

# REPORT

## Canadian National Railway Company

Burnaby Lake Coal Recovery  
Turtle Salvage/Restoration  
Yale Subdivision



June 2014

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June 4, 2014

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**Submitted digitally to: Karla.Graf@cn.ca**

**Re: BURNABY LAKE COAL RECOVERY - TURTLE SALVAGE**

Dear Ms. Graf:

Summit Environmental Consultants Inc. (Summit) was retained by Canadian National Railway Company to lead a turtle salvage operation at Burnaby Lake following a train derailment at Mile 122.7 of the Yale Subdivision in Burnaby, BC. In partnership with Triton Environmental Ltd., Summit has enclosed this Final Report regarding the Burnaby Lake Coal Recovery – Turtle Salvage.

Please contact the undersigned if you should have any questions or require further information.

Yours truly,

Nicole Basaraba, M.Sc., P.Ag.  
Environmental Scientist  
Summit Environmental Consultants Inc.

Darcy Schiller, B.Sc, B.I.T.  
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# REPORT

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## 1 Introduction

This report summarizes the turtle salvage program and nesting beach management strategies that were undertaken in support of the coal recovery program near the confluence of Silver Creek and Burnaby Lake in early 2014. Coal recovery was conducted by Quantum Murray LP (Quantum) on the basis of work plans developed in consultation with: Canadian National Railway Company (CN), Triton Environmental Consultants (Triton), Summit Environmental Consultants Inc. (Summit), EBB Environmental Consulting Inc. (EBB), B.C. Ministry of Forests, Land and Natural Resources, the City of Burnaby, and Metro Vancouver Parks. This work plan included an aquatic life salvage emphasizing turtle, amphibian and fish salvage before and during the coal recovery. Triton was the lead environmental monitor on site and Quantum provided site restoration services for the project. Summit and EBB led the turtle and amphibian salvages, respectively.

Coal recovery began on March 4, 2014 and ended April 2, 2014. As reported by Quantum a total of 142.82 tonnes of coal and sediment were removed from the site. Triton is currently preparing a post-construction report that will summarize the recovery program including Quantum's equipment and methods, the on-site mitigation measures that were implemented, water quality and aquatic life salvage data, and site restoration efforts.

### 1.1 BACKGROUND AND SITE DESCRIPTION

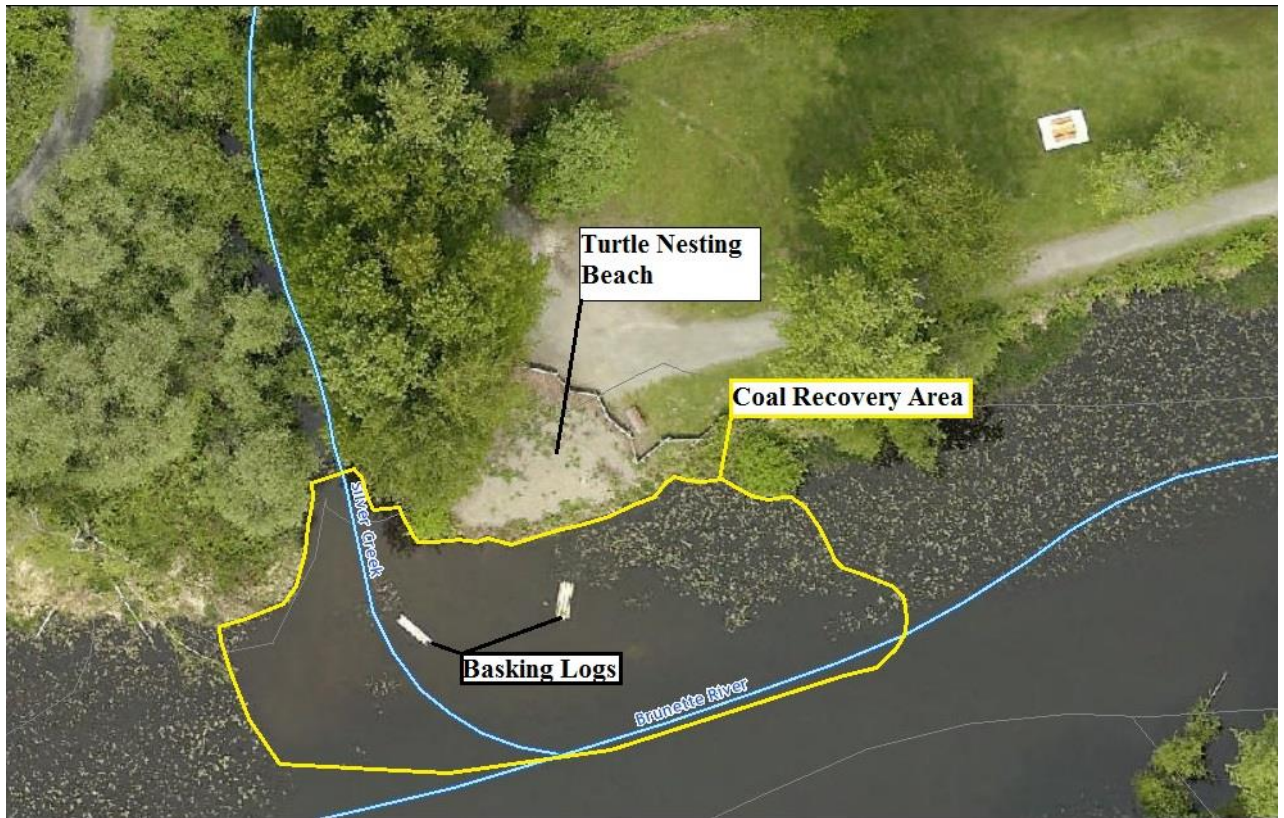
On January 11, 2014, a Canadian Pacific Railway train carrying metallurgical coal derailed at Mile 122.7 of CN's Yale Subdivision in Burnaby, B.C. Three rail cars partially released their contents into Silver Creek. Silver Creek extends approximately 350 m downstream of the CN track and enters Burnaby Lake approximately 200 m upstream of Cariboo Dam. A western painted turtle (*Chrysemys picta bellii*) nesting beach is located just upslope of the confluence of Silver Creek and Burnaby Lake. Burnaby Lake transitions into the Brunette River, which courses roughly 6 km between the Cariboo Dam and the confluence with the Fraser River (Figure 1-1).

After the derailment, Triton conducted deposition assessments in Silver Creek, Burnaby Lake, and the Brunette River to assess the feasibility of recovering coal. Thereafter, Triton developed a coal recovery plan in cooperation with Quantum, CN, Summit, and EBB.

The total volume of coal deposited in the three water bodies (Silver Creek, Burnaby Lake and Brunette River) was estimated at 82.8 m<sup>3</sup>. Based on the recovery assessment, habitat characteristics, and available recovery techniques, it was determined approximately 81.4 m<sup>3</sup> could be recovered. The coal recovery area in Burnaby Lake was defined during the deposition assessment, and included the mouth of Silver Creek, and the alluvial fan of substrate below Silver Creek (Figure 1-2). The estimated volume of coal deposited in this area was 76.2 m<sup>3</sup> with the remainder being located in the Silver Creek channel.



Figure 1-1 Site location near the confluence of Silver Creek and Burnaby Lake that transitions to the Brunette River (Image Source: Burnaby Map - City of Burnaby).



**Figure 1-2** Aerial photo of the site showing the turtle nesting beach and the approximate extent of the coal recovery area (Image Source: Burnaby Map - City of Burnaby).



## 1.2 WESTERN PAINTED TURTLE

Painted turtles (*C. picta*) are one of the most northerly freshwater turtle species in the western hemisphere. There are four subspecies (*C. p. marginata*, *picta*, *bellii*, and *dorsalis*). The western painted turtle (*C. p. bellii*) is the only native freshwater turtle in B.C. The coastal population of western painted turtles is a provincially Red-listed species and is federally listed as “Endangered” under Schedule 1 of the *Species at Risk Act*.<sup>1 2</sup>

Midland painted turtles (*C. p. marginata*) and red-eared sliders (*Trachemys scripta*) are not native to B.C., and were likely introduced through the pet trade.<sup>1,3</sup> There are conservation concerns regarding the western painted turtle and these non-native species, specifically, the potential for hybridization and competition for habitat,<sup>1</sup> particularly nesting habitat.

## 1.3 TURTLE HABITAT IN THE COAL RECOVERY AREA

The turtle nesting beach is located east of the confluence of Silver Creek and Burnaby Lake, next to a pedestrian trail that circles the lake (Figure 1-2). The area of this beach is approximately 118 m<sup>2</sup>. A sample of sand was collected from a representative area of the nesting beach where neonate turtles were found during nesting beach salvage efforts. Sieve analysis of this sample by Lafarge Canada indicated that almost 90% of the material was larger than fine sand (>0.15 mm grain size). Ten percent of the sample was coarse to medium sand (1 - 0.25 mm grain size) and the remainder was fine sand. Less than 3% of the material tested was in the silt/clay grain size range. When wetted, the material could be formed into a ball (i.e. it was not 100% sand), but could not be formed into a ribbon. The gritty texture of this substrate, its consistency (i.e. able to be formed into a ball), and its lack of cohesion (i.e. as is necessary to form a ribbon) indicated that the nesting beach material was best described as loamy sand.

The north end of the nesting beach is relatively flat, and the slope increases to approximately 20 degrees within 5 m of the shoreline. Prior to the coal recovery efforts, leaves and other organic debris from the adjacent forest and riparian habitat were observed on the beach. In addition, it was discovered during the salvage efforts that roots from nearby vegetation were encroaching on the nesting habitat. These small fibrous roots were found between 6 cm and 20 cm below the surface of the sand, and were observed throughout the area, particularly they were noticed near the shoreline where the majority of the turtle nests were excavated. Such roots can have negative impact on turtle nest integrity and turtle recruitment because they can penetrate eggs and damage neonates, causing mortality.

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<sup>1</sup> Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2006. COSEWIC assessment and status report on the western painted turtle *Chrysemys picta bellii* (Pacific Coast population, Intermountain-Rocky Mountain population and Prairie/Western Boreal - Canadian Shield population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 40 pp. ([www.sararegistry.gc.ca/status/status\\_e.cfm](http://www.sararegistry.gc.ca/status/status_e.cfm)).

<sup>2</sup> Species at Risk Public Registry. 2008. Species at risk public registry. Gatineau, Quebec. [Web accessed Feb 25th, 2010 <http://www.sararegistry.gc.ca>].

<sup>3</sup> Welstead, Kym. Personal Communication. March 2014. B.C. Ministry of Forests, Land and Natural Resource Operations (MFLNRO).

The turtle nesting beach habitat begins near the shoreline and extends to approximately 2 to 3 m south of the fence that demarcates the beach area (Figure 1-2). This 2 to 3 m section of land was comprised mainly of compact clay soils. This is typically not suitable nesting material because turtles are unable to dig effectively in compact substrate, and because this type of substrate has relatively high moisture content, which increases risk of neonates freezing during sub-zero temperatures. In addition, during the salvage efforts, similar compacted material was also encountered beneath the sand layer in some areas of the beach. This restricted the search depth in some areas (mainly the north portion of the beach) to less than 20 cm.

Shallow water areas (e.g. >15 cm deep) extend roughly 2 m to 3 m from the edge of the nesting beach and around a vegetated bar located near the outlet of Silver Creek. Water depths beyond this area increased gradually for a distance of 10-15 m from the where the depths were approximately 50- 70 cm. Beyond this outer edge of the alluvial fan the depth increased quickly to a maximum mid channel depth of 1.5 to 2.0 m. As water depth increased so did the presence and depth of soft sediment. This soft muddy substrate provides potential overwintering habitat for turtles and can provide shelter from predators, such as river otters (*Lontra canadensis*), which were observed west of the project area.

## 2 Coal Recovery Plan

### 2.1 AQUATIC LIFE

An aquatic protection plan was developed for the coal recovery area to mitigate potential impacts to wildlife and fish in the area. As part of the planning process, the following potential effects of the coal recovery program were identified:

- Disturbance of turtle overwintering and nesting habitat
- Disturbance of amphibian overwintering and breeding habitat
- Disturbances to wildlife caused by construction noise and personnel activity
- Possible exposure to hazardous materials from fuel and equipment (e.g. spills)
- Mobilization of suspended solids
- Disturbance to riparian habitats from site access

The following information sources were reviewed to develop the aquatic protection and environmental management plan, with special consideration for the western painted turtles and turtle habitat in the coal recovery area:

- B.C. Ministry of Forests, Land and Natural Resource Operations (MFLNRO), Species at Risk Biologist (Kym Welstead) (Feb 2014). Response to Burnaby Lake / Silver Creek Coal Deposition Recovery Plan
- B.C. Ministry of Environment - South Coast Region (Feb 2014) re: Burnaby Lake Coal Derailment Recovery Plan Review
- CN Environment (Feb 2014) Response to painted turtle comments raised by MFLNRO, Species at Risk Biologist (Kym Welstead)
- *Wildlife Act* permit SU-1493104 issued for painted turtle (*C. picta*), midland painted turtle (*C. p. marginata*), and red-eared Slider (*T. scripta*) salvage
- Multiple on-site meetings with Triton, Quantum, and Metro Vancouver to discuss logistics, land use and access, and site restoration

## 2.2 MITIGATION MEASURES

Environmental mitigation measures recommended and implemented on site as part of the coal recovery plan included but were not necessarily limited to:

- Isolating the coal recovery areas with silt curtains and silt fence to minimize impacts on water quality and aquatic life
- Treating discharge water from the recovery operation
- Monitoring water quality in the work area and at the treated water discharge point
- Restricting noise and activity to daylight hours (with the exception of overnight security personnel)
- Providing secure storage for solid waste and potentially hazardous materials
- Installing temporary fencing around upland working areas and shallow coal recovery areas to prevent access by unauthorized personnel
- Minimizing disturbance to riparian vegetation by restricting the number of designated access trails
- Pushing vegetation aside wherever possible, and minimizing cutting of vegetation where cutting was necessary (e.g. grubbing was not permitted, except for non-native species)

- Checking for wildlife in coarse woody debris cover and boulder cover near stream banks and/or in smaller terrestrial construction areas adjacent to main working areas
- Salvaging fish and aquatic wildlife, with the latter focusing on turtles and amphibians. The aquatic life salvage encompassed the entire coal recovery area, which included the nesting beach, the mouth of Silver Creek, and the alluvial fan of substrate below Silver creek. Daily salvages targeted specific areas where work was proposed for the day
- Covering the nesting beach with geotextile to minimize the potential for inadvertent contamination of the substrate with organic material
- Full-time monitoring of all in-water work by a qualified environmental professional

### 2.3 AQUATIC PROTECTION PLAN

The aquatic protection plan included the capture methods of hand sifting to detect (visually and by feel) sub-surface turtles, as well as minnow traps, electrofishing, hoop traps, beach seining, pole seining, dip netting, and fyke netting. Other specific aquatic life salvage and protection measures included the following:

- A dive survey was conducted along the outer edge of the alluvial fan to the inside edge of the silt curtains, and in areas deeper than 1 m to observe/feel for turtles that may have been hibernating in the soft sediments at the edge of the alluvial fan
- Sediment fencing was installed around the shallow areas adjacent to the nesting beach. This was done to prevent wildlife from moving into the work area after the salvage was complete, to contain turbid water and prevent it from escaping the site, and to reduce flow through the site during works
- Sediment and vegetation (including riparian vegetation) within 2 m of the shoreline was hand-salvaged to observe/feel for turtles that may have been hibernating in the sediment or among vegetation
- As requested by MFLNRO in response to the Mile 122.7 Derailment – Coal Recovery Plan for Silver Creek, Burnaby Lake and Brunette River, the coal recovery was conducted in sediment and vegetation within 2 m of the basking platforms (Figure 1-2) and in riparian vegetation within 2 m of the shoreline, and was only undertaken after the areas had been screened for turtles by hand<sup>4</sup>

The final phase of the salvage was completed by electrofishing through the work area in order to capture and remove as many organisms as possible.

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<sup>4</sup> B.C. Ministry of Forests, Land and Natural Resource Operations (Kym Welstead). February 2014. Response to Burnaby Lake/Silver Creek Coal Deposition Recovery Plan

## 2.4 COAL RECOVERY

Coal recovery began March 4, 2014 and ended on April 2, 2014. During this period, management strategies were refined in response to aquatic life capture results or observations, water quality monitoring results and the success of various coal recovery techniques. Management strategies for the turtle nesting beach included but were not necessarily limited to the following:

- Coal recovery was undertaken on and around the vegetated bar. Only a thin layer of coal was present in this area, and as much as possible was collected
- On March 17, filter fabric and sediment fencing was installed on the turtle nesting beach to reduce the chance of contaminating the beach sand with unwanted materials, and foot traffic on the nesting beach area
- On March 24, work pads were constructed on the turtle nesting beach to act as a protective barrier and allow equipment closer access to the coal recovery area. The main purpose of these pads was to reduce compaction and create a protective barrier beneath the two vacuum trucks that had to be parked on the turtle nesting beach. The work pads were constructed with a layer of ¾-inch plywood, a layer of poly, and a layer of filter fabric. The pad was checked daily for any forms of contamination, which could then be removed and/or cleaned as needed. No contaminants were found on the work pads

# 3 Turtle Salvage Methods

## 3.1 SALVAGE CREW AND HANDLING PROTOCOLS

The primary turtle salvage involving the nesting beach was conducted from February 28 to March 2, 2014 under CN's General *Wildlife Act* Permit SU-1493104, and was followed by salvage in shallow water habitat adjacent to the beach on March 3. The salvage was completed by a three to seven person crew led by turtle specialist Nicole Basaraba, M.Sc., P.Ag. of Summit and additional personnel from Triton and EBB. After March 3 aquatic life salvages were led by personnel from Triton as part of the project environmental monitoring program. The primary turtle salvage involved raking the nesting beach and shallow water habitat and sifting the sediments to look for turtles in the proposed coal recovery area (both undertaken prior to coal being removed). Salvage efforts in deeper water areas included tactile surveys during diver surveys as well as through the use of dip nets, and seine nets.

Turtle handling was consistent with the following documents:

- Inventory Methods for Pond Breeding Amphibians and Painted Turtles Standards for Components of B.C.'s Biodiversity No. 27. 1998. Prepared by the Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee

- Resources Inventory Committee. 1998. Live animal capture and handling guidelines for wild mammals, birds, amphibians and reptiles. pp. 47. Standardized Inventory Methodologies for Components of British Columbia's Biodiversity. Ministry of Environment, Lands and Parks, Government of British Columbia. Victoria, BC
- Canadian Council on Animal Care (CCAC). 2003. CCAC guidelines on: the care and use of wildlife. pp66. Ottawa, ON. Canada
- Canadian Council on Animal Care (CCAC). 2004. CCAC species-specific recommendations on: amphibians and reptiles. pp30. Ottawa, ON. Canada
- Ecosystem Branch, Ministry of Environment. 2008. Standard Operating Procedures: Hygiene Protocols for Amphibians Fieldwork. Victoria, B.C., Canada

During the salvage efforts, all captured turtles were given to the Species at Risk Biologist Kym Welstead to confirm species and to allow measurements to be collected, as per CN's work plan and General *Wildlife Act* Permit.

### 3.2 NESTING BEACH AND NEAR-SHORE AREAS

Western painted turtles dig a flask-shaped nest approximately 10 cm deep.<sup>5</sup> Prior to coal recovery, the turtle nesting beach was delineated with a 200 cm by 200 cm grid constructed using string and small wooden stakes. The grid was used as a visual reference to help organize salvage efforts. Each grid was carefully raked and screened to a depth of approximately 20 cm in search of neonate turtles or other evidence of nests (e.g. shell fragments). Turtles were expected to be found within 10 to 15 cm of the surface; however, search depths exceeded 15 cm (to a maximum of 20 cm) to minimize the risk of missing any neonates or nests. In some instances, search depths did not reach the 20 cm standard because of the underlying compacted substrate. Areas with compacted substrate were deemed unsuitable nesting habitat, and therefore search depths were terminated upon reaching these compacted substrates.

After the nesting beach salvage was completed, efforts were made to isolate the coal recovery area. During the initial stages of this process, a diver searched deeper waters (i.e.  $\geq 1$  m) for turtles and attempted to secure a silt curtain to the bottom of the lake. However, the area could not be fully isolated with the silt curtain because high flows from Silver Creek, in conjunction with dam operations, destabilized the curtain. Shallow portions of the coal recovery area were then isolated using silt fencing in order to minimize impacts from coal recovery (e.g. dispersion of sediment during high flows).

The first area isolated was directly in front of the turtle nesting beach. This area was hand-searched for turtles of all age classes by raking sediment to the shoreline or into piles. Deeper areas were searched using a seine net to dredge the top layer of the isolated area, and again with four people in a line swathing

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<sup>5</sup> COSEWIC 2006. COSEWIC assessment and status report on the Western painted turtle *Chrysemys picta bellii* (Pacific Coast population, Intermountain-Rocky Mountain population and Prairie/Western Boreal - Canadian Shield population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 40 pp. ([www.sararegistry.gc.ca/status/status\\_e.cfm](http://www.sararegistry.gc.ca/status/status_e.cfm)).

the area with dip nets to detect turtles or turtle movement. Two basking logs in the coal recovery area were removed during this time using an excavator. They were later pressure washed and replaced during site restoration. The second and third areas were then isolated using silt fence (the second area was located to the west of the outlet of Silver Creek and Burnaby Lake and the third was to the east of the outlet of Silver Creek bordered along the second area). Hand searches were conducted for turtles of all age classes by raking sediment up to the shoreline or into piles. The deeper areas were searched using a seine net to dredge the top layer of the isolated area. Finally, the areas were swathed by three people in a line using dip nets to search for turtles or turtle movement. The same isolation areas were salvaged for amphibians and fish.

Once the isolated areas were cleared of aquatic life, Quantum used a hand controlled vacuum truck system to suck coal into drying bins on site. The material was then disposed of offsite. Initially, the vacuum was outfitted with a metal screen to protect any undetected turtles from the vacuum system; however, initial attempts with this method prevented successful recovery of the coal and the screen had to be removed at various times, until a modified screen was later attached. To help mitigate impacts, Quantum staff maneuvered the vacuum end by hand slowly through the piles of substrate that had been previously sifted through for turtles.

### 3.3 OFFSHORE AREAS

When coal removal began in the deep water sections (i.e. with divers), the environmental monitor typically conducted a minimum of two passes of the work area using a 15 m long x 3 m deep, 60 mm mesh seine net ahead of any coal recovery. No turtles or other animals were captured by seining and this method was discontinued after the first 6 days of deep water recovery. At that time, divers had begun working further away from the alluvial fan, and it was determined by Triton that seining was not a successful technique. Coal removal was closely controlled in the water by the divers, who worked the equipment by hand so as to ensure no adult turtles were removed inadvertently. During the searches conducted by the divers no turtles were encountered.

### 3.4 TURTLE ACTIVITY MONITORING

Three hoop traps were set periodically from March 3 to March 28, south of the coal recovery area to assess whether adult and juvenile turtles were moving nearby in Burnaby Lake. These traps were baited with sardines (in soya oil), checked at intervals of 4 to 12 hours, and were deployed for a total 1,080 trap hours. In addition, the environmental monitor conducted surveys of the shoreline to search for basking turtles. No basking turtles were observed until March 31, during sunny conditions. One turtle (species unknown) was seen basking on a log approximately 20 m upstream of the work area. On April 1, two turtles were observed basking on the shoreline, one (species unknown) approximately 50 m downstream of the recovery area, and a second turtle (visually identified as a painted turtle or a hybrid) approximately 115 m downstream. On the last day of coal removal (April 2), when conditions were warmer, eight turtles were observed at one time at various locations between 20 and 120 m from the work area.

## 4 Turtle Salvage Results

One hundred and five (105) neonate turtles in 19 locations were detected at the nesting beach (see photographs in Appendix A). Eleven (11) of the 19 suspected nests had live neonates while the other 8 sites had only shell fragments, or partially developed eggs. Most of the nests were found under an open canopy, within 3 m of the shoreline on a west-southwest-facing slope of approximately 20-degree gradient. One neonate was also captured on March 3, during salvage of the shallow water isolated coal recovery area directly adjacent to the turtle nesting beach, and one neonate was recovered on March 13 walking on the pedestrian footpath during coal recovery activities.

Of the 107 neonate turtles detected, 61 were identified either as midland painted turtles (*C. p. marginata*) (an invasive species in B.C.) or as hybrids of western painted and midland painted turtles. The remaining 46 appeared to be western painted turtles; however, species confirmation of these individuals is pending genetic testing, overseen by the Species at Risk Biologist (K. Welstead). All individuals identified as midland painted turtles or hybrids (61 total), and all other turtles that were in grave condition (3 of the 46 tentatively identified western painted turtles) were sent to be euthanized, as required by the Species at Risk Biologist per CN's General *Wildlife Act* Permit.

### 4.1 SITE RESTORATION

After the coal recovery efforts were completed, a site restoration plan was prepared based on a comparison of pre and post construction conditions in wetted, riparian, and upland areas, and based on the need to secure the turtle nesting area. The site restoration plan was developed during an on-site meeting with representatives from CN, Quantum, Metro Vancouver Parks, and Triton. Nesting beach restoration began on April 3, 2014, immediately after coal recovery and the demobilization of the vacuum equipment by Quantum, and all restoration activities were completed by April 8. The site restoration measures included, but were not necessarily limited to:

- Work pads and other mitigation materials (e.g. geotextile on the turtle nesting beach, sediment fencing, and materials for area grid) were removed
- Organic materials and debris in or on the nesting each (e.g. leaf matter, root systems, tree stumps) were removed by hand, rake, and excavator
- To reverse any potential compaction from the machinery, rakes were used to turn the nesting beach sand over. This was done under the supervision of the environmental monitor and in consultation with Nicole Basaraba. The beach sand was raked to a depth of 10 cm to 20 cm, depending on the depth of the base compact clay material



- The section of original exclusion fencing at the turtle nesting beach that had been disassembled to allow equipment access was restored. Care was taken to follow the original fence design and ensure that fence materials were replaced in their original positions
- New hardware cloth was re-installed on the exclusion fence to minimize predator and dog access to the nesting beach
- Information signs were replaced on the exclusion fence
- After these initial steps a representative from MFLNRO visited the site and directed Quantum to re-position the fence such that it enlarged the nesting beach area by approximately 4 m<sup>2</sup>
- Basking logs were washed using a high-power pressure washer before they were re-installed

## 5 Conclusion

Post-coal recovery, there was no visible coal and/or recoverable coal in the wetted habitat adjacent to the turtle nesting beach. As noted, organic materials (roots, stumps, leaves, and other debris) were removed from the beach area, and this will help to restore/increase the quality of the nesting habitat. Further, the turning of the beach sand will have helped reverse any compaction of substrate that occurred during the recovery works. Covering the beach with the containment pad and filter fabric, and installing the sediment fence to restrict foot traffic and isolate recovery areas were successful in protecting the nesting beach and areas outside of the coal recovery operations from contamination.

During the turtle salvage operation, the nesting beach and the three watered portions of the coal recovery area were successfully isolated and searched for turtles. One hundred and seven (107) neonate painted turtles were found in the nesting beach, one (1) neonate was discovered in one of the isolated shallow watered portions of the recovery area, and one turtle was captured on the pedestrian path. No other juvenile or adult turtles were captured in the coal recovery area, although as the weather began to warm adult turtles were observed basking near the work area (see Section 3.4).

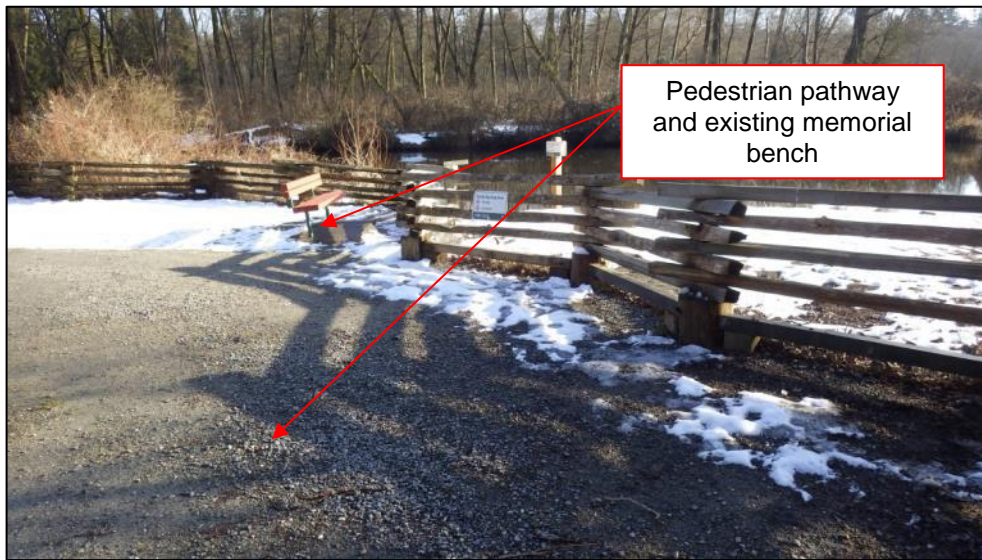
Overall, the salvage activities were successful with respect to removing neonates from the nesting beach and searching the coal recovery area for hibernating turtles. The coal recovery program resulted in successful removal of recoverable coal in wetted areas, and the nesting beach was largely restored to pre-existing conditions.

# REPORT

## Appendix A – Photographs



Photograph 1: South facing view of turtle nesting beach before coal recovery began



Photograph 2: South facing view of turtle nesting beach fence and bench before coal recovery began



Photograph 3: Southwest facing view of turtle nesting beach and lake interface before coal recovery began



Photograph 4: West facing view across turtle nesting beach looking toward the Silver Creek before coal recovery began



Photograph 5: Photograph of the east edge of the turtle beach after the fence was removed and before leaves were cleaned up prior to turtle salvage



Photograph 6: North facing view of the east edge of the turtle beach after the fence was removed and before leaves were cleaned up prior to turtle salvage.



Photograph 7: Southwest facing view of turtle nesting beach prior to turtle salvage



Photograph 8: West facing view of turtle nesting beach as turtle salvage began.



Photograph 9: Photograph of eight (8) neonate Western painted turtles salvaged from the beach



Photograph 10: Crew hand salvaging turtles while also removing roots



Photograph 11: Crew hand salvaging turtles inside the grid



Photograph 12: Crew hand salvaging turtles using tools such as sieve, rakes, and small gardening shovels





Photograph 13: All equipment (including diver gear shown here) was scrubbed and disinfected with bleach prior to use in the recovery area



Photograph 14: Crews salvaging the shallow area adjacent to the turtle nesting beach



Photograph 15: The basking logs were removed from the shallow area adjacent to the nesting beach and stored until they could be cleaned



Photograph 16: Quantum crew beginning coal recovery after salvage was complete



Photograph 17: South facing view of the recovery area and established grid for coal recovery adjacent to the turtle nesting beach



Photograph 18: Vacuum truck used in the recovery of coal



Photograph 19: East facing view of the filter fabric and sediment fence used to protect the turtle nesting beach during coal recovery



Photograph 20: South west facing view of the filter fabric and sediment fence used to protect the turtle nesting beach during coal recovery



Photograph 21: South facing view of the two vac trucks on the work pads constructed on the turtle beach while recovery was underway



Photograph 22. Basking logs were washed off the nesting beach over the pedestrian path with clean high pressure water



Photograph 23: Crew raking up the turtle nesting beach to reverse any compaction which might have occurred. The beach sand was raked to a depth of 100 mm to 200 mm, depending on the depth of the base material.



Photograph 24: Crew removing stump found in the turtle nesting beach



Photograph 25: Crews raking up the turtle nesting beach to reverse any compaction which might have occurred and removing roots and other debris



Photograph 26: Turtle nesting beach after restoration was complete



Photograph 27: Turtle nesting beach after restoration was complete



Photograph 28: Southwest facing view of the turtle nesting beach after restoration was complete – fence replaced





Photograph 29: Northwest facing view of the turtle nesting beach, crew installing the exclusion fence



Photograph 30. Southeast facing view of the turtle nesting beach while crews installed the exclusion fence.