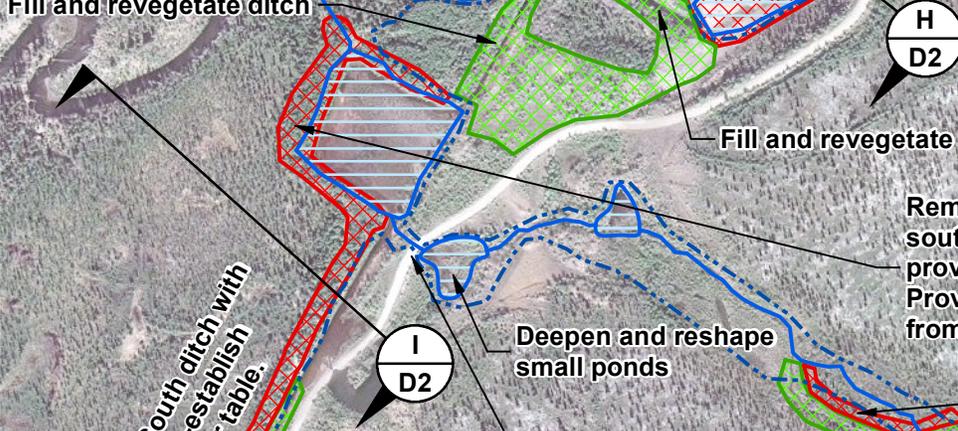
Compensatory Mitigation Plan
Attachment D, Upper Crooked
Creek PRM Plan, Appendix D-1

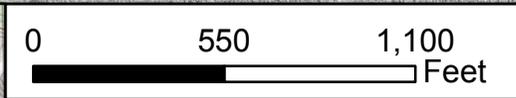
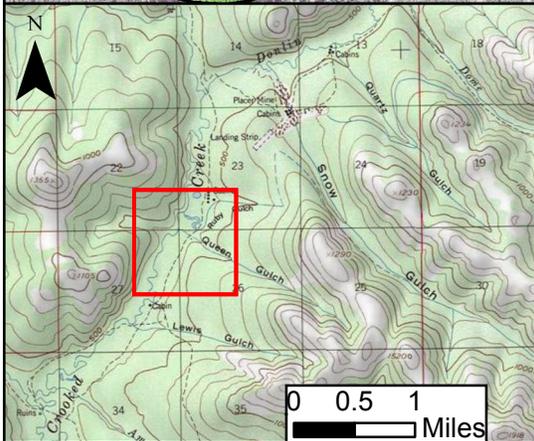
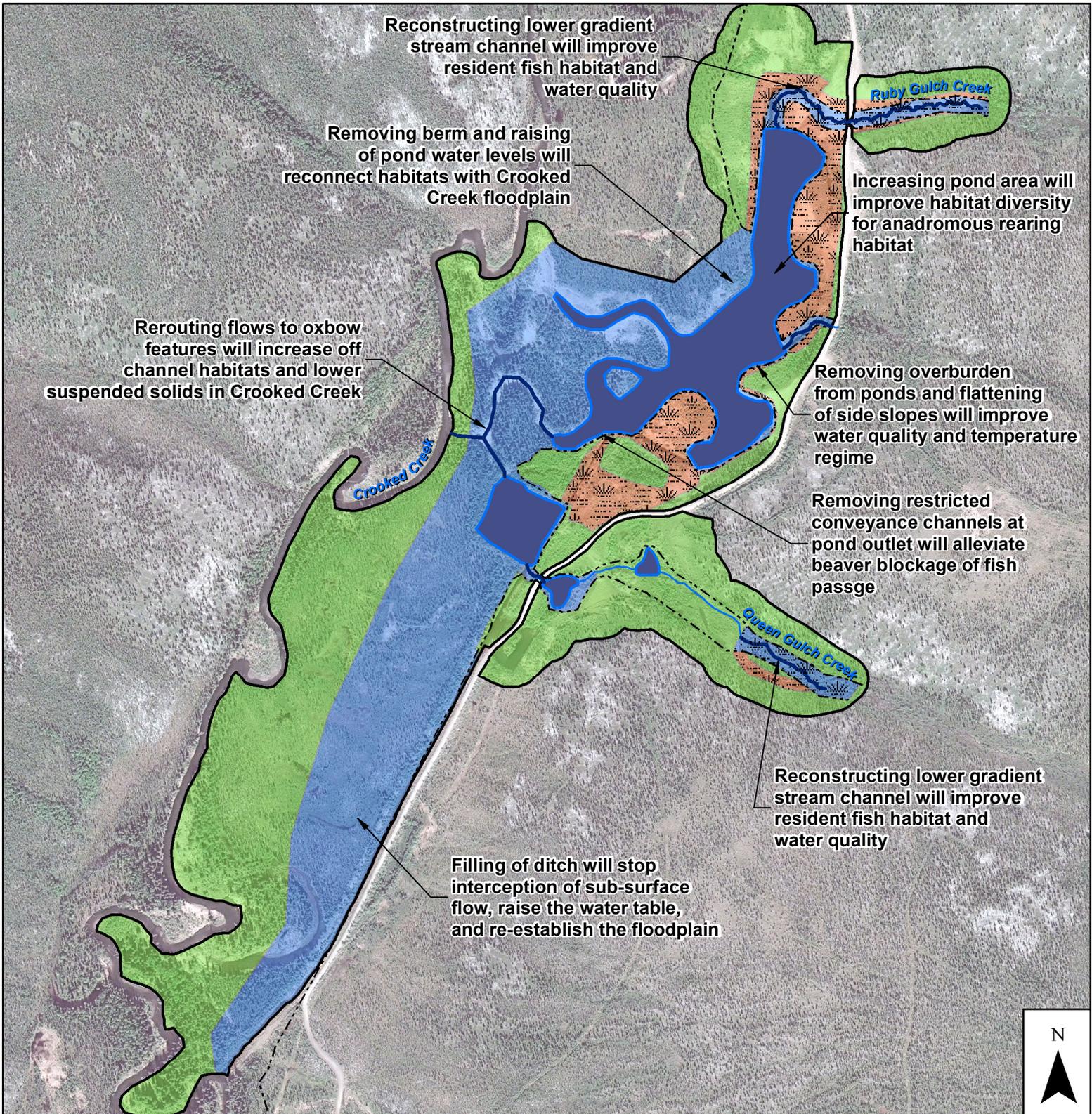
Ruby Queen Construction Plan

NAD 1983 UTM Zone 4N;
Imagery 0.5m resolution, capture date 5/29/16



Figure 12





Compensatory Mitigation Plan
Attachment D, Upper Crooked
Creek PRM Plan, Appendix D-1

Ruby Queen Post-Construction

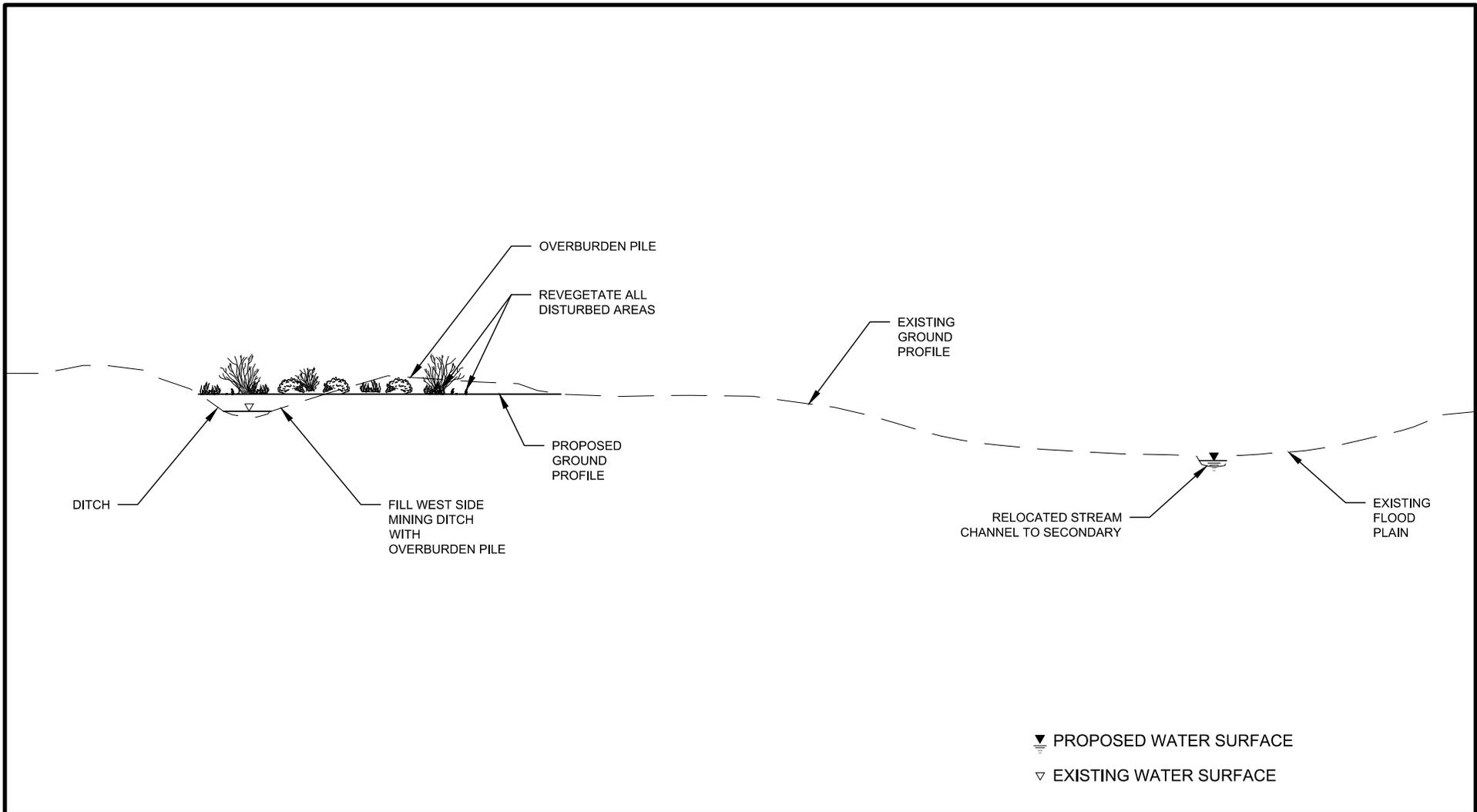
- Floodplain Boundary
- Stream
- Restoration Activity**
- Re-established Stream Channel
- Re-established Floodplain
- Enhanced Terrestrial Habitat
- Protection Buffer
- Enhanced Off-channel Pond Habitat
- Revegetation Area

NAD 1983 UTM Zone 4N;
Imagery 0.5m resolution, capture date 5/29/16



Figure 13

Appendix D-2



UPPER QUARTZ GULCH TYPICAL SECTION A



Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

Drawing is not to scale. Vertical exaggerated to show detail.

All section cuts taken facing in downstream direction.

Surface data in feet derived from ArcticDEM 2m.

Compensatory Mitigation Plan

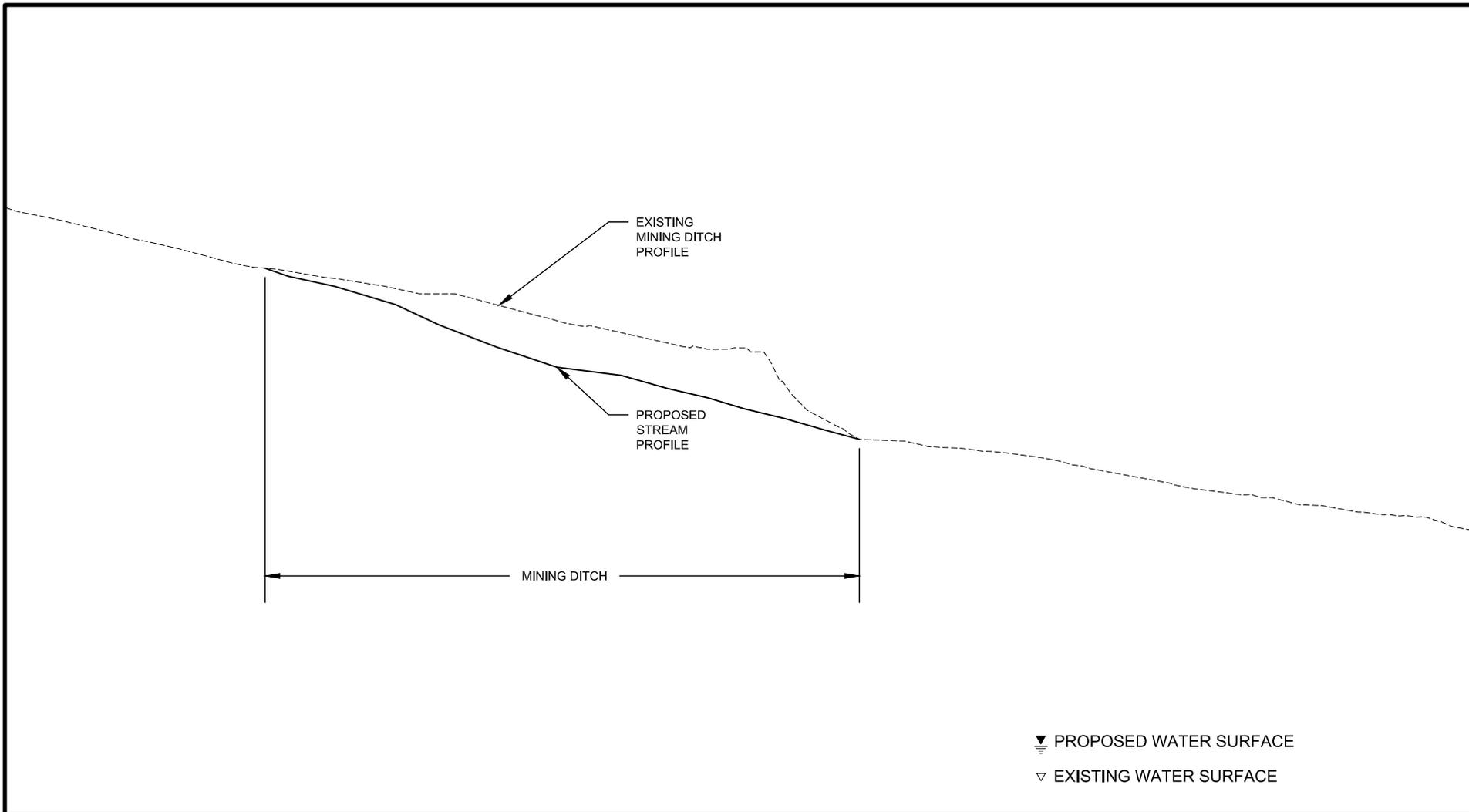
UPPER QUARTZ GULCH REMEDIATION

Drawn By: SRB

Date: 5/22/18

APPENDIX D-2

SHEET 1



UPPER QUARTZ GULCH PROFILE B

Compensatory Mitigation Plan



Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

UPPER QUARTZ GULCH RESTORATION

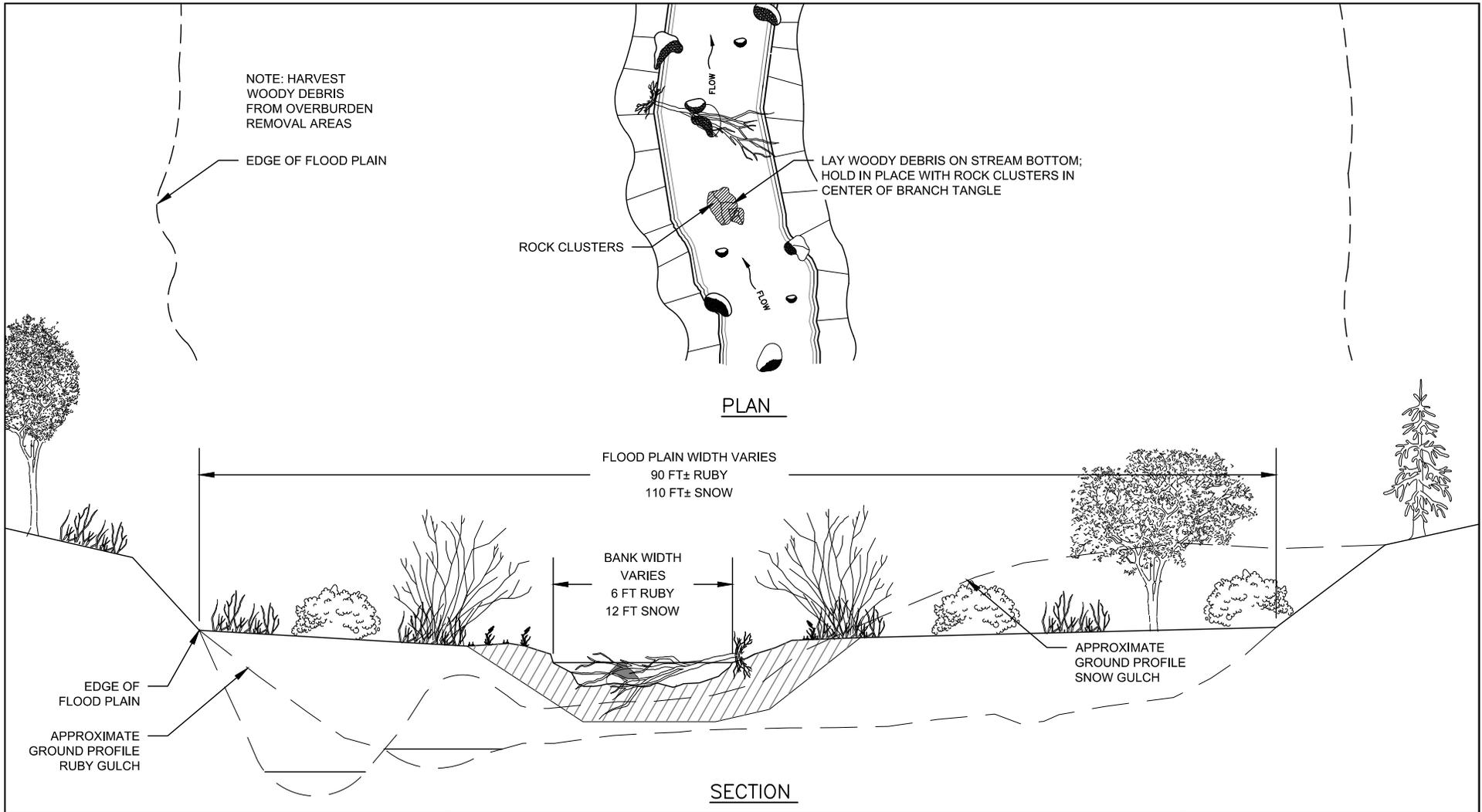
Drawing is not to scale. Vertical exaggerated to show detail.

Drawn By: SRB

All section cuts taken facing in downstream direction.

Date: 6/6/18

Surface data in feet derived from ArcticDEM 2m.



TYPICAL RESTORATION CHANNEL PLAN & SECTION

Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

Drawing is not to scale. Vertical exaggerated to show detail.

All section cuts taken facing in downstream direction.

Surface data in feet derived from ArcticDEM 2m.

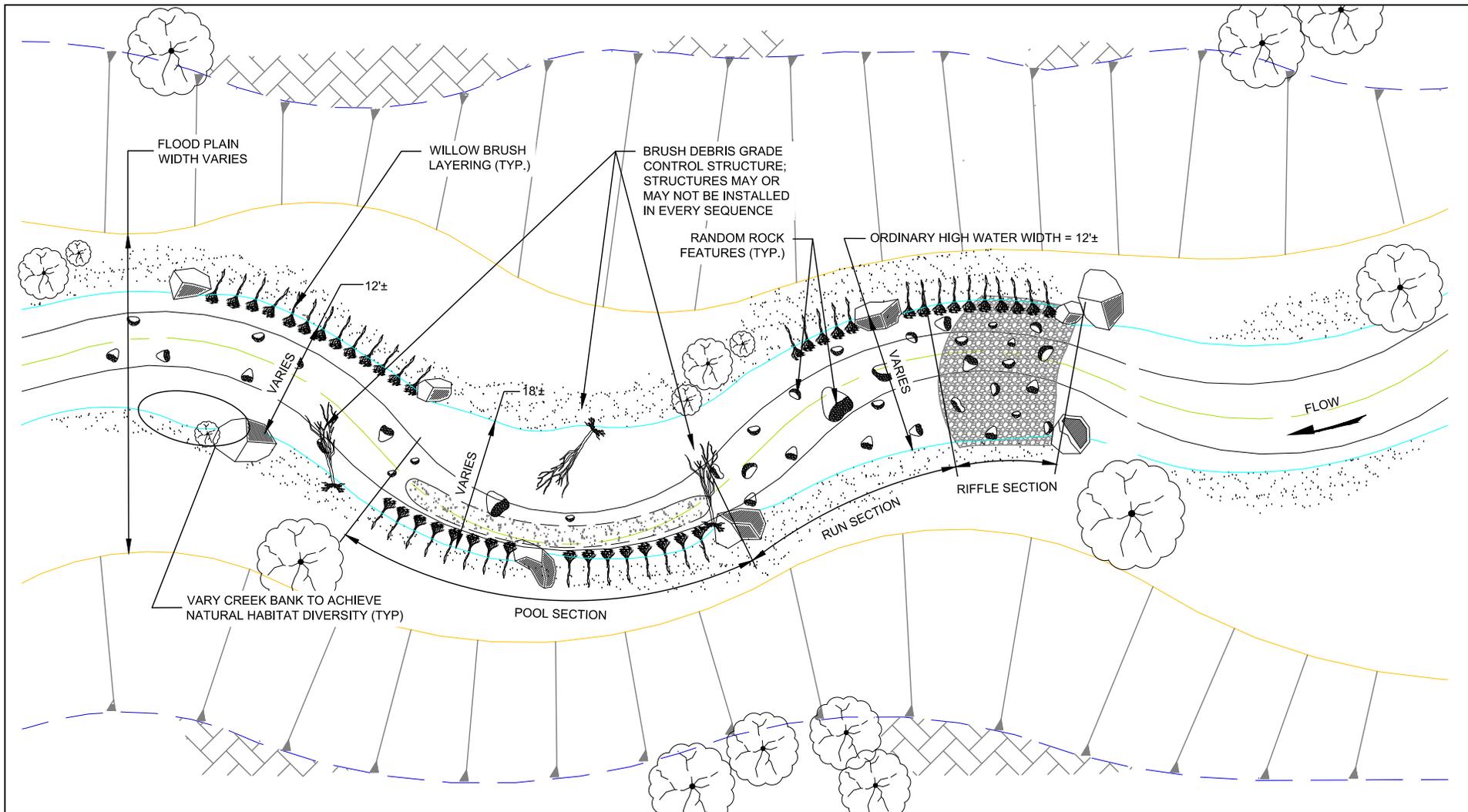
Compensatory Mitigation Plan

TYPICAL CHANNEL DETAILS

Drawn By: SRB

Date: 6/6/18

APPENDIX D-2 SHEET 3



TYPICAL STREAM CHANNEL PLAN, RIFFLE-RUN-POOL



Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

Drawing is not to scale.

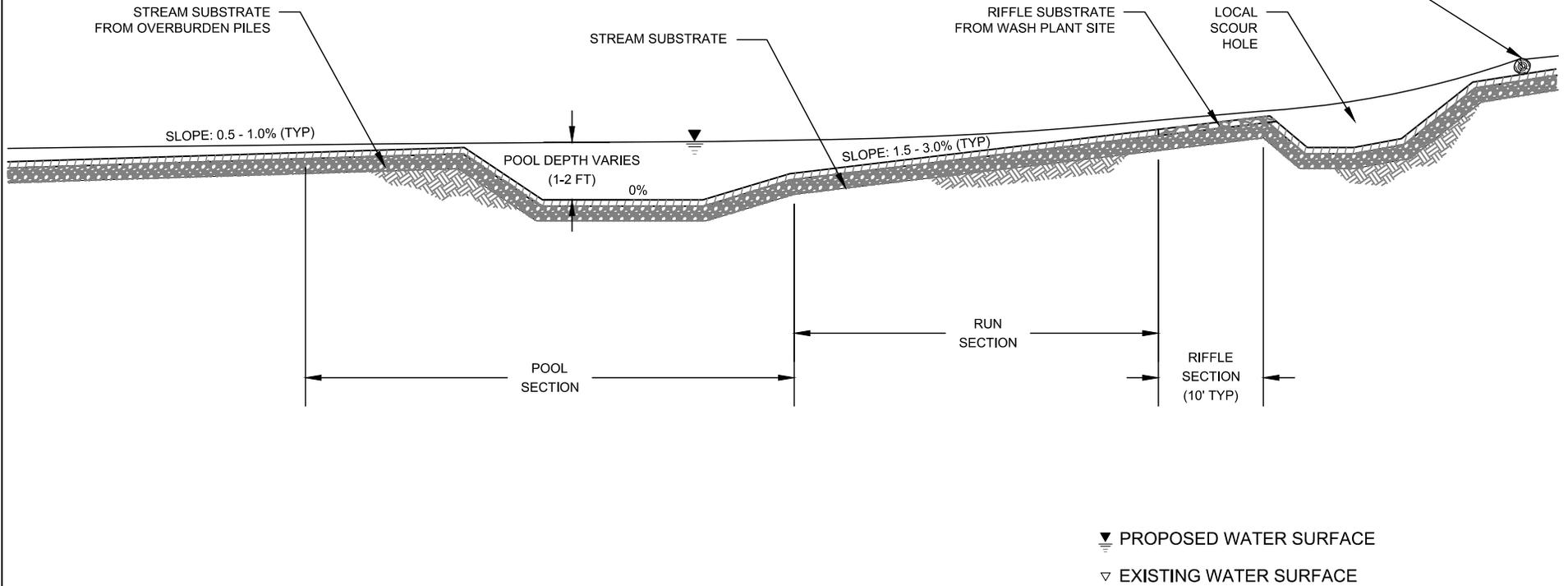
Compensatory Mitigation Plan

TYPICAL RIFFLE-RUN-POOL PLAN

Drawn By: SRB

Date: 6/6/18

LARGE WOOD DEBRIS GRADE CONTROL STRUCTURE. STRUCTURES MAY OR MAY NOT BE INSTALLED IN EVERY SEQUENCE. SEE SHEET 28 FOR HABITAT & GRADE CONTROL STRUCTURE LOCATIONS.



▼ PROPOSED WATER SURFACE

▽ EXISTING WATER SURFACE

TYPICAL STREAM CHANNEL PROFILE, RIFFLE-RUN-POOL



Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

Drawing is not to scale. Vertical exaggerated to show detail.

All section cuts taken facing in downstream direction.

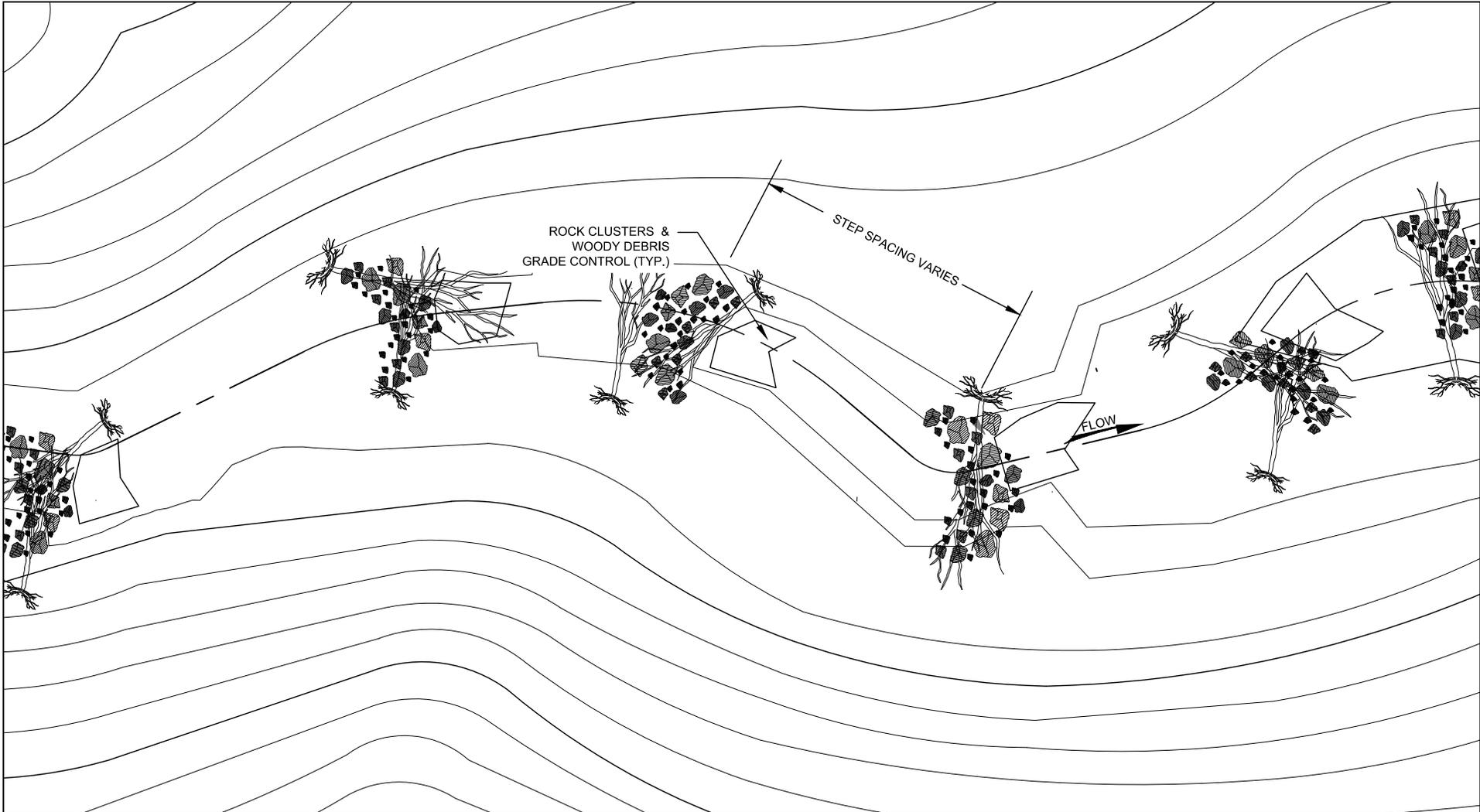
Surface data in feet derived from ArcticDEM 2m.

Compensatory Mitigation Plan

TYPICAL RIFFLE-RUN-POOL PROFILE

Drawn By: SRB

Date: 6/6/18



TYPICAL STREAM CHANNEL PLAN, STEP-POOL

Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

Drawing is not to scale. Vertical exaggerated to show detail.

All section cuts taken facing in downstream direction.

Surface data in feet derived from ArcticDEM 2m.

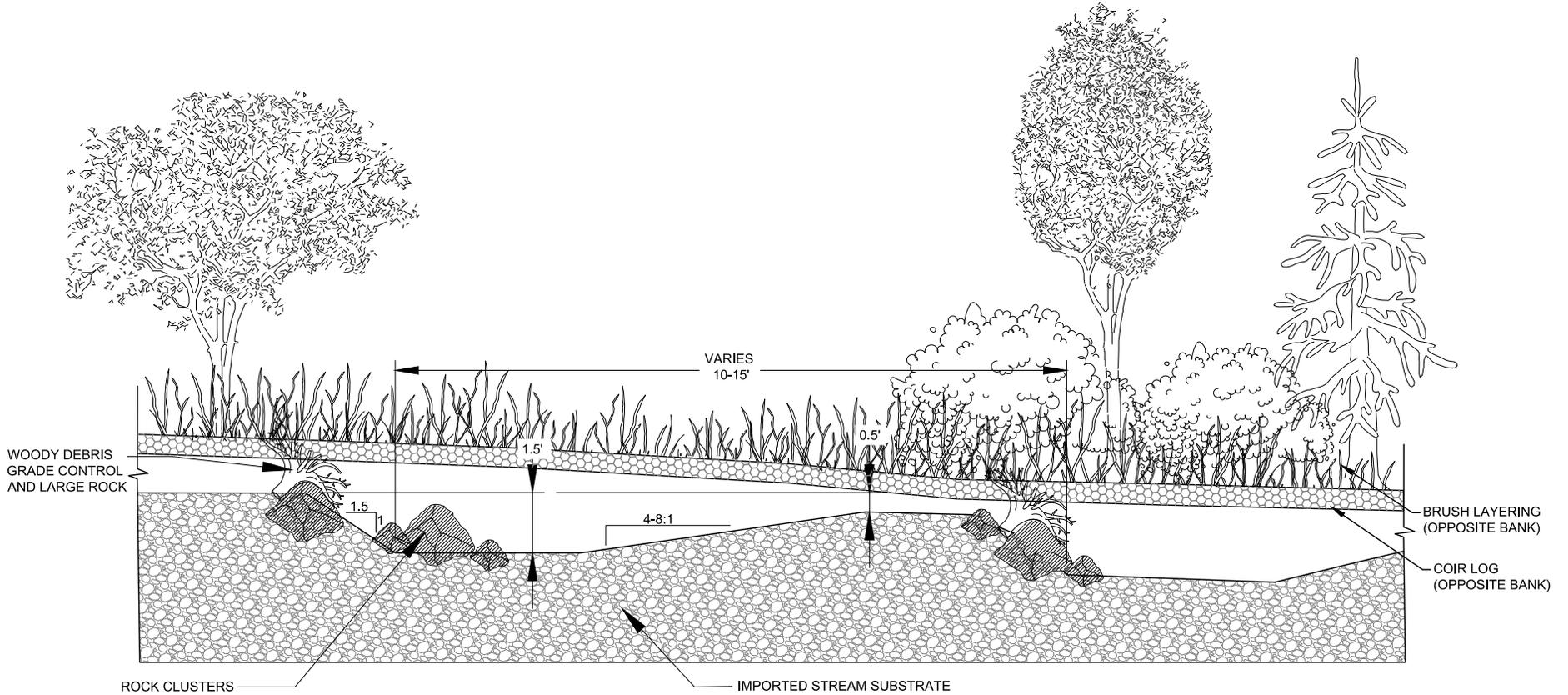
Compensatory Mitigation Plan

RUBY GULCH RESTORATION

Drawn By: SRB

Date: 6/6/18





TYPICAL STREAM CHANNEL PROFILE, STEP-POOL

Compensatory Mitigation Plan



Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

Drawing is not to scale. Vertical exaggerated to show detail.

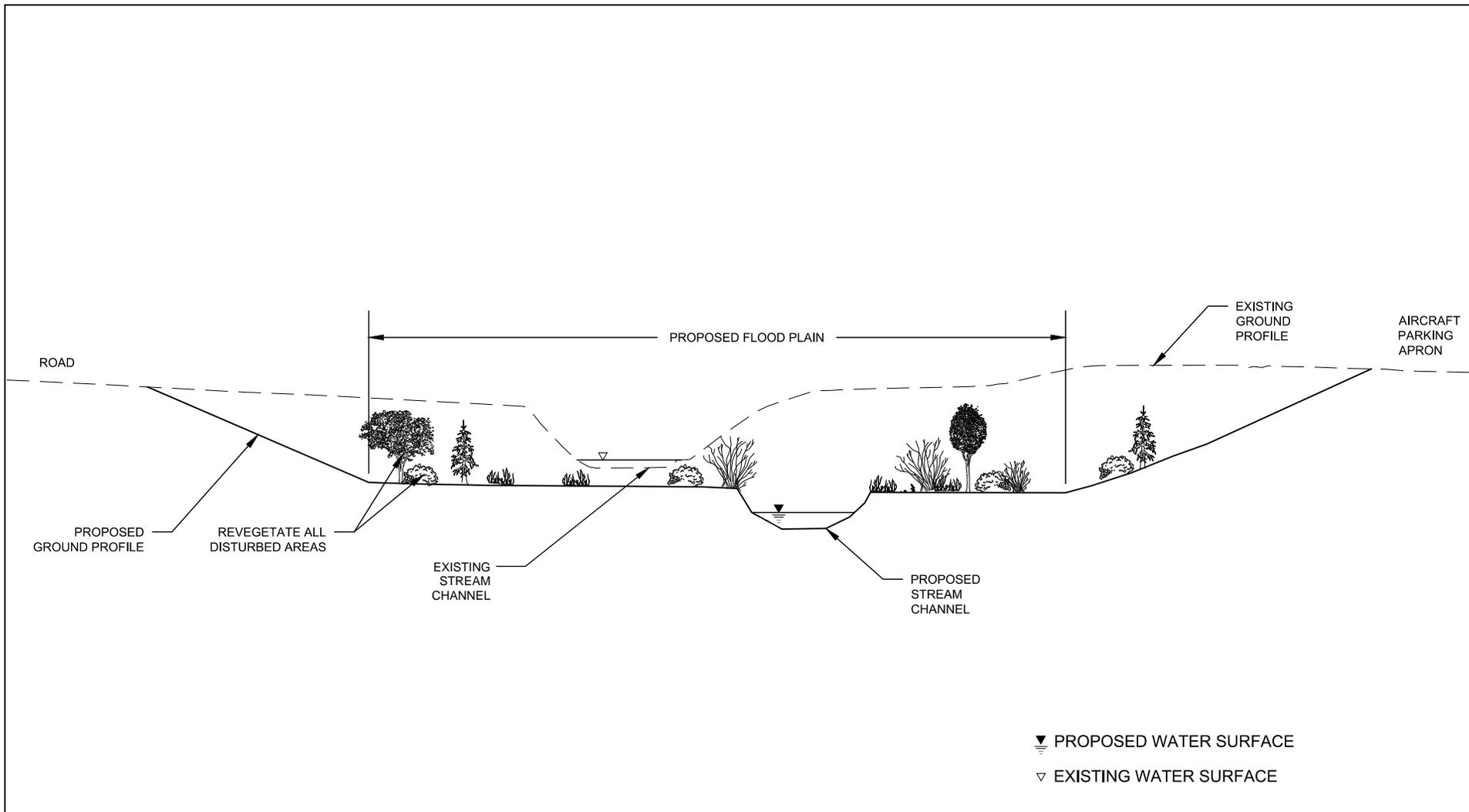
All section cuts taken facing in downstream direction.

Surface data in feet derived from ArcticDEM 2m.

RUBY GULCH RESTORATION

Drawn By: SRB

Date: 6/6/18



SNOW GULCH TYPICAL SECTION C

Compensatory Mitigation Plan



Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

SNOW GULCH RESTORATION

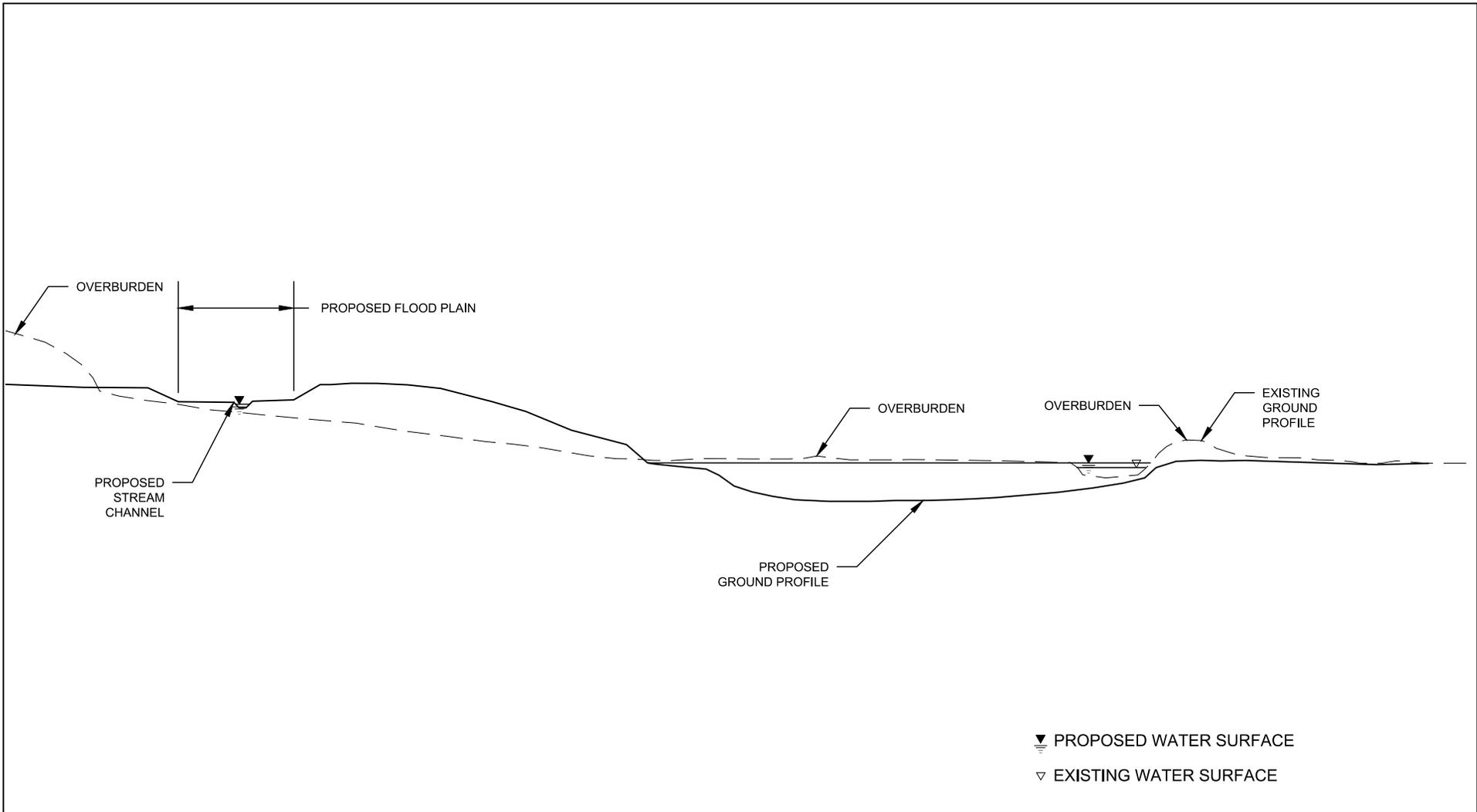
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Drawn By: SRB

All section cuts taken facing in downstream direction.

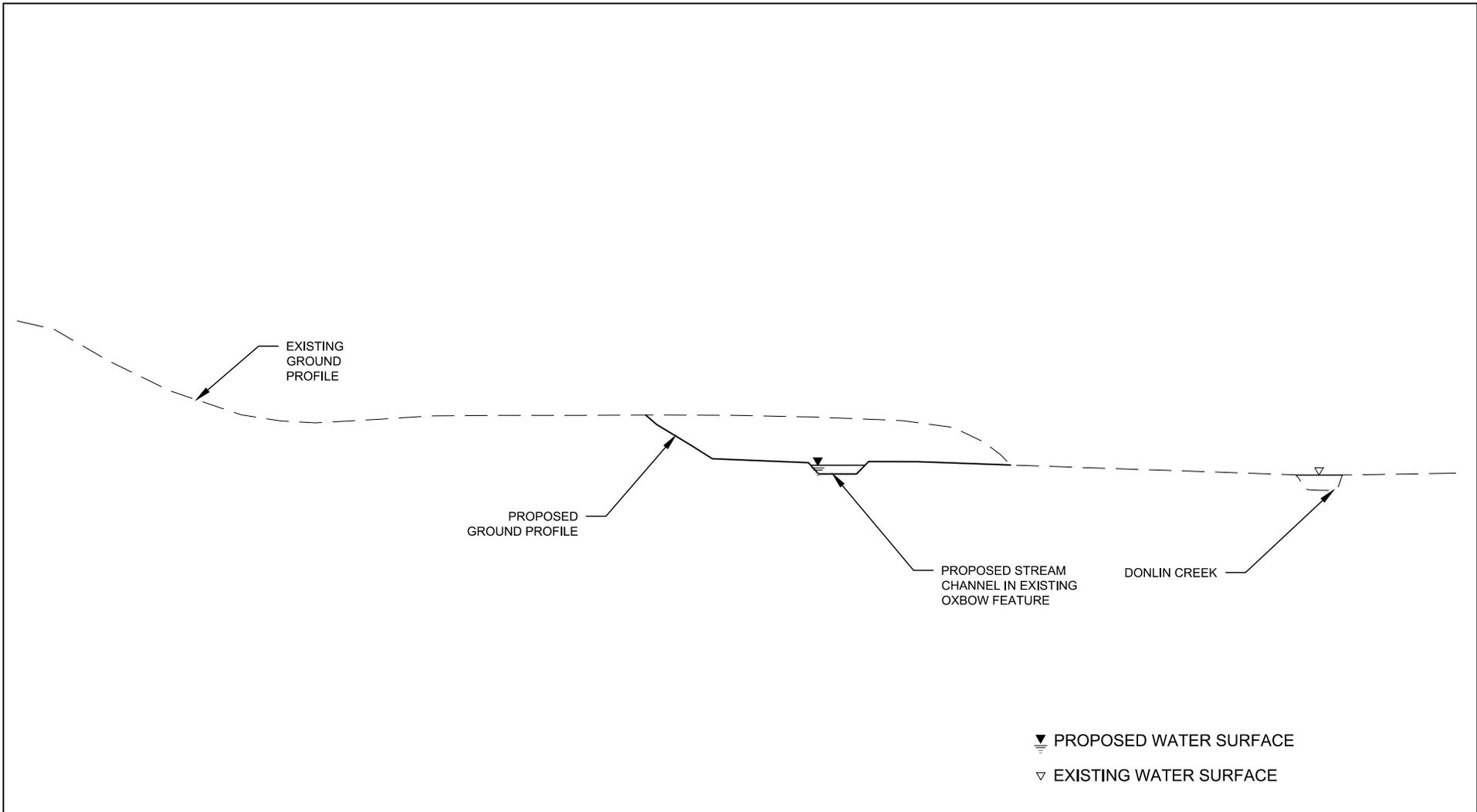
Date: 6/6/18

Surface data in feet derived from ArcticDEM 2m.



▼ PROPOSED WATER SURFACE
 ▼ EXISTING WATER SURFACE

	SNOW GULCH POND SECTION D		Compensatory Mitigation Plan	
	<p>Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.</p> <p>Drawing is not to scale. Vertical exaggerated to show detail.</p> <p>All section cuts taken facing in downstream direction.</p> <p>Surface data in feet derived from ArcticDEM 2m.</p>		SNOW GULCH POND SECTION	
			<p>Drawn By: SRB</p> <p>Date: 6/6/18</p>	
			APPENDIX D-2	SHEET 9



SNOW GULCH & DONLIN CREEK SECTION E

Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

Drawing is not to scale. Vertical exaggerated to show detail.

All section cuts taken facing in downstream direction.

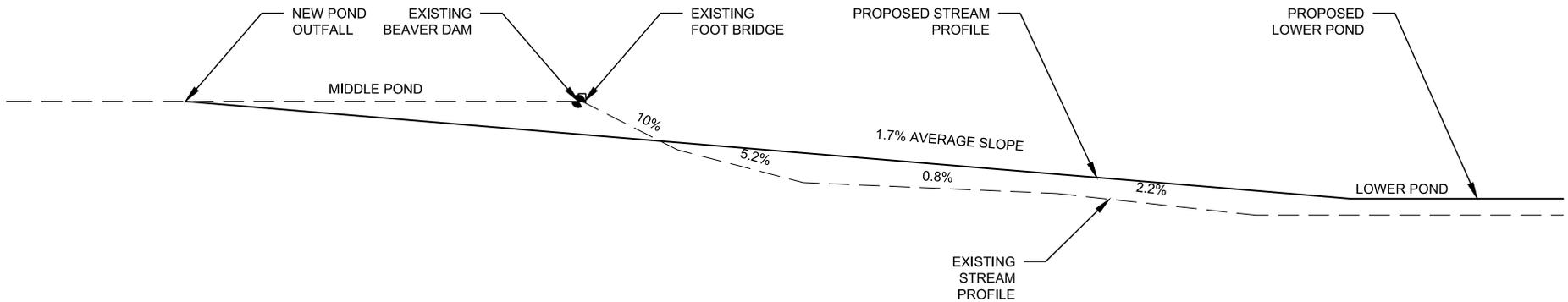
Surface data in feet derived from ArcticDEM 2m.

Compensatory Mitigation Plan

SNOW GULCH RESTORATION

Drawn By: SRB

Date: 6/6/18



SNOW GULCH PROFILE F



Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

Drawing is not to scale. Vertical exaggerated to show detail.

All section cuts taken facing in downstream direction.

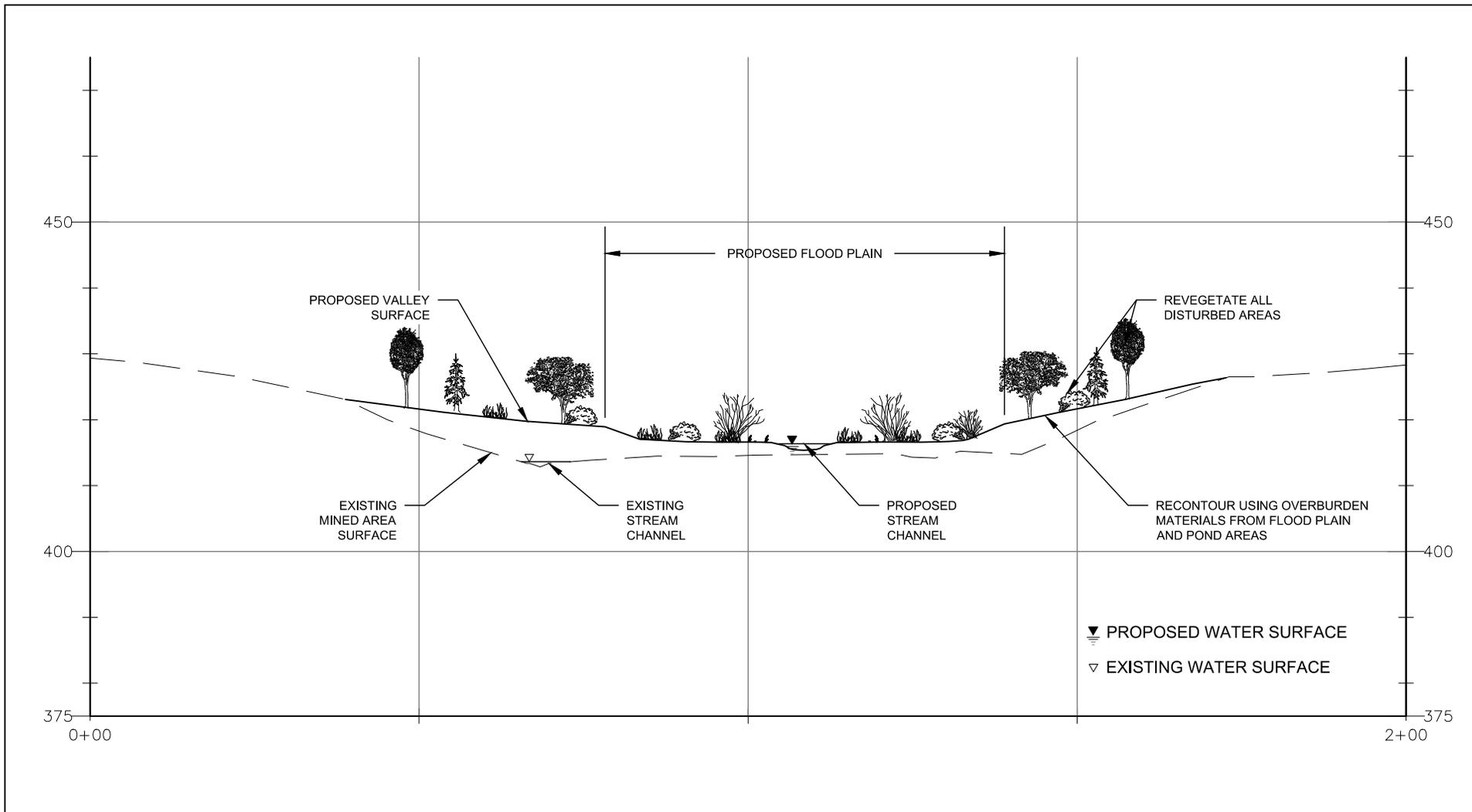
Surface data in feet derived from ArcticDEM 2m.

Compensatory Mitigation Plan

SNOW GULCH STREAM BED PROFILE

Drawn By: SRB

Date: 6/6/18



RUBY GULCH TYPICAL SECTION G



Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

Drawing is not to scale. Vertical exaggerated to show detail.

All section cuts taken facing in downstream direction.

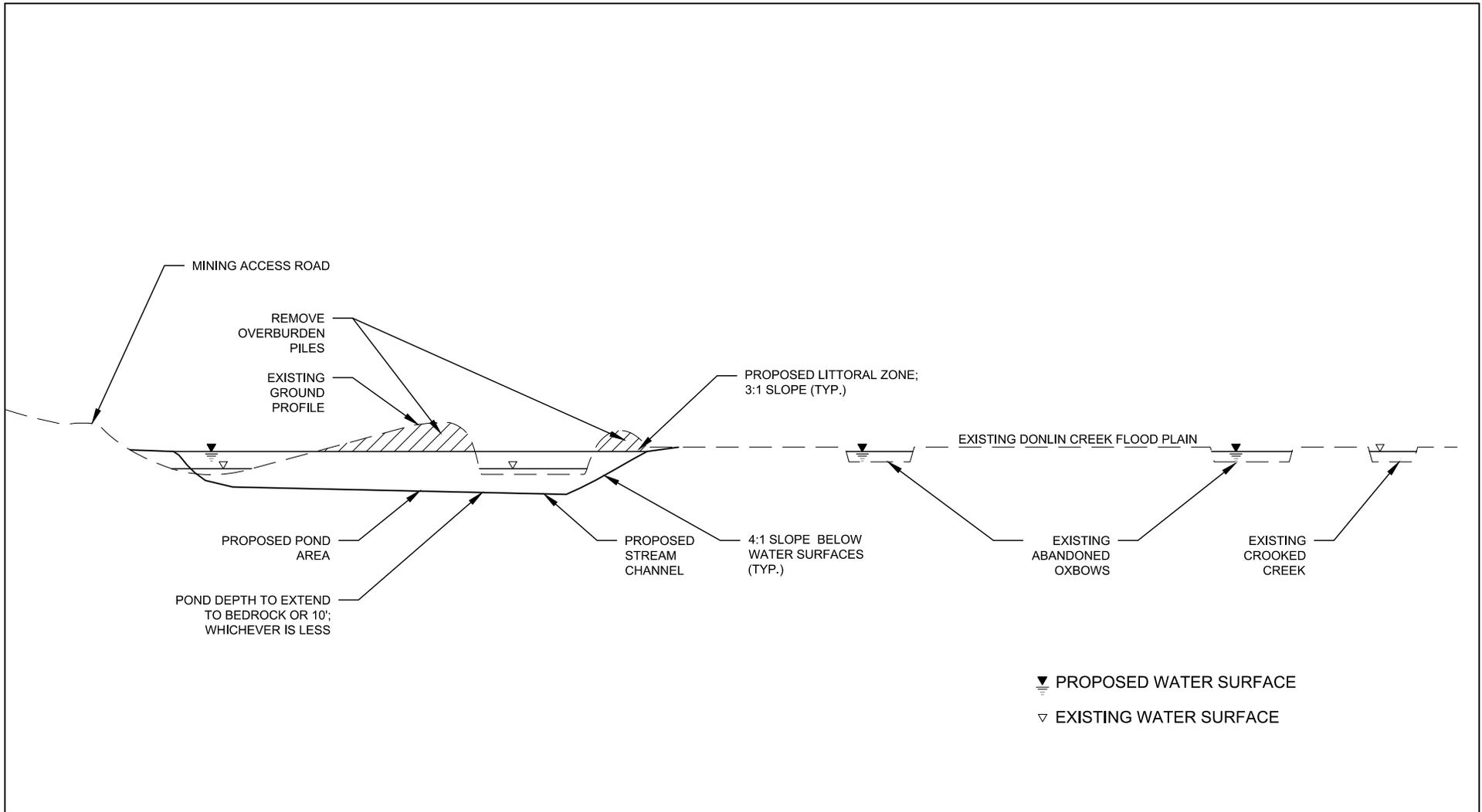
Surface data in feet derived from ArcticDEM 2m.

Compensatory Mitigation Plan

RUBY GULCH RESTORATION

Drawn By: SRB

Date: 6/6/18



RUBY-QUEEN TYPICAL SECTION H



Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

Drawing is not to scale. Vertical exaggerated to show detail.

All section cuts taken facing in downstream direction.

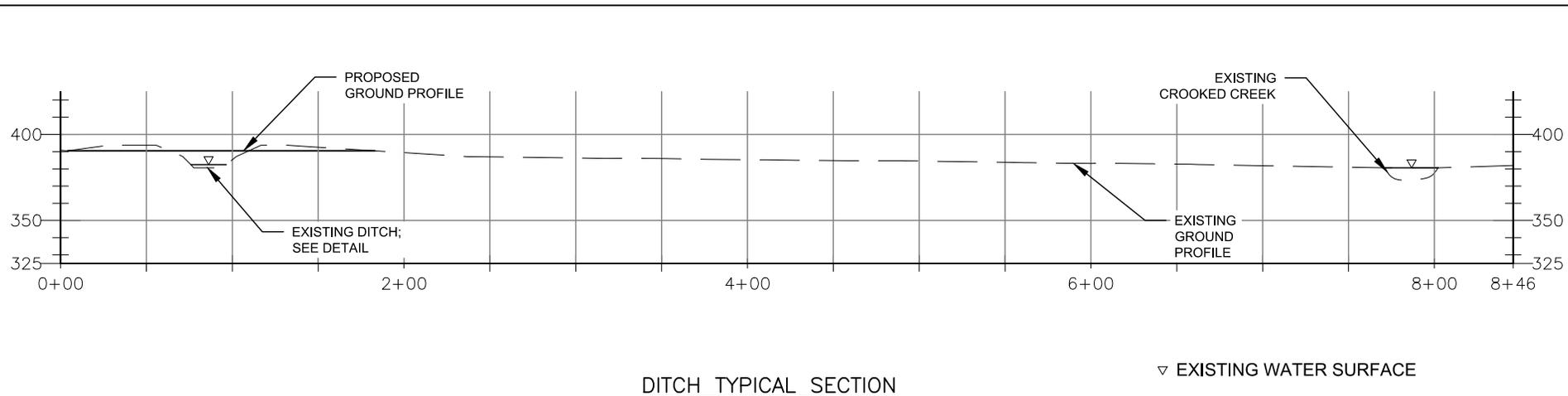
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Compensatory Mitigation Plan

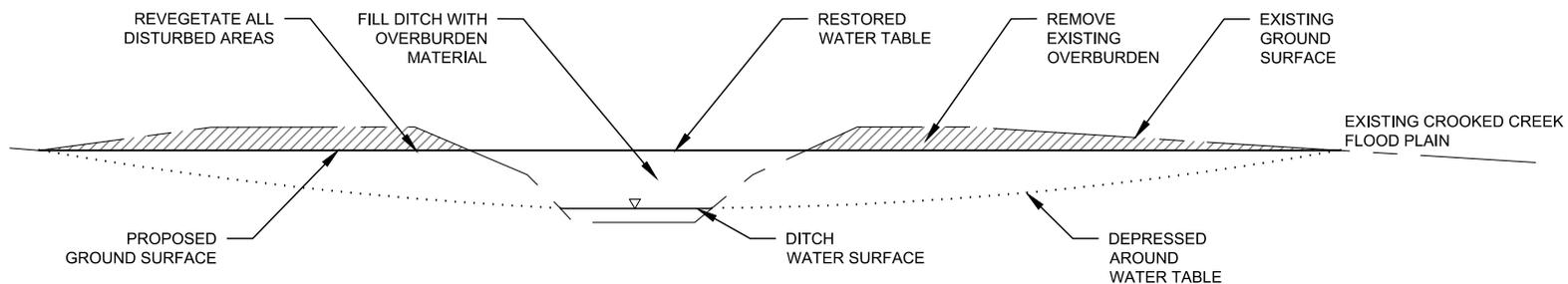
RUBY-QUEEN RESTORATION

Drawn By: SRB

Date: 6/6/18



DITCH TYPICAL SECTION



DITCH DETAIL



RUBY-QUEEN DITCH SECTION I

Notes: Not for construction. Plans are conceptual and require field verification prior to restoration activities.

Drawing is not to scale. Vertical exaggerated to show detail.

All section cuts taken facing in downstream direction.

Surface data in feet derived from ArcticDEM 2m.

Compensatory Mitigation Plan

RUBY-QUEEN RESTORATION

Drawn By: SRB

Date: 6/6/18

Attachment E
Chuitna Permittee Responsible Mitigation Plan

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Attachment E Chuitna Permittee Responsible Mitigation Plan

Objectives

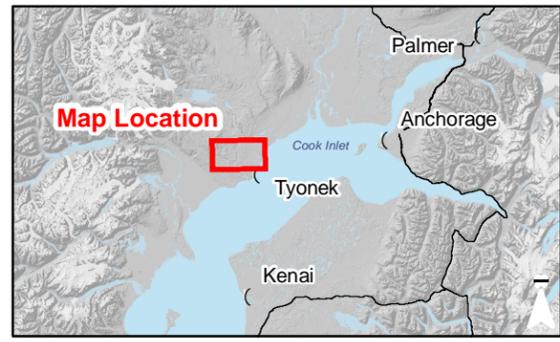
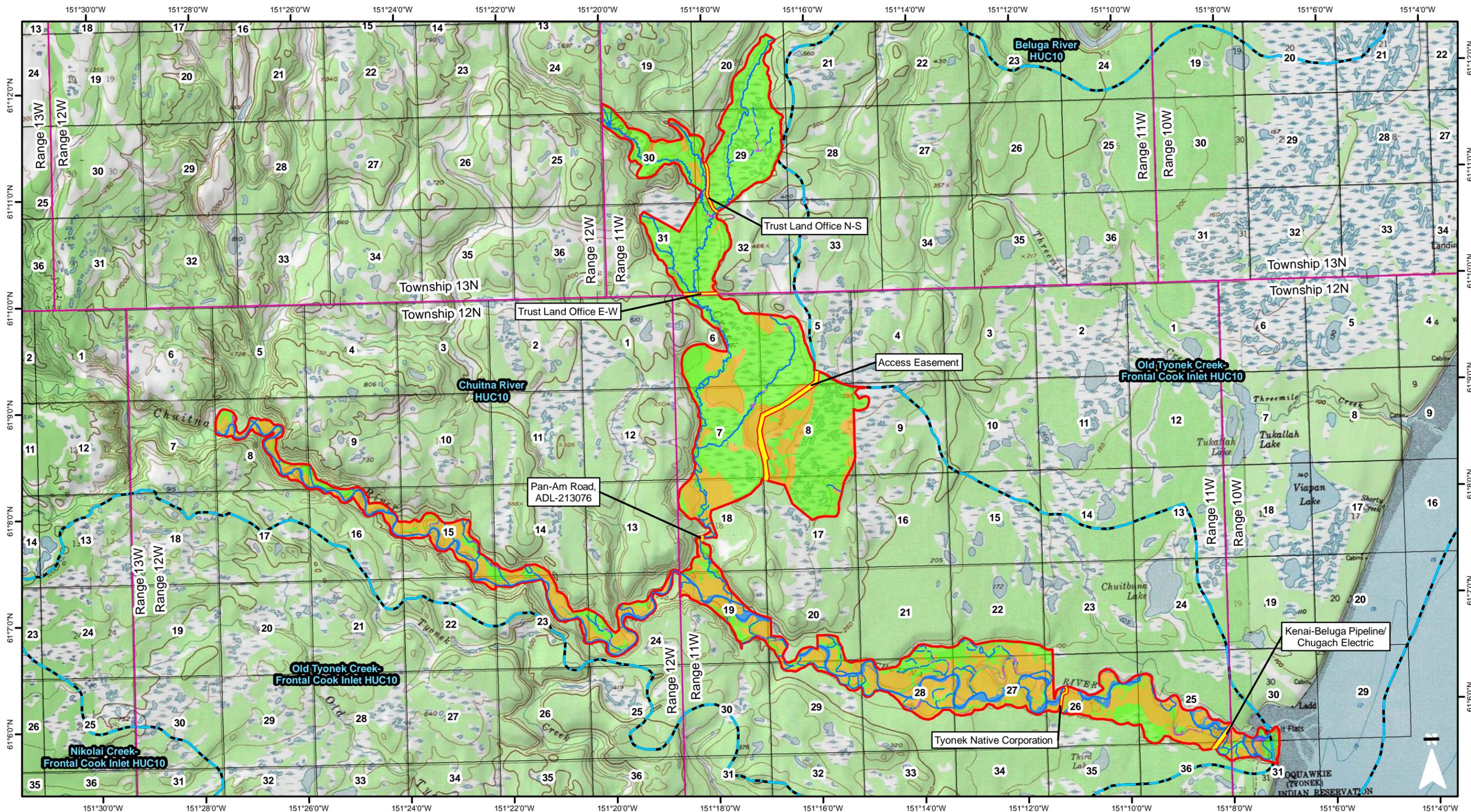
The objective of the Chuitna Permittee Responsible Mitigation (PRM) Plan (Plan) is to provide compensatory mitigation for the wetland and aquatic resource impacts associated with the Donlin Gold, LLC (Donlin Gold) Project (Project). The Plan will protect a parcel of land totaling 5,870 acres, including 3,269 acres of wetlands and ponds, and 418 acres of streams and rivers, totaling 3,687 acres of Waters of the United States (WOUS). It also protects 2,183 acres of upland riparian and buffers, and 258,056 linear feet (48.87 miles) of streams. Fill and other ground disturbing activities in wetlands in the Chuitna Preservation Area (Preservation Area) would be detrimental to aquatic habitat and wetland-dependent wildlife species, including all five species of Pacific salmon and endangered Beluga whales at the mouth of the Chuitna River. The Preservation Area is on land owned by the Tyonek Native Corporation (TNC) and the Alaska Mental Health Trust Authority (AMHT) as shown on Figure 1. Michael Baker International (Michael Baker) completed field wetland delineation work in the Chuitna Preservation Area from June 5th through 11th 2018. The field verified results are presented in this Plan. Preservation is appropriate under the 2008 Mitigation Rule (Rule) under the criteria of 33 CFR 332.3(h) (United States Army Corps of Engineers [USACE] and United States Environmental Protection Agency [EPA] 2008) and supported by the 1994 Alaska Wetland Initiative (EPA et al. 1994). In 33 CFR 332.3(3)(b)(4) of the Rule, USACE and the EPA discuss the mitigation hierarchy of mitigation banks, in-lieu fee (ILF) programs, and PRM projects. The Code of Federal Regulation (CFR) states:

“Where permitted impacts are not in the service area of an approved mitigation bank or in-lieu fee program that has the appropriate number and resource type of credits available, permittee responsible mitigation is the only option. Where practicable and likely to be successful and sustainable, the resource type and locations for the permittee-responsible compensatory mitigation should be determined using the *principles* [added emphasis] of a watershed approach...”

A portion of the natural gas pipeline includes some very limited permanent wetland impacts within the Great Land Trust ILF program and Su-Knik Mitigation Bank service areas (see Compensatory Mitigation Plan [CMP], Section 5.0). However, no existing bank or ILF programs are available for the Mine Area (MA) impacts, the Transportation Area (TA) impacts or the majority of the Pipeline Area (PA) impacts. Hence, the Preservation Area is proposed as PRM.

One concern often raised regarding PRM projects is that the applicants cannot gain control of all the land necessary for watershed level benefits; i.e., PRM areas often are small isolated areas that represent small parts of a much larger watershed area. The Chuitna parcel, in keeping with the principles of a watershed approach, provides a large, contiguous, and ecologically valuable site, selected based on its location, size, connectivity, unique aquatic values, and the ongoing threat of near-term development in the watershed. In establishing the Preservation Area, Donlin Gold specifically focused on protecting important and productive wetlands and streams at the watershed level. The parcel boundaries were determined through a detailed planning process that is based on geographic features. The goal is to

protect the streams and associated floodplains as well as the valley slopes adjacent to the floodplain. In most areas, the boundary is defined by the crest at the top of the valley.



- | | |
|-----------------------------|-------------------------------|
| Field Verified Stream/River | Field Verified Mapping |
| HUC 10 Watershed Boundary | Wetland |
| Easement | Pond/Lake/Ocean |
| Proposed Preservation Area | River/Stream |
| Public Land Survey Section | Upland |

1 Inch = 1 Mile 1:63,360

Seward Meridian, NAD 1983 UTM Zone 5N
National Geographic Society 2011 1:63,000 TOPO
Date: 7/16/2018

**Chuitna PRM
Preservation Area**

Figure 1

The unique and valuable ecological features of the Preservation Area are:

- The parcel is composed of productive wetlands, streams, and upland habitats. This diversity contributes to the ecological success and long-term sustainability of the watershed.
- The size and location of the parcel provide a connection between the hydrologic source waters in the Alaska Range, through shallow ground water that flows through the wetland string bogs, the tributaries, and finally to the Chuitna River and Cook Inlet.
- The ericaceous shrub bog-string bog wetlands, a specific type of slope Hydrogeomorphic (HGM) wetlands (also known as patterned fens) are a unique wetland type to the area, and only occur in a few very specific places worldwide.
- The parcel preserves important wetlands, riparian areas, and buffers adjacent to anadromous streams containing five Pacific salmon species.
- The riparian wetland areas provide ecological functions and services to maintain and protect water quality.
- The parcel contains estuarine habitat in Cook Inlet which supports Beluga whales and is part of the designated critical habitat area for this listed endangered species.

The method of legal conservation is land preservation via deed restrictions. The resources for preservation contribute to the ecological sustainability of the watershed, including Pacific salmon.

Site Selection Criteria

Regulatory Considerations

The Rule was consulted to determine the site selection criteria framework. Mitigation plans must address the following criteria if preservation is proposed [33 CFR 332.3(h)]:

1. "The resources preserved must provide important physical, chemical, or biological functions for the watershed;
2. The resources preserved must contribute significantly to the ecological sustainability of the watershed. In determining the contribution of those resources to the ecological sustainability of the watershed, the district engineer must use appropriate quantitative assessment tools, where available;
3. Preservation is determined by the district engineer to be appropriate and practicable;
4. The resources are under threat of destruction or adverse modifications;
5. The preserved site will be permanently protected through an appropriate real estate or legal instrument (e.g., easement, title transfer to state resource agency or land trust)."

In determining parcel size and location, Donlin Gold sought preservation parcels that provided:

- Important physical, chemical, or biological functions within a watershed;
- Contained wetland and aquatic resources that contribute significantly to the ecological sustainability of the watershed; and
- Provided sufficient acreage to offset the Project's permanent impacts to wetlands by at least an acre per acre.

To define ecological sustainability Donlin Gold consulted the Rule [33 CFR 332.3(d)(1) and 40 CFR 230.93(d)(1)]. In determining the ecological suitability, the following factors were considered:

- “(i) Hydrological conditions, soil characteristics, and other physical and chemical characteristics;
- (ii) Watershed-scale features, such as aquatic habitat diversity, habitat connectivity, and other landscape scale functions;
- (iii) The size and location of the compensatory mitigation site relative to hydrologic sources and other ecological features;
- (iv) Compatibility with adjacent land uses and watershed management plans;
- (v) Reasonably foreseeable effects the compensatory mitigation project will have on ecologically important aquatic or terrestrial resources (e.g., shallow sub-tidal habitat, mature forests), cultural sites, or habitat for federal or state listed, threatened and endangered species;
- (vi) Other relevant factors including, but not limited to, development trends, anticipated land use changes, habitat status and trends, the relative locations of the impact and mitigation sites in the stream network, local or regional goals for the restoration or protection of particular habitat types or functions (e.g., re-establishment of habitat corridors or habitat for species of concern), water quality goals, floodplain management goals, and the relative potential for chemical contamination of the aquatic resources.”

To help determine parcel size and location, Donlin Gold referred to the definitions (33 CFR 332.2) of “Riparian area” and “Buffer” to construct the boundaries of the parcel within the watershed, so the threats adjacent to the parcel would not degrade its features and functions. The definitions state:

- “Riparian areas are lands adjacent to streams, rivers, lakes, and estuarine marine shorelines. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality.”
- “Buffer means an upland, wetland, and/or riparian area that protects and/or enhances aquatic resource functions associated with wetlands, rivers, streams, lakes, marine, and estuarine systems from disturbances associated with adjacent land uses.”

Using the regulatory framework of the Rule, Donlin Gold developed its site selection criteria to evaluate size, location, wetlands, aquatic resources, hydrology, and ecological sustainability of preservation parcels. Donlin Gold adopted the following site selection criteria:

The site needs to supply watershed scale hydrology, wetlands, or soils providing aquatic habitat diversity, habitat connectivity, and aquatic and terrestrial resource habitats for Pacific Salmon and, if possible, federal or state listed, threatened and endangered species. The site needs to supply adequate wetland and riparian area to replace aquatic resources lost commensurate with project impacts. There must be sufficient parcel size to buffer preserved wetlands and streams from adjacent threat.

Preservation Area Location and Size

The Preservation Area is located on the west side of Cook Inlet within the Cook Inlet Lowlands Major Land Resource Area (MLRA). The Preservation Area totals 5,870 acres, and includes 3,269 acres of

wetlands and 258,056 linear feet (48.87 miles) of streams, in part of the most densely populated region of the state. Existing and potential future land use within the MLRA includes agriculture, logging, commercial fishing, mining, and oil and gas extraction. Additionally, tourism, recreation, urban development, and subsistence activities contribute to impacts within the area (Natural Resources Conservation Service [NRCS] 2004).

The parcel contains wetlands and aquatic stream resources to sufficiently offset the potential losses of aquatic resources associated with the Project. In addition, the parcel includes buffers that further protect this key portion of the Chuitna watershed and the important physical, chemical, and biological functions of the wetlands and streams.

Mitigation credits can include both wetlands and buffers. "District engineers may require the restoration, establishment, enhancement, and preservation, as well as the maintenance, of riparian areas and/or buffers around aquatic resources where necessary to ensure the long-term viability of those resources. Buffers may also provide habitat or corridors necessary for the ecological functioning of aquatic resources. If buffers are required by the district engineer as part of the compensatory mitigation project, compensatory mitigation credit will be provided for those buffers." [33 CFR 332.3(h)(2)(i)].

Preservation Area Wetland Ecology

The Preservation Area acreages in this Plan are rounded to the nearest whole number and will be further defined in the Chuitna Preservation Area Preliminary Jurisdictional Determination (PJD) anticipated in late July 2018. For comparison purposes, Project fill quantities in this Plan are also rounded to the nearest whole number; these data are from the 2016 PJD (Michael Baker 2016) and 2017 Department of Army (DA) Application (Donlin Gold 2017).

The Preservation Area linear feet and wetland acres have been calculated to avoid double-counting. Stream credits are calculated in linear feet, and wetland credits are calculated in acres. Streams visible in aerial imagery have been delineated as polylines and polygons. The polylines are used to calculate linear feet of stream length, while the polygons are used to delineate stream and wetland boundaries and to exclude stream acres from the overall credit calculation.

Wetlands have been classified using HGM (Brinson 1993) and National Wetland Inventory (NWI) (Cowardin et al. 1979) systems. The label "Riverine" is used in both classification systems.

- HGM: Following Brinson (1993), riverine HGM only applies to wetlands adjacent to streams where the dominant water source is hyporheic or overland flow from the stream. No streams delineated as polygons have been included in the riverine HGM wetland total. The riverine HGM applies only to wetlands.
- NWI: Following Cowardin et al. (1979), NWI riverine is a system level class that applies to habitats contained within a channel. Polylines classified under NWI as riverine correspond to stream systems, and count toward linear feet of stream. Polygons classified under NWI as riverine are not counted in the total wetland credit acres.

The Preservation Area contains wetlands and aquatic resources that are unique to the area and provide valuable ecosystem functions at the watershed level. The Preservation Area includes headwater streams flowing through large bogs, connecting to intermediate streams with highly productive salmon and riparian habitat, into an anadromous river, and to its outlet through an estuarine area into Cook Inlet. Most of the Preservation Area is located within the Chuitna River HUC-10 watershed (5,852 acres or greater than 99 percent), while a small portion at the mouth of the Chuitna River is located within the Old Tyonek Creek-Frontal Cook Inlet HUC-10 watershed (18 acres or less than 1 percent).

The two HUC-10 watersheds were mapped using the NWI and total 182,304 acres, of which 64,226 acres (35 percent) are WOUS. (Table 1). The Preservation Area totals 5,870 acres, of which 3,687 acres (62.8 percent) are WOUS (Table 2).

Table 1 Chuitna River and Old Tyonek Creek-Frontal Cook Inlet Watershed Wetlands and Waters (Acres, Percent)

Wetland Type (NWI)	Acres	Percent
Freshwater Emergent Wetland	9,156	5
Freshwater Forested/Shrub Wetland	27,337	15
Estuarine and Marine Wetland	13,212	7
Freshwater Pond	1,104	<1
Lake	1,487	<1
Estuarine and Marine Deepwater	10,707	6
Riverine (Stream and River Area)	1,223	<1
Total Wetland and Waters	64,226	35
Upland Riparian and Buffer	118,078	65
Total Area	182,304	100

Source: National Wetlands Inventory (NWI) 2017

Table 2 Preservation Area Wetlands and Waters and Buffers (Acres, Percent)

Wetland Type	Acres	Percent
Wetlands and Ponds	3,269	55.7
Stream and River Area	418	7.1
Total Wetlands and Waters	3,687	62.8
Upland Riparian and Buffer	2,183	37.2
Total Mapped Area	5,870	100.0

Source: Field Verified Mapping, Michael Baker June 2018

Wetlands and waters within the Preservation Area have been characterized through field verified mapping by HGM classification (Brinson 1993), summarized in Table 3; vegetation type classification based on a modified Viereck Classification System (Viereck et.al. 1992), summarized in Table 4; and Cowardin classification (Cowardin et al. 1979), summarized in Table 5.

The most common NWI mapped wetland vegetation type in the two HUC-10 watersheds is freshwater forested/shrub followed by estuarine habitat, the majority of which is within the Old Tyonek Creek-Frontal Cook Inlet watershed.

The most common wetland types in the field verified Preservation Area are ericaceous shrub bog-string bog and low shrub bogs.

Table 3 Preservation Area HGM Classification (Acres, Percent)

HGM Classification	Acres	Percent
Depressional	79	1.3
Estuarine Fringe	29	0.5
Riverine	500	8.5
Riverine Channel	418	7.1
Slope	2,661	45.3
Total Wetlands/WOUS	3,687	62.8
Upland Riparian and Buffer	2,183	37.2
Total Mapped Area	5,870	100.0

Source: Field Verified Mapping, Michael Baker June 2018

Notes: Apparent inconsistencies due to rounding

Table 4 Preservation Area Vegetation Type Classification (Acres, Percent)

Vegetation Type	Field Verified Acres	Field Verified Percent
Forested Types		
Open Black Spruce Forest	252	4.3
Black Spruce Woodland	206	3.5
Open Deciduous Forest	7	0.1
Closed Mixed Forest	5	0.1
Open Mixed Forest	523	8.9
Woodland Deciduous Forest	5	0.1
Woodland Mixed Forest	44	0.7
Total Forest Type	1,041	17.7
Shrub Types		
Closed Alder Shrub	12	0.0
Closed Alder Willow Shrub	36	0.6
Ericaceous Shrub Bog-String Bog	802	13.7
Low Shrub Bog	548	9.3
Open Alder Shrub	268	4.6
Open Alder Willow Shrub	230	3.9
Open Willow Shrub	41	0.7
Total Shrub Type	1,936	33.0
Herbaceous Types		
Aquatic Herbaceous	1	0.0
Mesic Herb	97	1.7
Wet Herbaceous	140	2.4
Total Herbaceous Type	239	4.1
Open Water (Pond and Estuarine Fringe)	54	0.9
Total Wetlands and Ponds	3,269	55.7
Riverine System (Streams and Rivers)	418	7.1
Total Wetlands/WOUS	3,687	62.8
Total Upland Riparian and Buffer	2,183	37.2
Total Mapped Area	5,870	100.0

Source: Field Verified Mapping, Michael Baker June 2018

Notes: Apparent inconsistencies due to rounding

Table 5 Preservation Area Cowardin Classifications (Acres, Percent)

Cowardin Groups	Cowardin Classification	Cowardin Acres	Percent
Coniferous Forests	PFO4/SS1	163	2.8
	PFO4	26	0.4
	PFO4/SS4	6	0.1
	PSS1/FO4	89	1.5
Total Coniferous Forests		284	4.8
Deciduous Forests	PFO1	3	0.0
	PFO1/SS1	3	0.0
	PSS1/FO1	4	0.1
	PF01/EM1	2	0.0
	PEM1/FO1	1	0.0
Total Deciduous Forests		13	0.2
Mixed Forests	PFO4/1	245	4.2
	PFO1/4	283	4.8
	PSS1/FO1	18	0.3
	PEM1/FO1	9	0.1
Total Mixed Forests		554	9.4
Coniferous Scrub	PSS1/4	134	2.3
	PSS4	5	0.1
	PSS4/1	51	0.9
Total Coniferous Scrub		190	3.2
Shrub	PSS1	283	4.8
	PSS1/EM1	1,570	26.7
	PEM1/SS1	84	1.4
Total Shrub		1,937	33.0
Herbaceous	E2EM1	26	0.4
	PEM1/2	3	0.0
	PEM1	208	3.5
Total Herbaceous		237	4.0
Ponds	PUB/AB3	1	0.0
	PUB	49	0.8
Total Ponds		51	0.9
Estuarine Waters	E2US	3	0.0
Total Estuarine		3	0.0
Total Wetlands, Ponds, and Estuarine		3,269	55.7
Rivers and Streams	R1UB	13	0.2
	R3UB	404	6.9
	R4SBC	1	0.0
*Total Rivers and Streams		418	7.1
Total Wetlands and Waters		3,687	62.8
Total Upland Riparian and Buffers		2,183	37.2
Grand Total		5,870	100.0

Source: Field Verified Mapped, Michael Baker June 2018

Notes: Apparent inconsistencies due to rounding

*Note: Streams and Rivers acreage is not included within wetlands and ponds

The wetland systems within the Preservation Area include large areas of slope HGM wetlands including ericaceous shrub bog-string bog wetlands, riverine HGM riparian wetlands, estuarine fringe HGM wetlands, and a small number of depressional HGM wetlands.

- Slope HGM Wetlands – The largest HGM wetland type in the Preservation Area is slope HGM. This wetland type covers 2,661 acres, or about 45 percent of the area (Table 3). The dominant source of water in slope HGM wetlands is discharge of groundwater to the land surface. Functions performed by these wetlands include discharge of water, modification of stream flow and water quality, export of detritus, maintenance of plant communities, and habitat support (Hall et. al. 2003). Lone Creek, a tributary of the Chuitna River, flows through or near much of the slope HGM wetlands in the Preservation Area. These wetlands contribute to the stream base flow and nutrient outputs, which then flow to the Chuitna River.

Ericaceous Shrub Bog-String Bog Wetlands – A type of slope HGM wetlands also known as patterned fens, these wetlands are a unique wetland type to the area, and only occur in a few very specific places worldwide. They are characterized by alternating ridges (strangs) dominated by shrubs and wet depressions (flarks). These features generally run perpendicular to the direction of water movement. Functions performed by these wetlands include discharge of water, water storage, particulate retention, export of carbon, cycling of elements, maintenance of plant communities, and habitat support including characteristic structures, interspersions, and connectivity (Hall et al. 2003). In the Preservation Area, 802 acres of the slope HGM wetlands are ericaceous shrub bog-string bog wetlands (Table 4).

- Riverine HGM Wetlands – Riverine HGM wetlands occur in floodplains and riparian areas. The dominant water sources are overbank flow from the channel or hyporheic flow between the stream and wetlands (NRCS 2008). Functions performed by riverine HGM wetlands include groundwater discharge and recharge of water, water storage, modification of stream flow and water quality, export of carbon, maintenance of plant communities, and habitat support (Powell et al. 2003). The Preservation Area contains 500 acres of riverine wetlands (Table 3).
- Estuarine Fringe HGM Wetlands – Estuarine fringe HGM wetlands occur along coastlines and are under the influence of sea water (NRCS 2008). Functions performed by estuarine fringe HGM wetlands include shoreline erosion control, nutrient absorption, maintenance of plant communities, and habitat support (EPA 2017). The Preservation Area contains 29 acres of estuarine fringe HGM wetlands surrounding the outlet of the Chuitna River into Cook Inlet (Table 3).
- Depressional HGM Wetlands – In the Preservation Area, there are 79 acres of the Preservation Area as depressional HGM wetlands (Table 3). These wetlands occur in topographic depressions. Functions performed by depressional HGM wetlands include groundwater discharge and recharge depending on landscape position, storm and floodwater storage, modification of streamflow and water quality, maintenance of plant communities, and habitat support (Powell et al. 2003).

The Preservation Area also protects areas adjacent to wetlands and streams. These uplands provide important ecosystem functions and values. Upland areas can be important for groundwater recharge, sometimes exceeding adjacent wetlands due to more permeable soil. Upland areas directly adjacent to slope HGM wetlands support groundwater discharge functions, helping to maintain the downgradient wetlands. Upland buffers adjacent to wetlands also protect and maintain wetland function. They act to slow and stop sediment and pollutants entering wetlands, provide organic matter to wetlands, and maintain wildlife habitat and movement corridors (McElfish et al. 2008). Figure 2 and Figure 3 show representative drawings of these areas and their functions.

Uplands and wetlands in the Preservation Area surrounding the Chuitna River and Lone Creek were selected to maximize the protection of wetlands, floodplains, anadromous streams, and riparian areas using a watershed approach. The Chuitna River floodplain includes back water sloughs, ponds, minor channels, riverine wetlands, and scrub and forested uplands in the bends of the river. The Preservation Area boundaries on the mainstem of the Chuitna River were selected to maximize full protection of the floodplain flow channels, which support the anadromous stream system. The protection of wetlands, streams, and upland riparian areas in the watershed provides a diversity of habitat and vegetation types, both terrestrial and aquatic, while protecting anadromous waters.

The boundaries around Lone Creek were established to maximize the amount of unique ericaceous shrub bog-string bog wetlands. This created a large contiguous undeveloped parcel of the stream and its tributaries and wetlands interspersed with uplands. This unfragmented parcel in the lower Lone Creek watershed protects the wetlands, baseflow, streams, and anadromous fisheries of both Lone Creek and the Chuitna River from development.

Figure 2 Representative Chuitna River Cross-Section in the Preservation Area

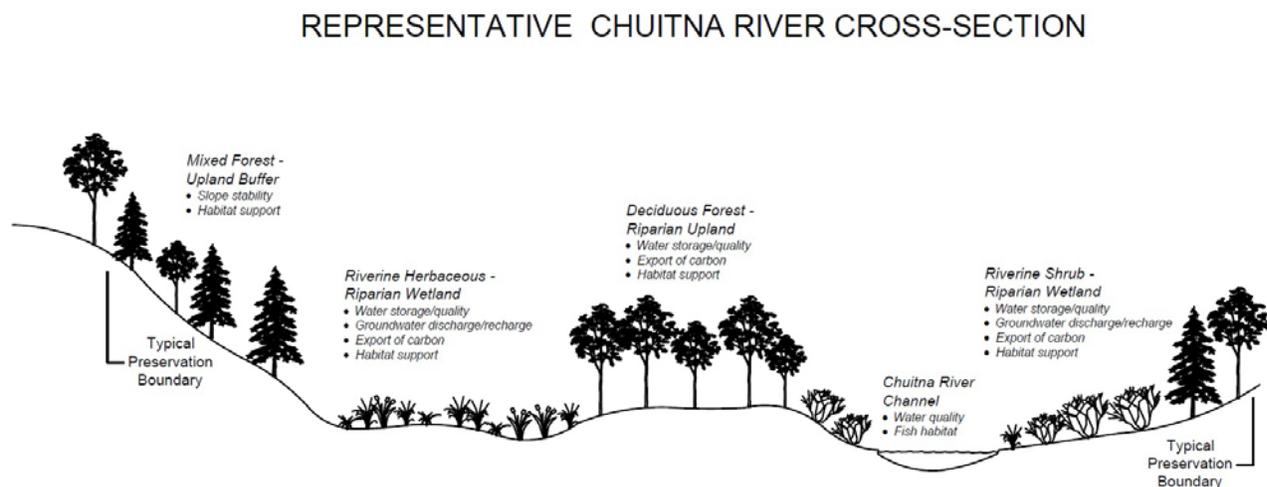
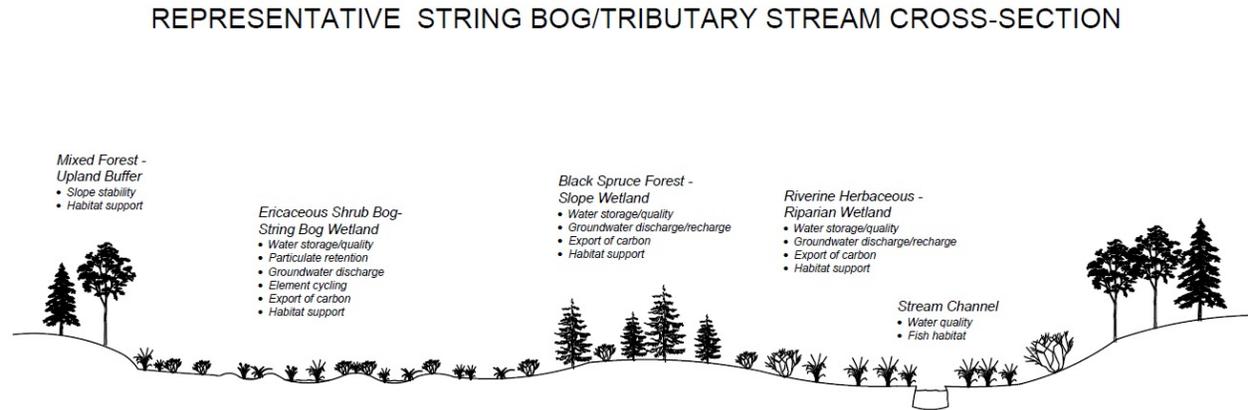


Figure 3 Representative String Bog/Tributary Stream Cross-Section in the Preservation Area



Preservation Area Wetland Ecology Comparison to MA/TA

Approximately 44 percent of Interior Alaska consists of WOUS (Hall et al. 1994). The MA/TA is in the Kuskokwim Highlands ecoregion in the Interior and consists of 55.4 percent wetlands (Hall et al. 1994). Precipitation drives the hydrology of most of the Interior wetlands and waters (Alaska Department of Environmental Conservation [ADEC] 1999); these are classified as flat HGM (Brinson 1993, ADEC 1999). As noted in Table 6, flat HGM wetlands comprise most wetlands impacted by the Project.

Slope wetlands comprise most wetlands in the Preservation Area. Buffer areas that provide similar functions as wetlands are also included in the Preservation Area; they are not shown in Table 6, but their functions are displayed in Figure 2 and Figure 3. The Preservation Area will permanently protect a parcel of land totaling 5,870 acres.

Table 6 Preservation Area HGM Classification Wetlands Comparison to MA/TA: Preserved and Permanently Filled (Acres)

HGM Classification	Preservation Area ¹ Acres Preserved	MA/TA ² Acres Permanent Fill
Depressional	79	3
Estuarine Fringe	29	0
Flat	0	1,623
Riverine	500	160
Slope	2,661	888
Total Wetlands³	3,269	2,676

Source: ¹Field Verified Mapping, Michael Baker June 2018, ²DA (Donlin Gold 2017),

Notes: ³Apparent inconsistencies due to rounding

Wetlands perform several functions including terrestrial support for plants/animals, geochemical retention and transformation, hydrologic functions, carbon/nutrient export, and fish/aquatic system support. Each HGM classification performs various functions within each class to differing degrees. The flat HGM wetlands in the MA/TA are comprised mostly of large black spruce vegetated hillsides, for the most part without streams. Streams would provide an outlet for nutrient/carbon export to the Crooked

Creek system, but without streams, there is no nutrient/carbon export and no opportunity for flat HGM wetlands to provide fish or aquatic system support. Within the Preservation Area, slope and riverine HGM wetlands are the dominant classes associated with groundwater systems that export carbon/nutrients, and contribute to adjacent streams which support the anadromous fish in the Chuitna River.

The slope HGM wetlands within the MA/TA are associated with small groundwater and precipitation driven hillside drainages, headwater intermittent and perennial streams, and black spruce wetlands at the toeslopes of the hills adjacent to the floodplains of the various valley streams. Slope wetlands are not supporting a large stream system. The upper swales and hillside drainages are vegetated with willow and alder, with bluejoint (*Calamagrostis canadensis*) understories (Photo 1).

In comparison, Lone Creek, a tributary of the Chuitna River, flows through or drains most of the slope HGM wetlands, including the ericaceous shrub bog-string bog wetland systems in the Preservation Area. These wetlands provide habitat support, nutrient cycling, flood water storage, and contribute to the stream base flow and nutrient outputs of the Chuitna River. Photo 2 shows an example of string bog systems within the Preservation Area.

Photo 1 MA/TA Upper American Creek

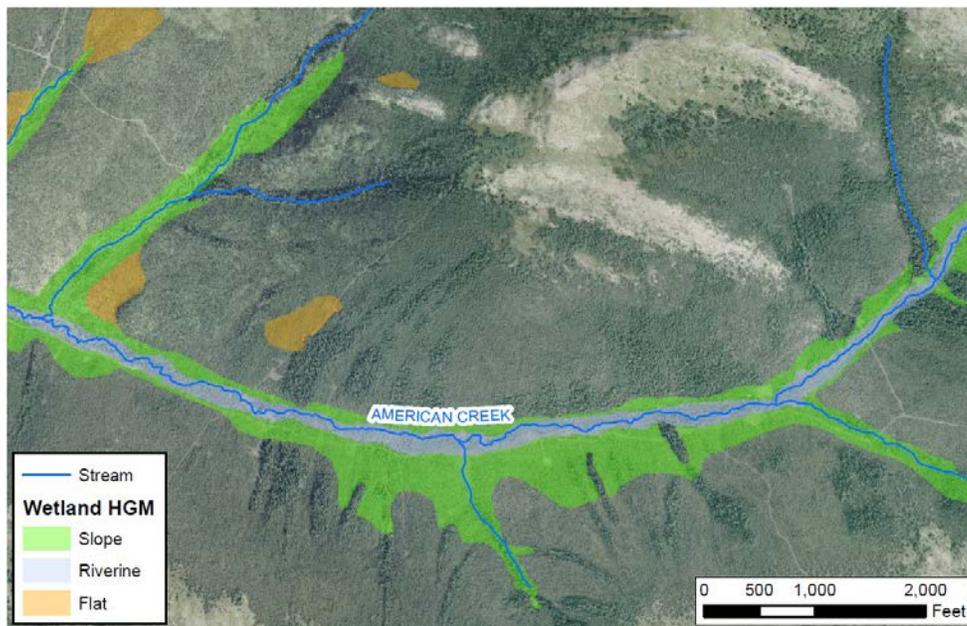
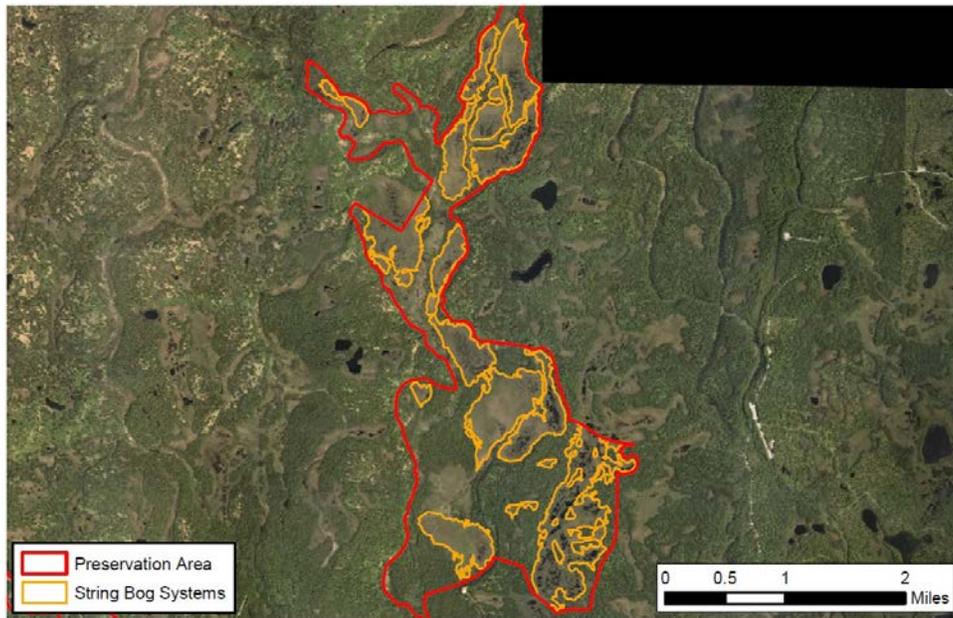


Photo 2 Preservation Area String Bog Systems Example



In the MA/TA, the American and Anaconda Creek drainages are small low-flow systems that appear to lack substantial winter flow. Each creek is associated with a narrow riverine HGM floodplain. The 160 acres of MA floodplains consist of willow, alder, and spruce/mixed forest types. Photo 3 shows the riverine HGM floodplain associated with the anadromous portion of American Creek.

Compared to the MA/TA's low-flow streams and small associated floodplains, the Preservation Area provides over three times the riverine HGM floodplains, and these floodplains help support the salmon fisheries of the Chuitna River. Also associated with the wetland floodplains are the riparian uplands included in the Preservation Area, as shown in Photo 4.

Photo 3 MA/TA American Creek Riverine HGM Floodplain

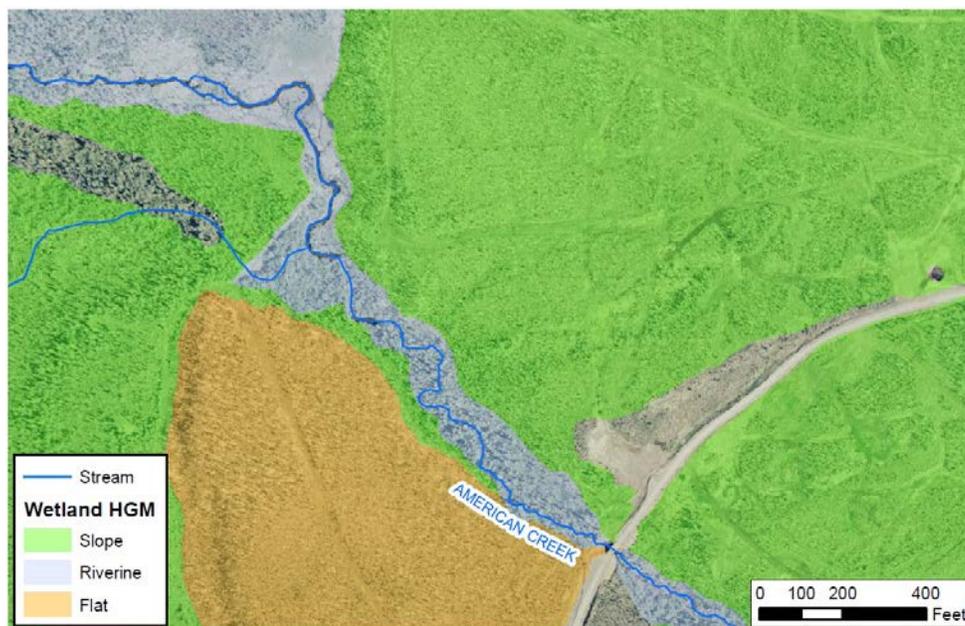
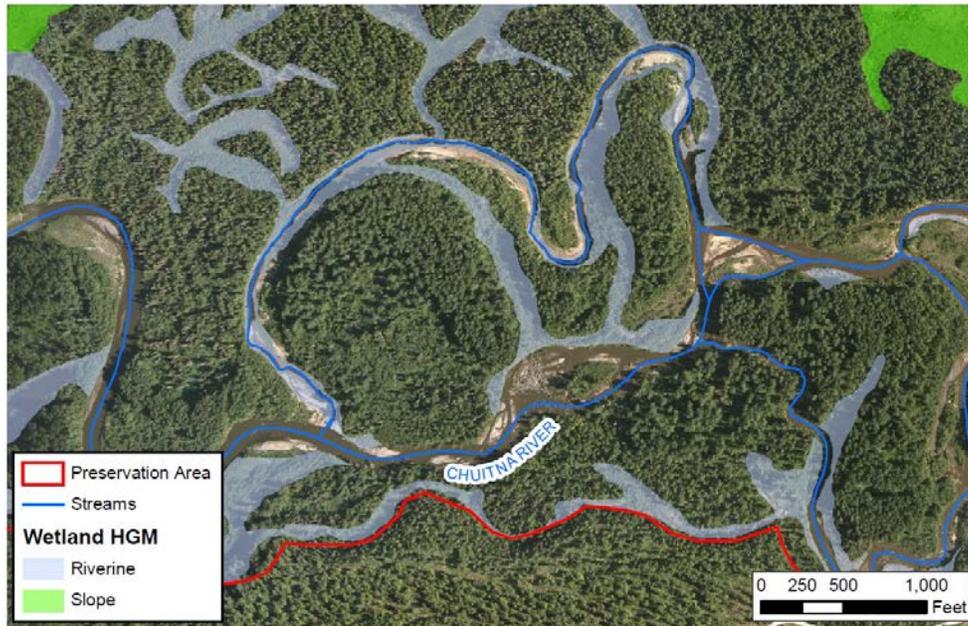


Photo 4 Preservation Area Riverine HGM Wetlands, Chuitna River



The Chuitna River and Lone Creek, both anadromous streams, have 424 acres of associated riverine HGM floodplains (Table 7) while the MA/TA has 8 acres. Only 76 acres of riverine HGM wetlands in the Preservation Area are associated with non-anadromous streams compared to 152 acres in the MA/TA.

Table 7 Preservation Area Riverine HGM Wetlands Comparison to MA/TA

HGM Classification	Preservation Area ¹ Acres	MA/TA ² Acres
Riverine, Anadromous	424	8
Riverine, Non-Anadromous	76	152
Total Riverine Wetlands	500	160

Source: ¹Field Verified Mapping, Michael Baker June 2018, ²DA (Donlin Gold 2017)

There are no estuarine HGM wetlands in the MA/TA. In the Preservation Area, these estuarine HGM wetlands and waters are connected to riverine HGM wetlands, the Chuitna River, and Cook Inlet. The critical habitat area of the Beluga whale encompasses intertidal and subtidal waters of Cook Inlet with depths less than 30 feet and within 5 miles of high and medium flow anadromous fish streams (National Oceanic and Atmospheric Administration [NOAA] 2011), including estuarine HGM waters at the mouth of the Chuitna River.

Preservation Area Stream Ecology and Fisheries

The streams and rivers in the Preservation Area provide habitat for Chinook, coho, chum, and pink salmon, as well as limited habitat for sockeye salmon, Dolly Varden, and rainbow trout. The mainstem of the Chuitna River includes Chinook, coho, chum, and pink salmon spawning habitat, and rearing habitat for all five Pacific salmon species. Tributaries to the Chuitna River within the Preservation Area also have documented use by all five Pacific salmon species. Acquisition of the Chuitna River drainage properties

will preserve 258,056 linear feet (48.87 miles) of field verified stream channels, of which at least 148,632 linear feet (28.15 miles) are documented as Pacific salmon habitat including spawning, rearing, and migration habitats in five streams, as shown in Table 8 and Table 9. Figure 4 shows the anadromous streams in the Preservation Area. Fisheries data was derived from the current Anadromous Waters Catalog (AWC) at the time the analysis was performed by Owl Ridge Consultants. The AWC assigns attributes for fish presence, utilization and habitat to stream reaches in the National Hydrography Dataset (NHD), and consequently stream lengths for fish presence and habitat do not exactly reflect the Michael Baker International field verified linear lengths of streams.

The Preservation Area includes 104,544 linear feet (19.80 miles) of the mainstem of the Chuitna River, within which, 49,262 linear feet (9.33 miles) of Chinook salmon spawning habitat, 69,115 linear feet (13.09 miles) of coho spawning habitat, 44,088 linear feet (8.35 miles) of chum spawning habitat, and 104,544 linear feet (19.80 miles) of pink spawning habitat are documented. The entire 104,544 linear feet (19.80 mile) reach contains documented rearing for Chinook and coho salmon juveniles. Some reaches of the mainstem are also documented as rearing habitats for other Pacific salmon, including 100,690 linear feet (19.07 miles) for sockeye, 12,514 linear feet (2.37 miles) for chum, and 13,253 linear feet (2.51 miles) for pink salmon (Table 8).

Table 8 Preservation Area Salmon Habitat Preserved in the Chuitna River Mainstem

Chuitna River Mainstem				
Species	AWC Presence Linear Feet (Miles)	AWC Spawning Linear Feet (Miles)	AWC Rearing Linear Feet (Miles)	Total AWC Linear Feet (Miles)
Chinook	55,282 (10.47)	49,262 (9.33)	104,544 (19.80)	104,544 (19.80)
Sockeye	100,690 (19.07)	0	100,690 (19.07)	104,544 (19.80)
Coho	49,526 (9.38)	69,115 (13.09)	104,544 (19.80)	104,544 (19.80)
Chum	80,414 (15.23)	44,088 (8.35)	12,514 (2.37)	104,544 (19.80)
Pink	29,885 (5.66)	104,544 (19.80)	13,253 (2.51)	104,544 (19.80)

Source: AWC, Owl Ridge 2017

In addition to the mainstem Chuitna River habitats, the Preservation Area includes important Pacific salmon habitats in Bass Creek (stream 2004 from Chuitna baseline surveys), Middle Creek (stream 2003 from Chuitna baseline surveys), Lone Creek (stream 2002 from Chuitna baseline surveys) and an unnamed anadromous stream (No. 247-20-10010-2020-3008) [LGL Alaska Research Associates, Inc (LGL) 2009], as shown in Table 9.

Table 9 Preservation Area Salmon Habitat Preserved in Tributaries to the Chuitna River

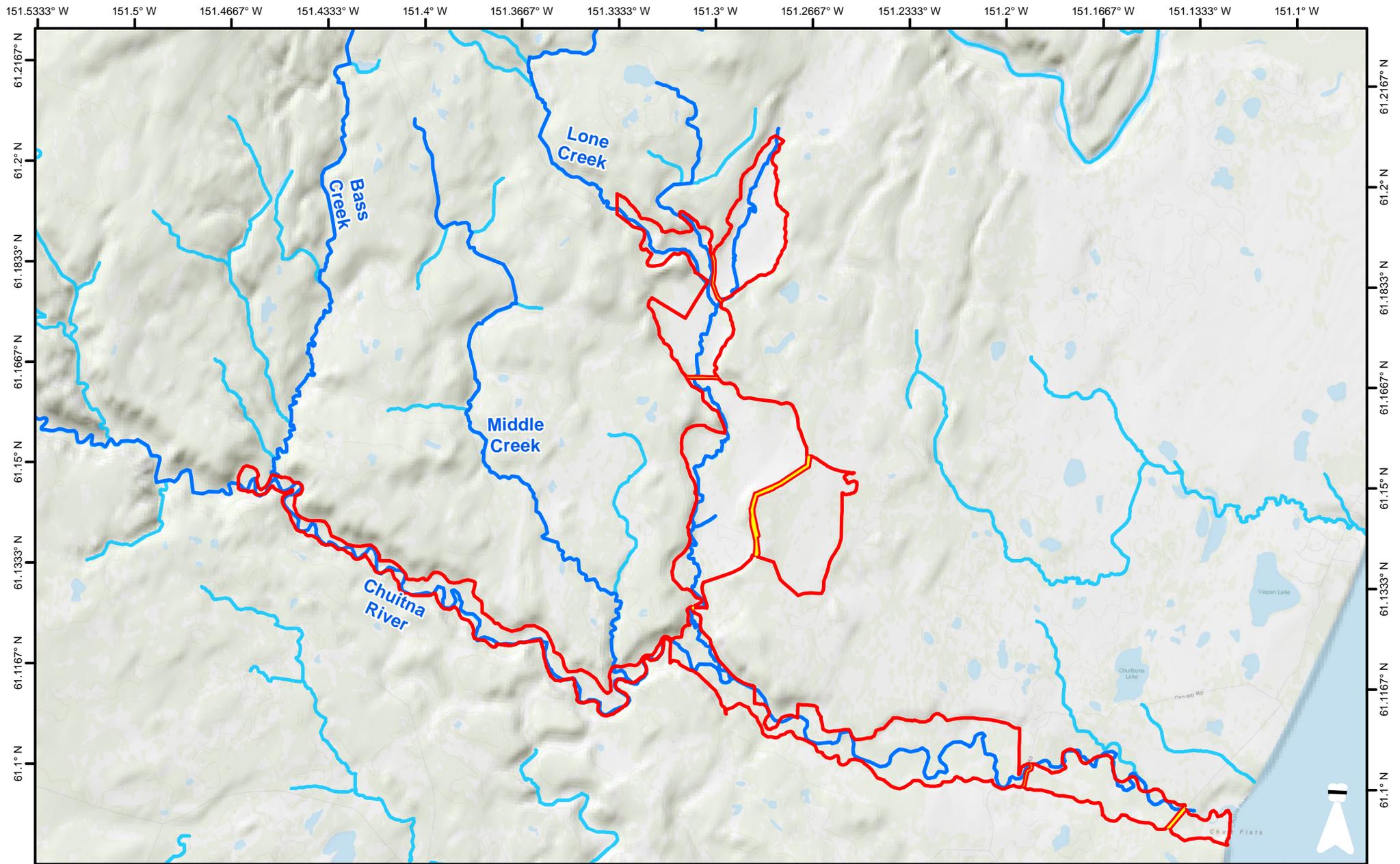
Species	AWC Presence Linear Feet (Miles)	AWC Spawning Linear Feet (Miles)	AWC Rearing Linear Feet (Miles)
Chinook	317 (0.06)	0	317 (0.06)
Sockeye	317 (0.06)	0	317 (0.06)
Coho	317 (0.06)	0	317 (0.06)
Chum	317 (0.06)	0	317 (0.06)
Pink	317 (0.06)	0	0

Species	AWC Presence Linear Feet (Miles)	AWC Spawning Linear Feet (Miles)	AWC Rearing Linear Feet (Miles)
Chinook	0	1,426 (0.27)	1,426 (0.27)
Sockeye	1,426 (0.27)	0	0
Coho	0	1,426 (0.27)	1,426 (0.27)
Chum	0	0	0
Pink	0	1,426 (0.27)	0

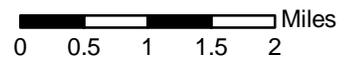
Species	AWC Presence Linear Feet (Miles)	AWC Spawning Linear Feet (Miles)	AWC Rearing Linear Feet (Miles)
Chinook	0	26,928 (5.10)	26,928 (5.10)
Sockeye	26,928 (5.10)	0	0
Coho	4,699 (0.89)	0	26,928 (5.10)
Chum	26,928 (5.10)	0	0
Pink	26,928 (5.10)	0	0

Species	AWC Presence Linear Feet (Miles)	AWC Spawning Linear Feet (Miles)	AWC Rearing Linear Feet (Miles)
Chinook	0	0	0
Sockeye	0	0	0
Coho	6,336 (1.20)	0	15,418 (2.92)
Chum	0	0	0
Pink	0	0	0

Source: AWC, Owl Ridge 2017



-  ADF&G Anadromous Waters Catalog Stream Intersecting Preservation Area
-  ADF&G Anadromous Waters Catalog Stream
-  Easement
-  Proposed Preservation Area



1 inch = 7,920 feet

1:95,040

**Chuitna Preservation Area
ADF&G Anadromous Streams
Figure 4**

Seward Meridian, NAD 1983, UTM Zone 5N
Imagery: DigitalGlobe, 2014
Date: 07/03/18

While only 317 linear feet (0.06 miles) of Bass Creek fall within the Preservation Area, juvenile Chinook, sockeye, coho, and chum salmon use this reach for rearing, while pink salmon have unspecified presence.

The lower 1,426 linear feet (0.27 miles) of Middle Creek fall within the Preservation Area and are documented spawning habitat for Chinook, coho, and pink salmon, as well as rearing habitat for Chinook and coho salmon. Unspecified pink salmon habitat is also documented in this reach.

Lone Creek has 26,928 linear feet (5.10 miles) and 15,418 linear feet (2.92 miles) of its downstream tributary stream (AWC Stream No. 247-20-10010-2020-3008) within the Preservation Area. The entire 26,928 linear feet (5.10 mile) reach of Lone Creek is documented as important Chinook salmon spawning habitat and Chinook and coho salmon rearing habitat. Sockeye, chum, and pink salmon are documented throughout the reach, but habitat uses have not been specified. The entire 15,418 linear feet (2.92 mile) reach of the Lone Creek tributary within the Preservation Area is documented as important coho salmon rearing habitat.

Salmon smolt production was estimated for coho salmon in the Chuitna River watershed and specifically for Lone Creek (2008), and Middle and Bass Creeks in 2008 through 2011 (LGL 2009, 2010, 2011, 2013a and 2013b). Average Chuitna River production ranged from 37,424 to 44,794 coho smolt, with Bass Creek accounting for 19 to 31 percent of production, Middle Creek accounting for 12 to 17 percent of total production, and Lone Creek accounting for up to 50% of production (LGL 2009).

Total salmon escapement for the Chuitna River and tributaries has been estimated with a variety of methods and in varying years for the different Pacific salmon species. Chinook salmon have the longest escapement record, with escapement data available between 1979 and 2015, ranging from 502 fish in 2012, to 4,043 fish in 1983 (Erickson et al. 2017). The Chuitna River did not meet the overall escapement goal of 750 fish in 2010, 2011, or 2012, which led to the stock being identified as a stock of management concern by the Alaska Board of Fisheries. However, Chinook salmon escapement increased to 1,690, 1,398, and 1,965 fish in 2013, 2014, and 2015, respectively.

In 2008, escapement for Chinook salmon was estimated at 217 to 341 fish in Lone Creek; 21 to 80 fish in Middle Creek; and 77 to 153 in Bass Creek. Coho, chum, sockeye, and pink salmon escapement estimates are not available for the entire Chuitna drainage; however, escapement has been estimated for the Chuitna River tributaries, including Bass, Middle, and Lone Creeks. Numbers of coho salmon entering these tributaries have been estimated at 2,336 to 2,903 fish in Lone Creek; 1,983 to 2,313 fish in Middle Creek, and 269 to 726 fish in Bass Creek (LGL, 2009 summarized by Owl Ridge 2017). These estimates are considerably higher than estimates from the early 1980s, when between 1,085 and 2,400 coho were estimated moving into the entire drainage (Erickson et al. 2017). Lone Creek has had the highest identified escapement of pink salmon among the tributaries. Chum salmon abundance has ranged from one to 100 fish in the drainage, while sockeye salmon were only found in 2008 and 2009 and in low numbers. In addition to Pacific salmon, anadromous Dolly Varden and resident rainbow trout are widely distributed throughout the drainage (Erickson et al. 2017).

Preservation Area Stream Ecology Comparison to MA/TA

American and Anaconda Creeks are the only Crooked Creek tributaries with documented fish use that will be directly impacted by the Project. Both drainages are small low-flow systems that appear to lack substantial winter flow. In American Creek, at least 1,320 linear feet (0.25 miles) used by rearing juvenile coho salmon and 10,930 linear feet (2.07 miles) of resident Dolly Varden habitat will be removed during pit development. In Anaconda Creek, 898 linear feet (0.17 miles) used by juvenile coho salmon and 13,200 linear feet (2.5 miles) of resident fish habitat used by Dolly Varden will be permanently filled by the tailings storage facility (TSF) construction. In total, 26,400 linear feet (5 miles) of habitat used by fish within the two drainages will be permanently filled with 2,218 linear feet (0.42 miles) being coho rearing habitat (Table 10).

Between 2004 and 2014, Crooked Creek drainage-wide baseline sampling of established 300-foot stream reaches averaged 405.1 coho for all stream reaches combined (OtterTail 2014). On average, American Creek contributed 6 (1.48 percent) coho per 300 feet and Anaconda Creek contributed 0.1 (0.02 percent) coho juveniles per 300 feet. All juvenile coho were captured in the lower reaches of both creeks, nearest their confluences with Crooked Creek. No other salmon species were captured in stream habitats that will be removed by MA development.

Table 10 MA/TA Crooked Creek Anadromous Fish Habitats Permanently Filled by Project Development

Anadromous Habitat Permanently Filled (American and Anaconda Creeks)	
Species	AWC Rearing Habitat Linear Feet (miles)
Chinook	0
Sockeye	0
Coho	2,218 (0.42)
Chum	0
Pink	0

Source: OtterTail 2014

Development of the Project will permanently fill up to 26,400 linear feet (5 miles) of fish habitat, including about 2,218 linear feet (0.42 miles) of anadromous coho salmon rearing habitat. In-watershed mitigation for these impacts will be provided by the Upper Crooked Creek PRM Plan (see CMP, Attachment D). In addition, the Preservation Area will provide an additional 147,840 linear feet (28 miles) of off-site mitigation through preservation of the mainstem Chuitna River and tributary habitat identified as important for all five species of Pacific salmon, anadromous Dolly Varden, and resident rainbow trout (Table 11). The Preservation Area preserves habitat that is considerably more productive salmon habitat, as shown by the numbers of juvenile salmon produced in the Chuitna River versus the impacted habitat in the Crooked Creek drainage, as well as by adult escapement data (Table 12). Considering only Chinook salmon, preservation of the Chuitna River properties will protect a stock of management concern, as well as a population with consistently higher escapements (even during the lowest three years) than in the entire Crooked Creek drainage. Escapement for coho salmon from the three Chuitna River tributaries also exceeds those found in the entire Crooked Creek drainage.

Table 11 Summary of Anadromous Stream Habitat Preserved (Chuitna Drainage) and Permanently Filled (Crooked Creek Drainage)

Species	Spawning		Rearing		Total Anadromous Habitat	
	Chuitna Drainage	Crooked Creek Drainage	Chuitna Drainage	Crooked Creek Drainage	Chuitna Drainage	Crooked Creek Drainage
	Preserved	Permanently Filled ¹	Preserved	Permanently Filled ¹	Preserved	Permanently Filled ¹
	Linear Feet (miles)		Linear Feet (miles)		Linear Feet (miles)	
Chinook	77,616 (14.7)	0	133,214 (25.23)	0	133,214 (25.23)	0
Sockeye	0	0	101,006 (19.13)	0	133,214 (25.23)	0
Coho	70,541 (13.36)	0	148,632 (28.15)	2,218 (0.4)	148,632 (28.15)	2,218 (0.4)
Chum	44,088 (8.35)	0	12,514 (2.37)	0	131,789 (24.96)	0
Pink	106,128 (20.1)	0	13,253 (2.51)	0	133,214 (25.23)	0

Note: ¹ American and Anaconda Creeks in the MA/TA; Source: Table 8, Table 9, and Table 10.

Table 12 Salmon, Rainbow Trout, and Dolly Varden Comparison: Crooked Creek and Chuitna River

Species		Crooked Creek Mainstem (2008-2012) ¹	Chuitna River Mainstem (2008-2015) ²	Chuitna River Tributaries (2008) ³			Combined
				Bass Creek (Stream 2004) (2008)	Middle Creek (Stream 2003) (2008)	Lone Creek (Stream 2002) (2008)	
Chinook	Min	29	502	77	21	217	315
	Max	100	1,956	153	80	341	574
	Mean	59	1,069	115	50.5	279	445
Coho	Min	591	NA	269	1,983	2,336	4,588
	Max	4,204	NA	726	2,313	2,903	5,942
	Mean	1,634	NA	498	2,148	2,619.5	5,265
Pink	Min	4	NA	0	1	232	233
	Max	59	NA	0	4	338	342
	Mean	20	NA	0	2.5	285	288
Sockeye	Min	1	NA	6	24	12	42
	Max	60	NA	50	NA	NA	50
	Mean	18	NA	28	24	12	64
Chum	Min	832	NA	0	0	4	4
	Max	3,755	NA	NA	NA	NA	NA
	Mean	1,907	NA	NA	NA	NA	NA
Rainbow Trout	Min	NA	NA	38	73	92	203
	Max	NA	NA	340	172	316	828
	Mean	1.4	NA	189	122.5	204	516
Dolly Varden	Min	NA	NA	189	146	272	607
	Max	NA	NA	406	306	440	1,152
	Mean	32	NA	298	226	356	880

Notes: ¹ Five-year average based on resistance board weir counts (Ottertail 2014)

² Eight-year average based on Alaska Department of Fish and Game (ADF&G) aerial counts, includes lowest three years on record (ADF&G 2017)

³ Estimates based on camera trap passage, upper and lower bounds of estimate are presented as min/max (LGL 2009)

NA – Not Available

Preservation Area Endangered and Protected Species

Belugas are small, toothed whales. They are about 5 feet long at birth and weigh 90 to 130 pounds. Adults grow to be 11 to 15 feet long. Females are smaller than males, rarely growing over 12 feet. Reports of adult Beluga weights vary from 1,000 to 3,300 pounds (ADF&G 2018).

The Beluga whale is a northern hemisphere species that inhabits fjords, estuaries, and shallow waters of the Arctic and subarctic oceans. Five distinct stocks of Beluga whales are currently recognized in Alaska: Beaufort Sea, eastern Chukchi Sea, eastern Bering Sea, Bristol Bay, and Cook Inlet. The Beaufort Sea and

eastern Chukchi Sea populations are considered healthy and stable. The Bristol Bay and eastern Beaufort Sea populations are stable or increasing (ADF&G 2018).

The Cook Inlet population is numerically the smallest of these, and is the only one of the five Alaskan stocks occurring south of the Alaska Peninsula in waters of the Gulf of Alaska. The Cook Inlet Beluga whale stock may once have numbered as many as 1,300 individuals but declined dramatically during the 1990s. Population abundance surveys indicated a 47 percent decline between 1994 and 1998. Annual population abundance surveys from 1999 to 2016 estimated abundance ranging between 278 and 435 Beluga whales, with a 2016 estimated abundance of 328 Beluga whales. Since 1999, the population has declined by 0.4 percent annually with a 10-year decline (2006-2016) of 0.5 percent annually (NOAA 2018 72 [Federal Register (FR) 19854]).

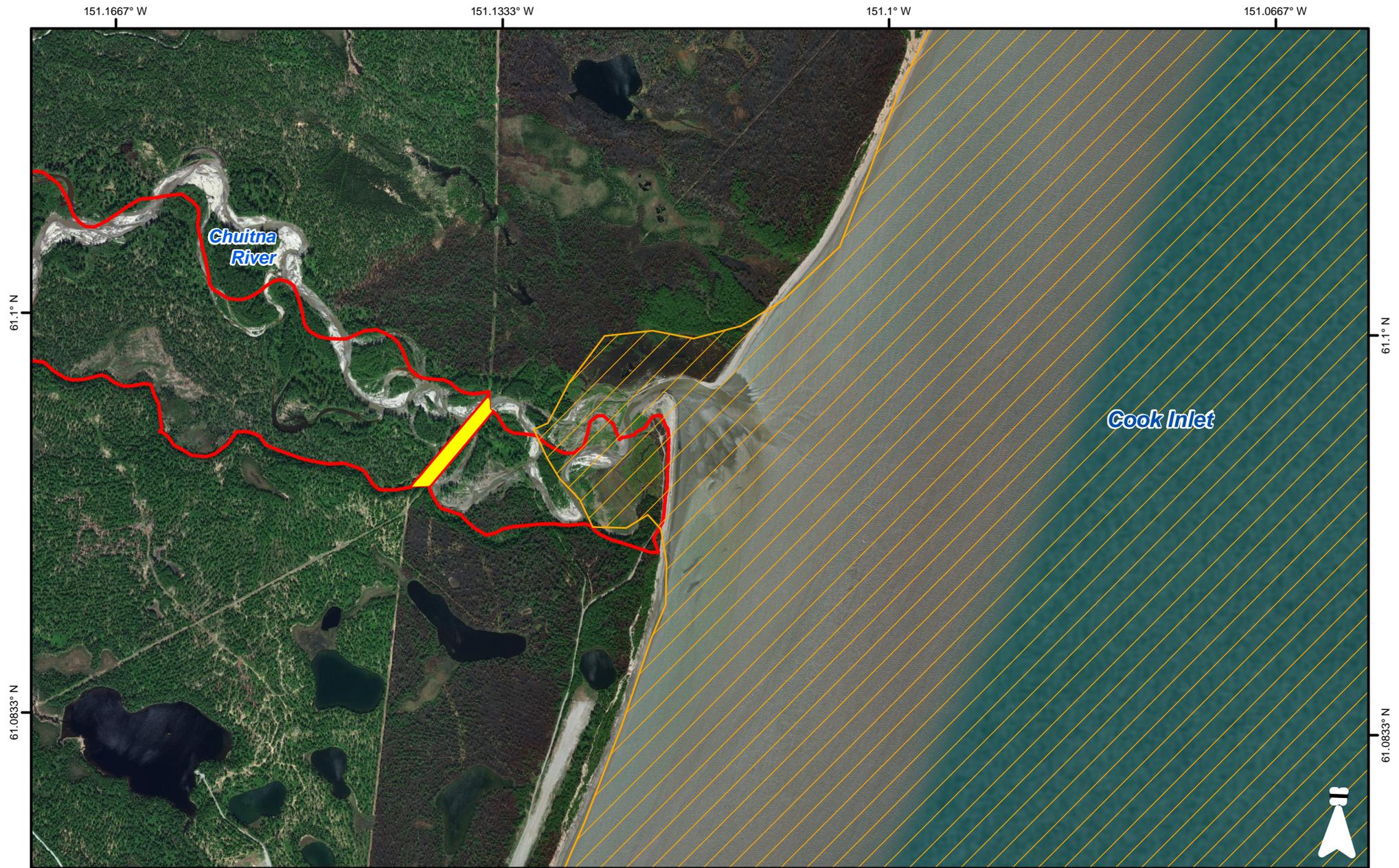
Cook Inlet is a unique biological setting in terms of these Beluga whales because it supports the southernmost of the five extant Beluga populations in Alaska, and is the only water south of the Alaska Peninsula, or within the Gulf of Alaska, which supports a viable population of Beluga whales. The ecological setting of Cook Inlet is also unique in that it is characterized as an incised glacial fjord, unlike other Beluga habitats to the north. Cook Inlet experiences large tidal exchanges and is a true estuary, with salinities varying from freshwater at its northern extreme to marine near its entrance to the Gulf of Alaska. No similar Beluga whale habitat exists in Alaska or elsewhere in the United States (NOAA 2018 [72 FR 19854]).

Potential threats to Beluga whales include hunting, interaction with fisheries, stranding, entrapment in sea ice, predation, underwater noise pollution, contaminants, and climate change. Alaska Natives hunt Belugas as part of their subsistence culture (ADF&G 2017). Belugas are harvested by Alaska Natives living in coastal villages from Tyonek in Cook Inlet to Kaktovik in the Beaufort Sea. Hunting is done in spring as whales travel northward through leads in the ice, as well as during the summer and autumn open-water period. Entanglement in gillnets can be a cause of mortality in some localized areas. There is also concern that Belugas may be competing with fisheries for their prey species. Strandings are a potential source of mortality for Beluga whales. Within estuaries, Belugas sometimes become stranded on tidal flats when tides retreat quickly. In Cook Inlet, numerous strandings on tidal flats have been documented. Mortality from these events is generally low, but larger whales are more likely to die in these situations than smaller whales. Belugas may also become trapped in sea ice. Beluga whales fall prey to orcas. Orca attacks on Belugas have been documented in Cook Inlet, Bristol Bay, and Hooper Bay. Belugas have been observed moving into shallow water or areas covered with sea ice to avoid orcas (ADF&G 2018).

On October 22, 2008, the National Marine Fisheries Service (NMFS) listed the Distinct Population Segment of Beluga whale found in Cook Inlet as endangered under the Endangered Species Act (ESA) of 1973, as amended. On April 11, 2011, NMFS designated critical habitat for the Cook Inlet Beluga whale under the ESA. Two areas were designated as critical habitat; both comprising 3,016 square miles (7,809 square kilometers) of marine and estuarine environments considered essential for the whales' survival and recovery. The designated critical habitat area encompasses intertidal and subtidal waters of Cook Inlet with depths less than 30 feet and within 5 miles of high and medium flow anadromous fish streams (NOAA 2011).

The Preservation Area includes 29 acres of estuarine fringe HGM wetlands at the mouth of the Chuitna River that support Cook Inlet Beluga whales (Figure 5) (NOAA 2018). Cook Inlet Belugas concentrate at rivers and bays in upper Cook Inlet in the summer and fall, moving offshore in winter (NMFS 2008). The mouth of the Chuitna River is characterized as having moderate use by Belugas during the summer and occasional winter use (Moore et al. 2000), with two Beluga whale carcasses found in the area in 1999 and 2000 (Moore et al. 2000) and a live sighting reported in 1982 (Shelden et al. 2015). In 2017, a baby Beluga was rescued from the tidal flats just south of the mouth of the Chuitna River. It was transported to the Alaska Sea Life Center for rehabilitation and was given the name Tyonek.

Estuarine habitat has value for Beluga whale feeding and molting. Feeding occurs over the continental shelf, in nearshore estuaries, and in river mouths. Estuarine environments are considered essential for the whales' survival and recovery (NMFS 2008). Most feeding dives are shallow. Belugas are generally considered to be opportunistic feeders (ADF&F 2018). Stomach content diet studies have found Chinook, coho, and chum salmon (NMFS 2008 and Quakenbush et al. 2015), all of which are supported by streams within the Preservation Area. Salmon are among the most important food sources for Cook Inlet Beluga whales, as identified through research and Alaska Native traditional wisdom and knowledge (NMFS 2008). Overall, fish species make up a large part of their diet including salmon, herring, capelin, smelt, cod, flatfish, sculpin, lingcod, and eulachon.



<p>Map Location</p>	<ul style="list-style-type: none"> Easement Proposed Preservation Area Beluga Whale Critical Habitat 	<p>0 1,000 2,000 Feet</p> <p>1 inch = 2,000 feet</p> <p>1:24,000</p>	<p>Cook Inlet Beluga Whale Critical Habitat Figure 5</p>
<p>Seward Meridian, NAD 1983, UTM Zone 5N Imagery: DigitalGlobe, 2014 Date: 07/03/18</p>			

Preservation Area Site Condition

The Preservation Area was reviewed both on the ground and by aerial photography to ascertain existing man-made disturbances. Areas of disturbance found in the aerial imagery, or by helicopter flights were confirmed on the ground, coded and mapped as part of the wetland field work. Existing disturbance within the Preservation Area includes a drill pad, trails, and small roads, but these disturbances are minimal. Within the Preservation Area, totaling 5,870 acres, only 6 acres were found to be disturbed. Table 13 presents the conditional analysis.

Table 13 Preservation Area Condition Analysis (Acres)

Disturbance Type	Upland Acres	Wetland Acres	Total Acres	Notes
Former Drill Pad	3	2	5	Beaver Activity has flooded 2 acres of the abandoned drill pad returning 2 acres to wetlands
Existing Roads	1	0	1	Two short roads access the Chuitna River near the mouth
Minor Trail Construction with Vegetation Cut	0	<1	<1	Three locations total less than 0.5 acres of vegetation clearing, two are in wetlands where soils appear undisturbed.
Total Area	4	2	6	

Apparent inconsistencies in sums are the results of rounding.

A former drill pad is located within the Preservation Area and totals 5 acres. Alders are growing on a 3 acre upland portion of the drill pad, and beaver activity has flooded the remainder (2 acres), converting this area back to wetlands. There are two small access roads located at the mouth of the Chuitna River. Their footprint is confined to 1 acre. There are three locations in the Preservation Area where trail construction has adversely disturbed the soils and hydrology. At these trail locations ponding, soil disturbance, and/or erosion are visible. These three sites total less than 1 acre.

A few low use All-Terrain Vehicle (ATV) trails exist in the Preservation Area. Their use has not altered the soils or hydrology of the area and has not changed the wetland status, or created ponding, flooding, or erosional features. These trails were not mapped as a disturbance type and they are not listed in Table 13.

Preservation Area Threat of Development

The Chuitna River watershed is a drainage located on the west side of Cook Inlet 45 air miles from Anchorage, the largest city in Alaska, as shown in Figure 6 (inset). This area has a unique mix of existing and potential industrial activities that surround the Chuitna drainage. The area has two active areas for handling of marine transportation – the port at North Foreland to the south, which includes a beach barge landing area and a pile supported trestle and dock; and a barge beach landing area to the north known as Grant’s Landing. These areas have been used for the import of oil field pipe, equipment, fuel, and local supplies for Tyonek and Beluga, two local communities. A series of connecting service trails and roads connect Tyonek and Beluga for local uses. Resource development roads have been interspersed in the region to facilitate the harvest of timber, and for the development of the regional oil and gas industry. Temporary roads have been constructed for coal exploration and development. The

Beluga coal field and the Beluga oil and gas basin are centered here on the west side of Cook Inlet. Gas from the region is collected and shipped to the Beluga natural gas power plant or into the regional gas supply system for distribution to Anchorage, the Matanuska Susitna Borough, and the Kenai Peninsula for heating and power generation. The Chuitna River area is used by Alaskans and non-residents for recreational and guided fishing. Shore based set-net fishing along the beaches provides for both commercial and subsistence harvest of salmon. Offshore fisheries in Cook Inlet include salmon and halibut. As discussed earlier, the Chuitna River contains a productive salmon run including Chinook salmon (listed as a species of concern by ADF&G), coho, sockeye (minor use), chum, and pink salmon. While state and federal permit programs are in place that strive to balance development with land, habitat, and wildlife protection, the pressures on the Chuitna River merit special consideration for additional protection through preservation of portions of the watershed. The key threats to the area include the following.

Oil and Gas Development

With the discovery of oil in Cook Inlet in the 1960s, the west side of Cook Inlet has been an ongoing region for development. The northwestern portion of the basin, within which the Chuitna River watershed lies, is primarily a gas field. Numerous companies have a series of wells and collection pipelines that extend from as far north as the Theodore River south to Nicolai Creek, past Trading Bay to West Foreland. Oil and gas wells on TNC lands are in the Chuitna watershed along Lone Creek and south of the Chuitna River, and wells drilled just north of the watershed in the Threemile Creek drainage are on AMHT land. Oil and gas facilities also exist to the south and west of the Chuitna River on lands owned by TNC and AMHT, which were selected for their natural resource potential. Collection pipelines exist in the area to gather the product from these well sites. Access roads connect the drill pads and development facilities. Portions of the Chuitna River watershed remain under active lease for oil and gas development. Easements in the Preservation Area have been included at the request of the adjacent property owners to ensure continued access to resources.

Coal Production

Numerous companies have held coal leases in the Chuitna watershed and surrounding area dating back to the 1960s. The entire Chuitna watershed is underlain by extensive, world class coal deposits. Numerous coal outcrops are visible along the mainstem of the Chuitna River. The Diamond Shamrock Joint Venture permitted a 300-million-ton coal deposit between 1985 and 1990. An EPA-led Environmental Impact Statement (EIS) for a coal mine was completed for Diamond Shamrock 's Chuitna Coal project in the Beluga coal field in 1990. Legal challenges between 1990 and 1994 prevented the project from going into development. By the time the legal challenges were settled, the international coal markets softened and the project was shelved, but the leases remained intact. The owners of those leases formed PacRim Coal, LP (PRC) in 2005 and re-initiated permit efforts that continued until 2016. A Supplemental EIS to inform Clean Water Act Section 402 and 404 permitting was evaluated. The work was undertaken by EPA as the lead Federal Agency and then transferred to USACE in November 2010. PRC proposed a run-of-mine surface coal export project. The mine life was proposed at 25 years. The coal was to be hauled by truck from the pit, crushed, and put on a conveyor for transport and storage at Ladd Landing for shipment. A 10,000-foot long offshore pile-supported elevated conveyor was proposed to extend from the shoreline to a water depth that would allow tide-independent coal loading at

approximately minus 65 feet mean lower low water. Proposed infrastructure included mine roads, stream diversions, settling ponds, material sources, an airstrip, and a camp. Approximately 2,400 acres of WOUS would have been impacted and two stream tributaries removed during the proposed mine operations. Due to changing economic conditions, the proposal was suspended in 2016. The coal reserves remain available for lease and the threat of future development still exists. The operating mine plan and data could be acquired, and a new application brought before the agencies for review. The mine plan pursued by PRC proposed a Logical Mining Unit northwest of the Preservation Area. A future coal mine following the PRC plan would not be precluded by this Preservation Area. The new mine plan would, however, need to refine the transportation design (roads and conveyor) in accordance with the provisions of the Preservation Area. In addition, the Beluga Coal Company currently maintains coal leases in the watershed just west of the leases that were held by PRC.

Coal Bed Methane and Underground Coal Gasification Development

Numerous companies have expressed an interest in producing gas from the coal seams in the Beluga coal field. Linc Energy held exploration rights for the areas surrounding the surface coal leases within the past decade and conducted preliminary test work to develop Underground Coal Gasification (UCG). Cook Inlet Regional Incorporated (CIRI) explored UCG potential on its lands to the east of the Chuitna River in 2008. The Cook Inlet basin sub-bituminous coals found at shallow depths (less than 5,000 feet) in the Tyonek and overlying Beluga formations, contain methane and cover most of the central and southern basin. Estimates of the gas from the sub-bituminous coals at shallow depths along the margins of the basin have been as high as 140 trillion cubic feet of gas (Montgomery and Barker 2003). Coal extraction requires surface drill pads and roads with an infrastructure to separate the gas from the ground water. In addition, buried gas pipelines would be required to collect the gas and move the gas to market.

Timber

In the 1970s, Kodiak Lumber Mills signed an agreement with TNC and built a dock at North Foreland to export wood chips from timber logged on TNC lands. This included several hundred acres of timber logged from the Chuitna watershed. AMHT has supported logging operations from their lands. Birch and spruce are prevalent and are of ongoing interest to the forest industry. Port Mackenzie, which is east of the Beluga area near Anchorage has an ongoing history of exporting wood chips using these species of trees.

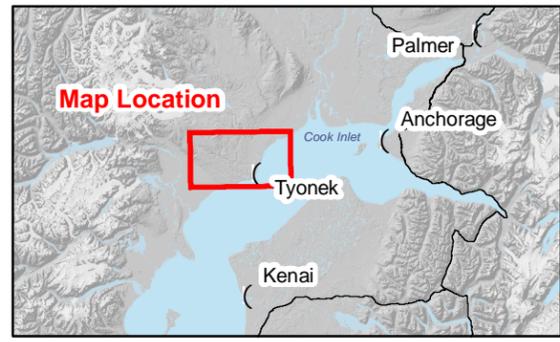
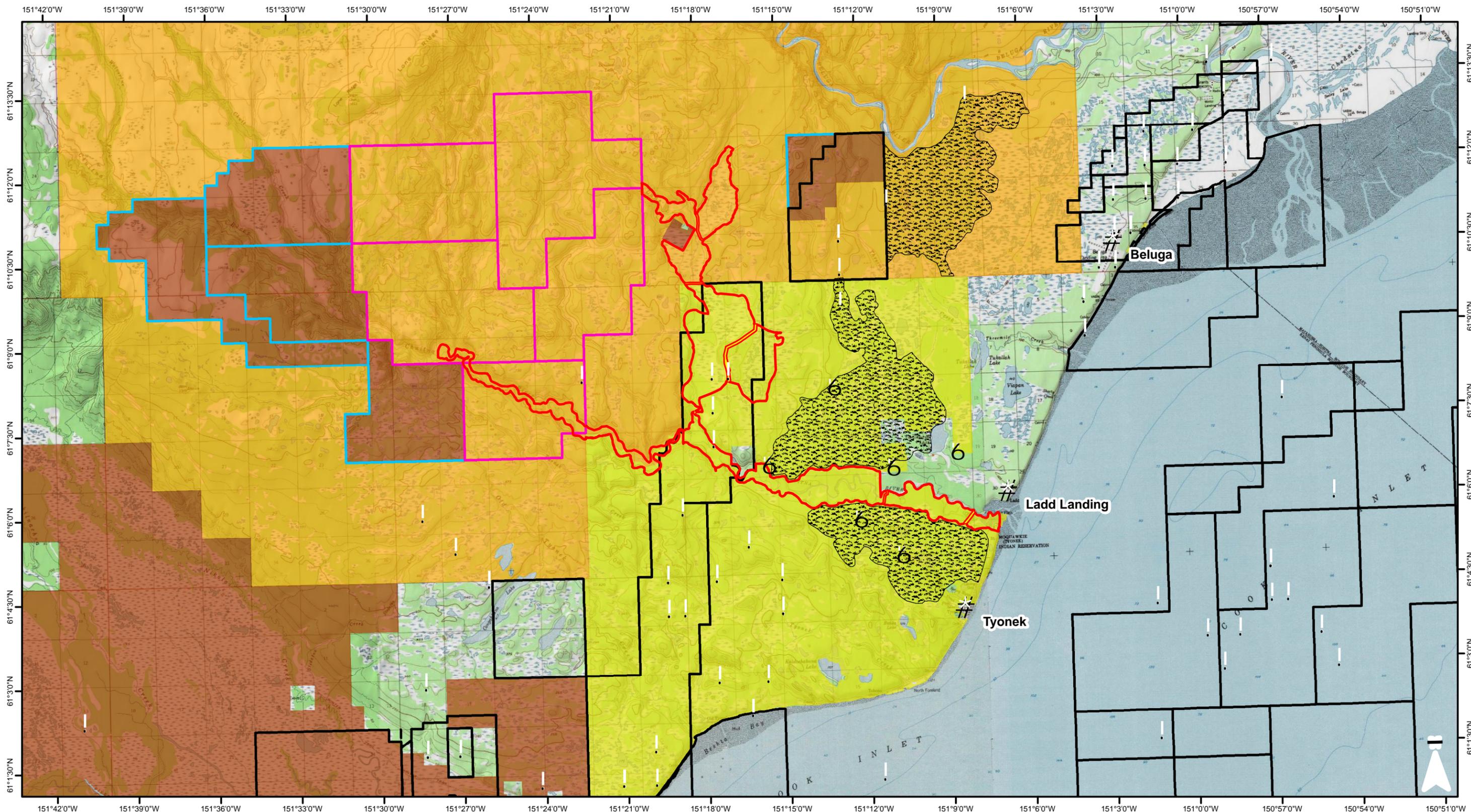
Gravel and Placer Mining

TNC conducts gravel mining in the area to support road construction for maintenance and expansion of oil and gas development. Several borrow pits are in the Chuitna watershed. Tyonek Contractors, a subsidiary of TNC, permitted a new multi-acre gravel source pit area just north of the Chuitna River and began development of the site within the past decade. The gravel in the majority of the watershed is glacially derived and is high in silt content. The gravels found closer to the mainstem of the Chuitna River tend to be cleaner (due to alluvial deposition) and more desirable for construction purposes.

Summary

AMHT and TNC manage their assets to generate income. Revenue-generating uses of their lands include: land leasing and sales; real estate investment and development; commercial timber sales; mineral

exploration and production; coal, oil and gas exploration and development; sand, gravel and rock sales; and other general land uses. There is ever-increasing resource development pressure in and surrounding the Chuitna watershed. This Plan restricts this development within its boundaries, but does not preclude development in adjacent areas, containing oil and gas leases and coal resources. The Preservation Area, however, ensures that any future development will not have direct impacts on important aquatic resources within the large contiguous Preservation Area in the watershed.



- | | | |
|---|---------------------------|--------------------------|
| Proposed Preservation Area | Place Name | Former PacRim Coal Lease |
| Easement | Oil Well Site (ADNR 2008) | Current Coal Lease |
| Landowner | Gravel Operation | Oil & Gas Lease |
| TNC (Surface)/CIRI (Subsurface) | Logged Area | |
| Alaska Mental Health Trust | | |
| Alaska DNR | | |
| <i>All other landowners unspecified</i> | | |

Miles
0 0.75 1.5 3

Seward Meridian,
NAD 1983 UTM Zone 5N
National Geographic Society 2011
1:63,000 TOPO

**Chitna PRM
Threat Map**

Figure 6

Site Protection Instrument

The following provides the language to be included in the deed restrictions for TNC and AMHT. These deed restrictions will be finalized and recorded prior to initiating Project construction. The instruments will “run with the land” for a substantial period of time in accordance with the USACE Compensatory Mitigation Site Protection Instrument Handbook (July 2016). Donlin Gold will provide for oversight by an independent third party in a manner acceptable to USACE, following the Long-term Management Plan (LMP).

Draft Language for TNC Lands

Description of Property

This deed restriction applies to lands owned by TNC with subsurface ownership held by CIRI. The lands are located in the Chuitna River watershed on the northwest shores of Cook Inlet. The deed restriction applies to 3,949 acres as shown on the attached Figure [Figure 7 in this document] (herein referred to as the Property).

Natural Conditions

The purpose of this deed restriction is to ensure the Property will be preserved in a “Natural Condition”, as defined as it exists at the time this document is recorded for 99 years.

Documentation of Current Conditions

The Current Conditions of the Property as of the date of this Deed are further documented in a "Present Conditions Report", dated, _____, 20__ and prepared by [preparer's name], which report is acknowledged as accurate by Grantor and Grantee:

- (a) a current aerial photograph of the Property at an appropriate scale taken as close as possible to the date the recording is made;*
- (b) on-site photographs taken at appropriate locations on the Property, including of major natural features;*
- (c) Wetlands mapping, conducted in 2018, documenting the streams and waters of the United States (WOUS) in the Preservation Area using USACE guidance in place at the time of the mapping; and*
- (d) Graphical depiction of the boundaries of the area being preserved at a scale and with a datum identified that can be used to overlay the Property on future site maps of the area.*

Prohibitions

- (a) There shall be no filling, flooding, excavating, mining or drilling; no removal of natural materials; no dumping of materials; and, no alteration of the topography in any manner except as provided for under Reserved Rights below.*
- (b) There shall be no clearing, burning, cutting or destroying of trees or vegetation, except as expressly authorized in the Reserved Rights; there shall be no planting or introduction of non-native or exotic species of trees or vegetation.*

(c) There shall be no construction, erection, or placement of buildings, billboards, or any other structures, or any additions to existing structures, except small structures or additions in areas not mapped as WOUS and as otherwise provided for under Reserved Rights below.

(d) There shall be no construction of new roads, trails or walkways except as provided in the Reserved Rights below and only with the prior written approval of the USACE, including the manner in which they are constructed.

(e) There shall be no construction or placement of utilities or related facilities in WOUS without the prior written approval of the USACE.

Reserved Rights

Actions required to prevent or repair severe erosion or damage to the Property or portions thereof, or significant detriment to existing or permitted uses, is allowed, provided that such actions are generally consistent with preserving the natural condition of the Property.

Harvesting and management of timber by Landowner is limited to the extent necessary to protect the natural environment in areas where the forest is damaged by natural forces such as fire, flood, storm, insects, infestations, or infectious organisms.

Landowner reserves the right to engage in any outdoor recreational activities, including hunting (excluding planting or burning) and fishing, with cumulatively very small impacts, and which are consistent with the continuing natural condition of the Property.

Landowner specifically reserves a qualified mineral interest (as defined in § 170(h)(6) of the Internal Revenue Code) in subsurface oil, gas or other minerals and the right to access such minerals. However, there shall be no extraction or removal of, or exploration for, minerals by any surface mining method, nor by any method which results in subsidence or which otherwise interferes with the continuing natural condition of the Property.

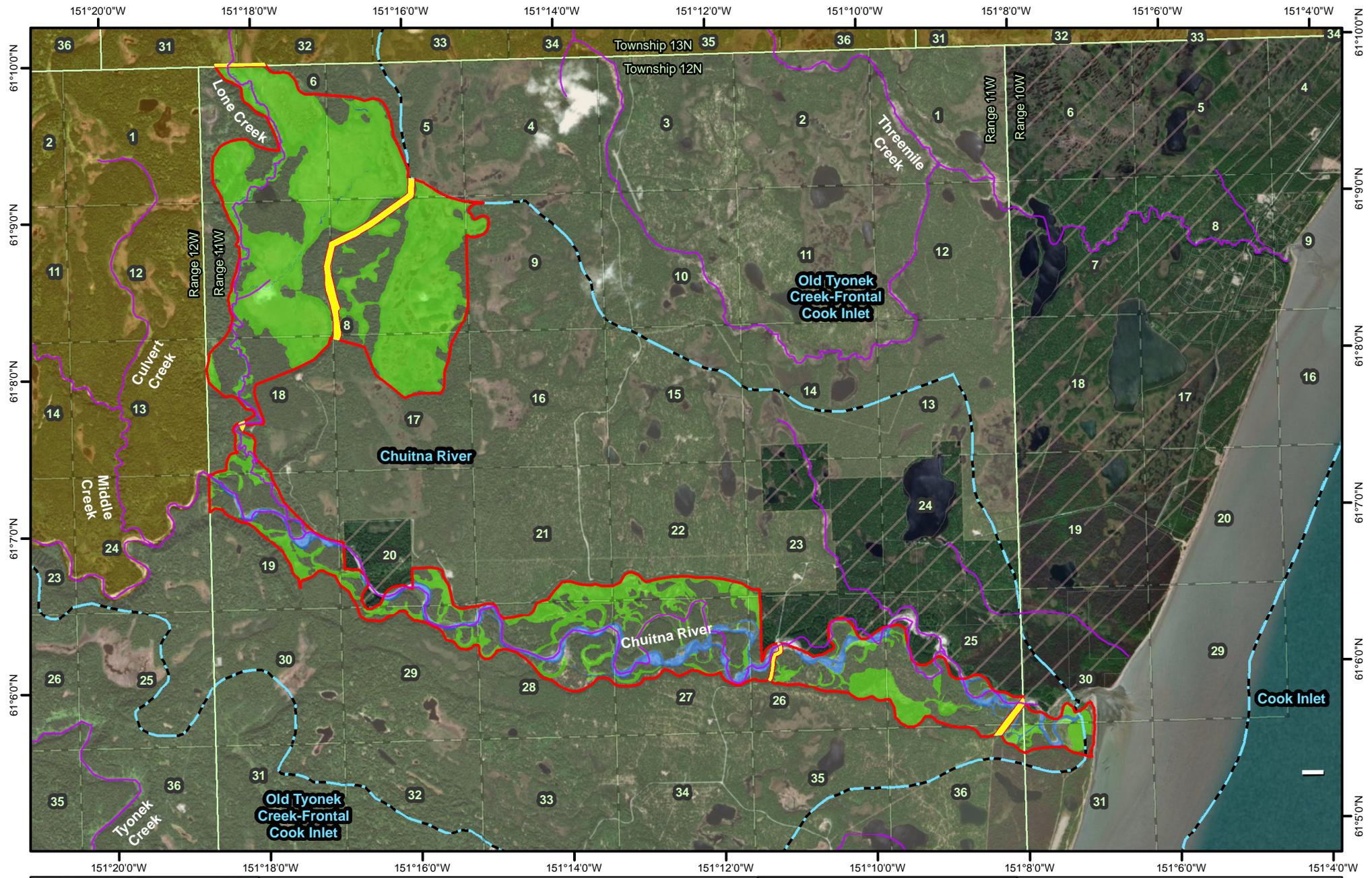
Landowner reserves the right to maintain existing roads, trails or walkways. Maintenance shall be limited to: removal or pruning of dead or hazardous vegetation; application of permeable materials (e.g., sand, gravel, crushed rock) necessary to correct or impede erosion; grading; replacement of culverts, water control structures, or bridges; and maintenance of roadside ditches.

Landowner reserves the right to engage in the removal or trimming of vegetation downed or damaged due to natural disaster, removal of man-made debris, removal of parasitic vegetation (as it relates to the health of the host plant) and removal of non-native or exotic plant or animal species.

Landowner reserves the right to construct habitat improvements within the Property, including activities such as creating moose browse, replacing blocked culverts to improve fish passage, or constructing new fish habitat in the area. The Landowner will be required to obtain the necessary permits for these activities, including from the Alaska Department of Fish and Game (ADF&G) and the USACE, as required.

Landowner specifically reserves the right to reconstruct or, if needed, relocate the existing bridge crossing over the Chuitna River for safety and structural reasons, upon approval of the relocation from the USACE.

Landowner reserves the right to engage in all acts or uses not prohibited by the Restrictions, and which are not inconsistent with the conservation purposes of this grant, the preservation of the Property in its natural condition, and the protection of its environmental systems.



Anadromous Stream	HUC 10 Watershed Boundary
Public Land Survey Section	Easement
Land Owner	Proposed Preservation Area
Tyonek Native Corp.	Field Verified Mapping
AK Mental Health Trust	Wetland/Pond/Lake
Other Land Owner	River/Stream

Mile
 0 0.25 0.5 1
 1 Inch = 5,000 Feet
 1:60,000

**Chuitna Wetland and Stream
 Tyonek Native Corporation
 Preservation Area
 Figure 7**

Seward Meridian, NAD 1983, UTM Zone 5N
 Imagery: DigitalGlobe, 2014
 Date: 07/03/18

Draft Language for AMHT Lands

Description of Property

This deed restriction applies to lands owned by AMHT managed by the Trust Land Office. The lands are located in the Chuitna River watershed on the northwest shores of Cook Inlet. The deed restriction applies to 1,921 acres as shown on the attached Figure [Figure 8 in this document] (herein referred to as the Property).

Natural Conditions

The purpose of this deed restriction is to ensure the Property will be preserved in a "Natural Condition", as defined as it exists at the time this document is recorded for 99 years.

Documentation of Current Conditions

The Current Conditions of the Property as of the date of this Deed are further documented in a "Present Conditions Report", dated, _____, 20__ and prepared by [preparer's name], which report is acknowledged as accurate by Grantor and Grantee:

- (a) a current aerial photograph of the Property at an appropriate scale taken as close as possible to the date the recording is made;*
- (b) on-site photographs taken at appropriate locations on the Property, including of major natural features;*
- (c) Wetlands mapping, conducted in 2018, documenting the streams and waters of the United States (WOUS) in the Preservation Area using USACE guidance in place at the time of the mapping; and,*
- (d) Graphical depiction of the boundaries of the area being preserved at a scale and with a datum identified that can be used to overlay the Property on future site maps of the area.*

Prohibitions

- (a) There shall be no filling, flooding, excavating, mining or drilling; no removal of natural materials; no dumping of materials; and, no alteration of the topography in any manner except as provided for under Reserved Rights below.*
- (b) There shall be no clearing, burning, cutting or destroying of trees or vegetation, except as expressly authorized in the Reserved Rights; there shall be no planting or introduction of non-native or exotic species of trees or vegetation.*
- (c) There shall be no construction, erection, or placement of buildings, billboards, or any other structures, or any additions to existing structures, except small structures or additions in areas not mapped as WOUS and as otherwise provided for under Reserved Rights below.*
- (d) There shall be no construction of new roads, trails or walkways except as provided in the Reserved Rights below and only with the prior written approval of the USACE, including the manner in which they are constructed.*

(e) There shall be no construction or placement of utilities or related facilities in WOUS without the prior written approval of the USACE.

Reserved Rights

Actions required to prevent or repair severe erosion or damage to the Property or portions thereof, or significant detriment to existing or permitted uses, is allowed, provided that such actions are generally consistent with preserving the natural condition of the Property.

Harvesting and management of timber by Landowner is limited to the extent necessary to protect the natural environment in areas where the forest is damaged by natural forces such as fire, flood, storm, insects, infestations, or infectious organisms.

Landowner reserves the right to engage in any outdoor recreational activities, including hunting (excluding planting or burning) and fishing, with cumulatively very small impacts, and which are consistent with the continuing natural condition of the Property.

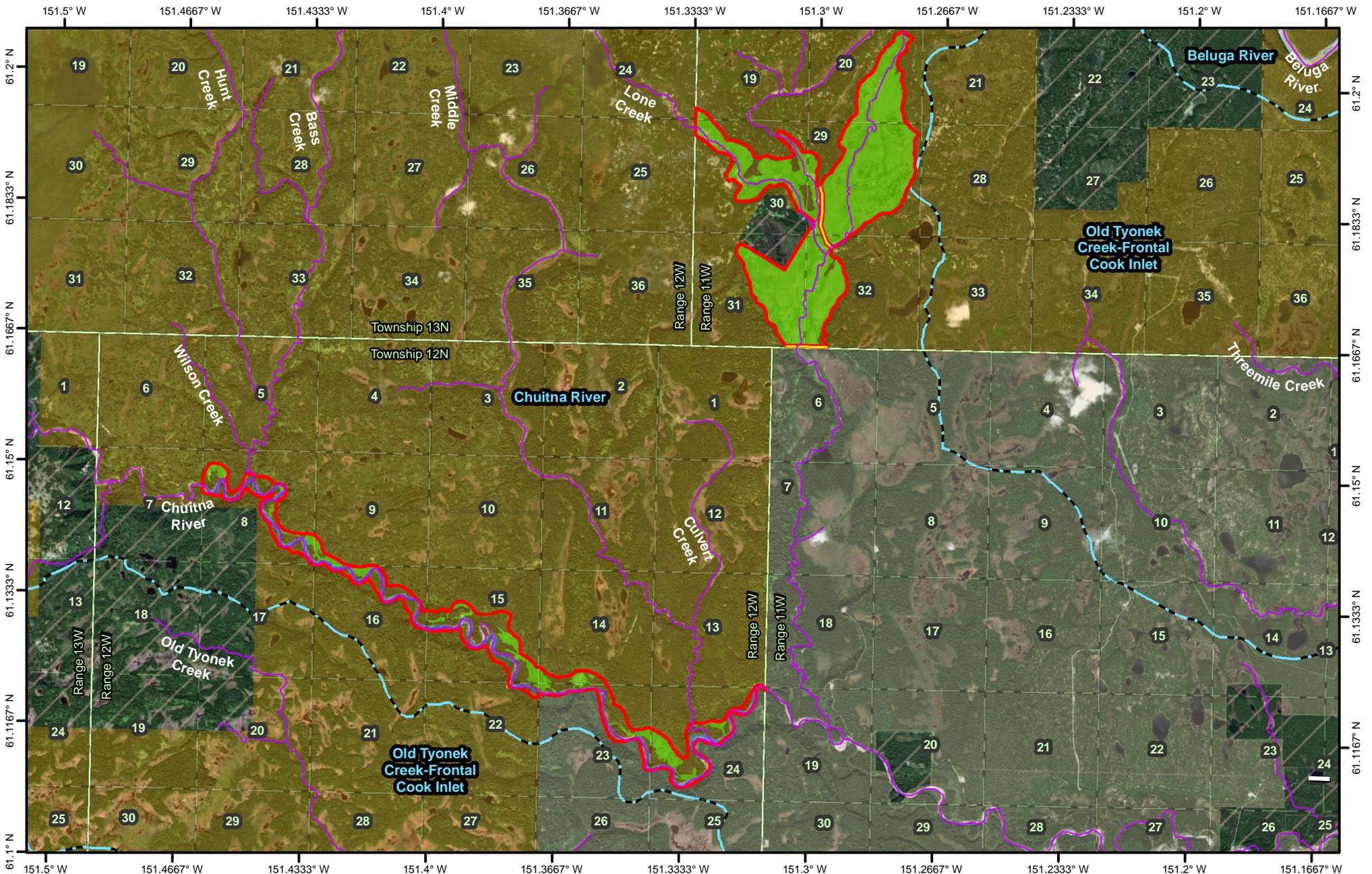
Landowner specifically reserves a qualified mineral interest (as defined in § 170(h)(6) of the Internal Revenue Code) in subsurface oil, gas or other minerals and the right to access such minerals. However, there shall be no extraction or removal of, or exploration for, minerals by any surface mining method, nor by any method which results in subsidence or which otherwise interferes with the continuing natural condition of the Property.

Landowner reserves the right to maintain existing roads, trails or walkways. Maintenance shall be limited to: removal or pruning of dead or hazardous vegetation; application of permeable materials (e.g., sand, gravel, crushed rock) necessary to correct or impede erosion; grading; replacement of culverts, water control structures, or bridges; and maintenance of roadside ditches.

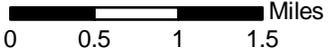
Landowner reserves the right to engage in the removal or trimming of vegetation downed or damaged due to natural disaster, removal of man-made debris, removal of parasitic vegetation (as it relates to the health of the host plant), and removal of non-native or exotic plant or animal species.

Landowner reserves the right to construct habitat improvements within the Property, including activities such as creating moose browse, replacing blocked culverts to improve fish passage, or constructing new fish habitat in the area. The Landowner will be required to obtain the necessary permits for these activities, including from the Alaska Department of Fish and Game (ADF&G) and the USACE, as required.

Landowner reserves the right to engage in all acts or uses not prohibited by the Restrictions, and which are not inconsistent with the conservation purposes of this grant, the preservation of the Property in its natural condition, and the protection of its environmental systems.



-  Anadromous Stream
-  Public Land Survey Section
- Land Owner**
-  AK Mental Health Trust
-  Tyonek Native Corp.
-  Other Land Owner
-  HUC 10 Watershed Boundary
-  Easement
-  Proposed Preservation Area
- Field Verified Mapping**
-  Wetland/Pond/Lake
-  River/Stream

 Miles
 0 0.5 1 1.5
 1 inch = 6,000 feet
 1:72,000

**Chuitna Wetland and Stream
 Alaska Mental Health Trust
 Preservation Area
 Figure 8**

Seward Meridian, NAD 1983, UTM Zone 5N
 Imagery: DigitalGlobe, 2014
 Date: 07/03/18

Baseline Information

The baseline data for the Preservation Area has been provided in the Site Selection section. Wetland ecology, stream, and fish data were summarized and then contrasted to the MA/TA. The fish data for the Preservation Area was summarized by Owl Ridge (2017) using the AWC and available resource data. The existing site disturbance conditions for the Preservation Area were summarized, including approximately 6 acres of pads, roads and trails.

Preservation Area Wetland Mapping

A seven-day field program was conducted to verify and update the preliminary desktop mapping in June 2018. Preliminary mapping was used to identify initial field targets. The wetland evaluation and collection of field data, wetland determinations, and the resulting digital maps were completed in accordance with guidance provided in the United States Army Corps of Engineers Wetland Delineation 1987 Manual (USACE 1987) and the Regional Supplement to the United States Army Corps of Engineers Wetland Delineation Manual: Alaska Region, 2007 Supplement Version 2.0 (2007 Supplement) (USACE 2007). All field data were reported using the 2016 National Wetlands Plant List (Lichvar et al. 2016).

All information required in SPN 2010-45 (USACE 2010) was collected in the field to complete a PJD report for the Preservation Area. Boundaries between wetlands and uplands were delineated, the preliminary mapping was used to identify and focus work in boundary areas including forest types, where wetland status is difficult to determine without field verification. Field plot locations were determined using the best available ESRI World Imagery collected by DigitalGlobe in 2014, preliminary mapping and by handheld Global Positioning System units. All field data were entered into a wetland database where the data was reviewed, and queries were generated to provide the information needed for the digital map and report. Detailed information was collected on one tenth of an acre plots (1/10) and was recorded in representative project vegetation types along wetland boundaries. Additional field data, notes, and photographs were gathered while walking through the study area to evaluate mapping areas with similar characteristics. Areas of disturbance were mapped and notes taken for inclusion in the PJD.

Field data were collected and recorded using four types of plots:

1. **Wetland Determination (WD) Plots.** At these sites investigators recorded detailed descriptions of vegetation, hydrology, and soils on field data forms. Wetland status for this plot type were determined based on the presence or absence of hydrophytic vegetation, hydrology, and hydric soils using the 2007 Supplement.
2. **Field Verification Points (FVP).** Photographs and Global Positioning System (GPS) locations were taken where investigators encountered vegetation communities and landscape positions that were clearly wetlands or upland based on WD results in nearby similarly situated areas. Project Vegetation Type, HGM, and Cowardin classifications were recorded.
3. **Stream Crossing (SC) Points.** Photographs and GPS locations were taken where investigators encountered streams and rivers. Information on the stream status as a seasonal or perennial

Relatively Permanent Waters (RPW) or Traditional Navigable Waters (TNW) and stream width at the ordinary high-water mark were recorded.

4. **Waterbody (WB) Points.** Photographs and GPS locations were taken where investigators encountered ponds, lakes, and Cook Inlet.

The Chuitna Preservation Area PJD (anticipated late July 2018) will include the detailed results of the final mapping.

Preservation Area Site Condition Analysis

The Preservation Area is almost entirely undisturbed. Maps of the existing condition showing the location of pads, roads, and trails will be supplied in the Chuitna Preservation Area PJD. The Preservation Area site condition survey noted 6 acres of existing disturbance with fill in wetlands or areas where hydrology and soils were adversely affected by man-made activity, see further discussion under Baseline Conditions.

Determination of Credits

The aquatic resource losses from the Project were quantified using the HGM and the Cowardin Classification systems by acres for wetlands and linear feet for stream loss (see 332.3(f)(1)). The aquatic resources preserved by the Plan have been described using the same HGM and the Cowardin Classification systems by acres for wetlands and linear feet for streams. The Preservation Area parcel includes 5,870 acres, including 3,269 acres of wetlands and ponds, 418 acres of streams and rivers, 2,183 acres of upland riparian and buffers, and 258,056 linear feet (48.87 miles) of streams, that will be permanently protected from development as shown in Table 14.

Table 14 Areas Permanently Protected by the Preservation Area

Land Description	Type	Acres	Linear Feet (Miles)
Wetlands and Ponds	Preservation	3,269	-
*Streams and Rivers	Preservation	418	258,056 (48.87)
Upland Riparian and Buffer	Preservation	2,183	-
Total		5,870	258,056 (48.87)

*Note: Streams and Rivers acreage is not included within wetlands and ponds

Mitigation Work Plan

The Preservation Area will be protected in the existing pristine state. The Mitigation Work Plan consists of implementing the Site Protection Instruments (shown above) and LMP Section (described on the next page).

Maintenance Plan

There are no plans to actively undertake maintenance or rehabilitation activities within the Preservation Area. No maintenance is specifically planned for the minimal existing disturbance in the area, see Baseline Conditions. All existing disturbed sites will be allowed to naturally revegetate. See the LMP

Section for the actions to be taken to ensure compliance with the deed restrictions, including any maintenance arising from observations during the annual site visits.

Performance Standards

Donlin Gold has proposed Site Protection Documents for the Preservation Area. Donlin Gold will execute preservation of the parcel concurrently with work authorized under the DA application for the Project. The Performance Standards consist of documenting compliance with the requirements of the deed restrictions through implementation of the LMP.

Monitoring Requirements

See the Long-term Management Plan Section (below) for discussion of the proposed site monitoring to ensure compliance with the deed restriction requirements.

Long-term Management Plan (LMP)

As part of finalizing the Site Protection Instruments for TNC and AMHT lands, Donlin Gold will prepare a LMP for the Preservation Area. This LMP will be implemented by a third party to conduct inspections and provide reports to demonstrate compliance with the deed restrictions. Finalizing the LMP and selection of the third party will be subject to USACE review and approval based on their qualifications to serve in this role.

Donlin Gold will submit the LMP to USACE at least six months prior to the start of Project construction. Project construction will not be initiated until the deed restrictions are in place and the LMP is approved by USACE.

Specifically, the LMP will be designed to ensure that the Preservation Area is monitored, managed, and maintained for the long-term sustainability and preservation of its baseline conditions. Existing conditions were delineated in June 2018 as described in the Chuitna Preservation Area PJD (anticipated late July 2018). Prior to construction, Donlin Gold will be responsible for confirming and updating the baseline conditions as needed. The LMP will be intended to extend for the duration of the deed restrictions. The LMP will also specifically describe the mechanism by which the proposed third party's inspections and reporting will be funded over the term of the restrictions.

To support preparation of the LMP (and finalize the deed restrictions), Donlin Gold will complete a metes and bounds survey of the Preservation Area or other method of identification and documentation according to methods acceptable to the USACE. The survey is expected to closely resemble the boundaries represented within this CMP and will be used to establish the exact property boundaries for the deed restrictions and LMP. The survey will specifically define the boundaries of the easements that have been excluded from the Preservation Area. Under the provisions of the LMP, the third party and the landowners will implement methods to limit access to, and restrict activities in, the Preservation Area where appropriate.

Donlin Gold shall implement the approved LMP for the purposes stated above. The LMP will require annual monitoring site visits by the third party to qualitatively monitor the general conditions of the

Preservation Area and compliance with the terms of the deed restrictions. The conditions of the Preservation Area will be evaluated, documented, and mapped during the site visits. The third party will be responsible for preparing annual monitoring reports detailing the existing conditions of the Preservation Area, and any recommended management actions. In the annual reports, the third party will specifically describe if there have been any anthropogenic changes to the status of the Preservation Area's conservation values including: WOUS, wetlands, and streams. The annual monitoring reports will be available to the USACE upon request.

As described in the LMP, the landowners will not be responsible for changes to the site conditions attributable to natural catastrophes such as flood, fire, drought, disease, regional pest infestation, and others that are beyond their reasonable control. Active management will not be required for ecological changes that come about because of processes such as climate change, fluctuating river levels, and sedimentation due to overbank flood deposits that many affect the Preservation Area's wetlands. Over time, natural successional processes could occur that may affect stream channels and wetland functions or total wetland acreages.

Finally, the LMP will describe how Donlin Gold and the third party will work with the landowners to ensure that any activities proposed to occur in the Preservation Area comply with the requirements of the deed restrictions. This will include preventing any activities that are specifically prohibited by the deed restrictions, see the Site Protection Instrument Section.

In summary, Donlin Gold proposes that the LMP include the following specific sections:

1. Introduction and Purpose
2. Third Party and Responsibilities
3. Preservation Area Description
 - a. Location and boundaries
 - b. Ownership
 - c. Existing land use and disturbance
 - d. Baseline conservation values, including wetlands, streams, and WOUS
4. Management and Monitoring
 - a. Annual site visits, including scope, documentation, and action items
 - b. Security, safety, and public access
 - c. Limits of responsibility, including exclusions of natural events
5. Allowable Improvements and Activities
 - a. Permitted and prohibited actions
 - b. Third party and landowner coordination
6. Adaptive Management
7. Reporting and Administration
8. Amendments, Transfer, Replacement/Termination, and Notice Provision
9. Funding
10. USACE Rights, Responsibilities, and Authorities
11. Signatures (Donlin Gold, Landowners, and USACE)

Adaptive Management Plan

Preservation Area site conditions are expected to change over time due to natural events. As discussed above under the Long-term Management Plan Section, monitoring reports will be completed yearly showing updated site conditions. The annual reports will identify any areas of concern (i.e., occurrence of prohibited activities) along with any necessary corrective or remedial actions.

Financial Assurances

The LMP will include an estimate of the annual third party costs required to implement its provisions. Prior to initiating Project construction, Donlin Gold will obtain financial assurance using an instrument acceptable to the USACE for the cost of 30 years of LMP implementation.

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Attachment F
Transportation Area Restoration Plan

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Attachment F Transportation Area Restoration Plan

Objectives

Donlin Gold, LLC (Donlin Gold) has developed a Restoration Plan (Plan) to address wetlands lost by Transportation Area (TA) facility development from the Donlin Gold Project (Project). The Plan provides restoration of wetlands in impacted watersheds with in-kind restoration. The TA is in the Crooked Creek, Veahna Creek-Kuskokwim River, and Headwaters Iditarod River HUC-10 watersheds. The actions are designed to exceed reclamation requirements imposed by the State of Alaska upon material site closure in these watersheds.

The material sites selected for restoration in the TA are all located on State Land. Donlin Gold cannot secure long term legal use exclusions and preservation on State Land. The Alaska Department of Natural Resources (ADNR) does not require the establishment of wetlands in material site reclamation plans (ADNR 2014). However, ADNR encourages restoring sites to ponds with littoral edges to enhance fish habitat associated with material sites. In its reclamation site plans, Donlin Gold proposes to restore wetland areas, where feasible. Donlin Gold is conducting this work as minimization and not requesting compensatory mitigation credits for the material site wetland restoration, and this no financial or preservation instruments or performance standards will be filed with United States Army Corps of Engineers (USACE).

Site Selection Criteria

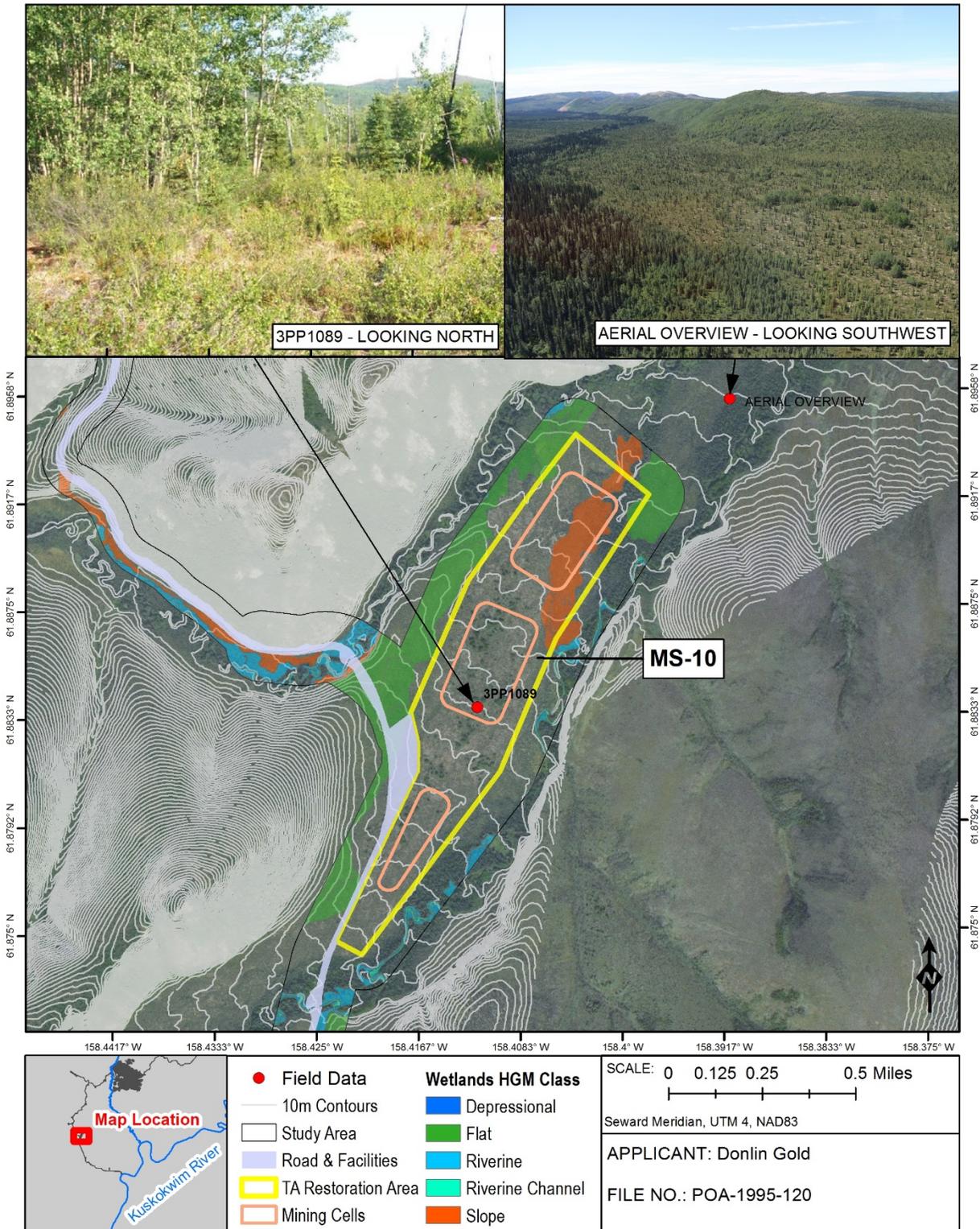
Material site candidates were identified as those most likely to provide wetland restoration opportunities based on groundwater hydrology (water table), favorable slope position, and the final shape (concave) after material removal. Each proposed material site in the TA was considered for restoration at closure. Not all can be restored because of location and the ability to remove fill. As shown in Table 1, the material sites selected for wetland restoration will restore 34.7 acres of wetlands.

Table 1 TA Material Site Wetland Impact Restoration Sites

TA Facility	HUC-10	Wetland Acres Impacted	Wetland Acres Restored
Material Site-10	Crooked Creek	25.3	25.3
Material Site-12	Crooked Creek	1.5	1.5
Material Site-16	Veahna Creek-Kuskokwim River	7.9	7.9
Total		34.7	34.7

Figure 1 through Figure 3 are maps and site photos of the three selected material sites.

Figure 1 TA Material Site-10 Map and Site Photos



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Figure 2 TA Material Site-12 Map and Site Photos

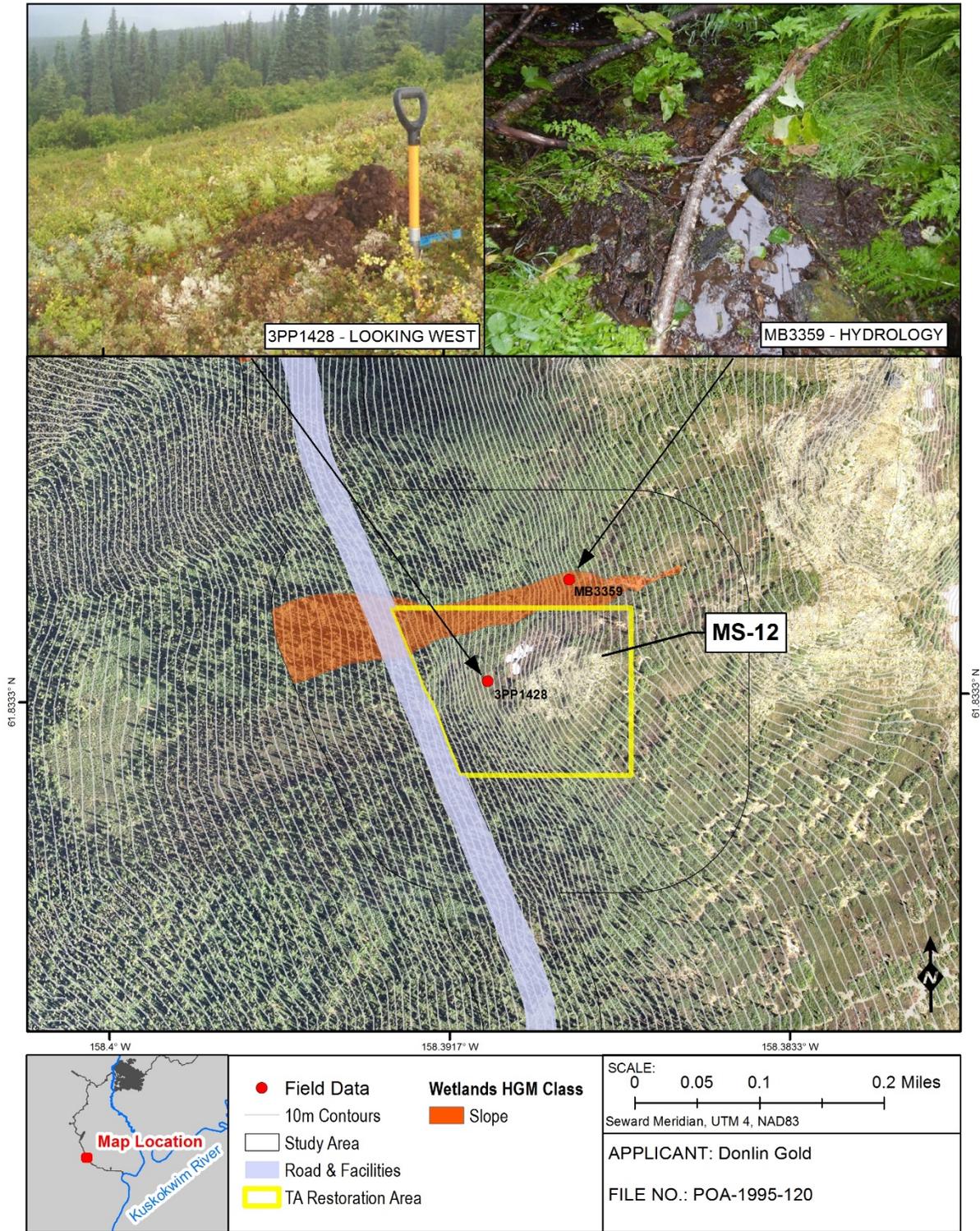
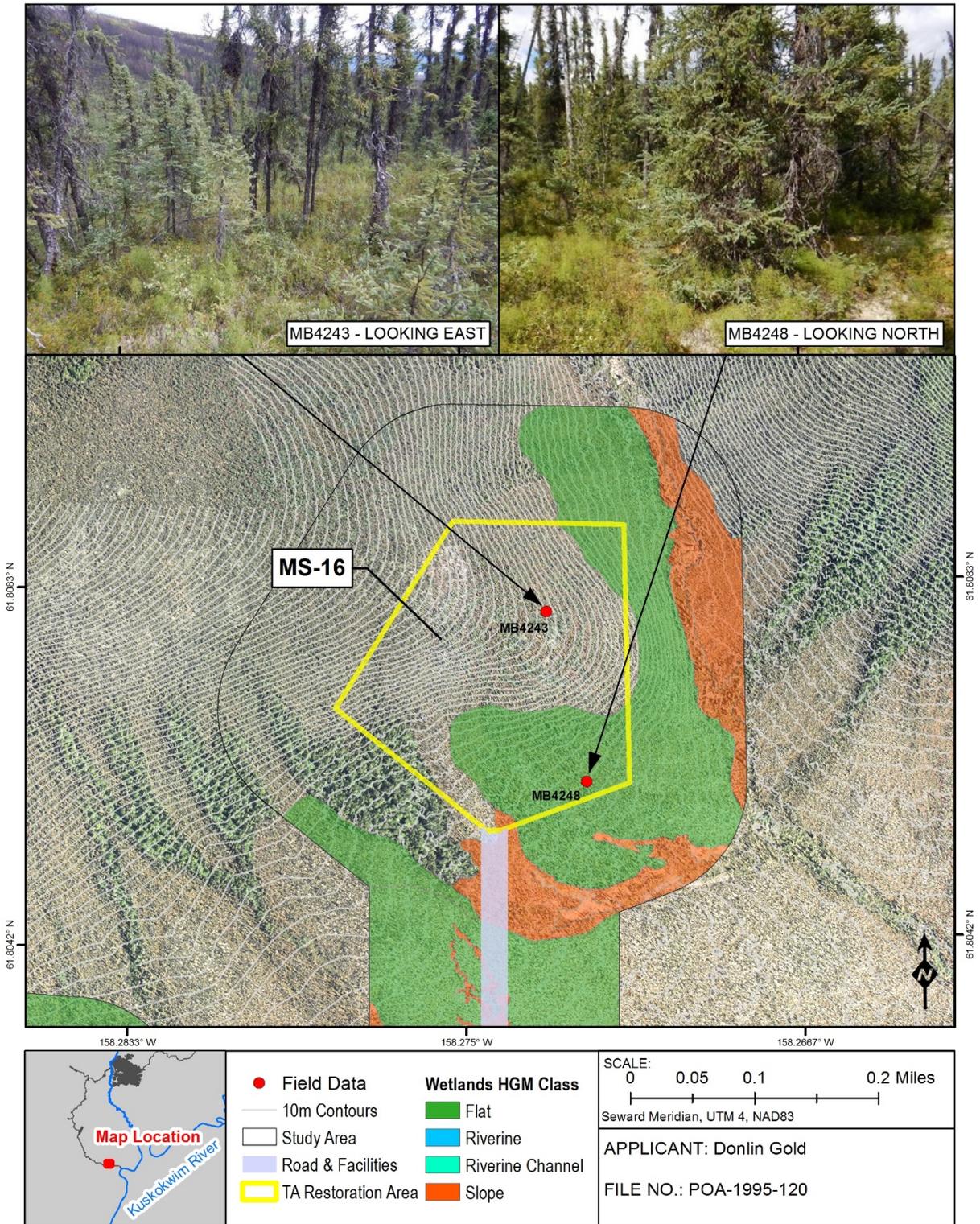


Figure 3 TA Material Site-16 Map and Site Photos



Material Site-10

Material Site-10, in the Crooked Creek HUC-10, is on a terrace between the confluence of the North and South forks of Getmuna Creek. The site is 208.3 acres. Wetlands associated with an abandoned channel of the South Fork of Getmuna Creek are at the northeast end of the site and total 25.3 acres (Figure 1). Three material site areas (cells) will be excavated, totaling 75.9 acres. Each excavation is projected to intersect the water table; the depth of water in each cell will vary along the gradient of the land surface, from less than three feet to greater than 17 feet.

Anadromous and resident fish populations are documented in both forks of Getmuna Creek indicating a diversity of species using the reaches above and below the proposed material site for spawning, rearing, and migration. Coho (*Oncorhynchus kisutch*), chum (*Oncorhynchus keta*), and Chinook (*Oncorhynchus tshawytscha*) salmon are documented throughout Getmuna Creek downstream from the confluence of the North and South forks; however, only coho salmon are documented upstream from the confluence, adjacent to the material site. Coho salmon are likely to be present throughout the year. Dolly Varden (*Salvelinus malma*), arctic grayling (*Thymallus arcticus*), and slimy sculpin (*Cottus cognatus*) are documented or expected to exist throughout the Getmuna Creek drainage and are also likely present throughout the year (USACE 2015).

Material Site-12

Material Site-12, in the Crooked Creek HUC-10, is on a hillside above a tributary to Getmuna Creek. Aquatic life is the same as described for the Material Site-10 site. The northern edge of the material site is a wetland swale, with at least two seeps at the head of the wetlands. The swale contains slope hydrogeomorphic (HGM) wetlands that are seasonally flooded from an intermittent headwater stream. The site is 14.2 acres, including 1.5 acres of wetlands within the swale (Figure 2).

Material Site-16

Material Site-16, in the Veahna Creek-Kuskokwim River HUC-10, is on a hillside and footslope above a tributary to Jungjuk Creek. Coho salmon, Dolly Varden, arctic grayling, round whitefish (*Prosopium cylindraceum*) and slimy sculpin have been recorded in Jungjuk Creek. The site comprises 27.7 acres and contains 7.9 acres of flat and slope HGM wetlands (Figure 3). Excavation in wetlands in this material site is projected to intersect the water table.

Vegetation

Low shrub tundra (LST), open black spruce forest (OBSF) (Photo 1, all photos Michael Baker 2016) and black spruce woodland (BSW) (Photo 2) are the most prevalent wetland vegetation types in the TA material sites. Other wetland vegetation types present in the TA sites include closed alder shrub (CAS), woodland mixed forest (WMF), and open white spruce forest (OWSF). Vegetation types are described in the 2016 Preliminary Jurisdictional Determination (PJD) (Michael Baker 2016).

Photo 1 Open Black Spruce Forest Vegetation Type



Photo 2 Black Spruce Woodland Vegetation Type



Following excavation, the material sites will be restored as permanently flooded to semi-permanently flooded waterbodies with wetland margins composed primarily of emergent vegetation with a vegetation classification of wet herbaceous (WH) (Photo 3). Excavation of material will create concave features that will hold water, thus creating the waterbodies and associated sedge/grass marshes adjacent to them.

In the Yukon-Kuskokwim Highlands Major Land Resources Area (MLRA) (Crooked Creek and Veahna Creek-Kuskokwim River HUC-10s), WH plots typically contain leafy tussock sedge (*Carex aquatilis*),

northwest territory sedge (*Carex utriculata*), bluejoint (*Calamagrostis canadensis*), and purple marshlocks (*Comarum palustre*) as dominant plants (Photo 3) (Michael Baker 2016).

Photo 3 Wet Herbaceous Vegetation, Crooked Creek HUC-10



Wetlands

The wetland impact restoration areas include HUC-10 watersheds in the Yukon-Kuskokwim Highlands MLRA. The material sites will impact a variety of wetland types based on HGM and Cowardin Classifications. Table 2 shows field data collected at the restoration sites. Table 3 lists the wetland acres, by HGM and Cowardin Groups impacted by each TA site.

Table 2 Field Data in TA Restoration Sites; HGM and Cowardin Classifications and Hydrology Notes

Plot Number	HGM	Cowardin Classification	TA Restoration Area	Hydrology Notes
3PP1804	Flat	PSS4B	Material Site 10	Saturation at 8", Water table at 20"
MB0253	Flat	PFO4/SS1B	Material Site 10	Surface water at 0", Water table at 15", Saturation at 10"
MB3358	Slope	PSS1C	Material Site 12	Spring seeps with surface water
MB3359	Slope	PSS1C	Material Site 12	Spring seeps with surface water
MB4248	Flat	PSS1/FO4B	Material Site 16	Saturation present
MB4250	Slope	PSS1/FO4B	Material Site 16	Water table at 10"

Table 3 Baseline Wetland Types Impacted, by TA Site

Facility	HGM Class	Cowardin Groups	Acres	Total Acres
Material Site-10	Flat	Coniferous Forests	1.4	
		Scrub Shrub	1.3	
	Total			2.7
	Slope	Coniferous Forests	15.5	
Scrub Shrub		7.2		
Total			22.7	
Material Site-12	Slope	Coniferous Forests	0.1	
		Scrub Shrub	1.4	
	Total			1.5
Material Site-16	Flat	Scrub Shrub	7.7	
	Slope	Scrub Shrub	0.2	
	Total			7.9
Grand Total			34.7	

Sites After Restoration

Based on the information presented in Table 2 (Michael Baker 2016), it is expected wetland hydrology will be re-established at the material sites after site closure and restoration.

Material Site-10

The Plan is to create ponds and littoral zone habitat and connect them to Getmuna Creek by engineered channels. Littoral zones (emergent wetlands along the shoreline) are productive areas of the ponds, allowing for nutrient retention and cycling of elements, shoreline and sediment stabilization, aquatic vegetation growth, refuge for juvenile fish, and organic material inputs (Peters and Lodge 2009). Side slopes of the cells will be graded to create littoral zone habitat, with shallow sedge marshes expected along the edge of the ponds. In total, 25.3 acres of wetlands will be restored to include ponds, emergent wetlands, and connecting channels for fish. Several of the created ponds are expected to provide rearing and overwintering habitat for fish.

Material Site-12

The final material site pit design will leave a concave depression in the remaining upland hillside. The surface contour of the swale will be re-graded to convey surface water downhill. The material site depression next to the swale will be excavated to proper depth so water will funnel into the depression to create a new wetland. With hydrology in place, the overburden can be returned to the wet depression and an emergent wetland is expected. However, this restoration Plan is only for the re-establishment of the original wetland swale.

Material Site-16

Upon restoration, a concave feature will capture and slowly release water downhill. After the material site is reclaimed, the 7.9 acres of wetlands will be restored as slope HGM.

Restored Wetlands

The aquatic resource losses from the Project have been described using HGM and the Cowardin Classification system by acres for wetlands and linear feet for stream loss. The same methods are used to identify aquatic resources restored by this Plan.

Final acres of HGM and Cowardin Groups for TA restoration areas are shown in Table 4. The dominant Cowardin and HGM classification when completed is slope palustrine forested/scrub shrub.

Table 4 HGM Classifications and Cowardin Groups of TA Restoration (Acres)

HGM Classification	Cowardin Group	Acres
Depressional	Palustrine Emergent	13.0
Flat	Palustrine Scrub Shrub	10.4
Slope	Palustrine Scrub Shrub	11.3
Total		34.7

Restoration Plan

Restoration timing of material sites in the TA will vary based on the duration of material removal from the sources and the sequence of the construction. As material is no longer required from these sites, they will be restored as soon as practicable. Material from Material Site-12 and Material Site-16 will be used for construction of the Jungjuk Road. After the road is constructed and fill material needs are met, these sites will be restored. Material Site-10 will provide material for road construction and aggregate for concrete for mine operations. Restoration will not occur at this site until the first cell can be restored or until mine closure.

Work at the material sites will typically be completed in four phases: construction, operation, restoration, and monitoring (Table 5).

Table 5 TA Material Site Work Schedule

Years	Phases and Objectives
0 to 1	Construction: Design, plan, survey, construct the access road and facilities; grade, remove and stockpile organics and topsoil.
0 to MSC (Material Site Closure)	Operation: Maintain water and erosion control structures; excavate, stockpile, and use the material; complete interim reclamation; monitor.
Within Year 1 after MSC	Restoration dirt work: Re-grade and re-contour excavation; remove and reclaim roads, facilities, stockpiles, ditches, berms; spread topsoil and organics; create final water and erosion control structures.
Within Year 2 after MSC	Restoration vegetation: Develop seed bed plans; preparation of bed, fertilizing, mulch additions, planting, and seeding; organic control for desired vegetation mix.
2 Years after MSC	Monitoring: Ensure site meets final reclamation criteria.

Throughout all phases, water and erosion control structures and measures will be maintained to protect water quality in adjacent wetlands, streams, and rivers. The following is a synopsis of each activity:

- During construction of required access roads to the material site and construction of facilities, organics and topsoil will be removed and stockpiled in the mining areas. Organics and topsoil will be stockpiled on site to be used in final reclamation and restoration of each site. Facility work includes installing fueling locations, constructing storm water controls, and placing crushing or screening plants in the material site pits as required.
- Cells will be excavated and sand and gravel will be stockpiled on-site before being transported to work areas. Water and erosion control structures and measures will be installed and maintained during this phase to protect water quality in adjacent streams and rivers. Excavation of the material sites is projected to intersect the water table. The cells are anticipated to be excavated below ground water on site to minimize pumping impacts on adjacent wetlands and streams. Surface drainage from operations will be controlled to protect adjacent streams. Interim reclamation and stabilization will be conducted during operations where mining has been completed.
- Following cell excavation, side slopes will be flattened to promote establishment of littoral zones and herbaceous emergent vegetation around the newly formed ponds. The pits will be designed to maintain surface hydrology and contoured to maximize vegetated wetlands. Cell edges will be completed in irregular shapes to promote edge habitat. The stockpiled topsoil or surface organic material will be returned to promote vegetation regrowth. Additional segregated organics removed from adjacent project areas may be placed when additional carbon is desirable. If necessary, fertilizer will be added to promote re-vegetation. Seeding and planting will be conducted using guidelines from A Re-Vegetation Manual for Alaska (Wright 2008) and the Interior Alaska Re-vegetation and Erosion Control Guide (Czapla and Wright 2012). Seed mixes will be cultivated from both the seedbank in stockpiled wetland topsoil (growth media) and from commercially available native wetland seed mixes. Species present in currently available wetland and upland seed mixes are shown in Table 6. Egan American Sloughgrass, a primary component of the seed mix, has been shown to be successful for revegetation in wetlands in Interior Alaska (Czapla and Wright 2012).

Table 6 Wetland and Upland Seed Mixes

Species Name	Latin Name	National Wetlands Inventory (NWI) Indicator Status	Upland Mix, Percent	Wetland Mix, Percent
Arctic Red Fescue	<i>Festuca rubra</i>	Facultative	50	20
Tundra Glaucous Bluegrass	<i>Poa glauca</i>	Not Listed	20	0
Gruening Alpine Bluegrass	<i>Poa alpina</i>	Facultative Upland	20	0
Nortran Tufted Hairgrass	<i>Deschampsia caespitosa</i>	Facultative	10	40
Egan American Sloughgrass	<i>Beckmannia syzigachne</i>	Obligate	0	40

- Re-vegetation – Re-establishment of plant cover by means of seeding, or natural re-invasion. If necessary, fertilizer will be added to promote re-vegetation. Uplands will be re-vegetated to control sediment and nutrient loading to wetlands. Detailed re-vegetation techniques are included in the Interior Alaska Re-vegetation and Erosion Control Guide (Czapla and Wright 2012). Depressional, palustrine emergent wetlands will be the primary established wetland type in the former material sites. Over time, native seeds will germinate from the growth media seed bank or from natural colonization from adjacent vegetation; black spruce and shrubs may return to the restoration areas over time as palustrine scrub shrub and forested wetlands.

Reclamation Criteria

Vegetation and hydrology reclamation criteria are modified from General Permit (GP) POA-2014-55: Mechanical Placer Mining Activities within the State of Alaska (USACE 2014). No soil reclamation criteria are proposed; development of hydric soils typically lags the other two parameters following creation or restoration of wetlands.

Vegetation Criteria

Vegetation criteria will ensure restored and re-vegetated wetland areas and upland berms are following a trajectory to be stable and functioning biologically. Table 7 contains the Plan vegetation reclamation criteria and timing.

Table 7 TA Vegetation Reclamation Criteria and Timing

Restoration Area	Reclamation Criteria
Upland Berms	Achieve 30% live plant cover of the upland berm by the end of three (3) growing seasons.
	Achieve 70% live plant cover of the upland berm by the end of five (5) growing seasons.
	Cover of invasive species is no more than 10%.
Wetlands	Achieve 30% live plant cover of constructed wetland areas by the end of three (3) growing seasons.
	Achieve 70% live plant cover of constructed wetland areas with vegetation community meeting the Dominance Test or Prevalence Index for hydrophytic vegetation by the end of five (5) growing seasons.
	Cover of invasive species is no more than 10%.

Wetland Hydrology Criteria

Wetland hydrology indicators as described in the Alaska Regional Supplement (USACE 2007) will be used as evidence of sufficient hydrology to support wetland and pond formation and function. However, only a subset of those indicators will be used during the monitoring period. This subset includes three of the four groups of indicators presented in the supplement (Table 8). The fourth group, Group D – Evidence from Other Site Conditions or Data, will not be used to monitor hydrologic conditions within the restored wetland areas because landscape variables for the group were derived for natural settings and are not applicable for use in recently constructed wetlands. Additionally, the indicator Sparsely Vegetated Concave Surface will be excluded because it is counter to the vegetation reclamation criteria.

One primary indicator from any group is sufficient to conclude that wetland hydrology is present. Secondary indicators have been excluded from the reclamation criteria. Monitoring for hydrologic indicators will occur within 10-meter-squared (m²) plots coinciding with the vegetation monitoring sampling.

Table 8 TA Wetland Hydrology Indicators

Group	Indicator
Group A – Observations of Surface Water or Saturated Soils	A1 – Surface Water
	A2 – High Water Table
	A3 – Saturation
Group B – Evidence of Recent Inundation	B1 – Water Marks
	B2 – Sediment Deposits
	B3 – Drift Deposits
	B4 – Algal Mat or Crust
	B5 – Iron Deposits
	B6 – Surface Soil Cracks
	B7 – Inundation Visible on Aerial Imagery
Group C – Evidence of Current or Recent Saturation	B15 – Marl Deposits
	C1 – Hydrogen Sulfide Odor
	C2 – Dry-season Water Table

Monitoring

Wetland monitoring will include periodic inspections, once a year for five years following restoration. The inspections will occur during the growing season. The purpose of the monitoring is to assess the success of the restored habitats using the reclamation criteria described above and to determine whether remedial actions are necessary to assure the reclamation criteria are met.

Monitoring of restored wetlands and ponds will consist of collecting and evaluating quantitative data on the hydrology and plant communities within the restored wetlands. Monitoring points will be established to monitor trends in plant communities. Transects at monitoring points will be run to determine vegetation cover across the restoration area.

Monitoring point locations will be monumented with Global Positioning System and physically using rebar stakes and flagging to facilitate revisit. At shrub vegetation sampling points, the percent cover of shrub species, bare ground, and open water, as well as the number of species will be recorded within a 10-m² plot. Herbaceous species and percent cover will be recorded within a 1-m² quadrat placed at random in the plot area. Hydrology will be characterized at wetland and pond sampling points. All non-native plant species and their relative cover will be recorded. Non-native plant recruitment data will be used to assess the need for active measures to remove non-native plants from restoration areas.

Monitoring reports will be produced annually and submitted to USACE December 31 of each year until the areas meet reclamation criteria.

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