Regional District of Nanaimo

2017 Biosolids Management Summary

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1 INTRODUCTION

The Regional District of Nanaimo (RDN) operates two wastewater treatment plants that produce municipal biosolids:

1. French Creek Pollution Control Centre (FCPCC)
    a. Average annual production: 1,200 wet tonnes (wt) of Class A biosolids
    b. Authorization # 4200
2. Greater Nanaimo Pollution Control Centre (GNPCC)
    a. Average annual production: 3,100 wt of Class B biosolids
    b. Authorization #5989

In 2017, RDN biosolids were managed by SYLVIS Environmental in a forest fertilization program on private forest lands owned by TimberWest on Weigles Road in Nanaimo, BC (the TimberWest Properties). This site was formerly leased by Vancouver Island University from 1988 to May 2017. RDN biosolids have been managed on an annual basis at this site since 2007. The objectives of biosolids forest fertilization at the TimberWest Properties are to increase tree biomass and to increase the likelihood of natural tree seeding (through improved soil and moisture conditions). In 2017, RDN biosolids were also managed in a soil fabrication project located at the Nanaimo Forest Products Harmac Mill in Nanaimo, BC (Harmac). In January and February of 2017, biosolids were disposed of at the RDN Reginal Landfill during periods of reduced access at the TimberWest Properties due to winter weather. 3,662 wet tonnes (wt) (80% of annual production in 2017) were delivered to the TimberWest Properties; 797 wt (18%) was delivered to Harmac, and the remaining 129 wt (3%) were delivered to the RDN Regional Landfill.

This report includes a summary of volumes managed in 2017 and details of regulatory compliance for the forest fertilization project. SYLVIS provided Qualified Professional services for the soil fabrication project and reports addressing the regulatory requirements are provided separately.

2 2017 BIOSOLIDS MANAGEMENT SUMMARY

This document contains a summary of the 2017 RDN biosolids management program including a summary of contractual requirements for the forest fertilization program (Table 1), a biosolids management summary (Table 2, Figure 1 and Figure 2), a biosolids quality summary data (Table 3), a soil quality summary (Table 4), a summary of updates to regulatory soil criteria (Table 5), a biosolids management program carbon emissions estimate (Table 6), a summary of historical management (Table 7), a map of application areas at the TimberWest Properties, (Figure 3), and photographs from the management program (Photographs 1 to 3).

2.1 PROJECT OVERVIEW

In 2017, RDN biosolids were managed at the TimberWest Properties on Weigles Road in Nanaimo, BC. Over the course of the year, biosolids management occurred under three separate contracts:

1. A tripartite agreement between the RDN, SYLVIS, and Vancouver Island University (expired May 31st, 2017);
2. A four-month contract between the RDN and SYLVIS (expired October 7th, 2017); and,
3. A 4-year contract between the RDN and SYLVIS (expires May 31st, 2021).

All contractual tasks relating to biosolids quality monitoring, transport coordination, biosolids beneficial use, site safety, environmental monitoring, public engagement, reporting, coordination with site stakeholders, and adherence to the conditions of site use under the RDN land-use agreement with TimberWest were completed for 2017 (Table 1).

RDN biosolids delivered to Harmac were managed under contract by Harmac with SYLVIS providing Qualified Professional oversight. Additional details of biosolids storage and soil mixing at the Harmac Mill are available in SYLVIS's report *Mixed Topsoil QA/QC Summary*.

2.2 BIOSOLIDS TRANSPORTATION

In 2017, 3,662 wt of RDN biosolids (976 wt from FCPCC; 2,686 wt from GNPCC) were transported by DBL Disposal to the TimberWest Properties (Table 2 and Photograph 1). Monthly tonnage delivered in 2017 is graphically summarized in Figure 1.

In 2017, 797 wt of RDN biosolids (236 wt from FCPCC; 561 wt from GNPCC) were transported by DBL Disposal to Harmac (Table 2). Monthly tonnage delivered in 2017 is graphically summarized in Figure 2.

In January and February of 2017, 129 wt of RDN biosolids (39 wt from FCPCC; 90 wt from GNPCC) were transported by DBL Disposal to the RDN Regional Landfill as a result of reduced access due to adverse winter conditions at the TimberWest Properties (Table 2).

Total RDN biosolids production in 2017 (4,588 wt) was above the five-year average annual production of 4,370 wt.

2.3 BIOSOLIDS STORAGE

The four storage facilities at the TimberWest Properties consist of an asphalt base with lock blocks delineating three sides of the facility (Photograph 2). Three of the facilities were utilized for biosolids stockpiling in 2017. Biosolids storage conformed to rainy season storage practices where biosolids are required by the *Organic Matter Recycling Regulation* (OMRR) to be covered from October 1st to March 31st of every year.

The storage facility at the Harmac Mill consists of an asphalt base with lock blocks delineating one side of the facility. Biosolids storage conformed to rainy season storage practices where biosolids are required by the OMRR to be covered from October 1st to March 31st of every year.

2.4 2017 PRE-APPLICATION MEASURES

At the TimberWest Properties, a site inspection was carried out by a SYLVIS Qualified Professional prior to biosolids fertilization. During the site inspection, water features were identified, mapped, and 30-metre (m) setback distances were determined. Pre-application soil

samples were collected in order to determine an appropriate agronomic rate of biosolids application which adheres to relevant OMRR soil limits. Groundwater depth was measured using a soil auger or confirmed visually in road cuts and was confirmed to be in excess of 1 metre (m) prior to commencing biosolids applications.

At Harmac, a site inspection was carried out prior to initiating mixing operations to confirm the suitability of the storage facility, the mixing methodology, and the topsoil stockpile area. All mixed topsoil incorporating RDN biosolids in 2017 was stockpiled for future use, therefore no further pre-application assessments were undertaken.

2.5 BIOSOLIDS LAND APPLICATION

In 2017, 3,876 wt of RDN biosolids (1,033 wt from FCPCC; 2,843 wt from GNPCC) were applied as a fertilizer and soil amendment to the TimberWest Properties (Table 2). Biosolids were land-applied to 44 hectares (ha) of forested lands at the TimberWest Properties for a site-wide average application rate of 89.4 wt/ha (23.3 dry tonnes or dt/ha), 93% of the agronomic application rate of 25 dt/ha specified in the LAP. At the end of 2017, 150 wt (39 wt from FCPCC; 111 wt from GNPCC) remained in storage facilities at the TimberWest Properties (Table 2).

Biosolids was land-applied using a side-discharge spreader equipped with a hydraulic fan which propels the biosolids up to 30 m into forest stands (Photograph 3). All biosolids applications adhered to a 30-m setback distance from permanent water features and identified ephemeral water features. Biosolids applications were completed weekly or bi-weekly throughout 2017 except during periods of extreme weather (i.e., snowfall, heavy rainfall) or when ground was snow-covered: land application operations were suspended during these times.

Biosolids will be land-applied at the Harmac Mill's landfill as a topsoil cover during landfill closure operations. To date, no such closure operations have occurred and mixed topsoil is stockpiled adjacent to the landfill. No RDN biosolids were land-applied at the Harmac landfill in 2017.

2.6 BIOSOLIDS QUALITY

Biosolids quality was characterized throughout 2017 to ensure that it met quality requirements set forth in the OMRR for trace elements and pathogen reduction. Three composite samples, each composed of eight equal-volume subsamples, were collected from the FCPCC and two composite samples were collected from the GNPCC. The biosolids were analyzed for physical parameters, nutrients, and trace elements (Table 3). All RDN biosolids produced in 2017 met OMRR Class A biosolids criteria for trace elements.

A total of thirteen discrete samples were collected for analysis of fecal coliforms over three sampling events (Table 3). The geometric mean for fecal coliform in 2017 for the FCPCC was 200 most probable number per gram (MPN/g) which is below the OMRR limit of 1,000 for Class A biosolids. The geometric mean for fecal coliform in 2017 for the GNPCC was 77,000 most probable number per gram (MPN/g) which is below the OMRR limit of 2,000,000 for Class B biosolids. As a weighted average, RDN biosolids produced in 2017 met the standards for

pathogen reduction for OMRR Class B biosolids; both FCPCC and GNPCC biosolids are managed at the TimberWest Properties as Class B.

The RDN performed analysis of volatile solids reduction (VSR) throughout 2017. Average VSR was 48% for the FCPCC and 69% for the GNPCCC; both were above the minimum VSR of 38% specified in the OMRR (Table 3).

2.7 SOIL MONITORING

Post-application soil monitoring was carried out at the TimberWest Properties throughout 2017. Soil quality data remain at or below applicable OMRR soil criteria for this site (Table 4). In 2017, OMRR soil criteria were updated in conjunction with a major revision of the BC *Contaminated Sites Regulation*. The new criteria represent, in most cases, a decrease in soil limits (Table 5).

Mixed topsoil quality in the Harmac soil mixing project conformed to applicable OMRR soil criteria as detailed in SYLVIS's report *Mixed Topsoil QA/QC Summary*.

2.8 REGULATORY COMPLIANCE

Biosolids land application activities at the TimberWest Properties were carried out in compliance with the Land Application Plan (LAP) notified to the BC Ministry of Environment and Climate Change Strategy (ENV) on February 28th, 2017 (authorization #108802). This authorization expires on February 28th, 2018 and notification for an additional year of biosolids land applications was made to ENV and the Vancouver Island Health Authority on January 25th, 2018. All regulatory requirements of the OMRR and specifications of the 2017 LAP were met including the requirements for rainy season storage, agronomic application rate, groundwater level during application, water feature buffers biosolids quality, pre-application and predicted post-application soil concentration limits, signage, and storage.

A LAP was submitted to ENV on February 28th, 2017 (authorization #108801) to authorize land application of RDN biosolids in landfill closure activities at the Harmac landfill. This authorization expires on February 28th, 2018. A LAP is required specifically for land application of biosolids and this will not occur until landfill closure commences. Therefore, biosolids stockpiling, topsoil mixing, and topsoil stockpiling may continue after the current authorization expires. A new notification will be made to ENV prior to actual land application of the topsoil and the biosolids therein.

3 BIOSOLIDS PROGRAM GREENHOUSE GAS EMISSIONS

Greenhouse gas emission accounting is an increasingly important consideration for municipalities. In 2010, SYLVIS produced the Biosolids Emissions Assessment Model (BEAM) for the Canadian Council of Ministers of the Environment. While the BEAM focusses largely on emissions from biosolids treatment at the wastewater treatment plant, it also addresses the transport and land application of biosolids. Based on these aspects of the BEAM, SYLVIS has produced an estimate of greenhouse gas emissions from the RDN's 2017 biosolids management program. While transportation and equipment operation created positive emissions, soil amendment and incremental biomass production created negative emissions (sequestration or

emissions avoidance). In 2017, the RDN's biosolids management program accounted for -114.1 tonnes of carbon dioxide equivalents (CO_2eq) (Table 6).

It should be noted that this emissions estimate is not a validated estimate and cannot be used to claim credits on carbon markets.

4 CONCLUSION

RDN biosolids were managed at the Weigles Road TimberWest Properties and at the Harmac Mill in 2017 in the 10th year of biosolids management by SYLVIS. 3,662 wet tonnes (wt) (80% of annual production in 2017) were delivered to the TimberWest Properties; 797 wt (18%) was delivered to Harmac, and the remaining 129 wt (3%) were delivered to the RDN Regional Landfill. The partnership between the RDN and SYLVIS has existed since 2007 with over 31,000 wt of material managed (Table 7, Appendix One). Beginning in November 2017, RDN biosolids are being managed by SYLVIS in a long-term contract which expires on May 31st, 2021. SYLVIS looks forward to continuing this productive relationship and providing biosolids management services and support to the RDN throughout 2018 and beyond.

APPENDIX ONE – TABLES

Table 1: Summary of SYLVIS 2017 deliverables as outlined in the RDN-SYLVIS 2017-2021 biosolids management contract.

Task or Activity	Description
Biosolids Quality	RDN biosolids quality was monitored throughout 2017 through the collection of five full suite samples and 13 fecal coliform samples.
Biosolids Quantity	3,662 tonnes of RDN biosolids were transported to the TimberWest Properties by DBL Disposal in 2017. 3,876 tonnes of biosolids were land-applied in 2017. 150 tonnes remained stockpiled at the end of 2017.
Biosolids Transportation and Delivery	TimberWest Properties interior roads were maintained in October 2017.
Contingency	797 tonnes of RDN biosolids were sent to the Harmac contingency site. 39 of these tonnes were delivered in December 2017 due to weather-related reduced access at the TimberWest Properties.
Storage of Biosolids	Biosolids were stored in three storage facilities at the TimberWest Properties and covered with tarps from October 1st to March 31st as per OMRR requirements.
Biosolids Beneficial Use	A biosolids Land Application Plan (authorization #108802) was submitted on February 28th, 2017. 3,876 tonnes of biosolids were land-applied in 2017 to fertilize 44 ha of forested lands.
Invoicing	Biosolids management was invoiced on a monthly basis.
Environmental Monitoring and Incidents	No environmental incidents occurred in 2017.
Site Safety	No near-miss or safety incidents occurred at the TimberWest Properties in 2017. SYLVIS maintained COR safety accreditation and obtained a BC Forest Safety Council SAFE Company accreditation in 2017.
Public and Media Relations	No Open Houses were undertaken at the TimberWest Properties or RDN WWTPs in 2017.
Complaints Management	No complaints were received by SYLVIS or the RDN relating to biosolids fertilization activities at the TimberWest Properties.
Annual Reporting	This summary report fulfills the regulatory requirement for written certification under OMRR Section 5(3).
Biosolids Transport Coordination	Biosolids transportation was coordinated with the RDN and DBL Disposal throughout 2017. TimberWest Properties interior roads were plowed once in December 2017.
Storage Facility Management	SYLVIS managed 3 established biosolids storage facilities throughout 2017. No work was completed on storage facilities in 2017.
Application Planning	SYLVIS sampled, planned, notified, and mapped all application areas fertilized in 2017.
Nanaimo Mountain Bike Club Land Use Coordination	Starting in July 2017, bi-weekly application maps for use by site recreational users were produced. Starting in August 2017, no biosolids applications occurred on the Northern Bike Corridor or in the Biking Section south of Weigles Road. Starting in November 2017, signage on non-approved bike trails was affixed to trails impacted by biosolids applications.
Biosolids Applications	3,876 tonnes of biosolids were land-applied in 2017 to 44 ha.
Record-Keeping	SYLVIS kept detailed records of all fertilization activities and environmental monitoring in 2017.
Environmental Monitoring	Surface water was monitored at the TimberWest Properties beginning in November 2017.
TimberWest Rules	SYLVIS obtained a BC Forest SAFE accreditation in 2017.
Construction	No works were constructed by SYLVIS at the TimberWest Properties in 2017.
Fires	SYLVIS followed a fire prevention protocol throughout 2017.
Hazardous Substance	No hazardous substances were introduced by SYLVIS to the TimberWest Properties in 2017.
Condition of TimberWest Lands	SYLVIS maintained the condition of the TimberWest Properties in 2017.
Storage	Except for temporary overnight storage of heavy equipment during fertilization activities, SYLVIS did not store any equipment at the TimberWest Properties in 2017.

Table 2: Regional District of Nanaimo biosolids – management summary, 2017.

Site	TimberWest Properties			Harmac[a]			Landfill[b]			Total
WWTP	**GNPCC**	**FCPCC**	**Subtotal**	**GNPCC**	**FCPCC**	**Subtotal**	**GNPCC**	**FCPCC**	**Subtotal**	
Carry-over from 2016										
wet tonnes	268	96	364	-	-	-	-	-	-	364
dry tonnes	67	29	96	-	-	-	-	-	-	96
Delivered										
wet tonnes	2,686	976	3,662	561	236	797	90	39	129	4,588
dry tonnes	669	298	966	140	72	212	22	12	34	1,178
Applied										
wet tonnes	2,843	1,033	3,876	-	-	-	-	-	-	3,876
dry tonnes	708	315	1,023	-	-	-	-	-	-	1,023
Carry-over to 2018										
wet tonnes	111	39	150	561	236	797[c]	-	-	-	946
dry tonnes	28	12	39	140	72	212	-	-	-	251

a Biosolids managed at the Nanaimo Forest Products Harmac Mill are incorporated into a fabricated soil totalling approximately six times the volume of the biosolids.

b Biosolids were sent to the RDN Regional Landfill in January and February of 2017 when adverse winter conditions impacted access roads at the TimberWest Properties.

c Biosolids delivered to the Harmac site have been incorporated into a mixed topsoil but not land-applied. Carry-over amounts refers to the biosolids component of the stockpiled mixed topsoil.

Table 3: Regional District of Nanaimo biosolids quality monitoring – 2017 summary statistics.

Parameter	FCPCC[a]	GNPCC[b]	Weighted Average[c]	Regulatory Limits		Units
	Class A	Class B		Class A[d]	Class B[e]	
Available Nutrients, Physical Properties, Acidity						
Total Nitrogen - TKN	44,633	48,750	47,653	-	-	µg/g
Ammonia - N (available)	3,317	6,315	5,516	-	-	µg/g
Nitrate - N	10.0	10.0	10.0	-	-	µg/g
Phosphorus (available)	1,833	2,200	2,102	-	-	µg/g
Potassium (available)	751	792	781	-	-	µg/g
Organic Matter	65.1	60.8	61.9			%
Total Solids	31.0	24.9	26.5	-	-	%
pH	6.4	3.6	4.4	-	-	pH
Electrical Conductivity	6.8	7.0	6.9	-	-	dS/m
Trace Elements						
Arsenic	3.0	2.8	2.9	75	75	µg/g
Cadmium	1.44	2.20	1.99	20	20	µg/g
Chromium	25.4	26.3	26.1	-	1,060	µg/g
Cobalt	1.9	3.9	3.4	150	150	µg/g
Copper	740	498	562	-	2,200	µg/g
Lead	19	26	24	500	500	µg/g
Mercury	0.59	1.10	0.96	5	15	µg/g
Molybdenum	4.23	6.21	5.68	20	20	µg/g
Nickel	11.0	15.9	14.6	180	180	µg/g
Selenium	4.44	4.05	4.15	14	14	µg/g
Zinc	998	898	924	1,850	1,850	µg/g
Microbiological Analysis						
Fecal Coliforms	200[f]	77,000[g]	57,000	1,000	2,000,000	MPN/g Dry
Vector Attraction Reduction						
Volatile Solids Reduction	48%	69%	63%	38% (minimum)	38% (minimum)	%

Note: All analyses based on dry weight.

a French Creek Pollution Control Centre values are the average of three samples taken on April 18, July 25, and December 14, 2017 by SYLVIS and analysed by Exova Laboratories in Surrey, BC.

b Greater Nanaimo Pollution Control Centre values are the average of two samples taken on April 18 and July 25, 2017 by SYLVIS and analysed by Exova Laboratories in Surrey, BC.

c Weighted average is based on GNPCC production of 73% and FCPCC production of 23% of total biosolids production.

d Limits specified in Trade Memorandum T-4-93, Standards for Metals in Fertilizers and Supplements.

e Limits specified in the BC *Organic Matter Recycling Regulation* for Class B biosolids, Schedule 4, Column 3.

f Value is the geometric mean of seven samples taken by SYLVIS on April 18, July 26, and December 14, 2017 and analyzed by AGAT Laboratories and ALS Laboratories in Burnaby, BC.

g Value is the geometric mean of six samples taken by SYLVIS on April 18 and July 26, 2017 and analyzed by AGAT Laboratories and ALS Laboratories in Burnaby, BC.

Table 4: TimberWest Properties soil quality – 2017 summary statistics

Parameters	Min[a,b]	Max[a]	Mean[a,b]	OMRR Soil Criteria[c]	Units
Available Nutrients, Physical Properties, Acidity					
Total Nitrogen - TKN	2,200	3,160	2,827	-	µg/g
Ammonium - N (dry basis)	2.2	8.2	4.8	-	µg/g
Nitrate - N	2.0	13.0	8.6	-	µg/g
Phosphorus - available	49	460	200	-	µg/g
Potassium - available	97	250	163	-	µg/g
Organic Matter	9.21	14.2	12	-	%
C:N Ratio	19.6	27.8	24.0	-	-
pH	4.8	6.1	5.1	-	pH units
Electrical Conductivity	0.15	0.53	0.26	-	dS/m
Trace Elements					
Arsenic	2.7	9.9	5.6	10	µg/g
Cadmium	0.06	0.25	0.16	1	µg/g
Chromium	18	42	30	60	µg/g
Cobalt	6.6	20.0	12.3	25	µg/g
Copper	12	74	46	75	µg/g
Lead	6.1	20.6	13.6	120	µg/g
Mercury	0.036	0.250	0.098	10	µg/g
Molybdenum	< 0.20	0.81	0.53	80	µg/g
Nickel	11	29	21	100	µg/g
Selenium	0.1	0.5	0.3	1	µg/g
Zinc	32	108	79	150	µg/g

a Values are based on a set of 18 composite samples collected throughout 2017 by SYLVIS and analyzed by EXOVA Laboratories in Surrey, BC.

b Where the value was below detection limit, the detection limit was included in the determination of the minimum and mean.

c BC *Organic Matter Recycling Regulation* (OMRR) soil quality criteria as updated in November 2017, based on site-specific factors "intake of contaminated soil", "toxicity to soil invertebrates and plants", "groundwater flow to surface water used by freshwater aquatic life", and "major microbial functional impairment".

Table 5: Updated OMRR soil trace element criteria.

Trace Element	Previous[a]	Current[b]	% change	Units
Arsenic	20	10	-50%	µg/g
Cadmium	2	1	-50%	µg/g
Chromium	100	60	-40%	µg/g
Cobalt	50	25	-50%	µg/g
Copper	100	75	-25%	µg/g
Lead	150	120	-20%	µg/g
Mercury	15	10	-33%	µg/g
Molybdenum	10	80	+700%	µg/g
Nickel	100	100	0%	µg/g
Selenium	3	1	-67%	µg/g
Zinc	150	150	0%	µg/g

a BC *Organic Matter Recycling Regulation* (OMRR) soil quality criteria prior to November 2017, based on site-specific factors "intake of contaminated soil", "toxicity to soil invertebrates and plants", "groundwater flow to surface water used by freshwater aquatic life", and "major microbial functional impairment".

b BC *Organic Matter Recycling Regulation* (OMRR) soil quality criteria as updated in November 2017, based on site-specific factors "intake of contaminated soil", "toxicity to soil invertebrates and plants", "groundwater flow to surface water used by freshwater aquatic life", and "major microbial functional impairment".

Table 6: Regional District of Nanaimo biosolids management program greenhouse gas emissions estimate, 2017.

Process	SYLVIS	Transporter	Total
Transportation[a]	0.5	26.9	**27.4**
Land Application[b]	-74.3	-	**-74.3**
Biomass[c]	-67.2	-	**-67.2**
Total	**-141.0**	**26.9**	**-114.1**

Note: All values in tonnes of carbon dioxide equivalents (CO_2eq). Estimated emissions are not validated and cannot be used to claim credits on carbon markets.

Note: Emissions from soil mixing and storage at Harmac are not included in this estimate.

a Includes transportation to the TimberWest Properties and Harmac.

b Includes land application of biosolids at the RDN TimberWest Properties but not at Harmac.

c Based on broad assumptions, sequestration value of incremental increase in carbon storage in trees due to fertilization.

Table 7: Historical management of Regional District of Nanaimo biosolids by SYLVIS, 2007-2017.

Year	Total (wet tonnes)
2007	1,150
2008	3,350
2009	3,000
2010	0
2011	1,350
2012	1,280
2013	3,930
2014	4,812
2015	4,383
2016	4,263
2017	3,662
Total	**31,180**

APPENDIX TWO – FIGURES

Figure 1: Tonnage of Regional District of Nanaimo dewatered biosolids managed at the TimberWest Properties by month in 2017.

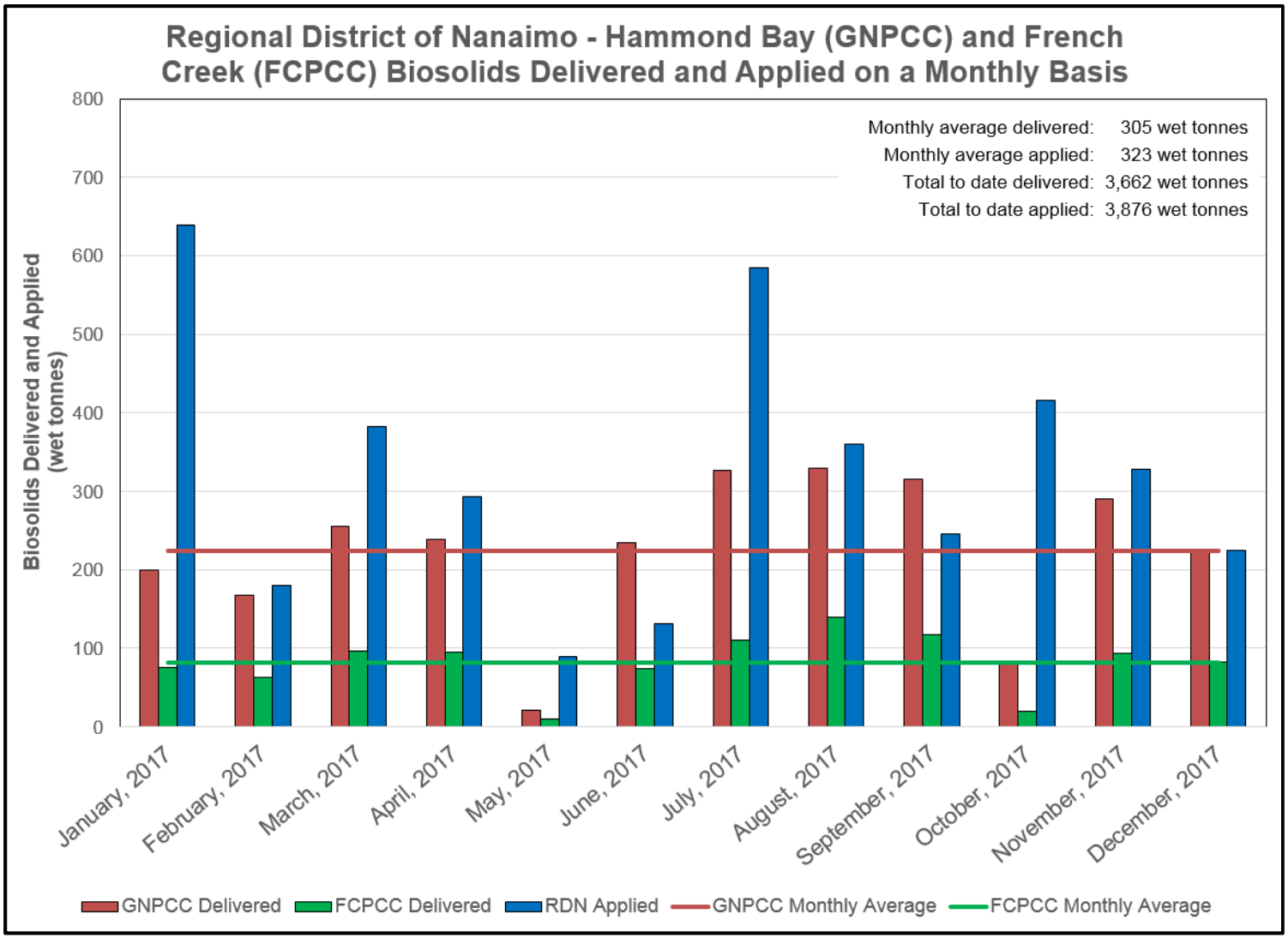


Figure 2: Tonnage of Regional District of Nanaimo dewatered biosolids managed at the Harmac Mill by month in 2017.

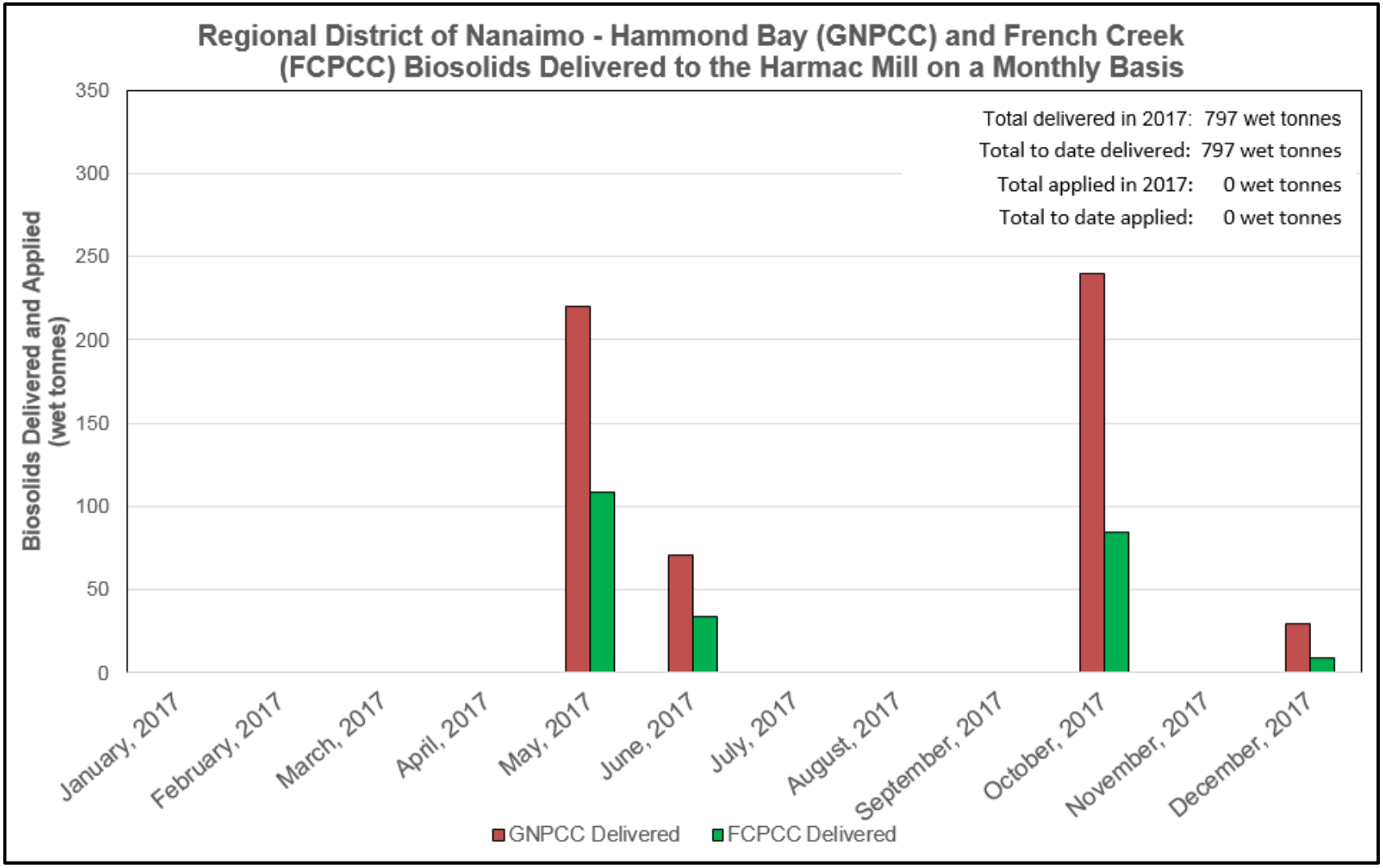
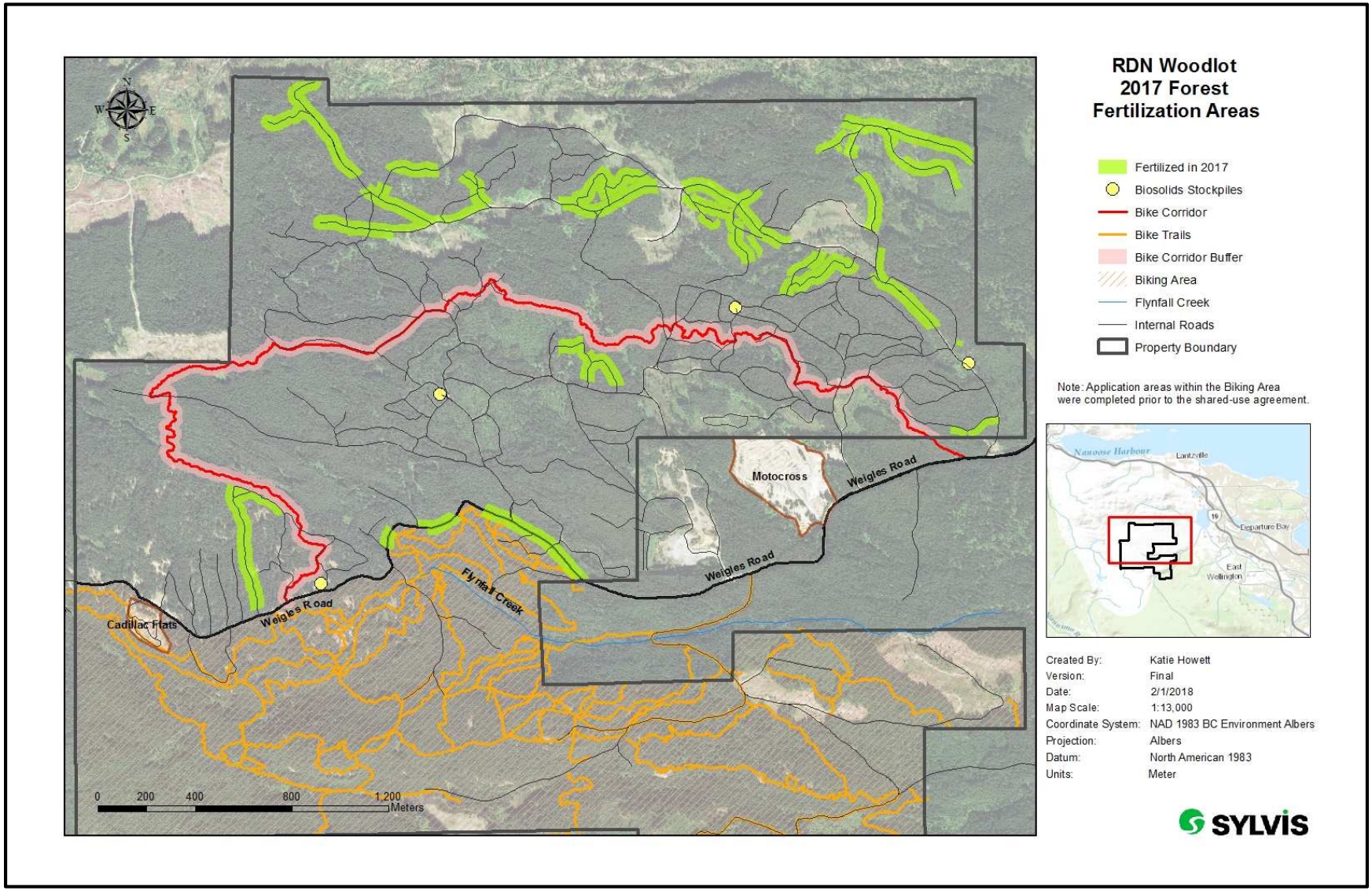


Figure 3: TimberWest Properties application areas fertilized with Regional District of Nanaimo biosolids in 2017.



APPENDIX THREE – PHOTOGRAPHS

Photograph 1: RDN biosolids are delivered to the TimberWest Properties in 10-tonne bin trucks.

(September 2016)

Photograph 2: Four biosolids stockpile facilities exist at the TimberWest Properties which consist of an asphalt pad and lock block barriers.

(April, 2016).

Photograph 3: Biosolids are applied from the roadway using customized SYLVIS heavy equipment which can apply 30 m into the forest.

(March, 2014)