


Project Components	Segmentation	Habitat Characteristics
Revised project layout (May 2013)	Fish barrier	Flow direction
Drainage infrastructure (May 2013)	Stream segment	
	Type of habitat	
	Fast water	
	AV-S1 MO-B	
	Substrate	
	Segment number	
	Substrate	
	B Boulder (250 to 1,000 mm)	
	MO Organic material	


 Joyce Lake Direct Shipping Iron Ore Project
 - Fish and Fish Habitat Baseline Study -

Stream Crossing CR01

Sources:
 Base: CanVec, 1/50 000, RNCan, 2010
 Orthophoto: Mosaïque photo XEOS
 Mapping and inventory: GENIVAR 2012
 File: 121-18002-00_F26_FAQ_CR01_130619.mxd

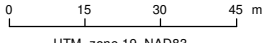

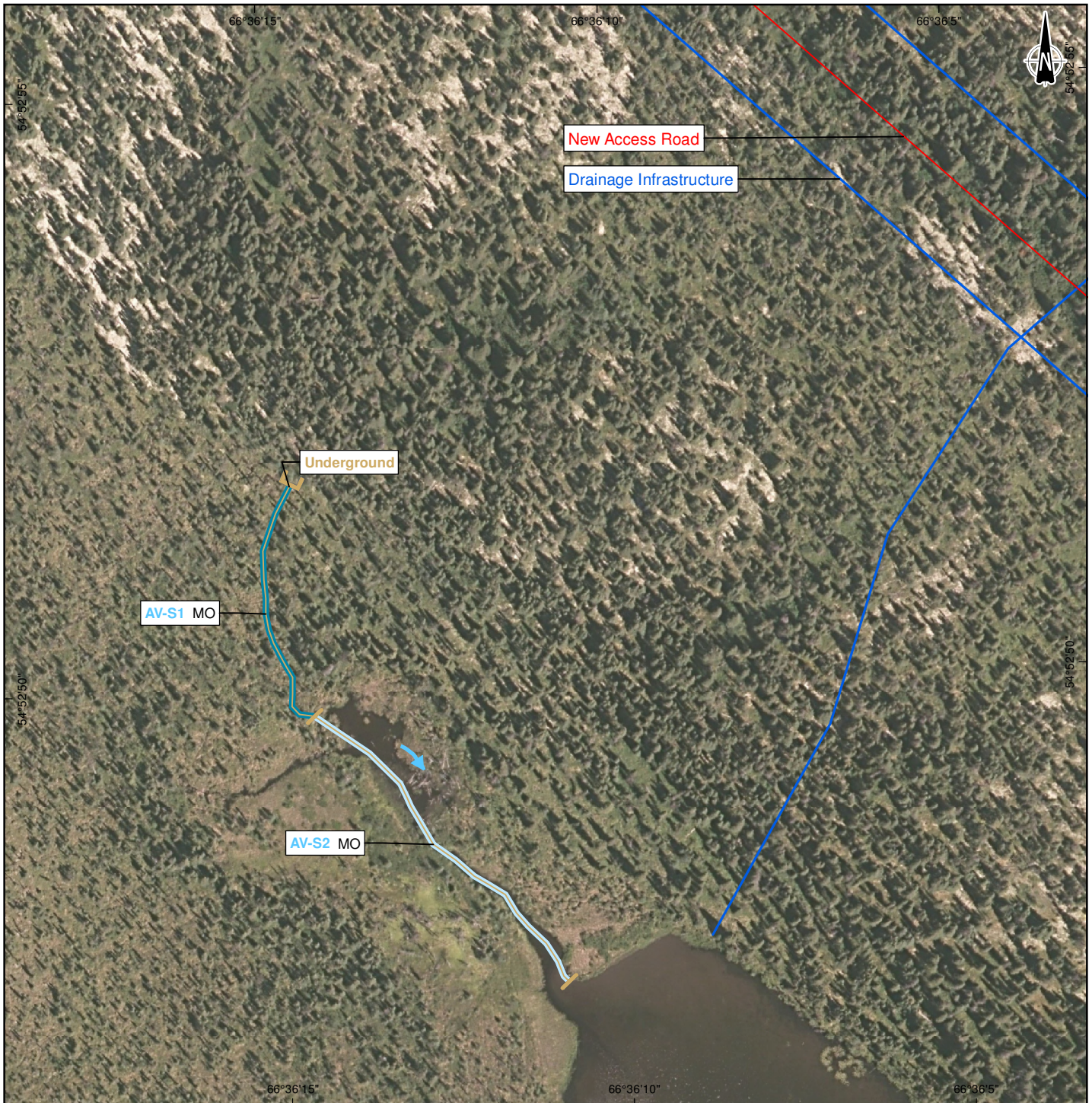
Scale 1:1 500

 UTM, zone 19, NAD83

Figure 26

November 2013





Project Components

- Revised project layout (May 2013)
- Drainage infrastructure (May 2013)

Segmentation

- Fish barrier
- Stream segment

Type of habitat

- Slow water
- Moderate water

AV-S1 MO

- Substrate
- Segment number

Substrate

- MO Organic material

Habitat Characteristics

- Flow direction



Joyce Lake Direct Shipping Iron Ore Project

- Fish and Fish Habitat Baseline Study -

Stream Crossing CR02

Sources:

Base: CanVec, 1/50 000, RNCan, 2010
 Orthophoto: Mosaïque photo XEOS

Mapping and inventory: GENIVAR 2012
 File: 121-18002-00_F27_FAQ_CR02_130619.mxd

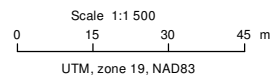


Figure 27

November 2013



flow velocity was 0.2 m/s. Muck was the only substrate constituent and aquatic vegetation was found on 30 % of the stream bed.

No fish sampling was conducted in this stream. However, it discharges into a series of lakes that connect to Petitsikapau Lake. Downstream, these lakes discharge through CR20 where a beaver dam was determined to act as barrier to fish passage. Northern pike was found in CR20 and CR03 which are located a few kilometres downstream. Other than this fish barrier found, it remains possible that CR02 is used by fish.

During the field work, the water conductivity was 43.9 $\mu\text{S}/\text{cm}$ and the pH was 6.96 (Table 8).

CR03 and CR20

CR03 no longer exists as the access road layout was changed. The crossing is found upstream in the lowermost part of CR20 (Segment AV-S2; Figure 28). Information concerning CR03 is found in Appendix H. This 315-m long section has a good northern pike reproduction potential due to the high density of aquatic vegetation (bur-reed) and slow moving waters (Photos 39 to 42, Appendix D). Small northern pike were observed in CR03 during field work in the summer of 2012.

CR20 is the outlet of a large nameless lake and is separated from CR03 by a small pond (Figure 28). The stream crossing intercept is found in segment AV-S2 characterized by rapid/run types of habitats (Appendix H). Mean width was 10.0 m and mean water depth ranged from 0.05 to 0.22 m during the field work. Flow velocities ranged from 0.2 to 0.7 m/s. The substrate was coarse with cobble and rubble as the dominant classes found. Riparian vegetation offered a 25 % cover while aquatic vegetation was found on approximately 5 % of the stream bed. AV-S2 discharges into a small pond that connects to Petitsikapau Lake via CR03. Photos of the stream (No. 43 to 50) are provided in Appendix D.

The upstream segment, AV-S1, is a long slow/moderate water pool/flat habitat with a mean width of 35.0 m (Appendix H). Water depths ranged from 0.10 to 0.24 m and flow velocities were 0.1 m/s. One small pool of 0.63 m depth was found in this segment. Vegetation cover was mostly submergent (15 %) and riparian vegetation was mainly composed of ericaceous species, sweet gale, birch and willows. Fish were observed in this section of the stream during field work.

The upper part of the stream is a succession of slow/moderate water habitat (flat/pool) and fast water habitats (run/rapid) (Appendix H). Stream width varies from 3.0 to 20.0 m and flow velocities ranged from 0.0 to 0.6 m/s. The substrate is coarse with cobble, rubble and boulders as the only three constituents and aquatic vegetation is scattered here and there all along the stream (mainly bur-reed). In the uppermost part of the stream, a large beaver dam was determined to act as a fish barrier. Some northern pike were observed downstream from this dam, but no fish was caught at station PE-05, probably due to the high water level caused by the rain (Appendix G). During the fieldwork, dissolved oxygen was 8.78 mg/L and pH was 6.47 (Table 8). No conductivity data is available for this stream.

CR04, CR05 and CR21

CR04 and CR05 no longer exist as the access road layout was changed. The crossing is found upstream in the area of CR21 (Figure 29).

During the field campaign in the summer of 2012, no stream was found at CR21, but a few pockets of water were observed. These seem to be part of some wetlands but not connected to each others. Therefore, CR21 is not considered as a fish habitat. Photo 51 in Appendix D presents the area where the road is planned and the small pockets of water.

Information collected for CR04 and CR05 is found in Appendix H. Both are small streams, 1 to 4 m wide with flat/run types of habitats and substrate composed of organic material. CR04 crosses through a fen while CR05 is found in a forested area and present an important vegetation cover (mainly shrubs). No fish sampling was conducted in these streams and no fish were observed during the field work. Both streams connect to a lake that discharges into Petitsikapau Lake.

CR06

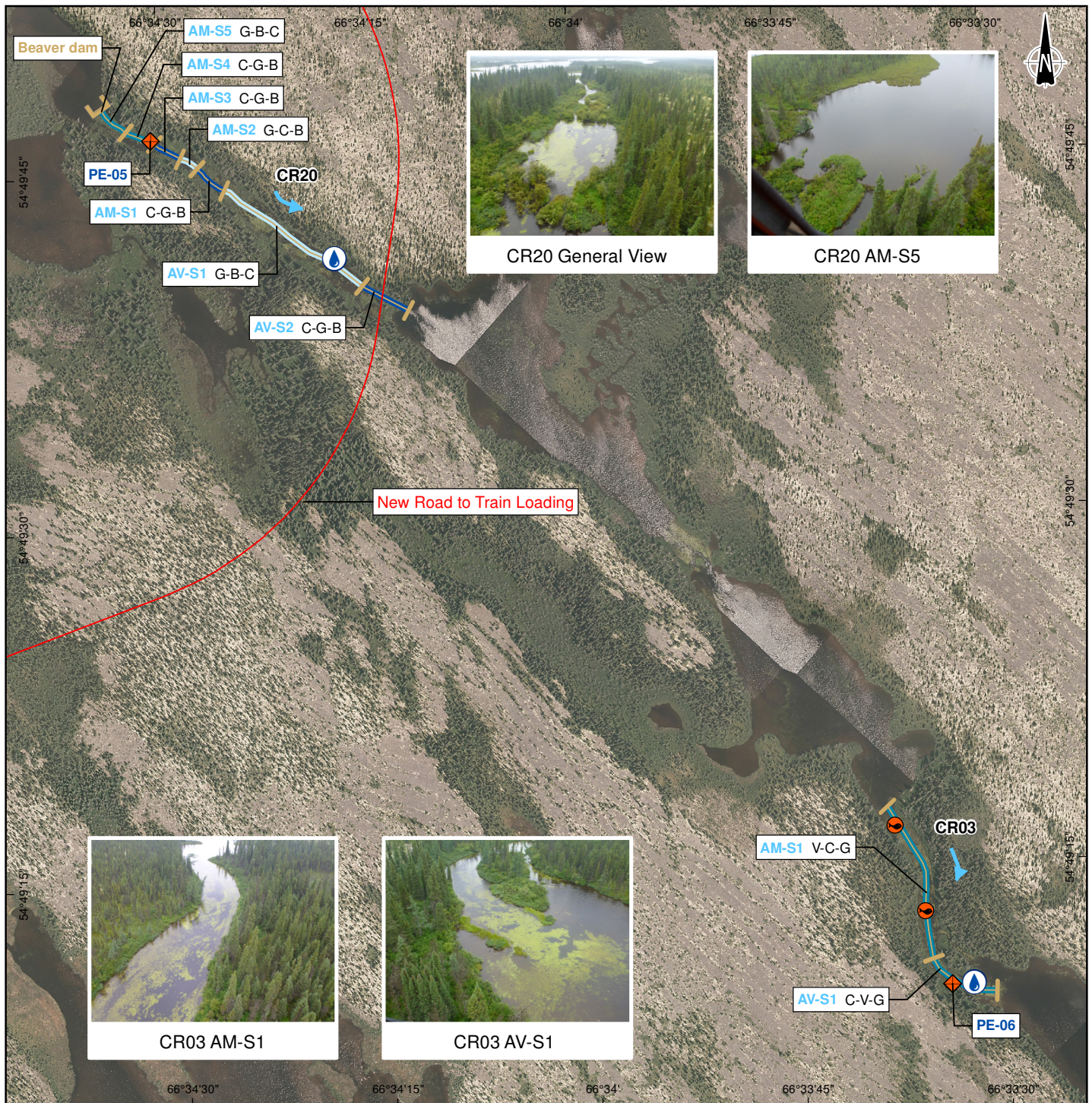
During field work at the end of July 2012, no stream was found at CR06 (Figure 2). Shrubby vegetation (*Ledum groenlandicum*, *Myrica gale*) with black spruce and larch were found, but no stream bed was observed (Photo 52, Appendix D). Mosses were present on the ground. The area identified as a potential crossing has no stream and is therefore not a fish habitat.

CR07

CR07 was characterized along approximately 415 m and the lowermost segment stopped when the stream becomes underground (Figure 30; Appendix H). The road crosses just a few metres downstream where the water disappears in the ground. It is assumed that CR07 connects to the small pond located to the south but there was no evidence of a stream bed in between and the connection is potentially underground down to the pond.

AV-S2 is the lowermost part of CR07 that was characterized in 2012 and begins where the water flows through the ground (Photo 54, Appendix D). The habitats found in this segment are flat/run with flow velocities of 0.1 to 0.2 m/s. The stream is narrow with a mean width of 1.0 m. The mean water depths were around 0.28 m. The substrate is composed of muck and aquatic vegetation was also found (10 % of the stream bed surface area).

The next two segments upstream are flat habitat type of 1.5 and 2.0 m wide (Photos 53 and 55, Appendix D). No water depths or flow velocities are available for this part of the stream. The substrate was composed of muck and no aquatic vegetation was found.



Project Components

— Revised project layout (May 2013)

Fish Sampling

— Gear type
— Sequential number

PE-05

× No fish

Fishing Gear

◆ Electrofishing (PE)

Segmentation

— Fish barrier
— Stream segment

Type of habitat

— Slow water
— Moderate water
— Fast water

— Substrate
— Segment number

Substrate
B Boulder (250 to 1,000 mm)
G Rubble (140 to 250 mm)
C Cobble (30 to 140 mm)
V Gravel (2 to 30 mm)

Habitat Characteristics

— Water physico-chemistry
— Potential spawning ground (ESLU)
— Flow direction



Joyce Lake Direct Shipping Iron Ore Project

- Fish and Fish Habitat Baseline Study -

Stream Crossings CR03 and CR20

Sources:
Base: CanVec, 1/50 000, RNCan, 2010
Orthophoto: Mosaïque photo XEOS
Mapping and inventory: GENIVAR 2012
File: 121-18002-00_F28_FAQ_CR03-CR20_130619.mxd

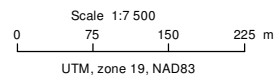
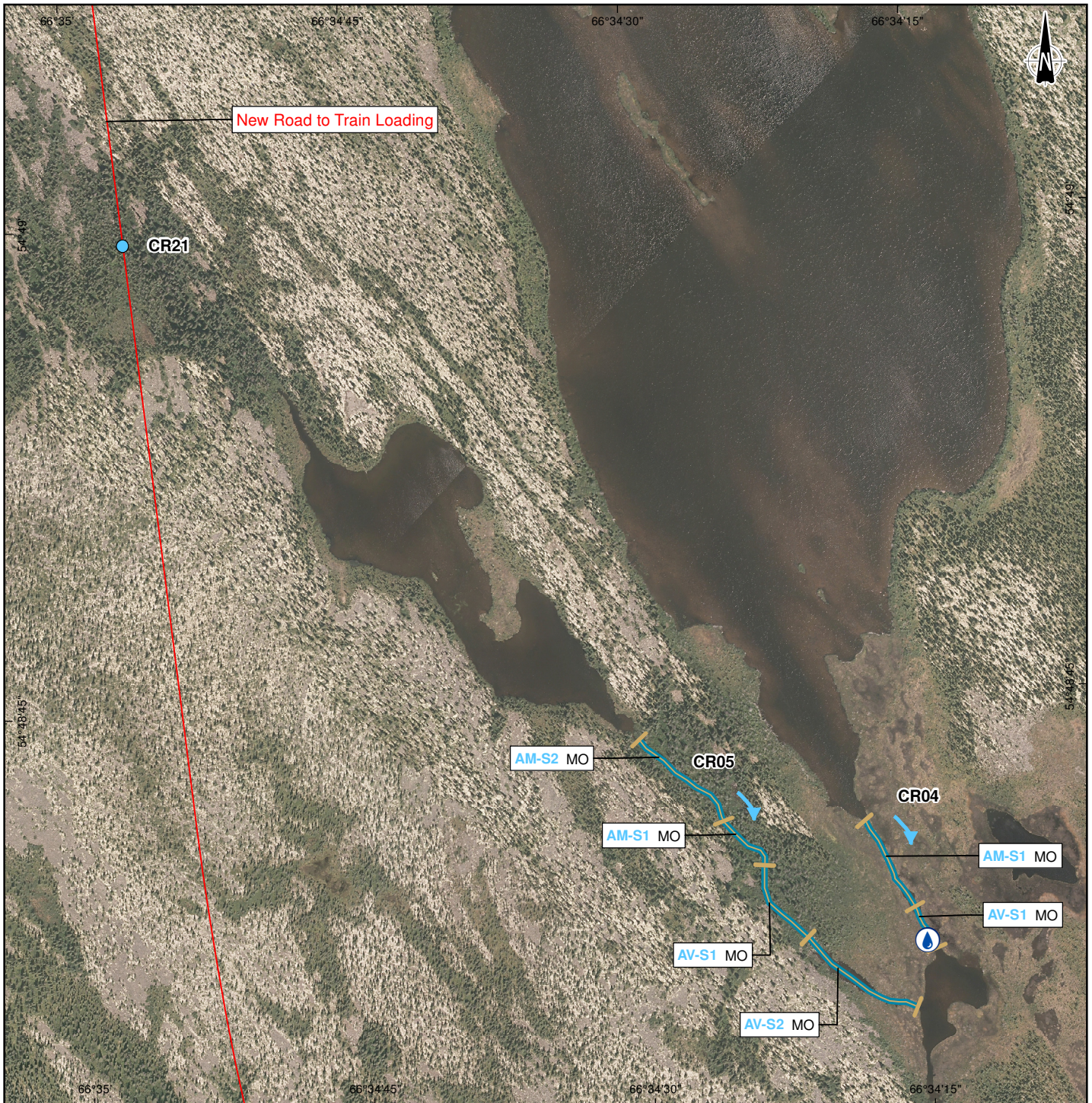


Figure 28

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Project Components	Segmentation	Habitat Characteristics
Revised project layout (May 2013)	Stream segment Type of habitat Moderate water	Water physico-chemistry Flow direction
	Substrate Segment number Substrate MO Organic material	



Joyce Lake Direct Shipping
Iron Ore Project

- Fish and Fish Habitat Baseline Study -

Stream Crossings CR04, CR05 and CR21

Sources:
Base: CanVec, 1/50 000, RNCan, 2010
Orthophoto: Mosaïque photo XEOS

Mapping and inventory: GENIVAR 2012
File: 121-18002-00_F29_FAQ_CR04-CR05-CR21_130619.mxd

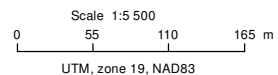
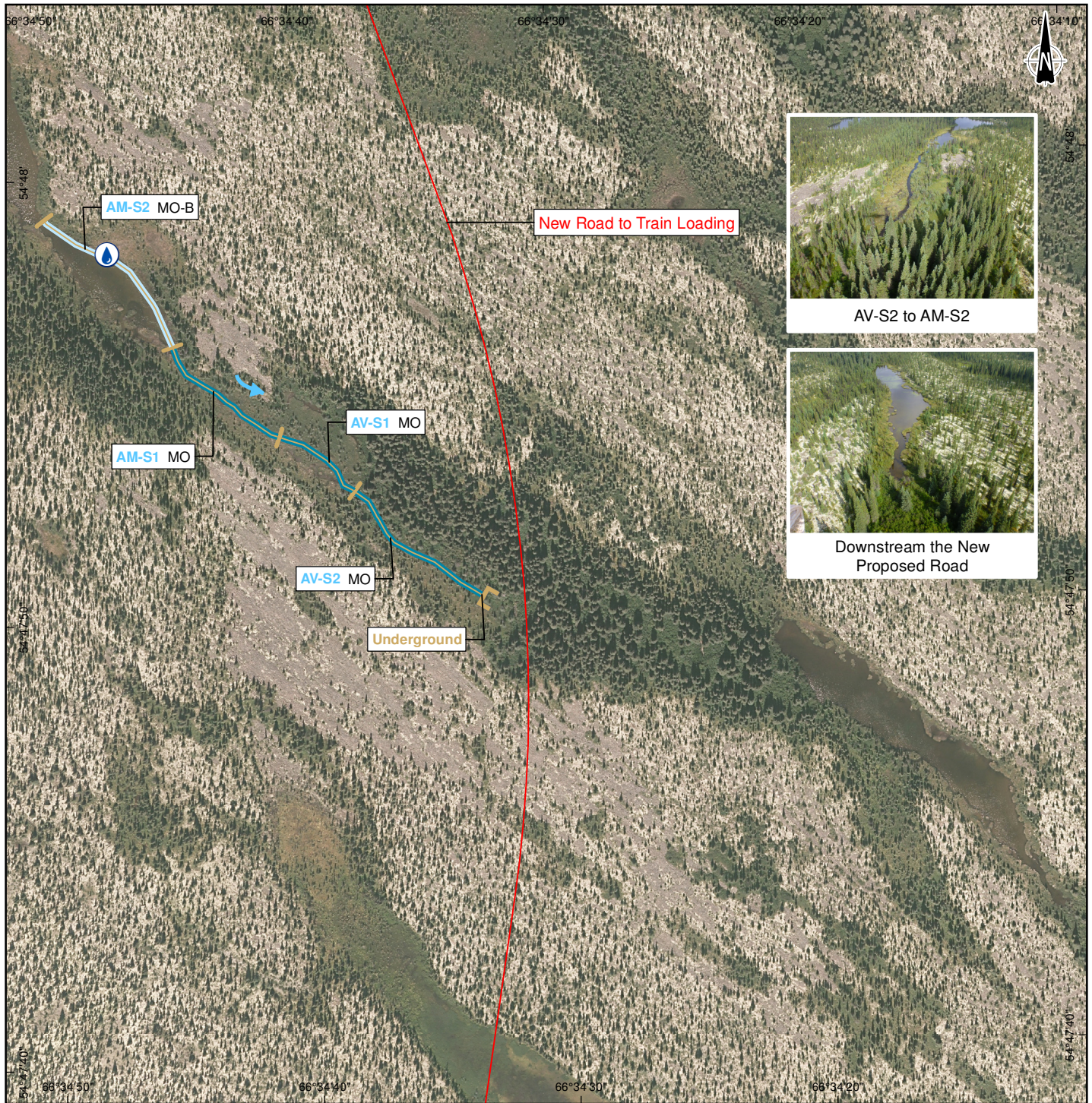


Figure 29

November 2013





Project Components

— Revised project layout (May 2013)

Segmentation

- Fish barrier
- Stream segment

Type of habitat

- Slow water
- Moderate water

AV-S1 MO

— Substrate

— Segment number

Substrate

- B Boulder (250 to 1,000 mm)
- MO Organic material

Habitat Characteristics

- Water physico-chemistry
- Flow direction



Joyce Lake Direct Shipping Iron Ore Project

- Fish and Fish Habitat Baseline Study -

Stream Crossing CR07

Sources:
 Base: CanVec, 1/50 000, RNCan, 2010
 Orthophoto: Mosaïque photo XEOS
 Mapping and inventory: GENIVAR 2012
 File: 121-18002-00_F30_FAQ_CR07_130619.mxd

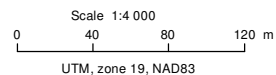


Figure 30

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The uppermost part that was characterized is a 10-m wide pond with a substrate composed of muck (90 %) and boulders (10 %; Photo 56, Appendix D). Aquatic vegetation was present on 10 % of the stream bed surface area.

No fish sampling was conducted in CR07. Considering that it does not connect to any important lake in its upper part and that the lowermost part is underground chances to find fish in this stream are very low. According to the high resolution aerial photographs, the small pond located upstream CR07 is very shallow (approximately 1 m deep) and does not connect to any other waterbody. This pond could potentially freeze to the bottom during winter.

During the field work, dissolved oxygen was 8.09 mg/L and pH was 5.84 (Table 8). No conductivity data is available for this stream.

CR08

CR08 no longer exists as the access road footprint was relocated completely away from this stream (Figure 2). Information on this stream reach can be found in Appendix H.

CR09

Even if the topographic map indicates the presence of a stream at the initial and revised road layout, no stream was found in the area of CR09 during the field work at the end of July 2012 (Figure 2). The high-resolution aerial photograph does not indicate any evidence that there is a permanent stream in this area, not even near the pond into which it should discharge according to the 1:50,000 topographic maps. If there is a stream there, it is probably intermittent and partially underground and does not connect upstream to any other watercourse or waterbody. It is considered that there is no fish habitat in this area.

CR10, CR10A and CR10B

CR10A and CR10B discharge via CR10 into a small lake (unnamed) that connects to Petitsikapau Lake. There are two stream crossings: one downstream from CR10 and the other one in CR10A (Figure 31).

CR10 is located downstream and collects water from CR10A and CR10B (Figure 31; Appendix H). In general, the sections characterized were 6.0 m wide and had a flow velocity of 0.1 m/s. The type of habitat is flat and substrate is mainly composed of organic material (muck). Aquatic vegetation covers 60 to 80 % of the stream bed. The habitat found in the area characterized during the summer of 2012 is typical of the habitat found downstream where the revised road layout is located (Photos 57 and 58, Appendix D).

CR10A was characterized in its uppermost part only (Photos 59 to 61, Appendix D). According to the latest project layout, the stream crossing is located in AM-S1 which is a small pond, but the layout could potentially moved a few metres downstream where the stream gets much narrower (Figure 31). CR10A was characterized over a distance of approximately 345 m. This section includes two pools connected together by a short channel (flat). The substrate is composed of muck and aquatic vegetation covers 25 to 75 % of the stream bed. Brook trout were observed during

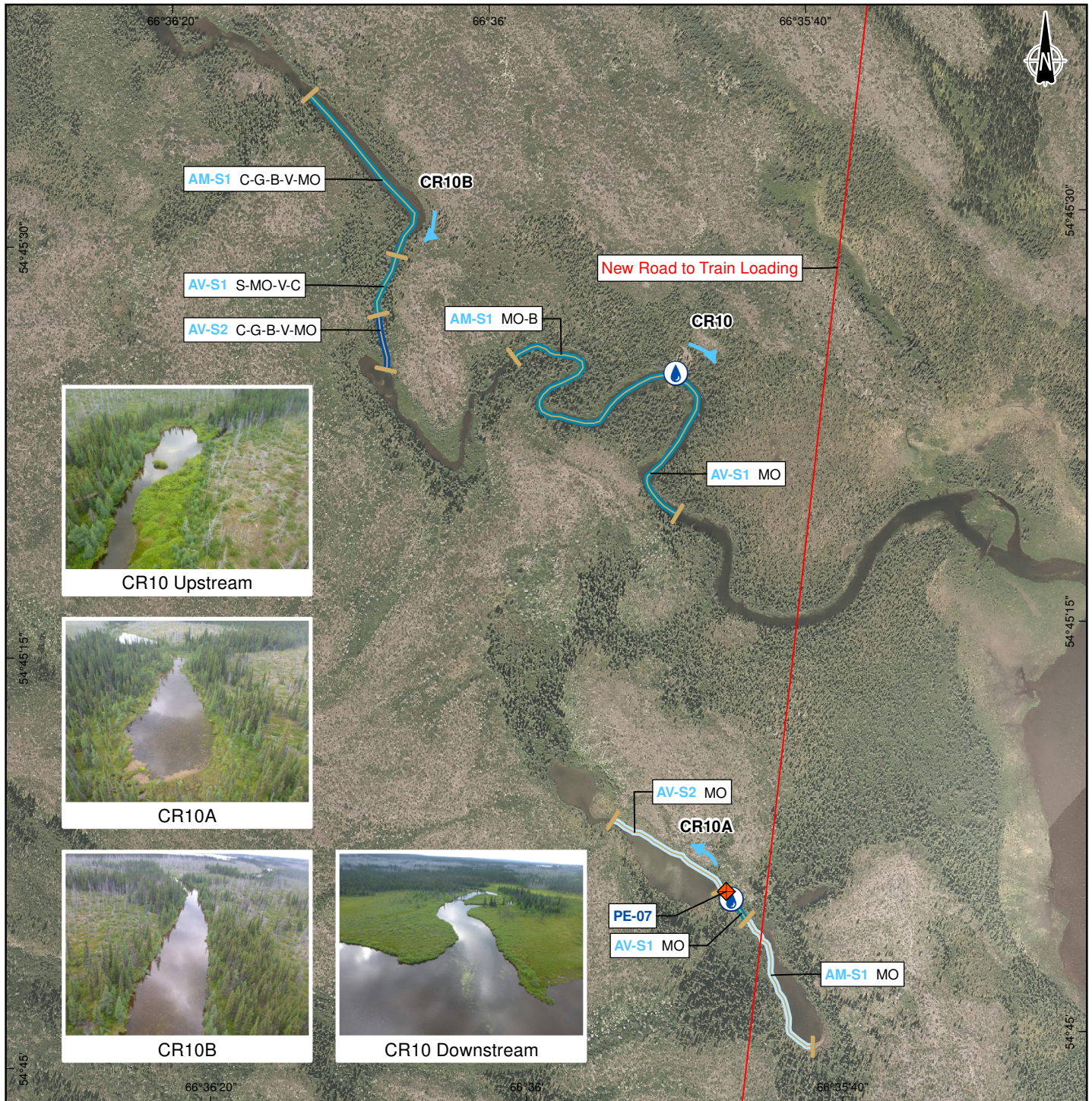
the characterization work on August 1. However, no fish were caught during electrofishing on August 8, probably due to the large increase in water depth caused by rain (Appendix G). During field work, dissolved oxygen was 8.87 mg/L, pH was 6.83 and conductivity was 33.3 μ S/cm (Table 8).

CR10B was divided into three segments (Appendix H; Photos 62 to 64, Appendix D). The lowermost segment (AV-S2) is approximately 5.0 m wide and water depth ranged from 0.16 to 0.34 m during the field work. The types of habitat found in this segment are rapid/run/riffle and the flow velocities ranged from 0.4 to 1.1 m/s. Aquatic vegetation was present in the stream (5 % cover). The next segment is a wide channel (18 m wide) with water depth ranging from 0.32 to 0.67 m. The type of habitat is flat and the flow velocity was 0.0 to 0.2 m/s. The substrate is mainly composed of sand (60 %), muck (30 %), with some gravel (5 %) and cobble (5 %). No aquatic vegetation was found in this part of the stream. Small northern pike were observed during the field work. The upper part of CR10B is the longest at 232 m and had a mean width of 8.0 m. The water depth ranged from 0.22 to 0.65 m during the field work. The types of habitat are flat/run and the flow velocities ranged from 0.0 to 0.4 m/s. The substrate is mainly composed of cobble (60 %), rubble (15 %), and boulders (15 %) with some gravel (5 %) and muck (5 %). The aquatic vegetation covers 30 % of the stream bed. During field work, dissolved oxygen was 5.97 mg/L, pH was 6.39 and conductivity was 42.4 μ S/cm (Table 8).

CR11

Due to accessibility and helicopter logistics, CR11 was not characterized at the planned crossing but much farther downstream (Figure 2). The section characterized on August 2, is a moderate/fast water type of habitat located in a mature forest area. The substrate is coarse with cobble, rubble, boulders, and bedrock in some area. Flow velocities ranged from 0.3 to 1.5 m/s.

The proposed crossing intercept is located in an area of slow/moderate water. Due to the dense riparian vegetation cover above the stream little information can be extrapolated for this crossing. However, electrofishing station PE08 was located 120 m downstream from the proposed crossing (Appendix G). At this station, the flow pattern was flat and the mean flow velocity was 0.2 m/s. The substrate was composed of organic material. The riparian vegetation was mainly composed of willows, birch and herbaceous species. The stream bed was also covered with aquatic vegetation. No fish were caught at this station (fishing effort of 242 seconds over a 25 m² area). The accessibility to this upper part of this stream could be difficult to some species like northern pike due to the presence of important cascades downstream (observed in the 2-km buffer characterized from the helicopter).



Project Components

— Revised project layout (May 2013)

Fish Sampling

— Gear type

— Sequential number

PE-07

Species

X No fish

Fishing Gear

◆ Electrofishing (PE)

Segmentation

— Stream segment

Type of habitat

— Slow water

— Moderate water

— Fast water

AV-S1 MO

— Substrate

— Segment number

Substrate

B Boulder (250 to 1,000 mm)

G Rubble (140 to 250 mm)

C Cobble (30 to 140 mm)

V Gravel (2 to 30 mm)

S Sand (0.006 to 2 mm)

MO Organic material

Habitat Characteristics

— Water physico-chemistry

— Flow direction



Joyce Lake Direct Shipping Iron Ore Project

- Fish and Fish Habitat Baseline Study -

Stream Crossings CR10, CR10A and CR10B

Sources:

Base: CanVec, 1/50 000, RNCan, 2010
Orthophoto: Mosaïque photo XEOS

Mapping and inventory: GENIVAR 2012
File: 121-18002-00_F31_FAQ_CR10-CR10A-CR10B_130619.mxd

Scale 1:6 500

0 65 130 195 m

UTM, zone 19, NAD83

Figure 31

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CR12

Stream crossing CR12 is now located approximately 900 m upstream from where the field work was conducted in August 2012 (Figure 32). However, the proposed crossing is located in the area that was characterized from the helicopter and no barrier to fish passage and suitable spawning habitats were observed.

The section of the stream characterized is a meandering channel in a relatively open area (shrubby vegetation) while the area of the revised crossing is more linear and located in mature forest. Besides the surrounding vegetation and linearity, the revised crossing shares some common characteristics with the section characterized in the summer of 2012 (Figure 32; Appendix H).

AV-S3 is the lowermost segment characterized in 2012 (Photo 67, Appendix D). The mean width was 2.0 m and the water depth ranged from 0.20 to 0.55 m during field work on August 2 (Figure 32; Appendix H). The type of habitat is rapid with some sections of flat/riffle. The flow velocities ranged from 0.1 to 1.5 m/s. The substrate was composed of cobble (60 %), rubble (25 %) and boulders (15 %). AV-S2 presents flat and run/riffle types of habitat (Photo 66, Appendix D). The water depth and flow velocities ranged from 0.18 to 0.54 m and 0.0 to 0.6 m/s. The substrate is mainly composed of cobble and gravel. AV-S1 presents a variety of types of habitat, where run/pool is dominant (Photo 65, Appendix D). The water depth and flow velocities are quite similar to what is found downstream, and substrate is predominantly cobble and rubble.

The upstream part characterized (AM-S1 to AM-S2) presents rapid/flat types of habitat (Appendix H; Photos 68 to 70, Appendix D). The water depths range from 0.17 to 0.48 m while the flow velocities ranged from 0.1 to 1.0 m/s. The substrate is predominantly rubble and cobble. The uppermost segment (AM-S3) is wider (mean width of 4.0) and located in an open area. This section presents flat/run types of habitat with some pools, rapids and eddies. The water depths ranged from 0.13 to 0.31 m and the flow velocities varied from 0.2 to 1.5 m/s. The substrate was mainly composed of cobble and rubble.

No aquatic vegetation was observed in the stream. No fish were observed during the habitat characterization and no fish were caught at electrofishing station PE-08 (Appendix G). During field work, dissolved oxygen was 11.37 mg/L, pH was 6.97 and conductivity was 24.7 μ S/cm (Table 8).

CR13

CR13 no longer exists as the access road layout was changed (Figure 2). Brook trout were observed in this stream during field work. Information on this stream reach can be found in Appendix H.

CR14

CR14 was characterized far downstream from where the revised haulage road crosses the stream (Figure 33). This stream is approximately 3.7 km long and discharges into Astray Lake. It does not connect to any other waterbody. The stream is meandering through herbaceous vegetation (mostly sedges), shrubs (willows, sweet gale; Photos 71 to 74, Appendix D). Black spruce and larch is the most

common tree species found near the stream banks. Based on the high-resolution aerial photographs, on the topography and vegetation photo-interpretation, the stream section characterized, in the summer of 2012, and the proposed stream crossing are found in similar habitats (fen).

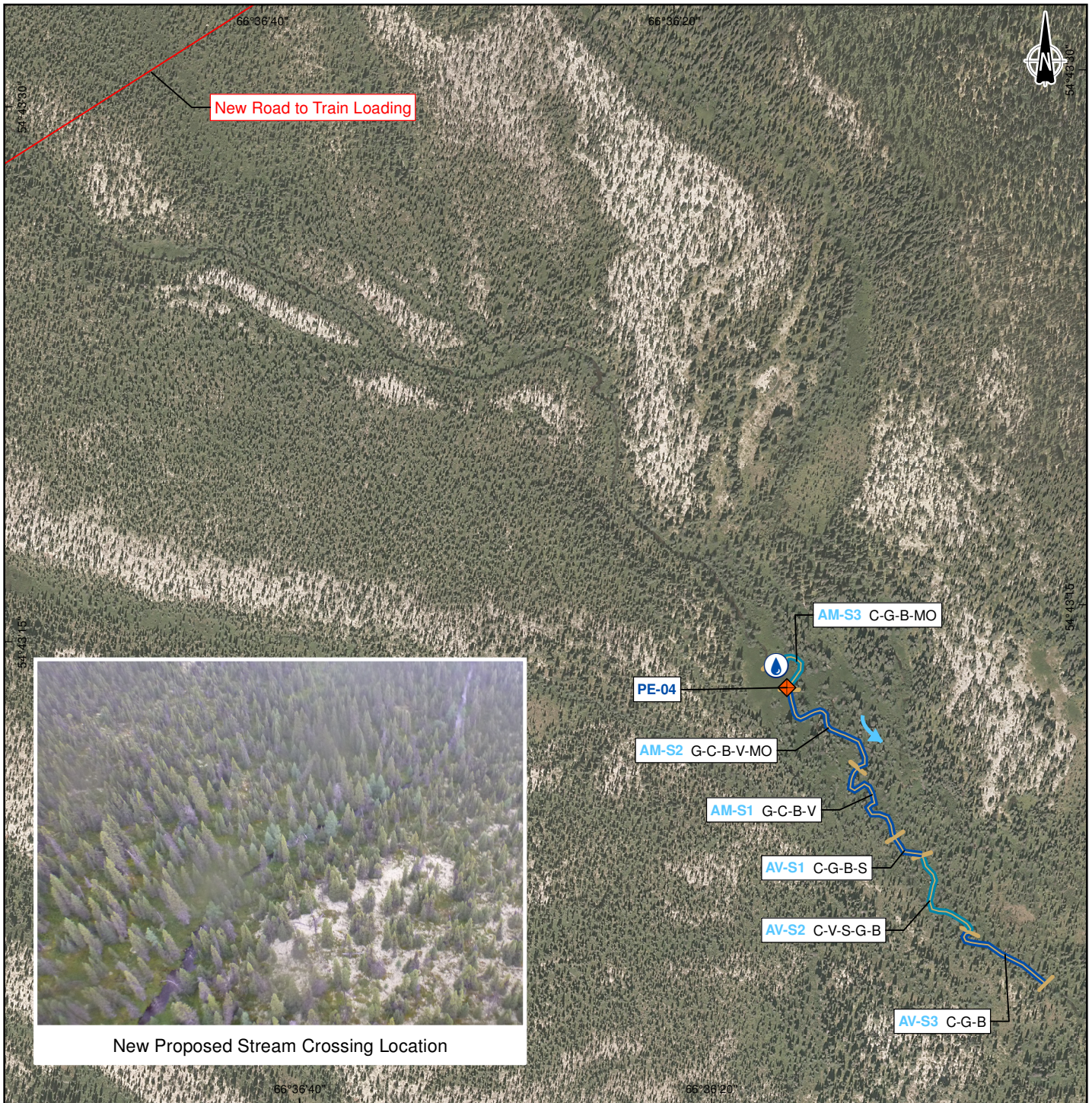
CR14 was characterized over approximately 490 m (Appendix H). This section is quite narrow with mean widths ranging from 1.0 to 2.0 m and water depths between 0.29 and 1.2 m. The type of habitat is predominantly flat with flow velocities generally between 0.2 and 0.5 m/s. Only the lowermost part (AV-S3) showed a higher flow velocity (1.3 m/s), and rapids and cascades were found in this segment. The substrate was composed of organic material, mostly muck with woody debris and fallen trees. The aquatic vegetation, predominantly bur-reed, was dense and covered 80 to 95 % of the stream bed. During field work, dissolved oxygen was 8.78 mg/L, pH was 6.31 and conductivity was 20.9 μ S/cm (Table 8).

CR15

CR15 was characterized from the ground in its downstream part located in a black spruce stand (Figure 34). The rest of the stream, up to Oboe Lake was characterized from the helicopter and only barrier to fish passage and suitable spawning habitat were searched in this section. The proposed crossing is actually located approximately mid-way between Mike Lake and Oboe Lake, at the junction between the black spruce stand and a shrubby swamp.

This stream is characterized by swift waters and the presence of several small cascades. In the section characterized from the ground, the types of habitat were run/flat with some rapid/riffle and pools (Photos 75 to 80, Appendix D). The stream mean width ranged from 2.5 to 3.0 m and the flow velocities ranged from 0.0 to 1.6 m/s (Appendix H). The substrate was predominantly cobble, gravel and sand in the lower segments (AV-S1 to AV-S3) and predominantly cobble and rubble in the upper segments (AM-S1 to AM-S3). Small patches of vegetation were scattered on the stream bed in some areas. Six suitable brook trout spawning habitats were identified and several juveniles were observed during the field work. At electrofishing station PE-02, brook trout, longnose sucker and lake chub were caught, while lake chub were caught at the uppermost electrofishing station PE-11 (Appendix G). During the field work, dissolved oxygen was 9.37 mg/L, pH was 7.79 and conductivity was 100.8 μ S/cm (Table 8).

Photos taken from the helicopter during the field work indicates that in the area of the revised stream crossing, rapid/cascade is the predominant type of habitat. The substrate is probably predominantly rubble and cobble. One suitable spawning habitat was identified during the characterization from the helicopter and it is located 875 m upstream from the revised crossing.



Project Components

— Revised project layout (May 2013)

Fish Sampling

— Gear type
— Sequential number
PE-04

Species

× No fish

Fishing Gear

◆ Electrofishing (PE)

Segmentation

— Stream segment

Type of habitat

● Moderate water
● Fast water

AV-S3 C-G-B

— Substrate
— Segment number

Substrate

- B Boulder (250 to 1,000 mm)
- G Rubble (140 to 250 mm)
- C Cobble (30 to 140 mm)
- V Gravel (2 to 30 mm)
- S Sand (0.006 to 2 mm)
- MO Organic material

Habitat Characteristics

- Water physico-chemistry
- Flow direction



Joyce Lake Direct Shipping Iron Ore Project

- Fish and Fish Habitat Baseline Study -

Stream Crossing CR12

Sources:
Base: CanVec, 1/50 000, RNCan, 2010
Orthophoto: Mosaïque photo XEOS
Mapping and inventory: GENIVAR 2012
File: 121-18002-00_F32_FAQ_CR12_130619.mxd

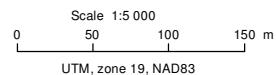
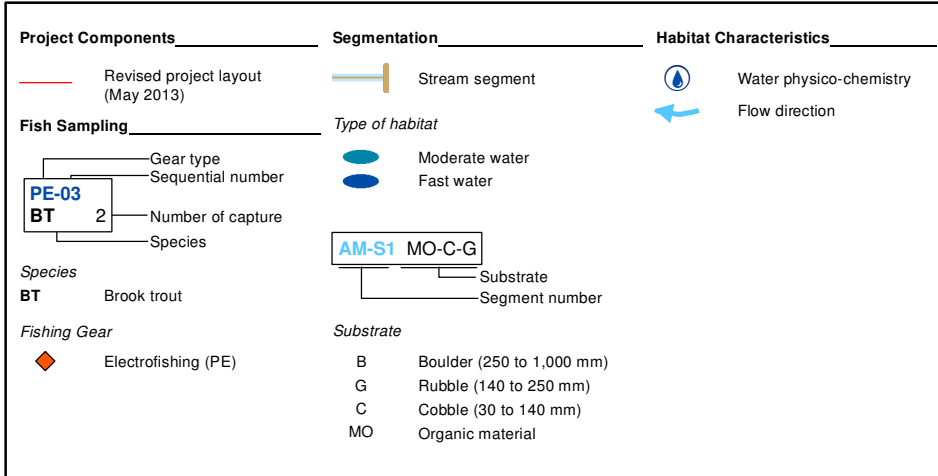
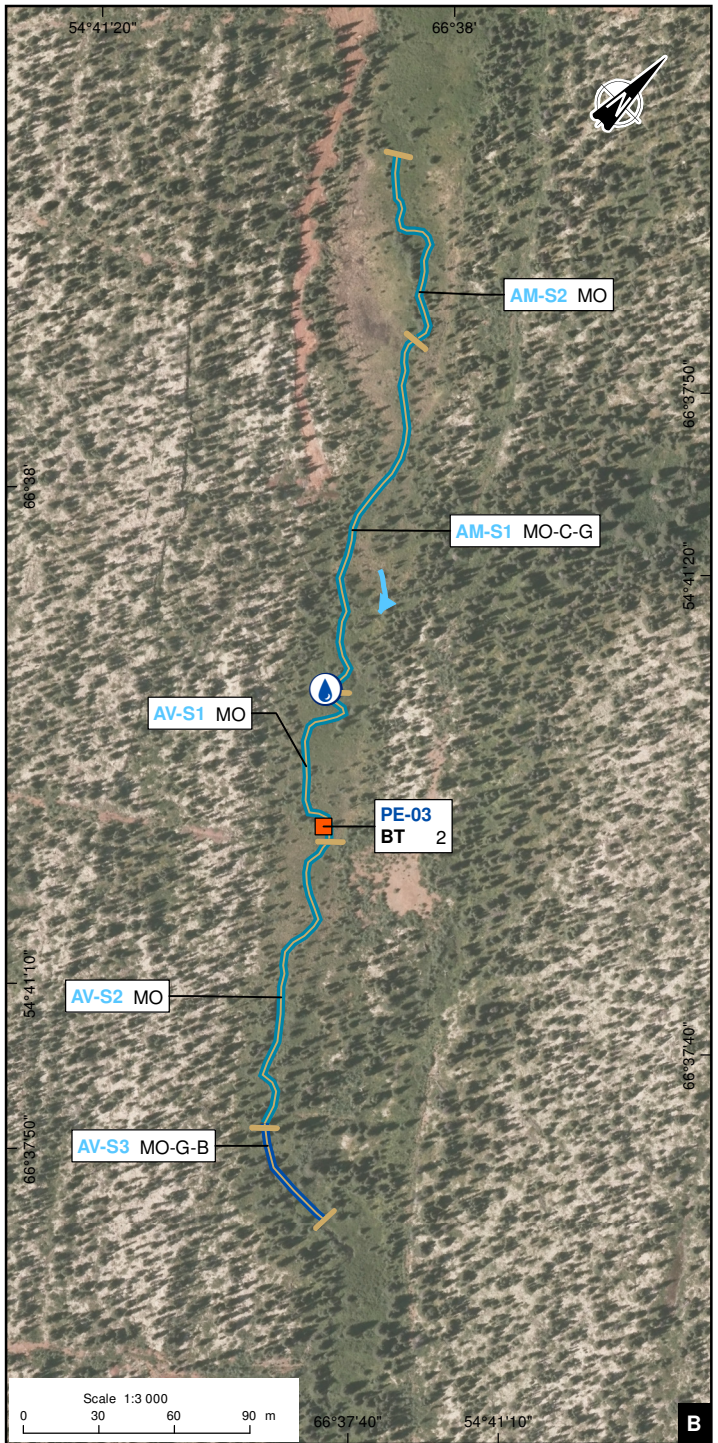
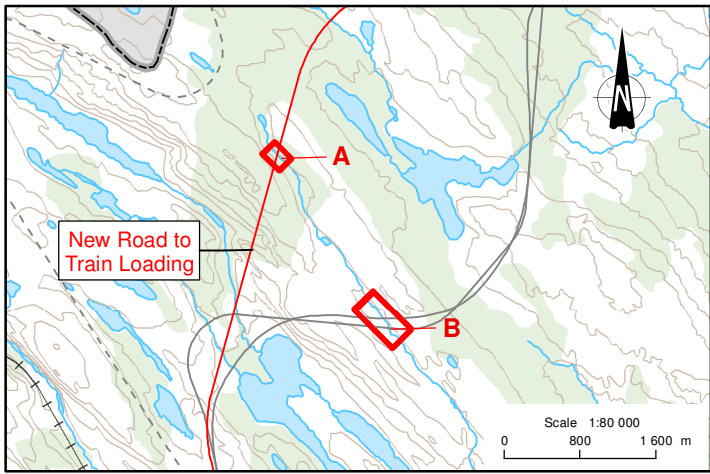



Figure 32

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Joyce Lake Direct Shipping Iron Ore Project

- Fish and Fish Habitat Baseline Study -

Stream Crossing CR14

Sources:
 Base: CanVec, 1/50 000, RNCAN, 2010
 Orthophoto: Mosaïque photo XEOS

Mapping and inventory: GENIVAR 2012
 File: 121-18002-00_F33_FAQ_CR14_130619.mxd

UTM, zone 19, NAD83

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Figure 33

